POSTER

1018 Intravascular Radiation

Sunday, March 12, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1018-75 Two Year Follow-Up After Post-PTCA β-Radiation: A QCA Analysis

Michel Joyal, David Meerkin, Jacques Lespérance, Guylaine Lucier, Raoul Bonan. *Montreal Heart Institute, Montreal, Canada*

Background: Post angioplasty intracoronary radiation therapy has been demonstrated to be safe and efficacious for restenosis prevention at 6 months. The influence of this therapy on vessel repair and physiology however mandates a more prolonged and detailed analysis of arterial response. The purpose of this study was to determine the effect of post-PTCA β-radiation on the intervened segments as assessed by QCA at two years.

Methods: Twenty-six patients (pts) included in the Canadian arm of the BERT trial underwent PTCA and β-radiation therapy without stent implantation. All pts were scheduled for 2 year clinical and angiographic FU. Analysis at the intervened site (IS) was performed over 15 mm centered at the original lesion.

Results: Clinically driven FU at 2 years revealed cumulative restenosis and target lesion revascularization in 3/26 and 5/26 pts respectively. Two-year angiographic FU QCA analysis is complete in 16 pts who had no restenosis at 6 months. Results of the total cohort will be presented.

IS	Baseline	Post	6 months	2 years
Ref. diam (mm)	2.87 ± 0.40	2.97 ± 0.40	2.91 ± 0.42	2.96 ± 0.47
MLD (mm)	0.91 ± 0.33	1.94 ± 0.36*	2.28 ± 0.51*‡	2.17 ± 0.67*
% stenosis	68.59 ± 10.84	34.56 ± 10.61*	23.02 ± 10.51*‡	27.16 ± 15.48*
MVD (mm)	2.07 ± 0.43	2.52 ± 0.38*	2.81 ± 0.41*‡	2.84 ± 0.58*‡

MLD = minimal lumen diameter, MVD = mean vessel diameter, *$P < 0.05$ vs. baseline, ‡$p < 0.05$ vs. post

Conclusions: Following a mean increase of vessel dimensions at the IS at 6 months, stability of mean vessel dimensions over the 2-year follow up period was demonstrated with minimal late loss and no further vessel expansion as assessed by QCA.

1018-76 Long-Term Morphological Effects of Post Angioplasty β-Radiation: An IVUS Study

David Meerkin, Michel Joyal, Johanne Vincent, Raoul Bonan, Jean-Claude Tardif. *Montreal Heart Institute, Montreal, Canada*

Background: IVUS analysis of vessel response to post PTCA brachytherapy has shown maintenance of vessel lumen and unchanged vessel dimensions at 6 months. The long-term effects of this therapy on unstented vessels have not been demonstrated, necessitating more prolonged follow-up (FU).

Methods: Twenty-six patients (pts) included in the Canadian arm of the BERT trial underwent PTCA and β-radiation therapy without stent implantation for restenosis prevention. All pts were scheduled for 2-year IVUS reassessment. Two series of measurements for restenosis assessment were performed. The cross-sections selected for serial analysis were the ones at the PTCA site with the smallest MLD at 6 months (series I), and 2 years (series II) respectively.

Results: Analysis of the first 13 patients has been completed. The MLDs of series I and II were separated by a distance of 3.9 ± 4.0 mm (range 0.00–12.50).

	Series	Post	6 months	2 years
MLD (mm)	I	2.5 ± 0.5	2.5 ± 0.4	2.5 ± 0.5
	II	2.4 ± 0.4	2.5 ± 0.4	2.2 ± 0.4*‡
Lumen area (mm^2)	I	5.6 ± 1.2	5.9 ± 2.0	5.8 ± 2.2
	II	5.5 ± 1.6	5.7 ± 1.7	4.6 ± 1.5*
EEM (mm^2)	I	14.0 ± 3.0	14.3 ± 3.4	14.8 ± 3.6
	II	13.2 ± 3.6	13.4 ± 3.0	13.6 ± 3.0
Wall Area (mm^2)	I	8.4 ± 2.8	8.3 ± 2.2	9.0 ± 2.9
	II	7.7 ± 3.2	7.7 ± 2.0	9.1 ± 2.7‡

*$P < 0.05$ vs. 6 months ‡$P < 0.03$ vs. post

In series I there was no significant change for any IVUS parameter. In series II, a slight increase in wall area, with a slight decrease in lumen area and MLD was observed at 2 years. The EEM remained unchanged irrespective of the method excluding aneurysm formation.

Conclusion: The effects of post PTCA brachytherapy on vessel morphology are largely maintained over 2 years. Vessel wall thickening without negative remodeling was responsible for late loss, where present.

1018-77 Intra-Coronary Radiation Therapy With Liquid Rhenium-186. The RadioCath Trial

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Background: Restenosis remains one of the major limitations of percutaneous coronary interventions. Since the introduction of coronary stents, anti-restenosis therapies are focusing on the inhibition of neo-intimal proliferation. Intra-coronary beta-radiation therapy with catheter-based systems is one of the strategies under investigation.

Methods: The RadioCath trial is a safety and performance study with a new device, consisting of a 25 mm-long radiation treatment balloon catheter (RTB), which can be charged with a solution of sodium perrhenate-186, a predominant beta-emitter with a half-life of 3.78 days. Between November 1998 and March 1999, 35 pts. with a de novo lesion in a native coronary artery have been enrolled in the trial. The prescribed dose of 20 Gy at 0.5 mm into the vessel wall was delivered successfully, immediately after the angioplasty, in 33 pts (94%). One pt. was excluded because of a severe, occlusive dissection after the PTCA, in a second pt. there was a technical failure of the inflation system. The average dwell time was 6 min. 58 sec. ± 1 min. 4 sec. In 26 pts. (79%) this was done in a single inflation cycle. In 5 pts. (15%) two cycles were required and in 2 pts. (6%) three cycles. After the radiation treatment, a stent was implanted at the target lesion site in 72% of the pts.

Results: Angiographic follow-up is completed in 33 pts (94%). Restenosis of the target lesion (≥50% diameter stenosis) was seen in 13 pts. (39%), which required re-intervention in 12 pts. (36%). 6 pts. (18%) were treated for progression of disease at a non-target site. 4 pts. (12%) experienced a 'late' (after 1 month) acute stent thrombosis of the target lesion, which was successfully treated with thrombolysis in 2 pts. and with re-PTCA in another 2 pts.

Conclusions: Intra-coronary radiation with a balloon catheter, filled with liquid rhenium-186, is feasible and safe. To draw conclusions on efficacy of this device, a randomized, placebo-controlled trial is mandatory. Prolonged aggressive antiplatelet therapy may be required to decrease the risk of 'late' acute stent thrombosis. The final results of the RadioCath trial will be presented at the meeting.

1018-78 Dosimetry of the RDX Cylindrical Shell P-32 Balloon Source

James Whiting, Alex Li, Jörg Hausleiter, Brett Trauthen. *Cedars-Sinai Medical Center, Los Angeles, CA; Radiance Medical Systems, Irvine, CA, USA*

Background: Until recently intravascular radiation sources have all had one of only three basic geometries: line sources (e.g. Best and Nucletron Ir-192, Novoste Sr/Y-90, Guidant and NeoCardia P-32 and Schneider Y-90), cylindrical volume sources (liquid Re-188 balloon), and radioactive stents (e.g. Isostent P-32). A new source consisting of an angioplasty balloon with P-32 incorporated in the wall material (RDX, Radiance Medical Systems) changes its configuration but continues to deliver as the balloon is periodically deflated to allow for perfusion. We report on calculations and measurements of the dose distribution for this device in both the inflated and deflated configuration.

Methods: Numerical point dose kernel calculations were performed for cylindrical shells with diameters ranging from the vessel diameter down to a diameter of 0.5 mm, approximating a fully refolded deflated balloon. Transaxial measurements of the inflated and deflated dose distributions were performed in a lucite phantom using radiochromic film, with and without a 3.0 mm AVE stent.

Results: The inflated balloon dose rate was found to be approximately 3.5 Gy/min at the 1.0 mm reference depth for a source activity density of 100 $\mu Ci/mm^2$, independent of source diameter or length. Agreement between calculations and measurements was good. The balloon surface dose when inflated was calculated to be 6.1 times greater than that at the reference depth, but fell to half the surface dose at only 130 microns depth (the stent thickness), similar to other linear P-32 sources. When deflated the reference dose rate was reduced by only about 25%, and the artery surface dose was reduced by half. Stent attenuation reduced the reference depth dose by less than 15%. No discrete shadowing by the stent struts was observered when the source was inflated; some minimal shadowing was observered up to 0.5 mm depth when the source was deflated.

Conclusions: The RDX cylindrical P-32 source provides a depth dose distribution similar to centered linear P-32 sources, with superior centering when inflated. Perhaps surprisingly, the dose rate is only slightly lower when the system is deflated, allowing short treatment times even if the balloon must be deflated frequently during treatment to allow for perfusion. The relatively high balloon surface dose falls off very rapidly, and is comparable to other linear beta sources at a depth of only 100–200 microns, or about the thickness of a stent. The system was found to be reliable and easy to use during testing, and operator exposure was negligible.

1018-79 Intracoronary Brachytherapy for In-Stent Restenosis With a ^{188}Re Liquid-Filled Balloon System. Results From the Pilot Phase of a Randomized Trial

Helmut Schühlen, Neal L. Eigler[1], James S. Whiting[1], Roland Haubner, Josef Dirschinger, Markus Schwaiger, Albert Schömig. *Klinikum rechts der Isar, Technische Universität, Munich, Germany; [1]Cedars-Sinai Medical Center, Los Angeles, CA, USA*

Objective of this trial is to evaluate the effectiveness of a ^{188}Re liquid-filled balloon system to prevent recurrent restenosis after PTCA for in-stent restenosis. The system device allows for safe transfer of the ^{188}Re liquid from the nuclear hot lab, secure handling in the cath lab to minimize radiation expose and the risk of spillage of ^{188}Re, and provides a simple PTCA-like protocol to perform brachytherapy. This abstract summarizes the pilot phase of the trial.

Methods: The primary endpoint is angiographic lumen loss at 6 months, secondary endpoints are additional QCA + IVUS data, and clinical outcome after 1, 6 and 12 months. Randomization to brachytherapy or no further therapy is done after successful repeat PTCA. The prescribed dose is 28 Gy at 0.5 mm depth. Dependent on the activity in the balloon, treatment time is typically 4 to 13 min, fractioned into 2-min balloon inflations with max. 3 atm.

Results: In the pilot phase until 1/99, 21 patients with at least a 2nd restenosis (average 3.7 previous procedures) have been randomized, 11 to radiation. The 4-week clinical follow-up has been uneventful in all patients. Six-month follow-up has been completed in all patients. There were no deaths or myocardial infarctions in both groups. Angiographic restenosis ($\geq$50% diameter stenosis of treatment site or adjacent segments) was present in 3/11 patients with radiation, and in 10/10 without radiation ($p < 0.01$), late lumen loss was reduced from 1.93 ± 0.38 mm to 0.78 ± 1.06 mm ($p < 0.01$).

Conclusions: Intracoronary brachytherapy with the ^{188}Re liquid-filled balloon can be safely administered with this system in a simple, PTCA-like procedure. These preliminary data from the pilot phase already suggest a significant benefit for patients with multiple recurrent restenoses.

1018-80 Differential Cytotoxicity of Radiocontrast (RC) Agents on Human Umbilical Vein Endothelial Cell (HUVEC) Monolayers In Vitro

Christina Fauser, Christlieb Haller. *University of Heidelberg, Heidelberg, Germany*

Background: The endothelium plays a central role in the regulation of blood flow and coagulation. During coronary angiography and interventions it is directly exposed to intravascular RC agents. Little is known on the interaction between endothelial cells and RC.

Objective: We studied the differential cytotoxicity of ionic and non-ionic RC agents with different physicochemical properties on HUVECs in vitro.

Methods: HUVECs were incubated for 1 to 3 hours with RC concentrations up to 37 mg iodine/ml in growth medium. Cellular damage/viability was assessed by trypan blue exclusion and measurement of lactate dehydrogenase (LDH) in the medium, The integrity of the HUVEC monolayers was determined by the transmonolayer resistance (TMR). The concentrations of the functionally important endothelial effector substances endothelin-1 (E), von Willebrand factor (vWF), plasminogen activator inhibitor-1 (PAI-1) and thrombomodulin (T) were measured by specific ELISAs.

Results: Diatrizoate induced significant cell death with an increase of LDH after 3 hours. The concentration of E was already decreased after 1 hour, while vWF was increased in the culture media. These findings can be attributed to cell damage, since there are no intracellular stores for E, whereas stored vWF may be released from injured cells; on the other hand the concentrations of PAI-1 and T were not significantly affected by diatrizoate. The dimeric ionic RC agent ioxaglate was less toxic than diatrizoate and did not differ from the non-ionic compounds iohexol and iopamidol. Therefore osmolality is more important for endothelial cell toxicity in vitro than ionic strength.

Conclusions: RC agents, in particular the hyperosmolal ionic compound diatrizoate, are not biologically inert and have differential cytotoxic effects on endothelial cells in vitro. This cytotoxicity is more related to hyperosmolality than to ionic strength. Although the RC exposure in clinical settings is usually shorter than in this in vitro study, in patients with renal failure prolonged exposure may occur which could adversely affect endothelial function and contribute to the poor results of PTCA in this patient population.

1018-81 Absence of Late Coronary Occlusions After Beta Radiation Following a Modified Antiplatelet Regimen in 120 Consecutive Patients

Sigmund Silber, Ingeborg Krischke, Norbert Seidel, Armin Schneider, Peter von Rottkay. *Dr. Müller Hospital, Munich, Germany*

Currently, beta radiation is being increasingly applied in Europe as clinical treatment of in-stent restenosis. Recently, however, there was considerable concern regarding the risk of late coronary occlusion after brachytherapy, which was reported to occur in up to 7% of the cases. This important side effect of intracoronary radiation may be related to delayed endothelialization following radiation therapy. It may thus be hypothesized that a prolonged ($\geq$3 months) prescription of clopidogrel may reduce the risk of late coronary occlusion in patients with and without stents after brachytherapy.

We report our experience in 120 consecutive patients who received intracoronary brachytherapy with the Novoste™ Beta-Cath System for de-novo lesions, restenosis without stents and in-stent restenosis. Mean age was 60.5 ± 9 years, LV-EF was 61 ± 10%, reference diameter was 3.0 ± 0.6 mm; MLD before and directly after radiation was 0.6 ± 0.36 respectively 2.8 ± 0.4 mm. The dose for coronary vessels with a diameter of 2.7–3.35 mm is 14 Gy; for 3.36–4.0 mm is 18 Gy. Mean duration of radiation with 14 Gy was 173 ± 8 s (165–187 s) and 222 ± 12 s (212–240 s) with 18 Gy. The 5F catheter led neither to dissections nor to clinically relevant myocardial ischemia. Coronary overdosing did not occur, but in two patients the pellets got stuck in the guiding catheter for less than 10 s. The additional time needed for the radiation procedure after PTCA was 18 ± 6 min. No acute or subacute stent/occlusion occurred; no later coronary occlusions were reported.

Conclusions: Prolonged application of clopidogrel for at least 3 months seems to be necessary to reduce the risk of late coronary occlusion following intracoronary brachytherapy.

1018-82 Intravascular Brachytherapy With Rhenium-188 Balloon: RADIANT Pilot Study

Raj Makkar, James Whiting, Alex Li, Joerg Hausleiter, Adela Robinson, Neal Eigler. *Cedars-Sinai Medical Center, Los Angeles, California, USA*

Background: RADIANT was a pilot study designed to assess the efficacy of brachytherapy with a β-emitting Rhenium-188 balloon after coronary intervention for *de novo* or restenotic lesions in native coronaries. Primary endpoint of the study is late loss on angiography at 9 months and freedom from target lesion revascularization at 4 and 9 months.

Methods and Results: 13 patients with an average of 1.1 restenosis in target vessel previously have been enrolled in the pilot study. Prescribed radiation dose was 24 Gy at 0.5 mm depth. Radiation was delivered by inflating the balloon to 2 arms for 4–7 mins, with one or more deflations as necessary for perfusion. One patient had a minor Re-188 leak *in vivo* resulting in total body exposure of 0.12 Gy. Radiation exposure to the operators was less than 15 mRems/procedure. No special shielding of the cath lab was necessary and the operators stayed with the patients in the room for the duration of the procedure. At 4 months, 2/13 patients required target lesion revascularization, including one patient with delayed stent thrombosis at 96 days. Nine month clinical and angiographic data is being collected.

Conclusion: Brachytherapy with Re-188 balloon is feasible in the clinical setting. Clinical and angiographic outcomes at 9 months will be presented.

1018-83 New Dose-Effectiveness Model for Intracoronary Brachytherapy Predicts External Beam Irradiation Results in the Pig Model

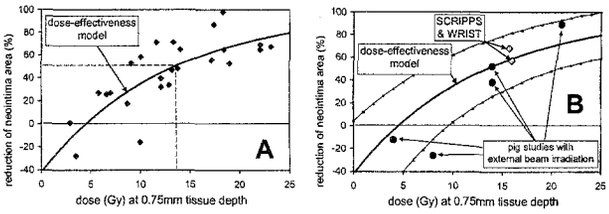
Jörg Hausleiter, Alex Li, Craig Abbey, Raj Makkar, Martin Sebastian, Hidehiko Honda, James Whiting, Neal Eigler. *Cedars-Sinai Medical Center, Los Angeles, CA, USA*

Background: The target tissue for coronary brachytherapy and the relationship between dose and effectiveness are not known. We analyzed the relationship between dose at different tissue depths and inhibition of neointima growth in a retrospective analysis of 11 published brachytherapy studies in the pig restenosis model (35 dose protocols).

Methods: The studies included different isotopes (Ir^{192}, Sr/Y^{90}, P^{32}, Re^{188} and Re^{186}) in centered and non-centered devices. Three statistical approaches (Spearman rank correlation, ROC analysis, and error in model fit for a new dose-effectiveness model) demonstrated the best agreement

between dose and inhibition of neointima growth for a tissue depth between 0.5 and 0.75 mm from the lumen surface.

Results: The dose-effectiveness model suggests (1) an increased proliferative response ("*Candy Wrapper*") with doses < 4.5 Gy at 0.75 mm and (2) the need of 13.5 Gy at 0.75 mm to achieve a 50% reduction in neointima area (Fig. A). When the results of published pig studies using external beam irradiation were applied to the model, a good agreement with the proposed model was obtained (Fig. B). Interestingly, the results of the clinical trials SCRIPPS and WRIST agreed similarly well, despite the differences in atherosclerotic wall morphology.



Conclusions: This retrospective analysis identifies the adventitia as the target tissue for intracoronary brachytherapy in the pig model of restenosis. Experimental studies with external beam radiation further support this concept. Additional results are needed to demonstrate the clinical validity of the proposed model.

POSTER

1019 Coronary Stenting: Clinical Outcomes

Sunday, March 12, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1019-84 Cost Effectiveness Analysis Between Percutaneous Coronary Interventions Versus Coronary Bypass Surgery in Multiple Vessel Disease: Long Term Follow Up Results of the Argentine Randomized Study (ERACI II)

Alfredo Rodriguez, Victor Bernardi, Julio Baldi, Jose Navia, Liliana Grinfeld, Carlos Mauvecin, Daniel Vogel, Raul Oliveri, Igor Palacios, William O'Neill, William Beaumont. *Otamendi Hospital, Buenos Aires, Argentina; Michigan, USA*

Background: Percutaneous Transluminal Coronary Revascularization (PTCR) and Coronary Artery By Pass Graft (CABG) in patients with multiple vessel disease (CAD) has been compared previously in several randomized studies using old techniques with PTCR (BARI, RITA, CABRI, EAST, GABI, ERACI).

Objective: The purpose of the present study was to compare cost effectiveness of current PTCR devices including free use of stents with conventional CABG in patients with multiple CAD.

Methods: 450 patients with multiple CAD were randomized at 7 sites in Argentina, 225 were randomized to PTCR with stents and 225 to CABG (ERACI II). One of the end point of this study was to compare overall cost of both procedures and a cost/benefit analysis. The costs included hospital charges, fees, professional fees, stents and drugs utilized during the procedures. In PTCR arm, 1.4 stent per patient was used as well abciximab in bolus and infusion in 28% of them. Overall costs and clinical outcome (19.5 ± 6.4 months) were present.

Results: Basal characteristics in ERACI II patients at the time of randomization showed that 91.1% had Unstable Angina II, III or C; 23% peripheral or vascular disease and 39% age > 65 years.

	PTCR (225)	CABG (225)	P
30 days cost	U$2.548.615	U$2.451.500	Ns
Follow up cost	U$261.000	U$95.500	= 0.04
Overall cost	U$2.809.615	U$2.511.000	ns
Per patient	U$12.487	U$11.160	ns
Survival	96.9%	92.5%	<0.017
Freedom from myocardial infarction	97.7%	93.7%	<0.017
Repeat PTCR/CABG	18.6%	5.3%	= 0.002

PCI would save 44 lives for 1000 patients treated.

Conclusions: In Argentina current PTCR techniques had similar costs than conventional CABG, however used in patients with ERACI II characteristics PTCR was more effective.

1019-85 Diabetic Patients With Multivessel Disease Treated With Percutaneous Coronary Revascularization had Similar Outcome Than Those Treated With Surgery: One Year Follow Up Results From Two Argentine Randomized Studies (ERACI-ERACI II)

Carlos Fernandez Pereira, Victor Bernardi, Jorge Martinez, Julio Baldi, Daniel Vogel, Liliana Grinfled, Miguel Russo Felsen, Carlos Mauvecin, Eduardo Mele, Igor Palacios, Alfredo Rodriguez. *Otamendi Hospital, Buenos Aires, Argentina*

Background: One large randomized study (BARI) demonstrated better survival with coronary bypass surgery (CABG) compared with percutaneous transluminal coronary revascularization (PTCR) in diabetics patients with multivessel disease (CAD).

The purpose of the present study was to assess late outcome of diabetic patients included in two randomized studies.

Methods: From 577 patients with multivessel CAD randomized either to PTCR or CABG included in two Argentine randomized studies (ERACI and ERACI II) we identified 90 diabetic patients. From these 46 patients were randomized to CABG and 44 patients to PTCR. Major adverse events (MACE) were defined as death, myocardial infarction (AMI) and requirement of new revascularization procedures. Clinical follow up was available at one year in all patients. Coronary stents were used in 86.4% (38/44) of patients in PTCR group (100% in ERACI II).

Results: Basal demographic and angiographic characteristics were similar 82.2% of them had unstable angina at time of randomization whereas 21% had concomitant peripheral vessel disease.

One year follow up results

	PTCR (44 pts)	CABG (46 pts)	P
Death	4.5% (2/44)	6.5% (3/46)	ns
AMI	0%	6.5% (3/46)	ns
Death + AMI	4.5% (2/44)	13% (6/46)	ns
Repeat PTCR/CABG	19% (8/42)	69% (3/43)	ns
MACE	22.7% (10/44)	19.5% (9/46)	ns

Conclusions: Diabetics patients with multivessel CAD randomized to PTCR had similar long term survival and incidence of myocardial infarction than those randomized to CABG.

1019-86 Medical Costs Over 18 Months After Stent Implantation With Versus Without Intravascular Ultrasound Guidance. Results of the Randomized "REStenosis After Intravascular Ultrasound STenting" (RESIST) Study

François Schiele, Nicolas Meneveau, Marie France Seronde, Patrick Arveux, Bernard Bertrand, Nicolas Danchin, Jean-Pierre Bassand. *Department of Cardiology, University Hospital Saint-Jacques, Besançon, France*

Background: One hundred and fifty five patients were randomized to routine stent deployment with versus without Intravascular Ultrasound (IVUS) guidance. At 6 months, a non significant 6.6% difference in restenosis was observed (22.2% vs. 28.8%, p = 0.18) and at 18 months, the difference in event free survival was 12% (p = 0.059). The medical costs (procedural and hospitalization) were calculated.

Methods: Units: 1996 actual prices for balloons, guide wire, guiding catheters, stents and intravascular ultrasound (IVUS) catheters as well as cost for hospitalization in general wards and intensive care unit were taken from Saint Jacques University Hospital, Besancon France. Volumes: procedural devices used and hospital stay for stent implantation and for all lesion revascularization procedures were recorded over 18 months. Medical costs were calculated by multiplying units by volumes and compared using Mann Whitney U test. Sensitivity analyses were performed to assess the robustness of the results.

Results: In the group without IVUS guidance, 27/76 required for revascularization (3 of them needed recurrent revascularization) whereas 19/79 (2 patients needed for second revascularization) in the group with IVUS guidance. The difference in number of revascularization procedures per patient was significant, 31/76 vs 21/79, p = 0.03. The procedural costs were 17% higher at stent implantation in the group with IVUS. The total medical costs (procedural + hospitalization) were 6.5% higher in the group with IVUS, 4716 (median 4030) vs 4627 (median 3620) Euro, p = 0.02. Sensitivity analysis showed a consistent overcost, ranging from 1% to 6.5%.

Conclusions: IVUS guidance for stent implantation allows a trend for better clinical outcome, with less need for lesion revascularizations. The overcost induced by the use of IVUS is not fully offset during follow-up, representing 1 to 6.5% of the medical costs.

1019-87 A Randomized Comparison of Clopidogrel and Aspirin Versus Ticlopidine and Aspirin After Coronary Stenting

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Background: The introduction of an effective antiplatelet therapy with aspirin and ticlopidine after the placement of coronary-artery stents has decreased the risk of subacute stent thrombosis (SAT) and hemorrhagic complications. However, the use of ticlopidine is limited by hematological and gastrointestinal adverse effects. The safety and efficacy of clopidogrel after stenting remains to be established.

Methods: After successful coronary stenting during elective or emergency PTCA, 700 patients with 899 lesions were randomly assigned to receive a four week course of either 500 mg ticlopidine (n = 345) or 75 mg clopidogrel (n = 355) in addition to 100 mg aspirin. All clinical events reflecting SAT we're included in the pre-specified primary cardiac endpoint: Cardiac death, urgent target vessel revascularization, angiographically documented SAT, or nonfatal myocardial infarction within 30 days. The primary non-cardiac endpoint was defined as non-cardiac death, stroke, severe peripheral vascular or hemorrhagic events, or any adverse event resulting in discontinuation of study medication.

Results: Cardiac events occurred in 17 patients: 11 (3.1%) with clopidogrel and 6 (1.7%) with ticlopidine (p = 0.24). The primary non-cardiac endpoint was observed in 16 patients (4.5%) assigned to receive clopidogrel versus 33 patients (9.6%) assigned to receive ticlopidine (p = 0.01).

Conclusions: After the successful placement of coronary artery stents in unselected patients, antiplatelet therapy with aspirin and clopidogrel seems to be as safe and effective as aspirin and ticlopidine. Non-cardiac events were significantly reduced with clopidogrel.

1019-88 Predictors of Refractory Stent Restenosis After Balloon Angioplasty: Statistical Analysis

Hiroyoshi Yokoi, Takashi Tamura, Yoshihisa Nakagawa, Naoya Hamasaki, Hideyuki Nosaka, Takeshi Kimura, Masakiyo Nobuyoshi. *Kokura Memorial Hospital, Kitakyushu, Japan*

The long-term effectiveness of coronary stent implantation is diminished when repeat balloon angioplasty (BA) procedures are required for recurrent stem restenosis (SR). The purpose of the present study was to identify the predictors of refractory SR which recurred alter 1 or more prior BA of SR, the clinical, procedural and angiographical parameters in refractory SR lesions (les) were analyzed. Out of 310 pts with 320 lesions (les) with successful first BA for SR undergoing 3-month follow-up (3MFU) quantitative coronary angiography (QCA), the first recurrent SR (>50% diameter stenosis at FU) was observed in 164 pts with 1 64 les (51%). Among these pts, medical therapy was selected in 53 asymptomatic pts. Bypass surgery (CABG) was performed in 3 pts and 108 pts had a second BA and 87 pts underwent 3MFUQCA (FUrate = 81%). Second recurrent SR was observed in 59 pts with 59 les (68%). Among these pts, medical therapy was selected in 13 asymptomatic pts and CABG was performed in 1 pts. Out of 45 pts who underwent a third BA procedure, 3MFUQCA was performed in 40 pts (FU-rate = 89%). Third recurrent SR was observed in 31 pts with 31 les (78%). Univariate analysis revealed 7 angiographical significant factors of refractory SR. The angiographical factors were ostial les (P = 0.04), RCA les (P = 0.007), RCA ostial les (P = 0.0001), pattern of SR (diffuse type) (P = 0.0001), minimal lumen diameter (MLD) at FU after stent implantation (P = 0.002), late loss after stent implantation (P = 0.003), loss index aider stent implantation (P = 0.004). These 7 factors were tested with multivariate logistic regression analysis. The only one factor of pattern of SR (diffuse type) was identified as the independent predictor of refractory SR after BA (P = 0.0001)

Conclusion: Repetitive BA for refractory SR was associated with very high recurrent restenosis rate rather than first BA for SR. BA in diffuse type SR was limited approach associated with a higher frequency of refractory SR after BA. The other modalities such as brachytherapy may be necessary to overcome some of these limitations.

1019-89 Clinical and Anatomic Predictors of Late Angiographic Outcome After High Pressure Stent Deployment

Edgar J. Massabni, David L. Fischman, Sheldon Goldberg, Diane E. Rehmann, Masakiyo Nobuyoshi, Ian Penn, Jeffrey Moses, Stephen Ellis, John Hirshfeld, Zoltan Turi, Jeffrey Werner, Michael P. Savage. *For the STRESS III Investigators; Jefferson Medical College, Philadelphia, PA, USA*

Background: Early trials of coronary stent implantation identified numerous predictive factors associated with in-stent restenosis including presence of diabetes, vessel size, and post-procedural lumen diameter. However, it remains unknown whether clinical or procedural factors affect the late angiographic outcome of coronary stents placed with current techniques of high pressure inflation and antiplatelet therapy.

Methods: In the STRESS III trial, 240 patients underwent elective Palmaz-Schatz stent placement for new, focal lesions in native coronary arteries using high pressure deployment (≥14 atm) and aspirin-ticlopidine regimen. Follow-up angiography was prospectively performed at 6 months and was available in 176 patients (78% of patients eligible for follow-up). In this analysis, we sought to assess whether late angiographic follow-up (6 month minimal lumen diameter) could be predicted by clinical and anatomic variables.

Results: For the entire study population, the median minimal lumen diameter (MLD) at baseline, immediately post-intervention and at follow-up was 0.69 mm, 2.62 mm and 1.70 mm, respectively. By univariate analysis, MLD at 6 months was significantly smaller in patients with diabetes (1.26 vs 1.77 mm, p < 0.001) and with recent MI (1.65 vs. 2.15 mm, p = 0.003). MLD was lower in LAD lesions (1.58 vs 1.83 mm, p = 0.016) and in vessels < 3.0 mm (1.50 vs 1.99 mm, p < 0.001). Follow-up MLD also correlated with MLD immediately before and after intervention (both p < 0.01). By multivariate analysis, independent predictors of 6 month MLD were diabetes (p < 0.002), post-procedural MLD (p = 0.002), MI within 6 weeks (p = 0.008), and small vessels (p = 0.018).

Conclusions: Late angiographic outcome in this prospective trial was determined by the presence of diabetes, recent MI, vessel size, and the initial angiographic result. Thus, the customary predictive factors of long-term outcome after coronary stenting have not been altered by the advent of high pressure techniques and adjunctive antiplatelet therapy.

1019-90 Clinical and Angiographic Predictors of CPK-MB Release Following Coronary Stent Implantation

Saihari Sadanandan, Jacqueline Tamis, Maziar Azadpour, Jarkarpun Chaipromprasit, Emad Aziz, Peter Homel, James Slater. *St. Luke's-Roosevelt Hospital Center, Columbia University, New York, USA*

Background: CPK release after PTCA is associated with long term adverse outcomes. Little is understood regarding the impact of stenting on CPK release.

Methods: We reviewed 673 consecutive pts undergoing coronary stent implantation. Among these, 86 (12.7%) pts had post procedure CPK release (CPK-MB positive or if MB negative, total CPK ≥ 3 times normal) (Group-1). This group was compared to 100 pts with no CPK release after stenting (Group-2). Pts undergoing primary angioplasty were excluded.

Clinical characteristics: The mean age of Group-I was 63 ± 12 years and 71% were males. The mean pre-procedural, 6–8, and 16–24 h post procedural CPK/CPK-MB% were 106/0.5, 220/5.0 and 302/6.0 respectively. Baseline clinical variables, including age, HTN, DM, anginal class, h/o MI, PVD, previous PTCA or CABG were not significantly different between the two groups. Group I pts were less likely to be smokers (18% vs. 31% p = 0.04) and more likely to have a h/o CHF (16% vs. 6% p = 0.03).

Angiographic characteristics: The number of vessels diseased, vessels intervened, restenotic lesions, LVEF, and the locations of stent (native or graft) were not different between the two groups. Group I pts had more complex lesions: Type C (65% vs. 22% p < 0.001), thrombus (20% vs. 5% p = 0.007), diffuse luminal irregularities (70% vs. 40% p = 0.007). They were also more likely to be treated with Reopro (28% vs. 13% p = 0.01) and to have <1 stent implanted (44% vs. 15% p < 0.001). Side branch occlusion was more common in Group I (31% vs. 5% p < 0.001), and most often involved ≤1-mm vessels. The incidence of distal embolism or major dissection was not different. By multivariate analysis, Type C lesion (p < 0.0001) and side branch occlusion (p = 0.01) independently correlated with CPK release.

Conclusions: Pts with post- stent CPK release have more diffuse disease, complex lesions and were more likely to receive <1 stent. Our results indicate that complexity of lesion and side branch occlusion may be the most important predictors of CPK release following stent implantation.

1019-91 Plaque Substrate and Arterial Damage are Predictors of Restenosis After Coronary Stenting in Humans

Andrew Farb, Deena K. Weber, Russ Jones, Renu Virmani. *Armed Forces Institute of Pathology, Washington, DC, USA*

Background: Despite the increased use of coronary stents, only limited pathologic data on stent restenosis in humans are available.

Methods: Histology and morphometry were performed on 34 coronary stents, implanted ≥60 days, from 21 patients (mean age 59 ± 13 years; 15 men, 6 women). The mean duration of stent implant was 263 ± 223 days. A histologic success was defined as a stent area stenosis of ≤50%

and restenosis as a stent stenosis of >50%. In cases with medial rupture, a fracture length (FL) was measured.

Results:

	Stent (mm^2)	Plaque (mm^2)	Lumen (mm^2)	Neointima (mm^2)	FL (mm)
Success	5.5 ± 2.3	6.0 ± 2.4	3.5 ± 1.7	2.0 ± 1.0	0.3 ± 0.8
Restenosis	6.0 ± 2.6	5.5 ± 3.2	1.4 ± 1.2	4.6 ± 2.1	1.9 ± 2.7
p	NS	NS	<0.0001	<0.0001	<0.02

Lumen area increased as stent area increased (r^2 = 0.19, p = 0.01), but there was a much stronger correlation between stent area and neointimal (NI) area (r^2 = 0.7, p < 0.0001). Underlying vessel morphology at the stent strut site strongly influenced neointimal growth (FP = fibrous plaque, RC = ruptured core, RM = ruptured media):

	FP	RC	RM	p
NI Thickness (mm)	0.65 ± 0.33*	0.95 ± 0.40*	0.85 ± 0.25*	*<0.03
NI Neoangiogenesis (mm^2)	0.005 ± 0.007*,†	0.010 ± 0.009*	0.019 ± 0.013†	*<0.07, †<0.001
NI Inflammatory Cell Density	1407 ± 1466*	3419 ± 2670*	3358 ± 3305*	*<0.002

NI neoangiogenesis and inflammation correlated positively with NI growth (r^2 = 0.11, p < 0.0001). Lipid core penetration by stent struts occurred in plaques with larger absolute core size (2.05 mm^2 vs 0.20 mm^2 in plaques without core penetration, p = 0.0002) and in those plaques in which lipid core composed a greater percentage of the plaque (21 ± 13% vs 4 ± 9%, p = 0.0004).

Conclusions: Stenting of lipid-rich plaques induces greater inflammation and neoangiogenesis, which are associated with restenosis. Increased fracture length of the media is associated with poor outcome indicating the limitation of the "bigger is better hypothesis" when applied to stenting.

1019-92 Increased Risk for Restenosis After Stent-Implantation in Patients With Mild to Moderate Renal Failure

Christof Weinbrenner, Jens Tuischer, Frank Edelmann, Ruth H. Strasser. *Department of Cardiology, University of Heidelberg, Germany*

Background: End stage renal disease in patients with diabetes mellitus has been suggested to be an additional risk factor for restenosis after percutaneous transluminal coronary angioplasty (PTCA) in coronary artery disease. It is not known, however, if isolated chronic renal insufficiency (CRI) without diabetes mellitus may promote an increased risk for restenosis. Therefore, we investigated the rate of restenosis in patients with CRI, who underwent a follow-up angiogram after combined PTCA and stent implantation.

Methods: 249 patients after PTCA and stent implantation were included in the study. Follow-up angiogram was performed after 4 to 12 months. Patients with diabetes mellitus, end stage renal disease, acute intervention because of stent-thrombosis, or acute myocardial infarction less than 3 months ago were excluded.

Results: 87 patients had a glomerular filtration rate below 75 ml/min (CRI), whereas 162 patients had no signs of renal impairment (controls). The two groups had the same demographic characteristics and did not differ in the main cardiac risk factors including lipid profile, except for hypertension which was more frequent in the CRI group (p < 0.05). On follow-up angiogram 58 patients with CRI (67%, p < 0.05) showed a significant narrowing of the target vessel of more than 50%. In contrast, in the group without CRI restenosis occurred significantly less frequent than in the CRI group.

Conclusion: Compensated CRI-patients per se also in the absence of diabetes mellitus are at higher risk for restenosis after stent-implantation. As shown here, this increased risk is independent of the lipid profile. The molecular mechanisms responsible for this increased risk of restenosis remains to be elucidated. Moreover, patients with CRI require intensive clinical surveillance and a consequent reduction of cardiac risk factors.

POSTER

1020 New Delivery Techniques

Sunday, March 12, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

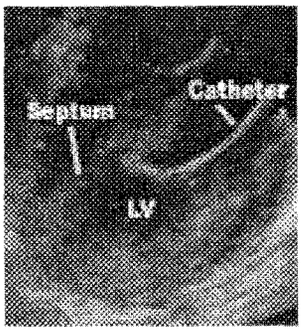
1020-109 Intracardiac Echocardiography Permits High Spatial Resolution for Percutaneous Local Myocardial Delivery Using a Needle Injection Catheter

Robert J. Lederman, Mark Richards, Erick Avelar, Hong San, P. Michael Grossman, Sanjay Rajagopalan, Maria Palasis[1], James J. Barry[1], Joan Main[2], Mani A. Vannan. *University of Michigan Health System, Ann Arbor, MI; [1]Boston Scientific Corporation, Natick MA; [2]Acuson Corporation, Mountain View, CA, USA*

Background: Transcatheter endomyocardial injection offers a minimally-invasive alternative to open-chest injection of emerging therapeutic agents including growth factors and genes. We tested the feasibility of precise catheter manipulation guided by conventional fluoroscopy and by intracardiac echocardiography (ICE).

Methods: A novel needle injection catheter (Boston Scientific) was advanced via the femoral artery into the left ventricular cavity in four 35–40 kg pigs under fluoroscopic guidance. Catheter manipulations were observed simultaneously using a 10 Fr, 5.5–10 MHz phased vector array transducer with 4-way steerable ICE (Acuson Corp) placed in the right atrium via the jugular vein. Paired injections of 50 μL fluorescent microspheres plus 50 μL 1% indelible dye permitted real-time ICE observation of injections in multiple fluoroscopic segments. The distance between endocardial injection points was measured from heart explants. The distance between ICE injection sites were measured off-line by a blinded observer comparing diastolic frames.

Results: Dye was localized as predicted to all fluoroscopic segments identified. ICE-predicted and postmortem-measured distances between multiple injection pairs were only 2.3 ± 2.1 mm apart.



Conclusion: Fluoroscopic guidance permits accurate segmental delivery of endomyocardial injectate. ICE permits millimeter-scale targeting of intramyocardial injections.

1020-110 Cryoapplication Induces Neovascularization: A Novel Approach to Percutaneous Myocardial Revascularization

Paul Khairy, Marc Dubuc, Richard Gallo. *Montreal Heart Institute, Montreal, PQ, Canada*

Percutaneous myocardial revascularization (PMR) is emerging as a therapeutic option in severe angina not treatable by conventional means. While its mechanism is poorly understood, neovascularization (angiogenesis/vasculogenesis) is hypothesized to account for the observed beneficial effects. We evaluated the feasibility of a new percutaneous cryocatheter as a means of PMR by assessing its effects on neovascularization. Cryoinjuries were performed in ventricles of 15 mongrel dogs at −55.5 ± 0.8ºC with a deflectable catheter (CryoCath Technologies Inc, Montreal). Dogs were sacrificed immediately, and at 3 and 6 weeks. Acute lesions revealed clear demarcations between cryoinjured and normal tissue with preserved myocardial architecture. Both 3 and 6 weeks lesions showed prominent neovascularization. Vessel counts in uninjured myocardium, intralesionally, and in a 1 mm surrounding border zone were assessed by averaging the number of vessels in 5 random sites under high power magnification (250X). Analysis of 3 and 6 weeks sections revealed greater vessel densities intralesionally (12.8 ± 0.6 vessels/mm^2) and in border zones (3.3 ± 1.0 vessels/mm^2) compared to

uninjured myocardium (0.6 ± 0.4 vessels/mm^2) ($p < 0.0001$). More vessels were noted at 3 weeks (n = 72) compared to 6 weeks (n = 68) (14.3 ± 6.3 vs 11.2 ± 4.6/mm^2, p = 0.002). However, vessels were larger at 6 weeks than at 3 weeks (0.022 ± 0.015 mm^2 vs 0.017 ± 0.009 mm^2, p = 0.04) and showed greater anatomical development.

Conclusions: Lesions created by a new cryocatheter result in prominent neovascularization without significantly damaging endocardial ultrastructure and may represent a promising alternative for PMR. This model suggests that over a 6 weeks period, angiogenic sites progressively evolve to form more developed vessels.

1020-111 Percutaneous Endocardial Gene Therapy: Patterns of In-Vivo Gene Expression Related to Regional Myocardial Delivery

Ezra Deutsch, Norman Tarazona, Timothy A. Sanborn, Jack L. Martin, Leonard Y. Lee, Neil Hackett, Tarek El-Sawy, Irene Blanco, Kenneth R. Fromkin, Todd K. Rosengart, Ronald G. Crystal. *Weill Medical College of Cornell University, New York, New York, USA*

Percutaneous endocardial administration of an adenoviral (Ad) vector coding for vascular endothelial growth factor using a catheter-based approach may represent a strategy to stimulate new blood vessel growth and improve myocardial perfusion to ischemic regions. However, the feasibility of percutaneous regional endocardial gene therapy and the subsequent pattern of distribution of gene expression in sites of delivery and in remote regions have not been characterized.

Methods: Regional endocardial delivery of a replication-deficient adenovirus expressing the gene for β-galactosidase (Adβgal) was performed in 5 swine guided by the Biosense NOGA™ system of left ventricular (LV) endocardial mapping. A novel delivery system (27 gauge/4 mm length needle) incorporated into the Biosense catheter permitted vector administration to all regions of the LV. Adβgal (10^{11} particle units/100 μl) was delivered in 100 μl injections (avg 7/animal). Endocardial delivery was confirmed by fluoroscopy. Animals were sacrificed 48 h after gene transfer, the LV was sectioned into 16 regions (apex to base; anterior to posterior), and quantitative analysis of βGal tissue levels (relative light units[RLU]/mg protein) was performed.

Results: Mean βGal expression was 1.5×10^6 in injected segments, 6.4×10^4 in adjacent segments, and 3.5×10^3 in remote segments (p = 0.005; 1 way ANOVA). βGal expression in injected and adjacent sites was each significantly greater than in remote regions ($p < 0.001$). βGal expression was equivalent in endocardial and epicardial halves of injected and adjacent regions.

Conclusions: βGal expression was observed in myocardial tissue in those regions prospectively targeted for gene transfer, and in adjacent segments. Regional myocardial delivery of gene products to injected zones using a catheter-based endocardial approach is feasible in this model, and is accompanied by significant gene product expression in adjacent border zones.

1020-112 Intracardiac Venous System as a Novel Conduit for Local Drug Delivery

Mehrdad Rezaee, Sidney T. Lo, Lynn Bailey, Takeshi Suzuki, David P. Lee, Paul G. Yock, Peter J. Fitzgerald, Alan C. Yeung, Simon Stertzer, Andrew Carter. *Stanford Cardiovascular Medicine, Stanford, California, USA*

Background: Effective strategies for administering angiogenic factors involve either multiple myocardial injections or intracoronary delivery into highly diseased conduits. Alternatively, access to cardiac venous system through the coronary sinus provides an extensive network of vessels for regional delivery of angiogenic agents to the distal myocardium.

Methods: Five swine underwent simultaneous right and left heart cardiac catheterization. A 7F balloon tip catheter over a guidewire was used to cannulate the anterior interventricular vein (AIV). 15 μm fluorescent microspheres were used to determine the territory of myocardium that drains into the AIV, and would be potentially available for drug delivery. A different color set of microspheres was used to label the left anterior descending artery territory (through subselective engagement of LAD). All injections were performed over constant time and pressure. Simultaneous ventricular end diastolic pressure (LVEDP), coronary wedge pressure, and distal venous wedge pressure were measured during the balloon inflation. The hearts were harvested and a circumferential sample was divided into eight segments; each segment was divided further into the epicardial and endocardial layers. These samples were processed for microspheres sedimentation, and subjected to scanning fluorometery to determine the amount of different color microspheres in each region.

Results: There was no significant increase in the LVEDP, and only transient elevation of VWP during the injections (range of 5 to 30 mm Hg). The concentration of microspheres in the LAD territory was similar in both LAD and AIV injections (93% ± 3.5 vs. 81% ± 7.0, respectively). 68% of the microspheres delivered through the AIV localized to the epicardial layer of myocardium vs. 53% delivered through the LAD (endocardial localization after AIV and LAD injections were 32% and 47%, respectively).

Conclusion: These data demonstrate the feasibility of using the cardiac venous system for regional myocardial reagent delivery.

1020-113 Left Anterior Descending Coronary Blood Flow is Unaffected by Complete Occlusion of the Anterior Interventricular Vein

Niall A. Herity, Sidney T. Lo, Frederick Oei, David P. Lee, Michael R. Ward, Steven D. Filardo, Ali Hassan, Takeshi Suzuki, Alan C. Yeung, Peter J. Fitzgerald, Paul G. Yock. *Stanford University, Stanford, CA, USA*

Background: Percutaneous selective catheterization of the coronary venous system, a novel potential route for local drug or growth factor delivery to chronically ischemic myocardium, requires complete balloon occlusion of the coronary vein to maximize the delivered concentration of therapeutic agents. The purpose of this study was to measure the impact of occlusion of the anterior interventricular vein (AIV), which drains the left anterior descending (LAD) territory, on blood flow in the LAD.

Methods: In 6 anesthetized pigs, baseline and hyperemic (intracoronary adenosine, 24 mcg) coronary arterial flow parameters were measured before and during complete balloon occlusion of the AIV. Recordings were made in the LAD and in the circumflex artery (CX), which served as a control.

Results: Complete occlusion of the AIV had no significant impact on initial or hyperemic flow parameters in either the LAD or CX (table).

	Before AIV occlusion			During AIV occlusion		
	Initial APV	Hyperemic APV	Hyperemic diameter	Initial APV	Hyperemic APV	Hyperemic diameter
LAD	12.33 (3.01)	24.33 (5.68)*	2.95 (0.42)	14.67 (3.78)	24.33 (5.72)*	2.91 (0.30)
CX	16.83 (4.58)	28.00 (4.24)*	2.75 (0.57)	16.17 (5.71)	28.00 (4.98)*	2.84 (0.62)

Mean (SD). APV = average peak velocity of blood in cm/sec. *P < 0.05 compared with initial value

Conclusion: Major cardiac veins can be completely occluded without jeopardizing perfusion of the myocardial territory they drain. These observations support the safety of the coronary venous route for targeted local drug delivery to ischemic myocardium.

POSTER

1021 IVUS Insights Into Radiation Therapy and Carotid Stenting

Sunday, March 12, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1021-114 Are the Intravascular Ultrasound Findings After Brachytherapy Treatment of In-Stent Restenosis Reproducible?

Gary S. Mintz, Neil J. Weissman, Balram Barghava, Ron Waksman, Paul S. Teirstein, Roxana Mehran, Alexandra J. Lansky, Lowell F. Satler, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

Three randomized trials used post-intervention and follow-up intravascular ultrasound (IVUS) analysis to show that brachytherapy with Ir-192 reduces in-stent restenosis. However, protocols varied; and the number of pts in each trial was either small or IVUS was only a substudy. Therefore, we compared the IVUS analysis in SCRIPPS, WRIST, and Gamma-1 to prove the reproducibility of IVUS endpoints across protocols. All studies were performed with

Follow-up @6 months	Ir-192	Placebo	p
Δ mean IH area (mm^2)			
SCRIPPS (n = 18)	0.7 ± 0.9	2.3 ± 2.8	0.0009
WRIST (n = 47)	0.2 ± 2.8	1.7 ± 3.1	<0.0001
Gamma-1 (n = 28)	0.8 ± 1.3	1.5 ± 1.1	0.049
Δ minimum lumen area (mm^2)			
SCRIPPS (n = 18)	1.0 ± 1.9	2.8 ± 4.5	0.0057
WRIST (n = 51)	0.6 ± 2.7	1.9 ± 3.5	0.0005
Gamma-1 (n = 29)	0.8 ± 1.4	2.3 ± 1.6	0.002

motorized transducer pullback. Stent, lumen, and intimal hyperplasia (IH = stent-lumen) areas were measured every 1 mm of in-stent restenosis length. IH area was averaged, minimum lumen area was measured, and differences were compared.

Importantly, there was no statistically significant difference among the three studies in assessment of in-stent neointimal hyperplasia accumulation (Δmean IH) or late lumen loss (Δminimum lumen area) in either the Ir-192 or placebo groups.

We conclude: Despite small pt numbers, IVUS findings after Ir-192 are similar across clinical trials. This substantiates the reproducibility of IVUS methodology as an endpoint for assessing efficacy of strategies to treat in-stent restnosis.

1021-115 Vessel Wall Distance Variation Between Centered and Non-Centered Radiation: Cross-Sectional and Longitudinal Analysis by Intravascular Ultrasound

Atsushi Takagi, Yasuhiro Honda, Yoshihiro Morino, Raoul Bonan, Ron Waksman, Paul S. Teirstein, Barry Rutherford, Ezra Deutsch, Kurt Malphurs, Jeff Werner, Paul G. Yock, Peter J. Fitzgerald. *Stent And Radiation Therapy (START) Trial Investigators; Stanford University, Stanford, CA, USA*

Background: Centering devices have been postulated to improve the dosing homogenicity in coronary brachytherapy after balloon angioplasty. However, the efficacy of centering is not well studied in the treatment of in-stent restenosis. Intravascular ultrasound (IVUS) cases for START (Stents And Radiation Therapy) trial which is an on-going randomized study using a noncentered beta radiation source (^{90}Sr) were analysed.

Methods: A total of 710 cross sections, obtained during IVUS pull back in 39 patients, were analyzed. Vessels were defined as large with a reference lumen $\geq$ 3.35 mm, and as small < 3.35 mm, based on the angiography-guided dose prescription. For each cross section, the maximum distance to the medial layer within the coronary wall with respect to the catheter (assumed to be equivalent to the position of ^{90}Sr source: SD), and the distance originating from the geometric center of the lumen (equivalent to the centering devices: CD) were measured. To assess the longitudinal variance in each target vessel, the absolute difference from the mean value of each measurement were calculated for both origins located at SD and CD.

Results: Cross-sectional analysis showed that CD was significantly less than SD in small vessel group (2.48 ± 0.50 vs. 2.66 ± 0.55 mm, $p < 0.001$). This difference was even more prominent in large vessel group (2.86 ± 0.45 vs. 3.10 ± 0.53 mm, $P < 0.001$). The longitudinal distance variation along the target segment was also significantly less originating in CD than SD (0.28 ± 0.22 vs. 0.37 ± 0.31 mm, $p < 0.0001$).

Conclusions: In patients with in-stent restenosis undergoing brachytherapy, centering within the lumen appears to minimize the distance variation to the vessel wall, not only in the cross-sectional geometry but also along the longitudinal axis.

1021-116 Angiography Reliably Differentiates In-Stent versus Stent Edge Restenosis: An IVUS Validation Study From the Isostent Restenosis Registry

Alexandra J. Lansky, Neil J. Weissman, Harish Rudra, Joelle Happi, Adrienne Tinana, Hui Bui, Roxana Mehran, Jeffrey Moses, Antonio Columbo, Gary S. Mintz, Martin B. Leon. *The Washington Hospital Center, Washington, DC, USA*

Background: Differentiating in-stent versus stent edge restenosis is an essential component of quantitative angiography of brachytherapy trials.

Methods: In order to gain insight into the accuracy of angiography to distinguish in-stent from stent edge restenosis, we compared intravascular ultrasound (IVUS) to quantitative angiography in 20 consecutive patients from the Isostent Restenosis Registry evaluating the p^{32} coated BX isostent. Angiograms were reviewed independently by a technician blinded to the IVUS evaluation. Based on a drawing of the precise stent location performed at the time of stent implantation, the location of restenosis by quantitative angiography (CMS, MEDIS) was classified as (1) "in-stent" if the maximal diameter stenosis (>50%) was confined to the axial length of the stent, (2) "outside the stent" if the maximal stenosis was beyond the stent edge, and (3) "both" if the maximal stenosis spanned the edge of the stent. A similar IVUS classification was based on the location of the smallest luminal area and in-stent IH > 50% of the stent area in relation to the stent.

Results: IVUS was not available in 4 patients because of total or subtotal occlusions or disease outside of the stent in 2 patients. Of the remaining 14 patients, IVUS and angiography were concordent in 12 (85.7%) cases.

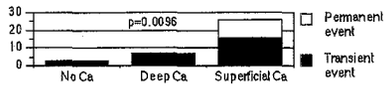
	In-Stent Angio	Out-of-stent Angio	Both Angio
In-Stent IVUS	2	0	0
Out-of-Stent IVUS	0	3	1
Both IVUS	1	0	7

Conclusions: Angiography can accurately localize restenosis at the stent margins in 85.7% of cases when using IVUS as the gold standard, and is available in all patients irrespective of total occlusions or disease outside the stent.

1021-117 Intravascular Ultrasound Lesion Calcium Predicts Adverse Clinical Events After Carotid Artery Stenting

Neil J. Weissman, Gary S. Mintz, George Dangas, Roxana Mehran, Michael Canos, Daniel A. Canos, Lee H. Monsein, Emily M. Parsons, John R. Laird Jr., Michael R. Jaff, Ann O. Greenberg, Lowell F. Satler, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

Hypotensive (Hypo) and neurologic events are reported complications after carotid artery stenting. We assessed the intravascular ultrasound (IVUS) predictors of these adverse events in 102 pts (69% male, 70 ± 9 yrs). IVUS (3.5F phased array catheter) was performed before and after stent placement. In this cohort, prolonged post-procedural Hypo occurred in 20 pts, and any neurologic event in 16 pts. (10 transient and 6 permanent). The only IVUS predictor of neurologic events was lesion calcium (Ca), present in 64% of lesions. Ca was assessed quantitatively (arc of Ca) and according to location (superficial, present in 77% of calcified lesions, vs deep). Neurologic events according to presence and location of Ca were



Hypo was present in 35% of pts with superficial Ca, half of whom had prolonged post-procedural Hypo ($p = 0.0279$ vs deep Ca or no Ca). The arc of Ca was larger in pts with prolonged post-procedural Hypo (110º vs 66º, $p = 0.096$). None of the following predicted neurologic or Hypo events: vessel size, plaque burden, lesion eccentricity, final stent dimensions, lack of stent-vessel wall apposition, or presence of dissections. There were no clinical predictors of lesion Ca.

We conclude: Lesion Ca, *especially superficial Ca identified by IVUS,* predicts major adverse clinical events after carotid stenting. These pts should be targeted for strategies to avoid both distal embolization and procedural hypotension.

ORAL

79 Interventional Cardiology Highlighted Abstract Session: Featured Topics in Stenting

Sunday, March 12, 2000, 1:30 p.m.–3:30 p.m.
Anaheim Convention Center, Lecture Hall A1

1:30 p.m.

79-1 Angioplasty Versus Rotational Atherectomy for Treatment of Diffuse In-Stent Restenosis: Clinical and Angiographic Results From a Randomized Multicenter Trial (ARTIST Study)

Juergen vom Dahl, Ulrich Dietz, Sigmund Silber, E. Niccoli, H.J. Buettner, Francois Schiele, Martin Thomas, F. Commeau, T. Ramsdale, Ernesto Garcia, Heinrich G. Klues. *On Behalf Of The ARTIST Investigators; University Hospital, RWTH Aachen, Germany*

Background: Diffuse in-stent restenosis (ISR) with high recurrence rates remains a challenging problem for which the best mechanical treatment is not clear. The ARTIST study compared balloon angioplasty alone (PTCA) with rotational atherectomy followed by adjunctive low-pressure (≤6 atm) balloon angioplasty (ROTA) in patients with a first ISR of 10–50 mm length.

Methods and Results: 298 symptomatic patients (80.3% male, 61 ± 11 years) were randomized. Baseline demographic, clinical and angiographic

parameters did not differ between the groups. Angiographic success (<30% diameter stenosis (DS)) with randomized device was 88% (PTCA) and 89% (ROTA) with crossovers in 0.7% and 5.9% resp. (p = 0.02). Stenting for a suboptimal results was necessary in 8.9% vs. 7.2% (ns). In-hospital complications (myocardial infarction, reintervention, tamponade, puncture site) were slightly higher in the ROTA group (22/152 pts vs. 10/146, p = 0.04). There was no in-hospital CABG or death. The achieved angiographic results (minimal luminal diameter (MLD), luminal gain, DS) at the end of procedure were not different by quantitative analysis (QCA) between the two groups. Event free survival at 6 months was 91.1% (PTCA) and 79.6% (ROTA, p = 0.005). Angiographic follow-up is available in 259/269 eligible patients. By QCA, MLD (1.2 ± 0.6 mm vs. 1.0 ± 0.6 mm, p = 0.008), DS (56 ± 20% vs. 64 ± 22%, p = 0.005), restenosis (>50% DS) rate (51.2% vs. 64.8%, p = 0.04) as well as the need for target lesion reintervention (36.2% vs. 47.8%, p = 0.06) were in favor for the PTCA group.

Conclusions: In this angiographically controlled randomized study in patients with diffuse ISR balloon angioplasty had a better clinical and angiographic outcome as compared to rotational atherectomy followed by low-pressure balloon angioplasty. If rotational atherectomy followed by high-pressure balloon angioplasty will have more favorable results needs further evaluation.

1:45 p.m.

79-2 Argentine Randomized Study Coronary Angioplasty With Stents Versus Coronary Bypass Surgery in Multiple Vessel Disease (ERACI II). One Year Follow Up Results

Alfredo Rodriguez, Victor Bernardi, Jose Navia, Julio Baldi, Liliana Grinfeld, Jorge Martinez, Daniel Vogel, Roberto Grinfeld, Alejandro Delacasa, Marcelo Garrido, Raul Oliveri, Eduardo Mele, Igor Palacios, William O'Neill. *On behalf of the ERACI II Investigators; Otamendi Hospital, Buenos Aires, Argentina*

Objective: The purpose of the present study was to compare percutaneous transluminal coronary revascularization (PTCR) employing stent implantation to conventional coronary bypass surgery (CABG) in patients with multiple vessel coronary artery disease.

Background: Previous randomized studies comparing balloon angioplasty vs CABG have demonstrated equivalent safety results however coronary bypass surgery was associated with significantly fewer repeat revascularization procedures.

Methods: A total of 2761 patients with coronary artery disease were screened at seven clinical sites and 450 patients were randomly assigned to undergo PTCR (225 patients) or CABG (225 patients). Only patients with multivessel disease and indication for revascularization were assigned. The primary end point was to compare major adverse events (MACE) with both techniques at 30 days, one three and five years of follow up. In PTCR group 1.4 stents per patients were used a well 28% of a bolus and infusion of abxicimab.

Results: Both groups had similar clinical demographics: unstable angina in 91%, 39% were older than 65 years, 23% had a history of peripheral vascular disease. During the first 30 days, PTCR patients had lower MACE compared with CABG. At 19.5 ± 6.4 months of follow up (range 11–35 months) survival was 96.9% in PTCR vs 92.5% in CABG, p < 0.017. Freedom from myocardial infarction was also better in PTCR compared to CABG (97.7% vs 93.4%, p < 0.017). Requirements for new revascularization procedures were higher in PTCR than CABG (18.6% vs 5.3%, p < 0.002). However only 6.2% of patients in PTCR cross over to CABG.

Conclusion: In this selected high risk group of patients with multivessel disease, PTCR with stent implantation showed better survival and freedom from myocardial infarction than conventional surgery. Repeat revascularization procedures were higher in PTCR group.

2:00 p.m.

79-3 Debulking Prior to Stenting Improves Acute Outcomes: Early Results From the SPORT Trial

Maurice Buchbinder, Richard Fortuna, Samin K. Sharma, Theodore Bass, Robert Kipperman, Joel D. Greenberg, Martin B. Leon. *For the SPORT Investigators; Scripps Memorial Hospital, La Jolla, California, USA*

To evaluate the role of debulking vs. balloon predilatation on acute and long term results of stent implantation (S), 675 patients (pts) were randomized to receive balloon dilatation (PTCA) (n = 342) or rotational ablation (RA) (n = 328) prior to S. In both groups (PTCA vs. RA) pts. were well matched for age (64.4 vs. 63.6), gender (70 vs. 68% males), diabetes (28.1 vs. 24.7%) and hyperlipidemia (55.3 vs. 51.2%). Multivessel disease was noted in (44.2 vs. 45.4%) of pts. Lesion length was (18.4 ± 8.3 vs. 18.4 ± 8.5 mm). Treatment site was in the LAD (49.7 vs. 49.1%), RCA (32.5 vs. 30.5%), CX (15.5 vs. 18.0%). In both groups pts received equal number of S per lesion (1.3 ± 0.6 vs. 1.3 ± 0.6). Average S diameter was (3.2 ± 0.4 vs. 3.3 ± 0.4 mm) while average S length was (19.6 vs. 20.1). In the RA group mean burr to artery ratio was 0.7 ± 0.1. Post S mean inflation pressure was (15.1 ± 4.4 vs. 14.0 ± 4.9 atm).

Results:

QCA (100%)	PTCA/S N = 194	Rota + S N = 170
Ref Vessel, mm	2.89 ± 0.5	2.89 ± 0.4
Pre Rx MLD, mm	0.92 ± 0.43	0.9 ± 0.43
Post Rx MLD, mm	2.75 ± 0.42	2.84 ± 0.42 (p < 0.041)
Anglo Success	100%	100%
Clinical Success	89%	84%
MACE (in hospital)	13.7%	17.1% (p = n/s)
Non Q MI	2.3%	4.3% (p = n/s)
Re-Intervention	9.9%	11.6%

Conclusion: Debulking using RA prior to S appears to offer a significantly larger final residual lumen without increase in complication rates. Angiographic and clincial long term (6 mo) outcomes will be presented.

2:15 p.m.

79-4 The SISA Study: A Randomized Comparison of Balloon Angioplasty and Stent to Prevent Restenosis in Small Arteries

Serge Doucet, Martin J. Schalig, David Hilton, Mathy Vrolix, Bernard De Bruyne, Patrick Chenu, Luc Bilodeau, Wasan Udaychalerm. *Montreal Heart Institute, Montreal, Canada; Leiden University Medical Center, Leiden, The Netherlands*

Background: The Stenting In Small Arteries (SISA) trial is a randomized, multicenter, worldwide study where balloon angioplasty (PTCA) is compared to stent in pts with a reference diameter (RD) of 2.3–2.9 mm. Angiographic restenosis at 6 months is the primary endpoint.

Methods: Between October 1997 and July 1999, 352 pts with stable angina and one de novo lesion in a native coronary artery were randomized to standard PTCA or Medtronic beStent implantation after on-line quantitative coronary analysis (QCA) measurement had confirmed RD of 2.3–2.9 mm.

Results: Clinical results for cumulative adverse events are available for 325 pts at 30 days and 199 pts at 6 months.

	30 days		6 months	
	PTCA	Stent	PTCA	Stent
N	171	154	103	96
Death	0 (0%)	0 (0%)	1 (1%)	1 (1%)
Q-wave MI	1 (0.6%)	1 (0.6%)	1 (1%)	1 (1%)
Non Q-wave MI	10 (5.7%)	3 (1.9%)	10 (9.7%)	5 (5.2%)
CABG	1 (0.6%)	1 (0.6%)	2 (1.9%)	3 (3.1%)
Re-PTCA	6 (3.5%)	1 (0.6%)	26 (25.2%)	16 (16.6%)
Pts with any events	*15 (8.8%)*	*6 (3.9%)*	*32 (31.1%)*	*22 (22.9%)*

Conclusion: There is a trend for less adverse events (including rePTCA) at 30 days and 6 months with stent compared to PTCA in vessel of 2.3–2.9 mm. The restenosis rate for each group will be presented.

2:30 p.m.

79-5 Elimination of Restenosis by Stenting After Plaque Reduction With Platelet Inhibitor Trial (ESPRIT): A Prospective Randomized Trial

Etsuo Tsuchikane, Tomoko Kobayashi, Nobuhisa Awata, Motohiro Kirino, Satoru Otsuji, Makoto Sakurai, Tohru Kobayashi. *Osaka Medical Center for Cancer and Cardiovascular Diseases, Osaka, Japan*

Optimal DCA provides a favorable long-term angiographic outcome. However, restenosis is observed in some cases even after optimal DCA, which results from constrictive remodeling and neointimal proliferation. Stenting inhibits the constrictive remodeling. We reported that cilostazol, an antiplatelet agent, controls neointimal proliferation after PTCA. The aim of the present study was to evaluate the efficacy of primary stenting after optimal DCA followed by administration of cilostazol. Ninety-six lesions successfully dilated by aggressive DCA using IVUS were randomly assigned to the DCA-stent group (47 lesions) or the DCA-alone group (49 lesions). Single or multiple Multilink stents were implanted in the DCA-stent group. Adjunctive balloon angioplasty was performed in the DCA-alone group if necessary. Administration of cilostazol (200 mg/day) without aspirin was commenced after the procedure and continued until 6 month (M) follow-up (Fu) in both groups.

Ticlopidine (200 mg/day) was added in the DCA-stent group for 1 M. Serial QCA and IVUS examinations were performed at pre- and post-procedure, and 3 and 6 M Fu. Acute results were shown in the table.

	DCA-stent	DCA-alone	P value
MACE	0	0	
Reference (mm)	3.33 ± 0.34	3.24 ± 0.38	NS
Post DCA MLD (mm)	2.84 ± 0.36	2.85 ± 0.34	NS
Final MLD (mm)	3.25 ± 0.25	2.87 ± 0.34	<0.0001
Final DS (%)	3.6 ± 7.1	11.1 ± 10.0	0.0003
Post DCA LA (mm^2)	7.9 ± 1.7	8.1 ± 1.9	NS
Final LA (mm^2)	10.3 ± 2.0	8.3 ± 1.8	<0.0001
Final % plaque area (%)	41.4 ± 7.0	53.2 ± 8.4	<0.0001

(MLD: minimal lumen diameter, DS: diameter stenosis, LA: lumen area, final: post-procedural)

Conclusion: Adjunctive stenting after aggressive DCA provides a larger immediate lumen compared to aggressive DCA alone. Follow-up clinical and angiographic data will be presented.

2:45 p.m.

79-6 Local Delivery of Enoxaparin Decreases Restenosis Rate After Coronary Stenting (POLONIA Study)

R. Stefan Kiesz, Pawel Buszman, M. Marius Rozek, Jack L. Martin, Ezra Deutsch, Ewa Gaszewska, Marek Rewicki, Piotr Seweryniak, Maciej Kosmider, Michal Tendera. *UTHSC at San Antonio, TX; Jefferson Health System – Main Line, Radnor, PA; Cornell University, New York, NY, USA; Silesian Cardiology Centre, Katowice; National Institute of Cardiology, Warsaw; Internal Ministry Hospital, Warsaw; Lodz Medical School, Lodz, Poland*

Experimental work suggests that low molecular weight heparin, at high concentration, inhibits smooth muscle cell proliferation. We investigated whether intramural delivery of Enoxaparin prior to stenting decreases in-stent restenosis. One hundred pts from 4 centers with single lesion, single vessel disease were randomized to local administration of Enoxaparin (LDD) versus systemic heparinization (SH). The LDD group received reduced systemic heparinization (2,500 U). Ten mg of Enoxaparin was administered locally during predilation with PTCA/drug delivery Transport catheter before stent was deployed. All pts were treated with 9 cell 16 mm NIR stents. The primary endpoints included late luminal loss and loss index. The secondary endpoints included major adverse cardiac events (MACE), target lesion revascularization (TLR) and angiographic restenosis at 6 months.

Results: Clinical follow up was obtained in all pts, and follow-up angiography at 6 month was performed in all but one pt. ate loss and loss index were significantly reduced to 0.76 ± 0.42 mm and 0.38 ± 0.21, respectively, in the LDD group vs 1.07 ± 0.49 mm and 0.55 ± 0.25 in the SH group, (both $p < 0.0001$). Activated clotting time at by the end of the procedure was significantly lower in the LDD group 146.9 ± 39.8 sec when compared with the SH group 381.9 ± 182.2 sec ($p < 0.0001$). There were no deaths or emergent CABG; one non Q-wave MI due to subacute stent closure occurred in the SH group. TLR in the LDD group was 8% vs 22% in the SH group ($p < 0.05$). Angiographic restenosis using binary definition occurred in 10% of pts in the LDD group and in 24% of pts in the SH group ($p < 0.05$).

Conclusions: Our study demonstrates, for the first time, a significant decrease in late lumen loss and angiographic restenosis as a result of local delivery of enoxaparin. These data suggest that local drug delivery may constitute a viable therapeutic option to prevent restenosis after coronary stent implantation

3:00 p.m.

79-7 Percutaneous Transluminal Coronary Revascularization Versus Coronary Bypass Surgery In-Patients With Multiple Vessel Disease and Proximal Left Anterior Descending Artery Stenosis: Results From the ERACI II Study

Alfredo Rodriguez, Sandra Saavedra, Carlos Fernandez, Maximo Rodriguez Alemparte, Julio Baldi, Liliana Grinfeld, Roberto Grinfeld, Jorge Martinez, Miguel Russo Felsen, Igor Palacios, William O'Neil. *On behalf of ERACI II Investigators; Otamendi Hospital, Buenos Aires, Argentina*

Background: Previous studies comparing percutaneous transluminal coronary revascularization (PTCR) with coronary bypass surgery (CABG) in multiple vessel disease (CAD) suggested a prognosis advantage with CABG when proximal left anterior descending artery (LAD) was affected.

Methods: From 450 pts included in the Argentine Randomized Study (ERACI II) we identified 230 with multiple CAD and severe stenosis involving proximal or ostial segment in LAD. 83 pts had two vessels disease and 147 pts three or more vessels. Major adverse events (MACE) as death, myocardial infarction (AMI) and repeat procedures (TVR) were present. In PTCR 1.5 stent/patient was used.

Results: Basal demographic characteristics were similar. Unstable Angina present in 89.6% and treated diabetic in 173%.

	PTCR (n = 113)	CABG (n = 117)	p
30 days Outcome			
Death	0%	2.5%	
AMI (Q)	0.9%	5.1%	
Death + AMI	0.9%	76%	0.036
TVR	1.8%	0%	
MACE	2.6%	7.6%	
Follow up (19.5 ± 6.4 months)			
Death	0.9%	4.3%	
AMI	2.6%	5.1%	
Death + AMI	3.5%	9.4%	
TVR	19.5%	3.4%	0.001
MACE	23%	13%	

Conclusions: Patients with multiple CAD and ostial or proximal LAD disease, treated with PTCR had lower acute adverse events compared with CABG. At follow up lower requirements of repeat procedures are the only advantage observed in CABG over PTCR.

3:15 p.m.

79-8 A Randomized Comparison Between Balloon Angioplasty and Elective Stent Implantation in Venous Bypass Grafts; the Venestent Study

Clara E.E. Hanekamp, Jacques J. Koolen, Peter Den Heyer, Martin J. Schalij, Jan J. Piek, Frits W.H.M. Bär, Hans J.R.M. Bonnier. *For the Venestent Study Group; Cardiology, Catharina Hospital, Eindhoven, The Netherlands*

Background: Balloon angioplasty of Saphenous Vein Graft (SVG) lesions may be performed with relative high immediate angiographic success rates, but is limited by high restenosis rates. Observational studies and one randomized study suggested a beneficial effect on restenosis of elective stent implantation in SVG lesions, compared to balloon angioplasty. To determine the benefits of elective stent implantation in de novo lesions in the body of a SVG, we compared acute and long term clinical and angiographic outcome of balloon angioplasty and Wiktor-I stent implantation in SVG lesions.

Methods: A total of 150 patients in 9 centers, with a denovo SVG lesion were randomly assigned to balloon angioplasty or Wiktor-I stent implantation. One month post procedure clinical follow-up was performed, and 6 months post procedure clinical follow-up, an exercise test and angiographic follow-up were performed. Analysis were performed on an intention to treat basis. The primary endpoint of the study was the angiographic binary restenosis rate, with restenosis defined as >50% diameter stenosis. Secondary endpoints were among others Major Adverse Cardiac Event (MACE) free survival and target vessel revascularization rate. MACE is defined as death, myocardial infarction, bypass graft surgery or angioplasty of the target vessel.

Results: See table

	Angioplasty	Stent	p
Number of patients	72	78	
Angiographic success	97.2%	98.7%	NS
Procedural success	88.9%	91.0%	NS
In-hospital MACE	9.7%	9.0%	NS
6 months target vessel revascularization	25.0%	11.5%	0.03
6 months MACE free survival	63.9%	80.5%	0.03
6 months angiographic restenosis	35.6%	21.9%	0.09

Cross-over to stent occurred in 23.6% of the patients randomized to balloon angioplasty. Angiographic follow-up could be completed in 82% of the patients.

Conclusion: Stent implantation in SVG lesions results in significantly improved MACE free survival, significantly decreased target vessel revascularization rates, and a strong trend towards reduced restenosis rates, as compared to balloon angioplasty.

ORAL

83 Interventional Cardiology Highlighted Abstract Session: Novel Therapies

Sunday, March 12, 2000, 4:00 p.m.–5:30 p.m.
Anaheim Convention Center, Lecture Hall A1

4:15 p.m.

83-2 Tissue and Myocardial Distribution of Intracoronary, Intravenous, Intrapericardial, and Intramyocardial ^{125}I-Labeled Basic Fibroblast Growth Factor (bFGF) Favor Intramyocardial Delivery

Roger J. Laham, Mehrdad Rezaee, Lawrence Garcia, Mark Post, Frank W. Sellke, Donald S. Baim, Michael Simons. *BIDMC/Harvard Medical School, Boston, MA, USA*

Background: Therapeutic angiogenesis trials are ongoing, however, the tissue and myocardial distributions of growth factors and gene therapy vectors using different delivery modalities have not been defined.

Methods: Yorkshire pigs (n = 48) underwent ameroid constrictor placement on the left circumflex artery to induce chronic ischemia. 25 μCi ^{125}I-bFGF with 30 mg cold bFGF was administered using intracoronary (IC, n = 12), intravenous (IV, n = 12), and percutaneous subxyphoid intrapericardial (n = 12) injections, and intramyocardial (IM, n = 12) delivery using BIOSENSE-guided endocardial delivery (15 injections in the ischemic LCX distribution). Tissue and myocardial distribution was determined at 1 and 24 hours by measuring ^{125}I-bFGF specific activity (TCA precipitation). Organ and tissue level autoradiography was performed.

Results: Data for all animals summarized below

	IC	IV	IP	IM
Liver 1 hr (%)**	37.6 ± 17.1	42.1 ± 17.7	0.41 ± 0.3*	1.47 ± 0.49*
Liver 24 hrs (%)**	2.8 ± 1.5	1.5 ± 0.9	0.38 ± 0.26*	1.1 ± 0.47*
Heart 1 hr (%)**	0.88 ± 0.89	0.26 ± 0.08	1.45 ± 0.98*	4.31 ± 1.67*
Heart 24 hr (%)**	0.05 ± 0.04	0.04 ± 0.01	2.98 ± 2.89*	2.3 ± 1.54*
Normal wall %/g**	0.008 ± 0.008	0.003 ± 0.001	0.01 ± 0.02*	0.0009 ± 0.0*
Ischemic wall %/g	0.009 ± 0.007	0.003 ± 0.001	0.02 ± 0.02*	0.03 ± 0.02*
Endo-/Epicardial	1.03	0.88	0.04$^{\Psi}$	2.25

*p < 0.05 compared to IC, **p < 0.05 by ANOVA, $^{\Psi}$ p < 0.05 vs. IM

IC and IV delivery have significant systemic recirculation with low cardiac deposition and retention (better with IC). IP and IM delivery result in markedly reduced systemic recirculation and improved cardiac deposition and retention. IP delivery is limited to the epicardial layers and requires a normal pericardium. Myocardial ischemia enhances myocardial deposition and retention.

Conclusion: IP and IM delivery have a more favorable tissue distribution and myocardial deposition than IC or IV delivery. IP delivery is limited by poor endocardial distribution and the inapplicability to post-CABG patients. IM delivery may emerge as the delivery strategy of choice for therapeutic angiogenesis. Clinical investigations are underway.

4:30 p.m.

83-3 Carotid Artery Intravascular Ultrasound: Safety and Morphologic Observations During Carotid Stenting in 102 Pts

Neil J. Weissman, Michael Canos, Gary S. Mintz, John R. Laird Jr., Lowell F. Satler, Daniel Canos, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

To assess the mophology of carotid atherosclerosis, intravascular ultrasound (IVUS) was performed in 102 pts undergoing carotid stenting. A 3.5 F phased array IVUS catheter was advanced to the distal internal carotid (DIC) and slowly withdrawn to image the DIC, lesion, and common carotid (CC) after pre-dilation and again after stent placement. There were no adverse events. 89% of lesions were at the origin of the internal carotid. Most were eccentric (max/min plaque thickness = 3.2 ± 3.4) with max plaque thickness opposite the flow divider separating the external and internal carotid in 69%. Lesion calcium (Ca) was common (61%, arc = 145 ± 97º); conversely, Ca of the DIC or CC was uncommon (arc = 2 ± 10º and 7 ± 1º, respectively).

	DIC	Lesion	CC
Arterial area (mm^2)	28.4 ± 10.0	44.5 ± 13.7	63.4 ± 14.8
Lumen area (mm^2)	20.9 ± 8.0	7.8 ± 4.2	36.2 ± 10.9
Plaque area (mm^2)	7.7 ± 5.0	26.8 ± 12.5	27.1 ± 8.6
Plaque burden (%)	27 ± 11	81 ± 14	43 ± 9

The lesion/DIC arterial area ratio was attenuated in smokers (p = 0.03) suggesting an impact of smoking on arterial remodeling similar to coronary arteries. The lumen of the DIC (distal reference) measured 5.4 ± 1.0 mm (range 3.5–8.0 mm). Final stent area (14.6 ± 5.1 mm^2) corresponded to an area stenosis (vs DIC lumen area) of 19 ± 23%; the residual area stenosis correlated with the arc of lesion Ca (p = 0.0097). 11 stents were poorly apposed; there were 3 edge dissections.

Conclusion: Carotid IVUS is safe. In pts undergoing carotid stent procedures, IVUS provides unique insights into vessel size, plaque morphology (especially Ca), and distribution of atherosclerosis.

4:45 p.m.

83-4 Two Years Follow-up After Intracoronary Gamma Radiation Therapy for In-Stent Restenosis: Results From a Randomized Clinical Trial

Ron Waksman, Larry R. White, Roxana Mehran, Alexandra J. Lansky, Ann Greenberg, Balram Bhargava, Lowell Satler, Kenneth K. Kent, Mandy Murphy, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

Background: The Washington Radiation for In-Stent Restenosis Trial (WRIST) is a double-blinded randomized trial assessing the effects of gamma radiation therapy (CRT) in pts with in-stent restenosis (ISR).

Methods: 130 pts with ≥1 episode of ISR (100 native coronary pts and 30 vein graft pts) underwent PTCA, laser ablation, rotational atherectomy, and/or additional stenting (36%). Pts were randomized to achieve either 192-Ir radioactive seeds or placebo. The prescribed dose was 15 Gy to a 2 mm radial distance from the center of the source. Patients were followed clinically at 6, 12 and 24 months

Results: Angiographic restenosis was dramatically reduced at 6 months in CRT pts. At 6, 12, and 24-month clinical follow-up, pts receiving CRT also had markedly lower target lesion and vessel revascularization (TLR and TVR) when compared with controls (see Table). *Between 6 and 12 months,* CRT pts had more late recurrences than placebo (TLR: CRT = ↑9.3% vs placebo = no change and TVR: CRT = ↑7.6% vs placebo-no change). Two years follow-up was completed on 102/130 patients and detected only one additional TLR in the irradiated group and one TVR in the placebo group.

Restenosis	6 mo Angio	TLR 6 m (%)	TLR 12 m (%)	TLR 24 m (%)
Control (65)	59%	63.1	63.1	63.1
IR-192 (65)	19%	13.8	23.1	26.2
P value	0.001	<0.0001	0.001	0.001

Conclusions: In WRIST, CRT for pts with in-stent restenosis using an 192-Ir system is associated with a marked reduction in the need for repeat target lesion and target vessel revascularization at 6 months. Despite increase in the late recurrences in the irradiated group between 6–12 months, the clinical benefit of radiation for this patient cohort was well maintained at two years.

5:00 p.m.

83-5 Prevention of Distal Embolization During Interventions in CABG and Native Coronary Lesions Using a New Protection Filter Device

Ulrich Gerckens, Ralf Mueller, Sabine Soblik, Thomas Wollweber, Eberhard Grube. *Department of Cardiology/Angiology Heart-Center Siegburg, Siegburg, Germany*

Background: Percutaneous interventions of CABGs and native coronary arteries carry the risk of distal embolization especially in degenerated and friable lesions. The AngioGuard™ Emboli Capture system consists of a guidewire-based filter device to capture and remove embolic debris without temporary vessel occlusion.

Device Description: The AngioGuard™ Capture Guidwire system consists of a 0.014 PTCA wire with an expandable filter basket at the distal end. After crossing the target lesion the basket is expanded and the intervention can be performed in a standard manner. Plaque debris is captured within the distal basket and can be extracted using the AngioGuard™ guidewire. The filter membrane allows a normal blood-flow during the procedure.

Method: To evaluate the safety and efficacy of this new protection device we used the AngioGuard™ system in 24 Patients with CABG (n = 10) or coronary artery lesions (n = 14). In 23 lesions angioplasty with additional stent implantation was performed. Assessment of the TIMI flow was performed pre- and postinterventional. Serial CK/CKMB values were obtained after 8, 16 and 24 hrs.

Results: In 23 of 24 patients (95.8%) the system could be safely placed, expanded and extracted. In one patient the device could not cross the target

lesion. In one case a pre-dilatation to place the system was necessary. We observed no in-hospital major cardiac events (AMI, urgent bypass surgery, death). In one patient discrete CK elevation (32/16 up to 102/18) occurred after the intervention. No postinterventional "no-reflow" was observed especially in the CABG lesion group. The average TIMI flow increased from 2.0 to 2.5. The TIMI flow during the procedures was unchanged except in one patient. In this case the plaque material captured within the basket completely covered the filter membrane with temporary vessel occlusion. Macroscopically visible debris was extracted in 20 cases. Single particles measured up to 2 × 2 mm.

Conclusion: The AngioGuard™ Emboli Capture system can be safely used to retrieve plaque debris and prevents distal embolization and "no-reflow" phenomenon during interventions in degenerated bypass grafts without temporary vessel occlusion. Even in PTCAs in native coronaries we could demonstrate liberation of plaque material.

83-6 See page 546A

POSTER

1040 Percutaneous Interventions: Coronary Outcomes

Sunday, March 12, 2000, 4:00 p.m.–6:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 4:00 p.m.–5:00 p.m.

1040-75 In-Hospital Outcomes Following Percutaneous Transluminal Coronary Angioplasty Versus Stent Placement for Acute Myocardial Infarction: New York State Experience

Babak A. Vakili, David L. Brown. *Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, New York, USA*

Background: Percutaneous transluminal coronary angioplasty (PTCA) is effective treatment for acute myocardial infarction (MI). Although stent placement offers certain advantages over PTCA in the elective setting, little data is available to support the use of routine stent placement in acute MI.

Methods: Using the 1995 New York State Angioplasty Database, we compared the in-hospital mortality of all patients in New York state undergoing primary or rescue PTCA with that of patients treated with stent placement for a first MI within 6 hours of symptom onset.

Results: A total of 861 patients undergoing primary or rescue PTCA or stent placement for acute MI were identified, of whom 706 (82%) had PTCA alone. Stent placement was performed in 155 patients (18%). Mean age was 60 years, 26% were female, 14% were diabetic, 48% were hypertensive and 29% were current smokers. A history of congestive heart failure (CHF) was present in 2%. There was no significant difference between PTCA and stent patients with regard to age, gender, hypertension, diabetes, smoking or CHF (p = NS for all comparisons). The frequency of left main coronary disease and three-vessel coronary disease did not differ between the groups. Balloon counterpulsation was required in 11% of PTCA patients and 8% of stent patients ($p = 0.64$). There was a trend toward more shock among patients treated with PTCA (7% vs. 3%, $p = 0.09$). Procedural complications including stroke, renal failure, emergency bypass surgery and transmural MI did not differ between PTCA and stent patients. In-hospital mortality was significantly lower for patients treated with stent placement rather than PTCA alone (0.6% vs. 5.2%, $p = 0.02$).

Conclusion: Patients undergoing stent implantation for primary or rescue treatment of acute MI have significantly reduced in-hospital mortality.

1040-76 Twenty-Year Follow-Up After Percutaneous Transluminal Coronary Angioplasty

Andrea S. Abizaid, Amanda Sousa, Marinella Centemero, Alexandre Abizaid, Aurea Chaves, Luiz F. Tanajura, Ana Cristina Seixas, Eduardo Sousa. *Instituto Dante Pazzanese de Cardiologia, São Paulo, Brazil*

We report the 20-year outcomes (death, MI and target lesion revascularization) from a consecutive series of 180 patients (pts) treated from December/1979 to August/1983 with balloon PTCA in native coronary arteries.

Methods: For all pts the technique used was braquial approach, Stertzer guiding catheter with a DG 20–3.0 Gruentzig balloon (a non-steerible system). The mean pressure was 6 atm and the mean inflation time was 10–30 seconds.

Results: Important clinical, angiographic and procedural characteristics were: median age 51 years, 80% men, 15% diabetes, 77% LAD, 72% proximal lesion location and all ACC/AHA type A/B1 lesions. By QCA analysis, the mean reference vessel diameter was 2.99 ± 0.42 mm, the % diameter stenosis was reduced from 68.4 ± 12.8% to 37.9 ± 18.1% and the absolute gain was 1.08 ± 0.58 mm. Follow-up was obtained in 134 (87%) pts of 155 pts treated successfully with balloon PTCA. At 20-year follow-up, 30% died (13% cardiac death), 9.7% had MI (85% not related to the target lesion) and 15% had TLR at 4.5 ± 2.1 months after PTCA (including 7% CABG and 8% re-PTCA). Thus, cardiac death, MI or TLR occurred in 50 (37.7%) pts. Non-TLR was required in 26.8% pts, including 17.9% CABG and 8.9% re-PTCA (mean = 7.2 years and 6.5 years after first PTCA, respectively). The two major causes of non-cardiac death were: cancer (45%) and cerebral vascular accident (20%). The probability of event-free survival was 89.6%, 78% and 65% in 5, 10 and 20 years, respectively.

Conclusions: The long-term follow-up of patients treated with balloon PTCA shows low incidence of cardiac death (13%) and MI (9.7%), mainly in the first 5 years. Need of any revascularization is more frequent during the first year (restenosis) and after 5 years (progression), probably reflecting the natural history of coronary artery disease.

1040-77 Long-Term Clinical Outcomes of Percutaneous Coronary Intervention in Patients With Severe Left Ventricular Dysfunction

Robert Siegel, Jennifer Vermillion, Ambika Bhaskaran, Barbara Barker, Alvin Nuttall, Paul Underwood, Tariq Khalil, Deborah Frazier, Stephanie Huemiller. *Advanced Cardiac Specialists, Phoenix, Arizona, USA*

Severe left ventricular (LV) dysfunction (global LVEF < 30%) is associated with adverse morbidity and mortality outcomes in coronary heart disease (CHD). Percutaneous intervention (PTCA) in these subsets has historically been associated with low rates of procedural success and a high incidence of target lesion revascularization (TLR). We present our registry experience of PTCA in patients with hemodynamically significant CHD and severe LV dysfunction. From 1/96 to 7/99, we performed PTCA in 317 patients (23% female; mean age 64.9 years; range 25–81). Mean global LVEF at catheterization was 23.97%. Thirty six percent were direct infarct interventions and 36.8% presented with unstable angina. Comorbidities included prior MI, 43%; age > 70 years, 37%; prior CABG, 25%; diabetes, 24%; multivessel disease, 21%; cardiogenic shock, 14.2%. The LAD was the target vessel distribution in 38%; 50% lesions were ostial or proximal, subtending large myocardial volume. Adjunctive IABP support and appropriate inotropic support were employed in 43.5% cases. Intracoronary stents were deployed in 31% patients.

Results: Procedural success was 93.1%.

In-hospital events (mean hospital stay days				1-year Follow-up (% complete; mean – months)			
Acute closure	CABG	Death	Mean LVEF	TLR PTCA/CABG	Death	EFS	Mean LVEF
6 (1.9%)	3 (0.9%)	1 (0.3%)	27.67%*	24 (7.6%)	21 (6.7%)	269 (84.9%)	38.2%*

*p value significant at <0.0001; TLR: target lesion revascularization; EFS: event-free survival

Conclusions: (1) Percutaneous coronary intervention can be performed safely with a high rate of success in a selected clinical subset of patients with hemodynamically significant CHD and severe LV dysfunction. (2) In-hospital event rates are tow. (3) At 1-year follow-up, clinical restenosis rates (death, TLR, MI) are low and event-free survival is impressive. (4) There is *very significant improvement* in global LV systolic performance at 12-month follow up, suggesting that the aggressive treatment strategy for salvage of jeopardized hibernating myocardium may have contributed to improved acute and long-term clinical outcomes.

1040-78 Mortality Trends in Single Coronary Percutaneous Intervention in the Prestent and Strent Eras

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Purpose: In recent years, interventional cardiology has undergone numerous changes, the most prominent of which has been the advent of coronary stinting. The aim of this study was to assess the impact of current trend of stent use on all-cause mortality and on mortality related to intervention in the circumflex (Cx), left anterior descending (LAD), and fight coronary artery (RCA) vessels after percutaneous coronary intervention (PCI) (balloon angioplasty, stenting, or debulking) in single coronary vessel interventions.

Methods: We retrospectively analyzed our institution's registry data for all patients undergoing single PCI in 1993 (when the stent was bein8 introduced)

and in 1997 (when the use of stent was established with the general policy of "stenting when feasible"). Mortality rates were obtained at hospital discharge by reviewing medical records.

Results: Over the period of study, the annual number of PCIs increased from 1326 to 2181. The rate of coronary stenting increased from 2% (under an experimental protocol) to 59%, the rate of balloon angioplasty decreased from 94 to 34%, and the rate of debulking increased from 4 to 7%. IVUS was used in 3% of interventions in 1997. In the stent era, the all-cause mortality at time of discharge was significantly reduced in the whole group and in the RCA group (Table).

Conclusions: There was a significantly decreased all-cause mortality between the prestent (1993) and the stent eras (1997) in single vessel PCI. The mortality difference was sagnificantly decreased for RCA intervention, borderline for LAD intervention, and not significant for Cx interventions.

	Cx		LAD		RCA		All	
Year	1993	1997	1993	1997	1993	1997	1993	1997
Number	329	512	563	917	434	752	1326	2181
Death Rate	1.8%	2%	2%	0.8%	1.8%*	0.1%	1.9%*	0.9%

*P value for the difference between 1993 and 1997 <0.05

1040-79 Predictors for Late Death of Patients With Chronically Occluded Coronary Arteries

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Backgrounds: Despite relatively low primary success rate and high incidence of restenosis, PTCA of chronic total occlusion (CTO) is widely performed. However, its beneficial effect on late survival has not been clarified in previous reports. The objectives of this study were to determine the predictors for late death of patients (pts) with CTO and evaluate the impact of successful recanalization of CTO on long-term survival outcome.

Methods: CTO was defined as follows; 1) TIMI flow = <1, 2) Duration of occlusion >2 weeks, 3) Located in prox. and mid. LAD or in prox. Cx or in prox. and mid. RCA. Of 1055 pts with single CTO, 930 pts received PTCA of CTO between Jan. 1989 and Dec. 1995 in Kokura Memorial Hospital, with a success rate of 64%. As a result, 597 CTOs were reopened and 458 remained closed. The mean interval of follow-up was 5.4 ± 2.5 years.

Results:

Risk factors	HR for OD (95%CI)	HR for CD (95%CI)
Age (/year)	1.06 (1.04–1.09)***	1.04 (1.01–1.07)*
DM	1.90 (1.35–2.68)**	2.15 (1.37–3.38)**
EF < 40%	2.61 (1.74–3.89)***	3.81 (2.32–6.28)***
Creatinine >1.5	3.70 (2.22–6.17)***	4.92 (2.62–9.22)***
CVA	2.01 (1.19–3.41)**	2.81 (1.45–5.44)*
Unopened CTO	1.89 (1.33–2.67)**	2.02 (1.25–3.26)*

HR;Hazard Ratio OD;Overall Death CD;Cardiac Death. CI; Confidence Interval * p < 0.005 ** p < 0.001 *** p < 0.0001

Conclusions: 1) Independent predictors for late overall and cardiac death of pts with CTO were advancing age, poor LV function, renal dysfunction, diabetes mellitus, cerebrovascular disease, and unopened CTO. 2) Successful PTCA of CTO improves long-term clinical outcome in terms of reduced overall and cardiac mortality.

1040-80 Patient Characteristics and In-hospital Outcomes Following Angioplasty of the Left Main Coronary Artery: New York State Experience

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Background: Percutaneous transluminal coronary angioplasty (PTCA) of the left main coronary artery (LMCA) is occasionally offered to patients who are poor candidates for surgical revascularization. However, little data is available regarding outcomes of LMCA PTCA.

Methods: Using the 1995 New York State Angioplasty Database, we identified the characteristics and outcomes of all patients undergoing PTCA of the LMCA. Univariate and multivariate analyses were used to determine independent predictors of adverse outcomes.

Results: In 1995, 154 PTCAs of the LMCA were performed. The mean age was 65.6 ± 11 years; 79% were males. Diabetes was present in 21%, hypertension in 62% and a history of congestive heart failure (CHF) in 14%. The mean angina class was 3.3 ± 0.7 and the mean ejection fraction was 39% ± 20. Only 7% of patients had suffered a myocardial infarction within 23 hours of the PTCA. CHF was present on admission in 13% of patients. Shock or hemodynamic instability was present in 11% of patients. The LMCA was unprotected in 53% of patients. The in-hospital mortality associated with LMCA PTCA was 7.4%. The incidence of a composite endpoint consisting of in-hospital mortality, emergency bypass surgery and stroke was 13%. Hemodynamic instability was the strongest univariate predictor of in-hospital mortality. Mortality of patients with hemodynamic instability was 58% compared to 7% in stable patients ($p < 0.001$). Multivariate analysis identified hemodynamic instability as the only independent predictor of in-hospital mortality following PTCA of the LMCA (OR 18.5, 95% CI 4.96–68.86, $p < 0.001$).

Conclusion: PTCA of the LMCA in hemodynamically stable patients has relatively low mortality, which may be appropriate for certain patients who are not candidates for bypass surgery.

1040-81 Outcome of Patients Undergoing Coronary Intervention at the Time of Diagnostic Catheterization: A Report From the 1999 Dynamic Registry

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Percutaneous coronary intervention (PCI) is more frequently being performed at the time of diagnostic catheterization (Ad-Hoc (AH)) PCI. To study the characteristics of patients undergoing AH vs scheduled (S) PCI and the impact on outcome, we evaluated 1630 patients in Wave 2 of the NHLBI Dynamic Registry of whom 983 (60.3%) (range 21.9–88.9%) underwent AH PCI in the absence of acute MI. There were no differences in age, gender, risk factors and comorbid or multivessel disease between groups. AH patients were more likely to have unstable angina (44.4 vs 34.9%, $p < 0.001$), undergo urgent or emergency procedures (38.8 vs 27.1%, $p < 0.001$) and receive IIb/IIIa receptor antagonists (35.7 vs 26.7%, $p < 0.001$) and were less likely to have diffuse disease (49.4 vs 61.8%, $p < 0.001$)) than S patients. Procedural characteristics are shown:

	AH	S	p value
Lesion Characteristics	n = 1376	n = 885	
thrombus (%)	17.9	13.1	<0.01
calcified (%)	24.7	30.3	<0.01
ostial (%)	6.3	8.8	<0.05
tortuousity (%)	26.2	30.2	<0.05
Lesion Success (%)	92.1	92.5	NS
Stent (%)	66.5	67.9	NS

Procedural complications and the incidence of MI (2.7 vs 2.9%), emergency CABG (0.5 vs 0.3%) and death (0.9 vs 1.5%) were similar in AH and S patients respectively. Multivariate analysis revealed emergency procedure (Odds Ratio (OR) 4.3), operator assessment of high risk (OR 0.4), absence of diffuse disease (OR 1.5) and class C lesions (OR 1.6) to be significantly associated with AH. These data suggest that AH procedures are performed in the majority of patients (although incidence varies among sites) undergoing contemporary PCI and that angiographic and procedural differences between AH and S patients do not influence acute procedural outcome. The impact of this strategy on hospital costs and revascularization decision making needs further study.

1040-82 The Effect of Hospital Volume on Long-Term Outcome After Percutaneous Transluminal Coronary Angioplasty

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Background: The effect of hospital volume on long-term outcome after PTCA is unknown. We studied the impact of hospital volume of PTCA on repeat PTCA, CABG, recurrent AMI and death 6 months after PTCA.

Methods: We analyzed the physicians' claims and discharge data of 6,635 patients who underwent a PTCA after AMI between 1991 and 1995 in Canada. For each administrative year, hospitals where the PTCA was performed were classified into three groups: low volume: <200/year, medium volume: 200–400/year and, high volume >400/year.

Results: Of 6,635 patients, 5% underwent PTCA in a low volume, 39% in a medium volume and 56% in a high volume hospital. Compared with patients in high and medium volume hospitals, patients in low volume hospitals were older, had a more recent AMI and were less likely to have been transferred for a PTCA. After adjustment for baseline differences, patients in the low and medium volume groups were more likely to undergo CABG within 6 months compared with patients in the high volume group (OR 2.1, 95% CI 1.3–3.3 and OR 1.5, 95% CI 1.2–1.9, respectively). However, patients in the low and

medium volume groups were less likely to undergo repeat PTCA within 6 months compared with patients in the high volume group (OR 0.37, 95% CI 0.24–0.58 and OR 0.8, 95% CI 0.70–0.92, respectively). At 6 months, there was no significant difference in adjusted rates of repeat revascularization, recurrent MI or death between the three groups.

Conclusion: We conclude that hospital volume does not affect adverse event rates at 6 months after PTCA. The higher rates of CABG in low volume hospitals and of repeat PTCA in high volume hospitals may represent different physician preferences for the treatment of failed PTCA rather than higher complication rates.

1040-83 Outcome Study of Two Large Populations With Different Rates of Cardiac Interventions

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Background: There is a large variability in the rate of diagnostic cardiac catheterizations, catheter-based interventions and coronary bypass surgery (CABG) among industrialized nations, between U.S. and Canada and within the U.S. Outcomes generally have shown little correlation to the rate. Demonstrated differences were criticized because the populations had different expectations. We compared a segment of a population in a metropolitan area with extensive cardiac resources which was insured with an HMO to the remainder of the population in terms of frequency of interventions and cardiac outcomes.

Methods: In the Los Angeles Basin with a population of 14.9 million, 1.73 million receive their care through the Kaiser Permanente Health Plan (K). All cardiac interventions are reported to the State of California. Data on cardiac mortality, mortality from acute myocardial infarction and hospitalizations for cardiac causes, we well as length of stay, are available. We identified the K and analyzed these outcomes in comparison to the remaining population (NK).

Results: In the demographics of these populations there was an excess of poor and minorities in the NK cohort. In 1994 and 1995, the rate for catheterizations per 100,000 was 250 and 270 for K and 400 and 425 for NK. PTCA was 55 and 70 K compared to 110 and 115 NK and 70 and 78 K versus 90 and 100 for NK in CABG. Previous MI mortality (1991–1993) for K was identical to risk stratified statewide mortality. In 1994–1995, total cardiac mortality was slightly lower for Ko The number of hospitalizations and length of stay and mortality from cardiac causes was lower for K than NK.

Conclusion: Despite a lower rate of cardiac interventions among K, no detrimental effects can be seen in cardiac mortality or hospitalizations for cardiac causes. The generally better outcomes in K may be due to fewer poor or uninsured patients and the expertise of high volume tertiary centers. Adherence to ACC guidelines and increased utilization of medical therapy explains the lower rate of interventions in K.

POSTER

1041 Coronary Stenting: Basic Aspects

Sunday, March 12, 2000, 4:00 p.m.–6:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 4:00 p.m.–5:00 p.m.

1041-84 Stent Based Sirolimus Delivery Reduces Neointimal Proliferation in a Porcine Coronary Model of Restenosis

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Background: Sirolimus (rapamycin) is a potent anti-rejection agent that inhibits vascular smooth muscle cell proliferation by blocking cell cycle progression. We hypothesized that local stent-based delivery of sirolimus would reduce in-stent neointimal hyperplasia after coronary stenting.

Methods: Fifteen mm long stainless steel balloon expandable tubular slotted stents were coated with a 5 μ thick layer of a synthetic nondegradable polymer matrix containing sirolimus (Sir). Fifty-nine stents (bare metal, n = 12; polymer coated, n = 12; polymer + Sir 1X dose, n = 11; polymer + Sir 3X dose, n = 12; polymer + Sir 1X dose in a sustained release matrix (Sir SR), n = 12) were implanted at a stent to artery ratio of 1.1–1.2 to 1 in the coronary arteries of 22 juvenile swine. After 28 days, histologic analysis of the stented coronary arteries was completed to determine treatment effects.

Results: see table

Summary of histologic data

Group	Neointimal Area (mm^2)	% Stenosis	Inflammation Score	Injury Score
Metal	4.57 ± 0.46	40 ± 4	0.54 ± 0.21	0.76 ± 0.24
Polymer	5.02 ± 0.62	47 ± 6	1.17 ± 0.37	1.11 ± 0.32
Polymer + Sir 1X	2.84 ± 0.31*†	27 ± 3†	0.43 ± 0.22	0.40 ± 0.16
Polymer + Sir 3X	3.06 ± 0.17*†	28 ± 2†	0.22 ± 0.08†	0.33 ± 0.10
Polymer + Sir SR	2.77 ± 0.41*†	24 ± 4*†	0.35 ± 0.19	0.49 ± 0.27

* $p < 0.05$ versus bare metal; † $P = 0.05$ versus Polymer

Conclusion: Stent based delivery of sirolimus via a nondegradable polymer matrix is feasible and effectively reduces late in-stent neointimal hyperplasia. This novel strategy to prevent in-stent restenosis warrants further study to determine dose response kinetics and long-term effects.

1041-85 Relation Between Tumor Necrosis Factor (TNF) Gene Polymorphisms and Thrombotic Events and Restenosis in Patients With Coronary Stenting

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Background: Recent findings suggest an important role for inflammation in the process of restenosis after percutaneous coronary interventions. TNFα is a proinflammatory cytokine with various biologic effects. A1/A2 and B1/B2 are the better studied polymorphisms for TNF-α and TNF-β, respectively. There are data about the association between TNFA2 or TNFB2 alleles and the production of TNF-α. We assessed whether there is an association between these polymorphisms and restenosis after coronary stenting.

Methods: In 1850 consecutive patients with stenting, clinical and angiographic outcome measures were evaluated over 1 year after the intervention. TNFA and TNFB genotyping was performed based on the polymerase chain reaction technique. Six-month angiography was carried out in 84% of patients. Restenosis was defined as a $\geq$50% diameter stenosis. Major adverse events (MACE) were defined as death, Q-wave and non-Q-wave myocardial infarction and need for revascularization.

Results: The allele frequency was 0.16 for TNFA2 and 0.68 for TNFB2. Early and 1-year clinical outcome as well as angiographic restenosis indexes were not significantly dependent on C/T genotype (Table). The rare TNFA2 homozygotes showed a nonsignificant trend toward a higher incidence of restenosis compared to carriers of other genotypes.

	TNFA1/1	TNFA1/2	TNFA2/2	TNFB1/1	TNFB1/2	TNFB2/2
30-day MACE, %	5.5	5.0	2.0	5.1	4.7	5.8
1-year MACE, %	24.5	22.7	29.4	23.0	23.4	25.1
Restenosis, %	33.6	30.2	43.6	30.3	32.2	34.3
Lumen loss, mm	1.20±0.85	1.21±0.83	1.36±0.80	1.17±0.76	1.20 ± 0.85	1.22 ± 0.85

Conclusions: These findings indicate no significant association between TNF-α- and TNF-β-polymorphisms and thrombotic events or restenosis in patients with coronary artery disease treated with stenting.

1041-86 Angiotensin Converting Enzyme Gene Polymorphism and Restenosis Rate After Coronary Stenting

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Background: Recent publications have brought up the hypothesis that the ACE gene polymorphism may influence the level of late luminal loss after coronary stent implantation.

Methods: As a substudy of the OPTICUS study (optimization with ICUS to reduce stent restenosis) we analyzed the ACE serum levels and the ACE gene polymorphism in 154 patients from 9 different centers. All patients underwent elective coronary stent implantation in a stenosis of a major coronary vessel. Balloon inflations were repeated until a satisfying result was achieved in online quantitative coronary angiography or intravascular ultrasound fulfilling the OPTCUS study criteria. After follow-up of 6 months all patients underwent reangiography. A blinded quantitative analysis of the initial procedure as well as the follow-up examinations were performed by an independent core lab.

Results: According to the ACE gene polymorphism we formed 3 subgroups: DD genotype (n = 86 patients), ID (n = 45) and II (n = 23). All subgroups were comparable in age, gender, extend of coronary artery disease, initial degree of stenosis and degree of stenosis after stent implantation. 39

patients (25.3%) had significant restenosis: DD 22 pts. (25.6%), ID 8 pts. (17.8%), II 9 pts. (39.1%). The serum levels were: DD 0.39 μmol/l/s, ID 0.36 μmol/l/s, II 0.09 μmol/l/s.

Conclusion: In this multi center study we did not fred a higher restenosis rate in patients with D allele of the ACE gene. In addition, the ACE serum levels did not correlate with the restenosis rate. We conclude that the polymorphism of the ACE gene is not a major factor of restenosis after coronary stem implantation.

1041-87 Polymorphisms of the Angiotensin Converting Enzyme and the Angiotensin II Type 1 Receptor Genes in In-Stent Restenosis. Is There a Synergism?

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Background: Activity of the renin-angiotensin system (RAS) is associated with the reparative process that follows vessel injury in animal models. Angiotensin converting enzyme (ACE) and angiotensin II (Ang-II) play a role in the proliferative response of the vessel wall after balloon trauma. The D allele of the I/D polymorphism (poly) of the ACE gene is a neutral marker of enhanced ACE activity, and the C allele of the of the A/C poly of the Ang-II Type 1 receptor gene seems to modulate the intracellular signaling of Ang-II.

Methods: both poly were assessed in a consecutive cohort of stented pts scheduled for angiographic follow-up. Total occlusions (26 pts) and diabetic patients (81) were excluded.

Results: A total of 644 pts were prospectively entered in this assessment of in-stent restenosis (R). Angiographic follow-up and genotyping were obtained in 609 pts (94.5%). The global R rate was 24.4%. R according to the I/D and A/C poly was distributed as shown in the table:

Poly I/D	D/D = 25.5%	I/D = 17%	I/I = 15.6%	p < 0.03
Poly A/C	A/A = 17.4%	A/C = 22.9%	C/C = 18.8%	p = ns

A synergistic effect of the association between alleles encoding an enhanced RAS activity (D and C) was investigated. The restenosis rate in D/D pts with or without associated C alleles was as follows:

Polymorphisms	A/A	%R	A/C + C/C	%R	P
D/D (217 pts)	114	26 (22.8%)	103	29 (28.2%)	Ns
I/D (302 pts)	170	29 (17.1%)	132	22 (16.7%)	Ns
I/I (90 pts)	44	2 (4.5%)*	46	12 (26.1)%*	0.0004*

I/I pts carrying at least 1 C allele of the A/C poly had an odds ratio for R = 7.41 (95%CI: 1.55–35.4), with 2DF.

Conclusion: No synergism was found between the D and the C allele in the occurrence of in-stent R; moreover, the highest R rate was observed in I/I pts carrying the C allele, what contrasts the low R rate of these pts. This finding indicates that the presence of the C allele in pts with low ACE activity (I/I) predispose to R, through Ang-II Type-1 receptor-mediated effects, independently of the ACE activity. These speculations are consistent with the presence of alternative pathways of AngII activation and stimulate further study.

1041-88 Endothelial Nitric Oxide Synthase Gene Polymorphism is Positively Associated With In-Stent Restenosis

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Background: Reduced or impaired synthesis of nitric oxide promotes the proliferation of vascular smooth muscle cells, and thus may induce the neointimal formation leading to in-stent restenosis. Recent reports have suggested that the Glu-Asp 298 polymorphism in exon 7 of the endothelial nitric oxide synthase (eNOS) gene is associated with coronary spasm and AMI. In this study, we have examined the implication of this polymorphism with regard to coronary restenosis after Palmaz-Schatz stent deployment.

Methods: Eighty-nine lesions in 85 consecutive patients were treated with Palmaz-Schatz stents, and were prospectively allowed up for 6 months. Those lesions were classified into restenosis (% diameter stenosis ≥ 50%) group (R) and non-restenosis group (NR). Assessment was made using an automated quantitative angiographic system. We performed PCR/restriction fragment length polymorphism analysis to detect the missense Glu-Asp 298 variant in exon 7 of the eNOS gene.

	Restenosis n = 16	No restenosis n = 73	p
AHA type B2/C lesions	56%	48%	n.s.
Small vessels (<3 mm in diameter)	56%	56%	n.s.
Multiple stenting	44%	27%	n.s.
Maximal balloon pressure > 16 atm	44%	27%	n.s.
Glu-Asp 298 variant	38%	12%	p < 0.05

Results: Coronary risk factors and angiographic findings of stenotic lesions did not differ between the groups. Univariate analyses showed that the missense Glu-Asp 298 variant was the only statistically significant predictor of restenosis (odds ratio, 4.27; p = 0.025). In addition, multivariate regression analysis revealed the missense Glu-Asp 298 variant as the only independent predictor for in-stent restenosis (odds ratio, 3.90; p = 0.036).

Conclusion: The missense Glu-Asp 298 variant is an independent risk factor for in-stent restenosis.

1041-89 Non-Invasive Heat-Delivery to Arterial Stented Segments In Vivo: Effect of Heat on Intimal Hyperplasia

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Background: A new approach for the elimination of intimal hyperplasia is external non-invasive heat delivery to stented arterial segments. The purpose of this study was to evaluate the effect of heat on intimal hyperplasia after stent implantation in porcine coronary arteries.

Methods: Heating of stented arterial segments was induced by a new method based on the properties of metals when placed into an alternative magnetic field. Accordingly, magnetic flux rapid alteration results in power loss to the magnetic circuit appearing as heat on the metallic stent in vivo. Thus, six Multilink™ stents were implanted in the LAD and 6 Multilink™ stents were placed in the LCx. The LAD stented segments had 15 cm distance from the induction coil and the LCx segments had 20 cm distance, respectively. The temperature of the stented segments was recorded in vivo by a thermography catheter that was previously validated (Circulation 1999;99:1965–71). All animals were sacrificed after 4 weeks and histomorphometry was performed.

Results: By regulating the generator's output power we achieved in-vivo heating of LAD stented segments of 55ºC. In the LCx stented segments a temperature of 45 ºC was achieved. In the LAD segments histomorphometry revealed extensive inflammatory and hyperplastic response. In contrast in the LCx segments the intimal hyperplasia was minimal without infiltration of inflammatory cells.

Conclusions: This study demonstrates the effect of non-invasive heat delivery on metallic stents in porcine coronary arteries. Thus, external heating of stents may reduce the hyperplastic response. However, the optimal temperature of stents needs to be determined.

1041-90 Degradation of Metallic Alloys – A New Principle in Stent Technology?

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Background: Degradable cardiovascular implants promise a reconstitution of vascular compliance, growth if necessary and allow steerable local drug delivery. Synthetic polymers produce a inflammatory proliferative response and contain drawbacks in their mechanical properties. We developed a new concept of degradation using magnesium alloys (MA) consisting of primary non-toxic components. We tested the in vivo degradation and the local response over time of one of the magnesium based alloys after intracoronary implantation in domestic pigs.

Methods: 12 domestic pigs (15–25 kg), pretreated by 250 mg ticlopidine (T), 21 stents (S) (prototyp, mesh-design) implanted in LAD (9), Circumflex (9) and RCA (2); 250 mg T p.d., explantation after 10 days (D) (4 S), 35 D (7 S), 56 D (6 S). Quantitative angiography and IVUS-analysis at the time of explantation; histological analysis (methylacrylate inbedding), semi-quantitative corrosion analysis.

Results: [1] The thrombogenicity was low (no acute, one subacute non-occlusive thrombosis). [2] The mechanical stability was to low over time leading to some late stent-recoil phenomenon at 5 weeks interval. [3] No vessel occlusion over time. [4] Clear correlation between velocity of degradation (max. 5 weeks), severity of strut-injury and local inflammatory response. [5] Distinct positive remodeling combined with lumen re-enlargement after 8

weeks (QCA) (mean relative lumen diameter 1.01 after 10 D, 0.69 after 35 D and 0.83 after 56 D; p (10 D vs 35 D < 0.01: 10 D vs 56 D and 35 vs. 56 D n.s.; Mann-Whitney-test).

Conclusion: The bio-degradation of magnesium-based alloys may be a promising new technology to improve cardiovascular implants as temporary effective systems. Further improvements with respect to prolongation of degradation and the mechanical stability over time are necessary.

1041-91 Immobilized Hyaluronic Acid as a Thromboresistant Coating for Cardiovascular Devices

Stefan Verheye, Mahomed Y. Salame, Keith A. Robinson[1], Barbara Wan[2], Cindy Nickerson[2], Kevin Skinner[2], Spencer B. King III, Stephen R. Hanson, Nicolas A.F. Chronos[1]. *[1]Atlanta Cardiovascular Research Institute, Atlanta, Georgia; [2]Genzyme Corporation, Cambridge, Massachusetts, USA*

Background: Stainless steel is highly thrombogenic and may lead to increased closure rate after coronary stenting. Coating stents with a biocompatible and non-thrombogenic material may solve this problem. Hyaluronic acid (HA) has been shown to inhibit platelet aggregation and adhesion when administered systemically. Since the effect of coating tubes (T) and stents (S) with immobilized HA is unknown, we assessed their thrombogenicity and compared these results with uncoated controls.

Methods: Thrombosis was assessed in non-human primates by continuous ^{111}In-platelet imaging using a γ-camera over 2 h during exposure of coated and uncoated stainless steel T (4 mm diameter, n = 8) and S (3.5 mm, 8 control, 4 HA-coated) to non-anticoagulated blood (100 ml/min) in exteriorized arteriovenous shunts. Time course of platelet deposition is presented as mean ± SD.

Results: Two-way ANOVA to compare the effect of coating or time found that coating T with HA resulted in a significant decrease in platelet deposition ($p < 0.001$). HA-coating of S resulted in a trend towards decreased platelet deposition ($p = 0.06$).

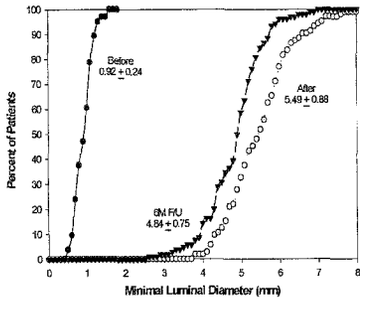
Conclusions: Immobilized HA significantly reduced local platelet deposition on stainless steel T and tended to decrease platelet deposition on S in the primate *ex vivo* shunt model. Immobilized HA may therefore provide a thromboresistant coating material for cardiovascular devices.

1041-92 Extent of Late Angiographic Luminal Loss Following Carotid Artery Stenting

Fayaz A. Shawl, Fernando Lapetina, Waleed Y. Kadro, Stephanie Cornell, Yan Huang, Kathryn G. Dougherty. *Washington Adventist Hospital, Takoma Park, Maryland, USA*

Background: Carotid stenting (CS) has been shown to be safe and effective in treating severe carotid artery stenosis. Restenosis has been the main complication of percutaneous angioplasty (PA), even after stenting. Restenosis would be a difficult challenge after CS. The angiographic restenosis and late luminal loss, however, is unknown.

Methods and Results: Among 176 consecutive pts who underwent CS between 8/95 and 8/98, 163 (93%) pts had angiographic follow-up at ≥6 months (mean 9 ± 4 months, range 6–15). There were 135 males and the mean age was 72 ± 10 yrs. Angiographic restenosis (>50% stenosis) occurred in 6 pts (3.6%). All were successfully treated with PA (n = 3) and stent (n = 3). Cummulative frequency distribution for minimal luminal diameter before and after CS and at F/U is shown with a late luminal loss of 1.23 ± 0.34 mm.



Conclusion: The late angiographic luminal loss following CS is favorable and the late restenosis rate appears low.

POSTER

1042 Restenosis: Basic Research I

Sunday, March 12, 2000, 4:00 p.m.–6:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 4:00 p.m.–5:00 p.m.

1042-109 A Novel Catalytic DNA Molecule Targeting The Transcription Factor Egr-1 Inhibits Neointimal Formation Following Rat Carotid Angioplasty

H.C. Lowe, F.S. Santiago, C.N. Chesterman, L.M. Khachigian. *Centre For Thrombosis And Vascular Research, The University of New South Wales, Sydney, Australia*

Background: In-stent restenosis is the result of neointimal formation, dependent on medial smooth muscle cell (SMC) migration and proliferation, in response to the mechanical vascular injury of angioplasty and stenting. Egr-1 is a transcription factor recently recognised as playing an important role in the regulation of a number of genes involved in vascular injury. We have recently developed a novel catalytic DNA molecule, ED5, which selectively targets Egr-1 mRNA.

Aim: To determine whether targeting Egr-1 mRNA using ED5 would inhibit neointimal formation following balloon angioplasty to the rat carotid artery.

Methods: Adult male Sprague Dawley rats underwent balloon angioplasty to the left common carotid artery. The DNA enzyme ED5, its scrambled counterpart (ED5 SCR) or vehicle alone (VEH) were delivered adventitially in pluronic gel with transfecting agent, 6 hours prior to, and again at the time of injury. Neointimal and medial areas were measured at 14 days. In a separate group of animals 1 hour following injury and drug delivery, carotid sections were examined for Egr-1 protein expression by immunohistochemistry. In a third group of animals, fluorescein isothiocyanate (FITC) tagged versions of the same drugs were delivered in an identical manner, and sections imaged under confocal microscopy.

Results: FITC labelled ED5 and ED5 SCR localised within the smooth muscle cells in the media. Egr-1 protein expression and neointima:media ratios were significantly reduced in the ED5 group, compared to the other groups.

Group	Neointima:media ratio (n = 5)	Egr-1Expression (n = 2)	
ED5	0.31 (0.11)*	+	
ED5 SCR	0.62 (0.13)	+++	
VEH	0.72 (0.15)	+++	
BALLOON ONLY	0.71 (0.17)	+++	*p < 0.05

Conclusions: The DNA enzyme ED5 is capable of localising to SMCs following adventitial delivery. ED5 inhibits Egr-1 protein expression and neointimal formation following balloon angioplasty in the rat. These findings imphcate DNA enzymes as potential inhibitors of restenosis.

1042-110 Sustained Expression of Chemokines Monocyte Chemoattractant Protein-1 And Interleukin-8 After Stent- But Not Balloon-Induced Arterial Injury

John F. Paolini, Michael A. Kjelsberg, Elazer R. Edelman, Campbell D.K. Rogers. *Health Science Technology, Harvard/Massachusetts Institute of Technology, Cambridge, Massachusetts; and Brigham and Women's Hospital, Boston, Massachusetts, USA*

Background: Experimental and human data implicate early inflammatory cell recruitment in intimal thickening after mechanical arterial injury, with different responses to different injuries.

Methods: To identify pro-inflammatory signals in vessels injured by balloon angioplasty or stenting, New Zealand White rabbits underwent iliac artery balloon injury (BI) or deeper stent-induced injury (SI). Four or 8 hours, or 14 or 28 days after injury arteries were harvested and frozen, and RNA was prepared by acid-phenol extraction. MCP-1 and IL-8 mRNA levels were determined by semi-quantitative reverse-transcriptase PCR, normalized to expression of the ribosomal gene 36B4, and compared to uninjured levels.

Results: After BI, MCP-1 mRNA levels peaked at 4 hours (5X control) and returned to baseline by 8 hours. IL-8 mRNA levels followed a similar pattern with lower magnitude. After SI, MCP-1 mRNA levels were markedly elevated at 4 hours (12X control), 8 hours, and even 14 days after injury, returning to baseline by 28 days. IL-8 mRNA levels were elevated more transiently.

Conclusions: 1) Stenting induces a more profound and prolonged inflammatory chemokine response than balloon injury. 2) MCP-1 but not IL-8 mRNA levels remain elevated for weeks after stent implantation. 3) Measur-

ing and targeting chemokine expression or action may be valid approaches to modulating vascular repair.

1042-111 Effect of a Recombinant Soluble P-Selectin Glycoprotein Ligand-1 Chimera on Restenosis Following Arterial Injury by Repeat Angioplasty in Pigs

Jean-Guy Bienvenu, Jean-François Tanguay, Jean-François Théorêt, Anjali Kumar, Robert G. Schaub, Yahye Merhi. *Montreal Heart Institute, Montreal, Quebec, Canada; Hemostasis/Immunology, Genetics Institute, Inc., Andover, MA, USA*

Background: P-selectin mediates leukocyte recruitment to activated platelets and endothelial cells via its high affinity counter-receptor P-Selectin Glycoprotein Ligand-1 (PSGL-1). Platelet accumulation, leukocyte activation and formation of platelet/leukocyte complexes have been previously reported following coronary angioplasty and were correlated with the occurrence of late clinical events. Selectin antagonism or P-selectin deficiency resulted in a smaller percent area stenosis in models of arterial injury or vascular remodeling, rPSGL-Ig is a recombinant soluble form of PSGL-1, fused to a human IgG_1. In this study, the effect of rPSGL-Ig on the development of restenosis 4 weeks following arterial injury by repeat angioplasty was investigated.

Methods: Balloon angioplasty was performed in both carotid arteries of cross-bred pigs. Animals were recovered for 4 weeks during which neointimal lesions developed at injury sites. Repeat angioplasty was then performed at the same sites 15 minutes following a single i administration of either vehicle (formulation buffer) or rPSGL-Ig (1 mg/kg IV, half life of 10 days in pigs). Animals were sacrificed at 1 hour, 1 week or 4 weeks following the second angioplasty. Adhesion of autologous ^{51}Cr-platelets and ^{111}Inneutrophils was quantified. Morphometric analysis was performed on arterial sections from the 4 week group of pigs.

Results: rPSGL-Ig reduced adhesion of platelets (by 85%) and neutrophils (by 75%) in deeply injured arterial segments 1 week following repeat angioplasty, but did not affect the acute adherence of these cells 1 hour post-injury. At 4 weeks, the residual lumen in deeply injured segments was 60% larger in the rPSGL-Ig treated pigs as compared to control (6.1 ± 0.6 vs 3.8 ± 0.1 mm^2; $p < 0.01$). This difference was not due to a smaller neointimal area (0.5 ± 0.1 vs 0.7 ± 0.1 mm^2). However, the ratio of the external elastic lamina surface in deeply injured to uninjured vessel segments was 1.5 ± 0.1 in the rPSGL-Ig group vs 0.9 ± 0.05 in the control group ($p < 0.01$) suggesting some effect on compensatory remodeling.

Conclusion: These results suggest that P-selectin antagonism using rPSGL-Ig may inhibit early platelet/leukocyte adhesion at the site of injury and positively impact vascular remodeling, both of which contribute to late lumen loss. Hence, rPSGL-Ig may have potential in the management of restenosis.

1042-112 Fucoidan Inhibits Smooth Muscle Cell Proliferation And Migration And is Suitable For Coating of Stents

Ralf Köster, Kai Gutensohn, Jan Dürig, Jan Kähler, Stephan Baldus, Thomas Bruhn, Christian W. Hamm, Peter Kühnl, Thomas Meinertz. *University Hospital Eppendorf, Hamburg, Germany*

Proliferation and migration of smooth muscle cells are mechanisms of restenosis after coronary intervention. Both processes are stimulated by platelet-derived growth factors released from platelets. Fucoidan is a polysaccharide with fractions of high molecular weight (HMWF) (100-150kD) and low molecular weight (LMWF) (50kD). We investigated the effects of these fractions on smooth muscle cell proliferation and migration, platelet activation and aggregation.

Proliferation of cultured human vascular smooth muscle cells incubated with different fucoidan fractions was analyzed by growth assays, migratory activity was measured by Boyden chamber assays. Platelet rich plasma was incubated with HMWF and LMWF and platelet activation-dependent expression of P-selectin and glycoprotein P53 was quantified by flow cytometry with CD62p and CD63 antibodies. Platelet aggregation was measured by turbidimetry.

Serum-induced proliferation of smooth muscle cells was inhibited by HMWF and LMWF (HMWF: $52 \pm 6\%$, LMWF: $68 \pm 6\%$ vs control, $P < 0.01$). Platelet-derived growth factor B (PDGF-B) induced proliferation could be completely inhibited by HMWF and LMWF ($P < 0.01$). Migration was equally decreased by both fucoidan fractions (maximum inhibition by LMWF: $59 \pm 7\%$, $P < 0.05$). Platelets were only slightly activated by LMWF and HMWF ($+10 \pm 2\%$ and $+12 \pm 3\%$ CD62p signals; $+8 \pm 1\%$ and $+9 \pm 2\%$ CD63 signals, $P < 0.05$). Platelet aggregation was stimulated by HMWF ($+45 \pm 15\%$ increase of light transmission, $P < 0.05$), whereas LMWF did not induce a significant change of platelet aggregation.

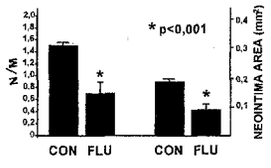
Conclusions: Fucoidans inhibit proliferation and migration of vascular smooth muscle cells. The antiproliferative effect may partially be explained by the inhibition of PDGF-B action. The low molecular weight fraction may be useful for the prevention of restenosis and for coating of stents.

1042-113 Fludarabine, A Stat-1 Inhibitor, Abolishes Smootn Muscle Cell Proliferation *In Vitro* And Prevents Neointimal Formation *In Vivo*

Daniele Torella, Ciro Indolfi, Marco Pascotto, Angela Maria Stingone, Eugenio Stabile, Cinzia Perrino, Alfonso Pisani, Luigi Cavuto, Antonio Curoio, Massimo Chiariello. *Division of Cardiology, Federico II University, Naples, Italy*

Background: Vascular smooth muscle cell (VSMC) proliferation is a major mechanism of neointimal formation after balloon angioplasty and is the only mechanism responsible for restenosis after arterial stenting. JAK-STAT intracellular signaling enhances VSMC proliferation and its inhibition reduces proliferative activity of VSMCs *in vitro*. Furthermore, previous studies have demonstrated that a nucleoside analog, Fludarabine (Fludara), causes a specific depletion of STAT-1 protein (and mRNA) in human lymphocytes. The aim of our study was to assess the effects of Fludara on VSMC proliferation *in vitro* and *in vivo*.

Methods: To study the effect of Fludara on VSMC proliferation *in vitro*, smooth muscle cells from rat aortic artery (A10) were used. Cells were grown in the presence of 0.05, 0.5, 5, 50, 500μM Fludara or in the absence of the same (control). Cell number in all conditions was assessed every 72 hr for 6 days. In order to evaluate the *in vivo* effect of this drug, balloon injury of the carotid artery of 20 Wistar male rats (350 g) was induced using a 2F Fogarty balloon and Fludara (5 mg) was locally delivered at the time of injury in 10 rats (Group FLU). In the other 10 rats only saline solution was delivered at the time of injury (Group CON).



Results: Fludara markedly inhibited VSMC proliferation in cell culture in a dose dependent manner. Furthermore, Fludara reduced neointimal area from 0.195 ± 0.016 mm^2 (CON) to 0.095 ± 0.030 mm^2 (FLU), *$p < 0.001$ and neointima/media ratio from $1,467 \pm 0.099$ (CON) to 0.688 ± 0.218 (FLU), *$p < 0.001$ after balloon angioplasty (see figure).

Conclusion: We demonstrated for the first time that local administration of Fludarabine, a specific STAT-1 inhibitor, abolishes VSMC proliferation *in vitro* and reduces neointimal formation after balloon injury *in vivo*. These data may have a clinical relevance in the prevention of restenosis after stenting and perhaps after PTCA.

POSTER

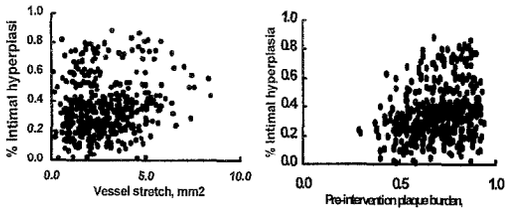
1043 IVUS Insights Into Percutaneous Revascularization

Sunday, March 12, 2000, 4:00 p.m.–6:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 4:00 p.m.–5:00 p.m.

1043-114 Predictors of Intimal Hyperplasia After Stenting: Serial IVUS Study

Myeong- Ki Hong, Seong-Wook Park, Cheol Whan Lee, Duk-Hyun Kang, Jae-Kwan Song, Jae-Joong Kim, Seung-Jung Park. *Department of Medicine, University of Ulsan, Asan Medical Center, Seoul, Korea*

We evaluated the predictors of intimal hyperplasia (IH) after coronary stenting. Pre- and post-intervention, and follow-up IVUS images were obtained in 59 patients (pts) with single stent implantation (GFX in 34 pts and NIR in 25 pts). Eight IVUS image slices were selected with equal distance within stent for serial comparisons. Total 472 matching images were obtained. Pre- and post-intervention IVUS variables such as EEM, lumen and P+M CSA, plaque burden (P+M CSA/EEM CSA), remodeling index (lesion/proximal reference EEM CSA at preintervention), vessel stretch{(post-intervention – pre-intervention) EEM CSA} and % vessel stretch (100× vessel stretch/pre-intervention EEM CSA) were entered into multivariate linear regression analysis model to predict % IH (100 x IH CSA/stent CSA at follow-up).



Conclusions: The independent predictors of % IH were pre-intervention plaque burden ($r = 0.217$, $p < 0.001$) and vessel stretch ($r = 0.129$, $p < 0.001$).

1043-115 Prognostic Significance of Left Main Disease Assessed by 3-Dimensional IVUS

Kelly M. Choi, John M. Pang, Lynne M. Goodreau, Karen S. Pieper, Charles J. Davidson. *Northwestern University Medical School, Chicago, IL, USA*

To determine the long-term prognosis of patients with angiographically insignificant left main coronary artery (LMCA) disease, 107 consecutive patients were evaluated with 2-D and 3-dimensional intravascular ultrasound (IVUS). IVUS was performed by automated pullback following left coronary artery (LAD 85%, LCX 15%) intervention (stent = 88%, balloon = 6%, and atherectomy 6%).

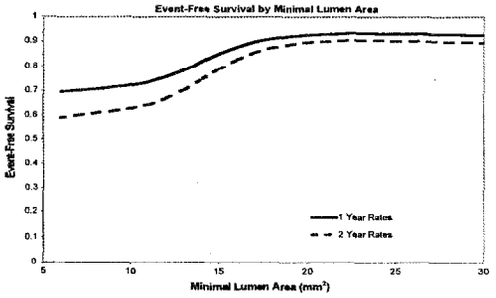
IVUS images were digitized and 3-dimensional reconstruction was performed. Minimum and mean lumen area, vessel area, maximum % stenosis (plaque area ÷ vessel area), and relative plaque burden (total plaque volume ÷ length of LMCA) were assessed for the entire length of the LMCA. LMCA angiography was analyzed in the worst view by QCA.

Long-term follow-up was available in 102 (95%), at a median follow-up of 31 (range 8 to 53) months. MACE was defined as death (n = 6), MI (n = 3), repeat PTCA (n = 13), or CABG (n = 16).

Results:

IVUS	Mean	Chi Square	Hazard RatiQ	p
Min. Lumen Area (mm^2)	15.6 ± 5.6	8.1	0.59 (0.40,0.88)	0.004
Mean Lumen Area (mm^2)	17.8 ± 5.6	7.0	0.62 (0.43,0.90)	0.008
Area Stenosis (%)	30.5 ± 14.5	0.72	1.1 (0.87,1.4)	0.40
Relative Plaque Burden	4.9 ± 3.0	0.01	1.0 (0.56,1.9)	0.90
Angio				
MLD (mm)	4.3 ± 0.9	4.2	0.59 (0.35,1.0)	0.04
Area Stenosis (%)	17.6 ± 9.7	0.02	1.0 (0.67,1.6)	0.90

In the multivariate stepwise logistic regression model, only minimum lumen area by IVUS was predictive of MACE ($p = 0.004$).

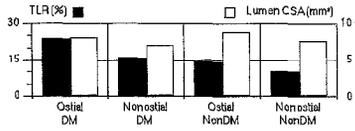


Thus, in pts. undergoing PTCA of the left coronary system, 3-dimensional IVUS quantitation of the LMCA provides independent prognostic information that is not available from contrast angiography.

1043-116 Diabetes And Ostial Lesion Location Have an Additive Effect on Target Lesion Revascularization After Stent Implantation

Gary S. Mintz, Roxana Mehran, Michel Jackson, Alexandra J. Lansky, Kenneth M. Kent, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

Both diabetes (DM) and ostial lesion location are reported risk factors for in-stent restenosis. To determine whether the combination of these two risk factors has an additive effect, we analyzed target lesion revascularizatinon (TLR @ 1yr) in 2242 patients with 2853 lesions treated with intravascular ultrasound (IVUS)-guided implantation of tubular-slotted or multicellular stents. IVUS final lumen areas were smaller in DM vs nonDM patients (7.2 ± 2.4 mm^2 vs 7.7 ± 2.5 mm^2, $p = 0.0011$), but larger in ostial vs nonostial lesions (8.5 ±3.2 vs 7.5 ± 2.3 mm^2, $p < 0.0001$). Thus, the higher TLR in DM vs nonDM pts (17.2% vs 10.6%, $p < 0.0001$) can be explained in part by the smaller final lumen area. However, the higher TLR in ostial vs nonostial lesions (17.4% vs 12.0%, $p = 0.0231$) occurred despite the larger final lumen area. Importantly, ostial lesions in DM patients were associated with the highest TLR ($p < 0.0001$) which did not parallel the variations in IVUS final lumen area among the four groups ($p < 0.0001$):



We conclude: DM and ostial lesion location had an additive effect on TLR that cannot be explained by differences in final lumen areas. This led to a strikingly high clinical restenosis rate (24%) suggesting that DM and ostial lesion location have a synergistic effect in promoting in-stent neointimal hyperplasia.

1043-117 Impact of The Vessel Size And Procedural Result on The Long Term Outcome Following Coronary Stenting

Khaled M. Ziada, Samir R. Kapadia, Guido Belli, Penny L. Houghtaling, Patrick L. Whitlow, Irving Franco, Stephen G. Ellis, Steven E. Nissen, E. Murat Tuzcu. *The Cleveland Clinic Foundation, Cleveland, OH, USA*

Background: The final result of stenting procedures may have an impact on long term outcome. The prognostic value of the different quantitative measures of the procedural result remains unclear.

Methods: Successful stenting with adjunctive intravascular ultrasound (IVUS) was performed in 234 consecutive pts, including 40 (17%) in vein grafts. At a median follow-up of 2.3 years, 48 (20%) patients required repeat revascularization (TVR). Quantitative angiography (QCA) was performed on pre- and post-stenting angiograms. A final post-stenting IVUS was analyzed. Cox logistic regression was used to identify predictors of TVR. Receiver operator curves for reference diameter and quantitative measures of the procedural result were plotted.

Results: Reference diameter was 3.0 ± 0.5 mm. QCA final minimum lumen diameter was 2.9 ± 1.9 mm and minimum lumen area by ultrasound was 7.2 ± 2.4 mm^2. SVG and minimum area by ultrasound were the only predictors of TVR (relative risk 2.9 [1.5, 5.4] and 0.72 [0.6, 0.8], respectively). Areas under the curve (AUC) for quantitative measures were:

Ultrasound minimum lumen area (mm^2)	0.66 †
QCA reference diameter (mm)	0.64 †
QCA final minimum lumen diameter (mm)	0.62 †
Ultrasound stent/distal reference area (%)	0.56
Ultrasound stent/mean reference area (%)	0.53

Larger AUC values indicate better sensitivity & specificity, † P = NS

Conclusions: Minimum lumen area by ultrasound was a better predictor of TVR than other quantitative measures of the procedural result. However, none of these measures was superior to reference vessel size, emphasizing the importance of vessel size in determining the long-term outcome of stenting.

1043-118 Time Dependent Morphologic Characteristics in Angiographic Chronic Total Coronary Occlusions: An Intravascular Ultrasound Study

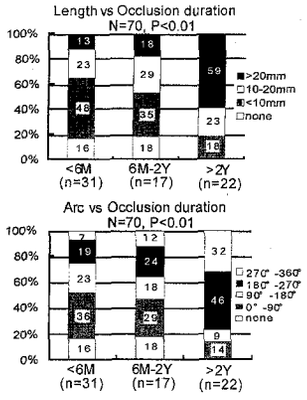
Takeshi Suzuki, Hiroaki Hosokawa, Koichi Yokoya, Takahilo Suzuki. *Stanford University, Stanford, California, USA; National Toyohashi Higashi Hospital, Toyohashi, Japan*

Background: Chronic total occlusion lesions (CTO) of the coronary artery are frequently difficult to cross and are at high risk for acute reocclusion or chronic vessel renarrowing. The aim of this study was to evaluate the influence of occlusion duration on coronary calcification in CTO using intravascular ultrasound (IVUS).

Methods: We performed IVUS in 70 CTOs at pre-procedure or after 1.5 mm balloon dilation. IVUS images were obtained with a motorized pullback speed of 0.5 mm/sec, and arc and length of calcification in lesions were measured. CTO is defined as lesions occluded for a period of 2 weeks or more, and TIMI-0 or TIMI-1 flow.

Results: As the figures indicate, old CTOs have considerably more calcification with a longer length and a larger arc (see figure next page).

Conclusion: These results suggest that older CTOs have more complex plaque components including a large calcific burden. This may explain the adverse revascularization profile of older CTOs.



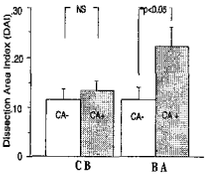
1043-119 Influence of Calcium on Coronary Dissection Following Cutting Balloon Angioplasty: An Intravascular Ultrasound Study

Shinichi Shimodozono, Hiroyuki Okura, Motoya Hayase, Hiroaki Hosokawa, Takahiko Suzuki, Tetsu Yamaguchi, Paul G. Yock, Peter J. Fitzgerald. *For the REDUCE Investigators: Stanford University Medical Center, Stanford, CA, USA*

Previous intravascular ultrasound (IVUS) studies have demonstrated that the presence of calcium within the vessel wall is strongly associated with both the location and size of the dissection following balloon angioplasty (BA). The Cutting Balloon (CB) has been shown to achieve an efficient lumen gain by creating a controlled dissection within the vessel wall. The aim of this study was to clarify the size and location of coronary dissection following CB in calcified coronary segments.

Methods: A total of 89 patients (50 CB and 39 BA) from the REstenosis ReDUction by Cutting Balloon Evaluation (REDUCE) trial were analyzed using IVUS. IVUS images were obtained throughout the tight segment and matched to the segment. The presence of intralesional calcium and the relative of dissection for each lesion were compared. For each cross section, the area of the dissected tissue arm was measured, divided by the neolumen cross sectional area, and expressed as a ratio (dissection area index, DAI).

Results: Target lesion calcification was detected in 17 of 39 (43%) cases in the BA group and in 28 of 50 (56%) in the CB group. The percentage of these patients in which the dissection was adjacent to the calcific portion of the vessel wall trended to be smaller in the CB group compared to the BA group (64% v s. 82%, p = 0.19). In the BA group, DAI was significantly larger in the calcified vessels than those in the non-calcified vessels (22 ± 15% vs. 12 ± 12%, p < 0.05). However, in the CB group, there was no difference in DAI between the calcified vessels and the non-calcified vessels (13 ± 12% vs. 12 ± 10%, p = NS).



Conclusions: Vessel dissection after CB was less dependent upon calcium deposits compared to conventional BA. The size of dissections with CB is less than BA. CB vessel arm is less dependent a calcium deposits. These finding suggests that the CB may be preferable for calcified lesion to the conventional BA in terms of the risk of large dissection caused by balloon inflation.

POSTER

1062 High Risk Subsets

Monday, March 13, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1062-75 Predictors of Late Clinical Outcomes in Patients With Unstable Angina Undergoing Percutaneous Coronary Interventions

Javed M. Ahmed, Roxana Mehran, George Dangas, Mun K. Hong, Manuela Negoita, Alexanda J. Lansky, Hassan Faraj, Nasra Hashmi, Petros Okubagzi, Navita Modi, Michael Astatkie, Kenneth M. Kent, Neil J. Weissman, Bryan Curry, Frank Küpper, Lowell F. Satler, Augusto D. Pichard, Kenneth M. Kent, Gregg W. Stone, Martin B. Leon. *Cardiovascular Research Foundation, Washington, DC, USA*

Background: Patients with unstable angina (UA) have an increased risk of restenosis after percutaneous coronary interventions (PCI). However, predictors of late events (death, Q-wave MI and any revascularization) and of target lesion revascularization (TLR) in these patients are not known.

Methods: We studied 597 patients with UA who underwent IVUS guided PCI. Baseline characteristics included age 69 ± 8 years, 65% male, 25% diabetes (11% insulin-treated), 58% hypertension, 36% left anterior descending (LAD), and 10% ostial lesions; 54% were treated with stents.

Results: By quantitative angiography, reference lumen diameter was 3.0 ± 0.53 mm and final diameter stenosis was 13.3 ± 15.1%. Final lumen cross-sectional area (CSA) by IVUS was 7.3 ± 2.5 mm^2. At one-year follow-up TLR was 24% and major adverse cardiac event (MACE) rate was 28%. Independent predictors of one year TLR and MACE are shown in the table.

Predictors of TLR	OR	P	Predictors of MACE	OR	P
Diabetes	1.99	<0.01	Diabetes	1.96	<0.01
Final lumen CSA	0.81	<0.01	Final lumen CSA	0.82	<0.01
LAD	1.54	<0.01	–		
Male gender	1.56	0.01	–		

Conclusion: The most powerful predictors of late cardiac events and TLR in patients with UA are diabetes and final luminal CSA by IVUS. In addition TLR is higher in males and in LAD lesions.

1062-76 Five-Year Outcome in Patients Treated by PTCA: A Comparison of Non-Diabetic Lesions to Diabetic Lesions

Sou Takenaka, Nobuaki Nakamura, Nobuo Shiode, Kinya Shirota, Hiromi Suyama, Yasutoshi Goto, Yoshio Nakazawa, Katsumi Inoue, Tsutomu Nagamatsu. *Matsue Red Cross Hospital, Matsue, Japan*

Backgrounds: Despite the increasing use of percutaneous transluminal coronary angioplasty (PTCA) to treat stenotic coronary disease, there are few retrospective studies evaluating it's long-term results.

Methods: A total of 104 patients with 183 lesions had no restenosis at 3–12 months and undertook coronary angiogram at least 5 years after PTCA. Twenty-five patients (24%) were diabetes mellitus (DM). Quantitative coronary analyses were performed (1) before and (2) immediately after PTCA, (3) during the 3–12 month period and (4) after 5 years had passed.

Results:

	all	non-DM	DM
Lesions (n)	183	138	45
Late restenosis rate (%)	8.2	6.5	13.3
Target lesion revascularization (%)	5.5	2.9	13.3
Total occlusion (%)	2.7	0.7	8.9*
Stenotic regression (%)	40.4	40.6	40.0
Stenotic progression (%)	18.6	16.6	24.4
(>10% regression/progression of %DS, comparing 5-years to 3–12 months)			
RD (before PTCA) (mm)	2.57 ± 0.58	2.61 ± 0.56	2.48 ± 0.57
MLD (before PTCA) (mm)	0.73 ± 0.43	0.74 ± 0.42	0.68 ± 0.47
MLD (immediately after PTCA) (mm)	1.98 ± 0.61	2.00 ± 0.58	1.93 ± 0.67
RD (>5-years follow-up) (mm)	2.48 ± 0.60	2.53 ± 0.57	2.36 ± 0.62
MLD (>5-years follow-up) (mm)	1.76 ± 0.62	1.84 ± 0.58	1.54 ± 0.68*
%DS (5-years)-%DS (3–12 months) (%)	−2.8 ± 23.2	−5.0 ± 19.7	3.5 ± 30.6*

*p < 0.05 compared to non-DM lesions, %DS = %diameter stenosis; RD = reference diameter; MLD = minimum lumen diameter; 42% of 154 non-diseased vessels at the first PTCA had new lesions (%DS > 50%) during the follow-up periods. In DM group, 51% of 35 non-diseased vessels had new lesions.

Conclusions: The late restenosis rate was low in the lesions with no restenosis during the 3–12 month period, and approximately two-fifths of

these lesions had stenotic regression. Compared with non-diabetic lesions, diabetic lesions which underwent PTCA were disposed to have stenotic progression and became total occluded.

1062-77 Coronary Angioplasty With Provisional Stenting in Dialysis Patients: In-Hospital and 6 Month Outcomes

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Background: Patients undergoing long-term dialysis have high rates of coronary artery disease and the outcome of coronary angioplasty (PTCA) in such patients is reported to be poor in small series.

Methods: We studied immediate angiographic results, in-hospital complications and 6 month outcome of PTCA, with provisional stenting, performed in 119 patients with long-term dialysis. The results were compared to those of 1328 non-dialysis patients undergoing PTCA during the same period [12/93–12/97]. Indications for stenting were post-PTCA diameter stenosis ≥35%, threatening dissection and bail-out after balloon PTCA. All patients were followed-up ≥6 months.

Results:

	Dialysis n = 119	Non-dialysis n = 1328
Stenting (%)	38*	26
Angiographic success (%)	91	91
In-hospital:		
Death (%)	2.5	1
MI (%)	3.9*	1.5
Follow-up:		
Angina (%)	60†	36
MI (%)	6	2.4
Death (%)	2.6†	0.2
Revascularization (%)	48†	33
TLR (%)	32*	22
MACE (%)	52†	37

*p < 0.05, †p < 0.01, MACE: death/MI/CABG/PTCA

Outcomes were comparable between dialysis patients with optimal result after balloon PTCA and those with stent implantation.

Conclusions: Compared to non-dialysis patients, balloon PTCA provides more suboptimal angiographic results in dialysis patients, requiring higher rates of stenting. Despite comparable final angiographic results, in-hospital and 6 month outcomes are poorer in dialysis patients.

1062-78 Cutting Balloon Angioplasty: An Alternate Way in the Treatment of Complex Coronary Lesions

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Background: The cutting balloon (Interventional technologies, Letterkenny, Ireland) is a non compliant PTCA-Balloon armed with 3–4 micosurgical blades mounted longitudinally on its outer surface. When the balloon is inflated the blades are exposed to achieve controlled surgical incisions in the stenosis avoiding uncontrolled dissection and reducing elastic recoil facilitating maximum dilatation. We investigated wether we could get stent like result without need for stentimplantation.

Methods: 69 patients (pts) with 69 de novo lesions had been chosen for cutting balloon angioplasty (CBA). We only used cutting balloons (CB) with a length of 10 mm. Procedural success was defined as a residual stenosis <30% compared to reference vessel diameter. Lesion location: LAD in 35 pts, CX in 22 pts, RCA in 12 pts, 28 lesions located in the proximal segment, 27 in the mid portion and 14 in the distal. According to AHA-criteria stenosis had been defined as type A in 26, type B in 32 and type C in 11 pts. Mean stenosis length was 7.9 mm (3–25 mm), mean number of inflations 1,4/stenosis (1–4), mean inflation pressure 5.9 bar (4–8).

Results: Placement of the device had been successful in 67 pts, in 2 pts unsuccessful because of severe kinking of the vessel and the relativ rigidity of the blade armed balloon. Mean reference vessel diameter was 2.89 ± 1.3, initial minimal lumen diameter (MLD) was 0.57 ± 0.46 mm, or 80.3% Diameter stenosis, postprocedural MLD was 2.32 ± 1.45 mm or 22.8% diameter stenosis. Procedural success was achieved with CB alone in 42 pts (60.9%), with adjunctive standard-PTCA (mostly due to primary undersizing of the CB) in 13 pts (18.8%), after additional stent-implantation in 14 pts (20.3%). Reasons for stentimplantation had been severe dissections in 9 pts and in 5 pts (7.23%) residual stenosis >30%.

Conclusions: The Cutting balloon is a good alternate approach compared to standard PTCA with a large number of "stent like results", reducing markedly the need for stent implantations following standard PTCA.

1062-79 Initial Experience With Angiojet® Mechanical Thrombectomy in the Treatment of Acute Myocardial Infarction

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Background: The achievement of TIMI grade 3 flow at discharge is an important indicator of in-hospital and long-term survival for patients with acute myocardial infarction (MI). While aggressive thrombolysis achieves TIMI 3 flow in only 50% of patients, primary intervention has been shown to be highly effective in establishing TIMI 3 flow. Angiographic evidence of thrombus is associated with an increased incidence of complications, and thrombus removal may potentially improve early patency rates and decrease complications. We evaluated the efficacy of thrombectomy with the AngioJet (AJ) catheter in patients receiving coronary intervention for MI.

Methods: AJ thrombectomy was performed in 46 patients with 44 native coronary lesions and 2 saphenous vein graft lesions, presenting to our center between 5/98 and 5/99. Four patients had history of prior MI, 2 presented in cardiogenic shock, and 45% of interventions were rescue procedures for failed thrombolysis. Angiographically evident thrombus was present in infarct-related vessels with reference diameter >2.0 mm by visual estimation, and the AJ catheter was used at the discretion of the angiographer. In most cases, balloon angioplasty and stenting was performed and IIb/IIIa inhibitors were used.

Results: Procedure success (final diameter stenosis <50% with final TIMI 3 flow, in the absence of death, emergency bypass surgery, or stroke during the hospital stay) was achieved in 44 of 46 (96%) patients. Pre-treatment flow was TIMI 0 in 40 patients, TIMI 1 in 5 patients, and TIMI 2 in 1 patient. All patients had final TIMI 3 flow. Balloon angioplasty followed by stenting was performed in 89% of patients and IIb/IIIa inhibitors were used in 87% of patients. The mean AJ operation time was 54.0 sec. Distal embolization occurred in 3 cases. Transient heart block and bradycardia were observed during AJ treatment, and temporary pacing was used in 2 patients, with no subsequent complications. There were 2 deaths, no emergency bypass surgeries, and no strokes during the hospital stay.

Conclusion: AJ thrombectomy can be performed safely and effectively in patients undergoing coronary intervention for the treatment of MI. While the combination of AJ, stent, and IIb/IIIa inhibitors has the potential to provide further improvement in clinical outcomes in the setting of MI, determination of the specific benefits of this combination therapy require further clinical study.

1062-80 Primary PTCA in Patients With Acute Myocardial Infarction and Prior Coronary Artery Bypass Grafting

Jassim Al Suwaidi, James L. Velianou, Peter B. Berger, Kirk N. Garratt, Guy S. Reeder, Diane E. Grill, David R. Holmes Jr.. *Mayo Clinic, Rochester, MN, USA*

Background: The impact of prior coronary bypass surgery (CABG) on clinical outcome in patients (pts) undergoing 1º PTCA for acute MI is unclear.

Methods: We compared the clinical outcome of 1073 pts with (n = 129) and without (n = 944) prior CABG undergoing 1º PTCA for MI at Mayo Clinic between 1991 and 1997. Prior CABG pts were divided into those in whom a vein graft (n = 63) vs native artery (n = 65) was believed to be the culprit vessel.

Results: Pts with prior CABG were older and more likely to have diabetes, hypertension, hyper-cholesterolemia, present with congestive heart failure, and have a lower left ventricular ejection fraction. Baseline characteristics of prior CABG pts with a vein graft vs native culprit vessels were similar. *MACE (Death, MI and target vessel revascularization)

	Prior CABG	No prior CABG	p	Vein graft	Native vessel	p
Procedural success (%)	78.9	83.9	0.16	71.4	86.2	0.04
30-days (%)						
Death	12.5	8.3	0.17	15.9	9.2	0.73
Reinfarction	9.0	4.3	0.05	12.7	7.7	0.96
CABG	13.2	7.1	0.04	6.5	0.0	0.04
1 yr (cumulative %)						
Death	25.8	11.9	0.001	30.2	21.6	0.27
Reinfarction	18.1	9.0	0.02	25.9	11.1	0.04
CABG	10.0	13.7	0.24	14.5	5.8	0.14
MACE*	49.2	35.8	0.04	52.4	46.2	0.48

On multivariate analysis, only a vein culprit vessel (RR 1.46 [CI 95%: 1.05,

2.03], p = 0.025) but not a native culprit vessel (RR 0.96 [CI 95%: 0.66, 1.38]. p = 0.08) or prior CABG (RR 1.18 [CI 95%: 0.91, 1.53], p = 0.20) were independently associated with major adverse events.

Conclusion: 1º PTCA for MI in pts with prior CABG is associated with a lower success and higher complication rate primarily because of baseline clinical characteristics or if a vein graft is the culprit vessel.

1062-81 Predictors of TIMI ≤ 2 Coronary Flow After Primary Angioplasty in Patients With Acute Myocardial Infarction

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Background: The goal of angioplasty during acute MI is the restoration of normal flow to achieve myocardial reperfusion. However, non-adequate coronary, flow is obtained in 10–20% of patients. This phenomenon is associated with poor outcome. Factors associated with TIMI ≤ 2 after primary angioplasty during acute MI are unknown.

Methods: Between 11/95 and 2/97, RAPPORT trial randomized 483 patients with acute MI to primary angioplasty with or without adjunctive abciximab. A multivariate model was used to detect baseline clinical, angiographic or therapeutic characteristics associated with TIMI flow grade ≤2 after angioplasty. TIMI flow grade was classified by an independent core lab. Variables with p < 0.15 in the univariate analysis were included in the multivariate model.

Results: The study population comprised of 434 patients (49 pts were excluded because no intervention, performed) with a mean age of 60.8 ± 12 years, 71% of male gender, and 36% with anterior wall localization. Patients underwent angioplasty within 4.9 ± 3.8 hours from the onset of chest pain. The incidence of TIMI 3 flow at the end of the intervention was 84%. Multivariate analysis revealed that patients older than 65 years (OR 2.6, 95% CI 1.4–5.0), male gender (OK 2.4 95% CI 1.1–5.2), baseline TIMI 0–1 flow (OR 2.7, 95% CI 1.2–5.9) and presence of thrombus at baseLine angiogram (OR 2.4 95% CI 1.2–4.9) were significantly associated with TIMI ≤ 2. Interestingly, the time from onset of chest pain to intervention and the use of adjunctive abciximab were not associated.

Conclusion: Angiographic evidence of thrombus and two specific demographic characteristic factors such as age and male gender predict lack of adequate coronary reperfusion, with resistance to abciximab effects. New strategies are needed to address this important unmet therapeutic goal.

1062-82 Predictors of Delay From ER to Cath With Primary PTCA for Acute MI

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Background: The detrimental effect of treatment delay for acute MI with thrombolytics is well validated but it remains controversial with primary PTCA. Since time of day is known to influence delay, we sought to define other predictors of delay (>60 minutes from ER to cath based on the ACC/AHA guidelines) utilizing the PAMI databases.

Methods: Data were available on 2820 patients from 98 sites participating in PAMI-2, Stent PAMI and NoSOS. Eighty-nine patients with no time from ER to cath due to pre-hospital diagnosis and direct admission to the cath lab (European Centers) were excluded.

Results: The mean time to cath was 103 minutes with 60.3% receiving "delayed" treatment. Of 41 variables, 6 were identified as predictors of delay. Specifically, a history of hypertension, diabetes, CHF, treatment at non-teaching centers, larger institutions (>200 beds) and privately funded institutions were associated with delay.

Predictor of Delay	Percent Delayed	Mean Time with Predictor	Mean Time without Predictor (p < 0.05)
History of Diabetes	71.1%	118.0	99.8
History of CHF	73.0%	121.5	102.6
Non-Teaching	66.5%	113.1	102.7
Center > 200 Beds	66.7%	111.7	73.9
Private Funding	63.8%	105.3	95.0

Conclusions: The majority of acute MI patients are not reperfused with primary PTCA within the recommended ACC/AHA time constraints. Rapid treatment protocols should be developed to identify MI patients with comorbid conditions and to expedite care in large centers.

1062-83 The Relationship of Primary Angioplasty Volume and Survival Among Interventional Hospitals in the National Registry of Myocardial Infarction

John G. Canto, Nathan R. Every, David Magid, William J. Rogers, Judith A. Malmgren, Paul D. Frederick, William J. French, Alan J. Tiefenbrunn, Vijay K. Misra, Catarina I. Kiefe, Hal V. Barron. *For the NRMI Investigators; University of Alabama at Birmingham, Birmingham, AL, USA*

Background: Previous studies have documented an inverse relationship between provider volume and outcomes in cardiovascular care, such as for elective coronary angioplasty (PTCA), stents, and coronary bypass surgery (CABG). However, it is unknown whether outcomes may be better among centers with higher volumes of primary PTCA for myocardial infarction (MI).

Methods: 450 interventional hospitals (with PTCA and CABG availability) were ranked according to primary PTCA volume. Volume was calculated by taking the total number of patients who received primary PTCA at each hospital divided by the total number of days that a hospital was enrolled in the NRMI. Quartiles of volume were then defined. Multivariable logistic regression models were developed to ascertain predictors of mortality. Candidate predictors were: primary PTCA volume, age, race, gender, region, smoker, diabetes, hypertension, high cholesterol, angina, prior MI, PTCA, CABG, heart failure, and stroke.

Results:

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
N	2,825	5,245	9,303	19,162
Volume/year	5–11	12–20	21–33	>33
Crude Mortality, %	7.7	7.5	7.0	5.7

OR for in-hospital mortality among MI patients who received primary PTCA

Unadjusted	OR	95% CI	p value
Quartile 2 (vs Quartile 1)	0.964	0.812–1.145	0.6779
Quartile 3 (vs Quartile 1)	0.888	0.757–1.042	0.1456
Quartile 4 (vs Quartile 1)	0.720	0.619–0.837	<0.0001
Adjusted			
Quartile 2 (vs Quartile 1)	0.929	0.775–1.114	0.4261
Quartile 3 (vs Quartile 1)	0.855	0.722–1.012	0.0683
Quartile 4 (vs Quartile 1)	0.719	0.614–0.843	<0.0001

Conclusion: Among patients who presented at interventional hospitals, mortality was significantly lower among those who received primary PTCA in high volume PTCA hospitals as compared to low volume PTCA hospitals.

POSTER

1063 Coronary Brachytherapy I

Monday, March 13, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1063-109 Effects of Intracoronary Radiation on Healing Dissection and Thrombosis Following Balloon Injury in the Porcine Model

Yves Cottin, Yoram Vodovotz, Marc Kollum, Han-Soo Kim, Rosanna Chan, Balram Bhargava, Ron Waksman. *Washington Hospital Center, Washington, DC, USA*

Background: Intracoronary radiation (IR) after balloon injury (BI) has an anti-restenotic effect, but can delay healing and increase thrombosis.

Methods: The effect of IR on dissection repair, thrombus formation, and internal elastic lamina (IEL) changes were evaluated. Thirty porcine coronaries underwent BI followed by either 0 or 18 Gy of ^{90}Y prescribed to 1.2 mm from the balloon center. The animals were euthanized 14d post-treatment, and intimal area (IA), IA corrected for medial fracture length (IA/FL), dissection area (DA), dissection rate (DR), and thrombus area were quantified. The roughness index (RI) of the IEL was calculated from the surface profile length and the straight-line length.

	Control (n = 12)	18 Gy ^{90}Y (n = 17)	P value
IA/FL (mm)	0.55 ± 0.29	0.05 ± 0.09	<0.001
DR (%)	77	88	NS
DA (mm^2)	0.19 ± 0.28	0.32 ± 0.29	<0.05
Mural TA (mm^2)	0.29 ± 0.30	0.03 ± 0.01	<0.001
RI	8.7 ± 1.2	20.1 ± 3.1	<0.001

Results: IA/FL was reduced following IR. Control and irradiated arteries had equal DR. The control had a smaller DA, with smaller mural thrombi. The surface of the IEL was more irregular after IR, as reflected in the RI (Table). DA and mural TA correlated positively only in the IR group ($R^2 = 0.889$; $p < 0.001$; $\alpha_{0.05} = 1.00$). When mural thrombi were present, TA and RI correlated positively ($\alpha = 0.76$, $p < 0.01$).

Conclusion: Incomplete healing of dissections may occur after IR at 14d, associated with a higher RI and TR. These findings may influence the design of IR studies.

1063-110 Brachytherapy Induces Positive Vascular Remodeling Using Self-Expanding Stents

Judah Weinberger, Sean Pinney, Renu Virmani, Frieda Trichter, C.-S. Wuu. *Columbia University, New York, NY; Armed Forces Institute of Pathology, Washington DC, USA*

Background: Observations of patients treated with vascular brachytherapy suggest that, in addition to inhibition of neointimal hyperplasia at sites of balloon angioplasty, but not stents, radiation induces positive remodeling leading to an improved late lumen diameter. We sought to test the hypothesis that self-expanding stents, by virtue of continued positive radial force on the vessel wall, together with brachytherapy would synergistically increase favorable arterial remodeling.

Methods: Nitinol self-expanding stents were implanted in pig iliac arteries (n = 12) bilaterally. Nominal stent size was 10–15% oversized, compared to the reference vessel diameter, based on IVUS measurements. One of the two arteries was randomly selected for vascular brachytherapy using the Rhenium^{188}-liquid-filled balloon to deliver 20 Gy at 0.5 mm into the vessel wall. At 4 weeks post implant, all animals underwent repeat angiography, and were killed. Pressure fixed distal aorta and iliac arteries were examined histologically.

Results: Self-expanding stents that were radiated immediately after implantation resulted in a markedly enlarged lumenal diameter (1.18 ± 0.17 [relative units] stented/irradiated vs. 0.81 ± 0.35 reference, $p = 0.04$). Self-expanding stents implanted in non-radiated iliac arteries did not significantly increase lumenal diameter (MLD: 0.78 ± 0.13 stent vs. 0.74 ± 0.2 reference vessel $p = 0.72$). Radiated, stented arteries had significantly larger lumens at follow-up than did control-stented arteries ($p = 0.0009$). There was, on average, a 35% larger lumen (95% C.I. 28%) in the radiated stent compared with controls. Histological results will be presented at the meeting.

Conclusion: Brachytherapy in conjunction with self-expending stent implantation produces positive vascular remodeling.

1063-111 Tungsten-188 Radioactive Coil Delivered Intracoronary Inhibits Neointima Formation After Balloon and Stent Injury of Porcine Coronary Arteries

Ron Waksman, Balram Bhargava, Rosanna Chan, Marc Kollum, Yoram Vodovotz, Efi Lavie. *Washington Hospital Center, Washington, DC, USA; Soreq, NRC, Yavne, Israel*

The effectiveness of a new coiled wire of 188-Tungsten (^{188}W) a pure β emitter (half-life 69.4 days) was tested.

Methods: Domestic pigs underwent intervention to their coronary arteries either by balloon injury (BI) n = 20 or intracoronary stenting n = 20. A 30-mm in length radioactive 188-Tungsten coiled-wire 1-mm in diameter manually delivered to cover the angioplasty site in eight of the BI arteries, in 4 arteries post stenting and in 6 arteries prior to stenting. A prescribed dose of 15 Gy at 2 mm from the center of the source required dwell time of 10 min. Two weeks after BI and four weeks after stenting the animals were killed, the arteries were examined by histological and morphometric techniques. The Intimal Area (IA), the IA corrected to the degree of injury (IA/FL) and the Injury Score (IS) were measured.

	Balloon IA (mm^2)	Balloon IA/FL	Stent IA (mm^2)	Stent IS
Control	1.00 ± 0.8	0.52 ± 0.32	2.72 ± 1.2	1.95 ± 0.7
Irradiated	0.15 ± 0.9	0.58 ± 0.10	0.57 ± 0.38	1.77 ± 0.7
P	<0.001	NS	<0.001	NS

Results: Nearly complete inhibition of neointima formation was demonstrated in the irradiated arteries with similar IA in arteries irradiated prior versus post stenting. There was no excess of fibrin, thrombus, or fibrosis in the irradiated arteries compared to control.

Conclusions: Intracoronary delivery of the radioactive coiled ^{188}W is feasible, safe, following balloon and stenting and results in consistent, inhibition of neointima formation in the porcine model.

1063-112 Device Influence on Outcome in the Treatment of In-Stent Restenosis With and Without Radiation. A Sub Analysis from the WRIST Study

Ron Waksman, Marco Zimarino, Roxana Mehran, Alexandra J. Lansky, Augusto D. Pichard, Balram Bhargava, Lowell Satler, Kenneth Kent, Larry R. White, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

Background: Different devices are available for the treatment of In-Stent Restenosis (ISR). Vascular Brachytherapy (VB) has demonstrated effecacy prevention recurrent ISR.

Methods: To determine the optimal device for the treatment of ISR, we evaluated 130 patients (pts) from the WRIST study who were randomized to placebo or gamma radiation (Ir192) following intervention. Devices used included Balloon (POBA), Rotational Atherectomy (RA), Excimer Laser (ELCA) and Stent. Six-month angiographic one year clinical outcomes were compared among the treatment groups. Baseline clinical characteristics, reference vessel size and minimal lumen diameters were similar.

Results: Selection of device did not influence the acute outcome in irradiated and placebo patients. Re stenting was associate with a trend of greater late loss ($p < 0.05$) and higher rates of late thrombosis when compared with other devices both for radiation and placebo patients (‡ $p < 0.02$).

		Length mm	Acute Gain	Late Loss (mm)	Restenosis Rate (%)	Late Thrombosis
Placebo	N = 56	22 ± 12	1.2 ± 0.5	0.8 ± 0.7	34 (61%)	3 (5%)
POBA	N = 7	16 ± 10	0.7 ± 0.5	0.3 ± 0.8	3 (43%)	0
RA	N = 18	22 ± 6	1.2 ± 0.4	0.9 ± 0.5	14 (78%)	0
ELCA	N = 13	25 ± 17	1.3 ± 0.5	0.7 ± 0.5	6 (46%)	0
Stent	N = 18	23 ± 11	1.4 ± 0.5	1.0 ± 0.6*	11 (61%)	3 (5%)‡
Radiation	N = 59	20 ± 10	1.1 ± 0.5	0.3 ± 0.7	12 (20.3%)	5 (8%)
POBA	N = 5	13 ± 5	0.7 ± 0.4	0.04 ± 0.4	0 (0.0%)	0
RA	N = 17	20 ± 9	1.1 ± 0.4	0.2 ± 0.5	3 (6%)	0
ELCA	N = 14	21 ± 9	1.0 ± 0.5	0.2 ± 0.8	4 (29%)	1 (2%)
Stent	N = 23	21 ± 10	1.1 ± 0.5	0.6 ± 0.8*	7 (30%)	4 (6%)‡

Conclusions: The overall recurrence of ISR in pts treated with conventional devices is high (61%). VB reduces the recurrence (to 20.3%) associated with a significant reduction in late loss. Device selection does not influence late outcomes in both irradiated and non-irradiated group. Re-stenting should be used selectively due to higher rates of thrombosis seen in both groups.

1063-113 Safety and Efficacy of Manual Stepping and Overlapping of a β-Emitter for Diffuse In-Stent Restenosis Lesions

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Background: Intracoronary β radiation has demonstrated efficacy for the treatment of In Stent Restenosis (ISR). Longer lesions require stepping of short β sources for adequate coverage of the lesion and its margins.

Methods: The efficacy and safety of manual stepping of 90Y (a pure β emitter) was evaluated in 16/50 patients with diffuse ISR in native coronaries who were enrolled in the BETA Washington Radiation for In-stent Restenosis Trial. Following an angioplasty with balloon, laser angioplasty, rotational atherectomy, and/or additional stents a segmented balloon catheter 2.5–4.0 mm in diameter was positioned at the treatment segment. A 90Y 0.014 wire source 29 mm in length was automatically loaded to deliver a dose of 20.6 Gy prescribed at 1 mm from the surface of the balloon. For lesions $\geq$25 mm manual stepping of the radiation catheter with an overlap of up to 3 mm at the stented segment was performed and the source delivered again to the new positioned. The calculated dose at the overlapped area did not exceed 70 Gy.

Results: At 6 months there was no evidence of perforation or aneurysm at the overlapped segments.

	Stepping (n = 16)	No stepping (n = 34)	P
Lesion length (mm)	22.3 ± 11.1	15.3 ± 8.4	0.04
Late Thrombosis	2/16 (12.5%)	4/34 (11.8%)	NS
Late loss (mm)	-0.06 ± 0.31	0.26 ± 0.48	0.04
Revascularization (6 m)	5/16 31.3%	9/34 (26.5%)	NS

Conclusion: Manual stepping and overlapped β-emitters for diffuse ISR is safe and may contribute to further reduction of the late loss.

1063-114 Stent and Stent-Edge Remodeling After Conventional and Radioactive Stent Implantation

I. Patrick Kay, Manel Sabaté, Marco A. Costa, Ken Kozuma, Mariano Albertal, Jurgen M. Ligthart, Veronique L. Coen, Peter C. Levendag, Willem G. van der Giessen, Patrick W. Serruys. *Thoraxcenter and Daniel den Hoed Cancer Center, Rotterdam, The Netherlands*

Background: Stent edge restenosis is a recognized complication of radioactive stent implantation. Little is known of the mechanism by which an 'edge effect occurs', or indeed whether it develops after conventional stent implantation. Equally remodeling behind the radioactive stent has not been described.

Aim: To describe remodeling of the stent and at the stent edge after conventional (CS) and radioactive stent implantation.

Method: 18 patients who had undergone stenting using conventional stents (Multilink n = 8, NIR n = 10) were compared with patients who had undergone radioactive stent (Palmaz Schatz, BX Isostent) implantation with activity levels 0.75–1.5 μCi (n = 17) and 6.0–12 μCi (n = 12). Intravascular ultrasound was performed post stent implantation and at 6 month follow-up using a motorized pullback device (0.5 mm/s), with subsequent 3-dimensional reconstruction and quantification. Measurements were made of the change in (Δ) lumen volume (LV) and total vessel volume (TVV) at the stent edge (up to 5 mm proximal and distal to the stent) and TVV, stent volume (SV), neointimal hyperplasia (NIH) and plaque volume (behind stent) (BPI). These findings were compared post stenting, at follow-up and between treatment groups.

Results: Clinical baseline characteristics, reference vessel size and stent length were similar between groups. No change was seen in stent volumes between post and follow-up.

Edge (mm^3)	ΔLV	ΔTVV	ΔPlaque
CS	−9.1*	−8.46*	+1.47
0.75–1.5 μCi	−8.49*	−11.21*	−2.31
6.0–12 μCi	−11.24*	−8.68*	+3.3

Stent (mm^3)	ΔLV	ΔTVV	ΔABP1	NIH
CS	−20.7*	+1.14	+1.67	+20.18
0.75–1.5 μCi	−21.84*	−4.1	−3.94	+18.03
6.0–12 μCi	−10.7*†	−2.77	−0.96	+8.90‡

*$p < 0.05$ (baseline vs follow-up), ‡$p < 0.05$ (between stent groups).

Conclusion: Stent edge renarrowing occurs after both conventional and radioactive stent implantation and is due to a decrease in the TVV with a concordant decrease in LV. Higher-dose radioactive stent implantation decreases NIH with no change in TVV or BP1.

POSTER

1064 Endovascular Treatment of Abdominal Aortic Aneurysm

Monday, March 13, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1064-84 Angioplasty and Stenting of Extracranial Carotid Arteries in High-Risks Patients

M. Henry, M. Amor, I. Henry, C. Klonaris, I. Masson, E. Leborgne, A. Polydorou, M. Hugel. *U.C.C.I., Polyclinique, Essey-les-Nancy, France*

Background: To study the safety and feasibility of percutaneous angioplasty and stent placement for atherosclerotic stenosis of the extracranial carotid arteries in high risks patients as an alternative to surgical endarterectomy.

Methods: Carotid angioplasty was attempted in 315 arteries, 290 patients M: 213, F: 77, mean age: 70.5 ± 9.6 y (40–93 y). Mean lesion length: 14.7 ± 6.7 mm. Mean arterial diameter: 5.3 ± 1.1 mm. In 15 patients, the contralateral carotid artery was thrombosed. 44% were symptomatic, 56% were asymptomatic. 55% had severe coronary artery disease, 34% had peripheral vascular disease. Stents deployed in all carotid arteries but 1: Palmaz (n = 199), Wallstent (n = 77), other stents (n = 79). 165 arteries were treated without cerebral protection (femoral approach: 150, direct puncture: 13 brachial approach: 2). 142 arteries were treated with cerebral protection Three protection techniques used: Theron's technique (n = 47), PercuSurge device (n = 93), and our technique with a new device (n = 10).

Results: Immediate technical success was 314/315. Mean stenosis dropped from 82.3 ± 8.7% to 2.9 ± 7%. Postoperatively one patient died (0.3%), no cases of myocardial infarction were noticed. Also 13 neurological complications occurred: 4 TIA, 4 minor and 5 major strokes. 8 appeared in patients treated without cerebral protection (4.8%) and 5 with cerebral protection (3.3%), $p < 0.02$. With cerebral protection 4 events occurred with Theron's technique (8.5%) and one with the PercuSurge device (1.1%) $p < 0.01$. One patient developed a minor stroke on third day due to cerebral hemorrhage after treatment with Reopro. Mean follow up was 17.1 ± 8.5 months, (max. 50 m). We observed 1 mild compression of a Palmaz stent and 10 restenoses (4%). No ipsilateral neurological complications were seen. Primary and secondary patency rates were 96% and 99% at 4 years.

Conclusion: Carotid angioplasty and stenting seems safe and effective procedure. Cerebral protection should decrease the neurologic embolic complication rate and enlarge its indications. Randomized studies are awaited.

1064-85 Endoluminal Stenting for Abdominal Angina: An Alternative to Surgical Revascularization

Suresh P. Jain, Christopher J. White, Tyrone J. Collins, J. Stephen Jenkins, Krishnamoorthy Vivekananthan, Stephen R. Ramee. *Ochsner Clinic, New Orleans, LA, USA*

To evaluate the clinical efficacy of endoluminal stenting (ES) in the treatment of chronic abdominal angina, we analyzed acute and long term outcomes in 13 pts (6 females, mean age 67 ± 8 yrs) who underwent ES. ES deployment were performed in celiac artery (n = 9), superior mesenteric artery (n = 6), inferior mesenteric artery (n = 1), and a vein graft to a superior mesenteric artery (n = 1). A total of 18 Palmaz medium stents and 1 multilink stent were deployed. The average balloon size was 6 ± 1 mm and stents were deployed at 12 ± 2 ATM. Clinical follow up (22 ± 16 mth, range 6–55 months) was available in all 13 pts. Quantitative angiography was performed using an automated edge detection technique.

Results: Acute clinical success (<20% diameter stenosis accompanied by symptomatic relief without emergency surgery or death) was achieved in all 13 pts (100%).

	Baseline	Post stent	p
MLD (mm)	0.83 ± 0.3	6.06 ± 1.30	<0.0001
Diameter stenosis (%)	86.19 ± 5.39	1.2 ± 3.19	<0.0001
Acute Gain (mm)		5.23 ± 1.21	<0.0001

Four pts died during follow up (2 cardiac failures, 1 renal failure, 1 lung cancer) and none had recurrence of symptoms till death.. One patient developed in-stent restenosis with recurrent symptoms after 6 months and was successfully treated with balloon angioplasty, the remaining 8 pts were completely asymptomatic.

Conclusion: Endoluminal stenting of the atherosclerotic mesenteric and celiac arteries is a safe and effective modality for chronic abdominal angina seconadry to mesenteric ischemia. It is a viable aternative to surgical revascularization.

1064-86 Comparison of Early Outcomes in Age and Gender Matched Patients Undergoing Conventional Open Surgical Repair of Abdominal Aneurysms vs Patients Treated Percutneously With the AneuRx Stent Graft

Marcus H. Howell, William K. Vaughn, Rollo P. Villareal, Biswajit Kar, Neil Strickman, Charles H. Hallman, Zvonimir Krajcer. *The Texas Heart Institute, Houston, Texas, USA*

Background: Percutaneous endovascular treatment of infrarenal abdominal aortic aneurysms is receiving increasing popularity among physicians and patients. The current third generation devices offer the potential to avoid the significant morbidity and mortality associated with conventional open repair. In an effort to test this potential we compared the early outcomes of age and gender matched patients undergoing conventional surgical repair versus those treated with the AneuRx stent graft.

Methods: Between 1993 and 1998 159 patients mean age 71.6 (range 52–86), 87% males, underwent conventional surgical repair of unruptured abdominal aneurysms at The Texas Heart Institute. From 1998 until present 55 patients have been treated with the AneuRx stent graft for abdominal aortic aneurysms mean age 71.2 (range 56–88) and 87% males at The Texas Heart Institute. One-month follow-up is available in all the surgical patients and in 50 of the AneuRx treated patients. *In the surgical group*: 45% had prior MI; 6.5% had diabetes; 9% had a history of congestive heart failure (CHF); 12.2% had stable angina; 36% had chronic obstructive pulmonary disease (COPD); and 65.8% had hypertension. *In the AneuRx group*: 42% had prior MI; 27% had diabetes; 29% had a history of CHF; 38% had stable angina; 40% had COPD; 80% had hypertension; 79% were American Society of Anesthesiologist grade IV or higher.

Results: In the surgical group there were 6 early deaths, average hospital stay was 11 ± 11.7 days, and less than 1% of patients had major morbidity (i.e. MI, stroke, CHF, renal failure, respiratory failure). In the AneuRx group there was no one month mortality or major morbidity (Fishers exact test p = 0.164), the average hospital stay was 2.31 days (range 1–8). Average blood loss was 432 cc's and only 7 patients required transfusions.

Conclusions: Our early results show that infrarenal abdominal aortic aneurysms can be safely and successfully treated with the AneuRx stent graft when compared with the gold standard open surgical repair. Not only is there no increased early morbidity or mortality there is a trend toward less morbidity and mortality and significantly lower hospital stay. Longer follow-up is required to determine the long-term efficacy of the AneuRx stent graft in the prevention of rupture and death due to abdominal aortic aneurysms.

1064-87 Transluminal Endovascular Treatment of Thracic, Thoracoabdominal Aortic Aneurysms and Dissection With INOUE Stent Graft

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Background: Endovascular treatment for Abdominal aortic aneurysm becomes to be popular. But previously reported stent graft technology for thracic (TAAs), thoracoabdominal aortic aneurysms (T-A AAs) and dissection (DAAs) is limited by involvement of major side-branches. The aim of the study was to evaluate safety and efficacy of Transluminal Endovascular Graft Placement (TEGP) with INOUE stent graft for TAAs, T-A AAs and DAAs.

Methods: Since Aug. '98 and Aug. '99, we performed TEGP with INOUE stent graft for TAAs, T-A AAs and DAAs in 13 patients (pts.) 14 lesion (les.) (10 men and 3 women; mean age 69 ± 11 years). The les. consists of 4 TAAs, 3 T-A AAs and 7 DAAs (3B). Mean maximum diameter of the aneurysms was 63 mm (range, 42–118 mm). Eight (61.5%) of the pts. had medical conditions that excluded them from open repair, 2 high age more than 79 years, 4 sever pulmonary dysfunction, 1 sever renal dysfunction and 1 impossibility to have blood transfusion for his faith. INOUE stent graft was inserted through 20–24 Fr. sheath via a femoral artery under local anesthesia and was fabricated as self-expandable with adjunctive balloon expanding. Seven (50.0%) of les. had a single brunch graft, 1 (7.1%) had a dual brunch graft, 1 (7.1%) had a three brunches graft and 5 (35.7%) had a straight graft. In 5 les. of DAAs, INOUE stent graft was used to close the entry site and to protect left subclavian artery by its brunch. In 4 les. of TAAs involving main brunches of arch, the stent graft was planed to keep the blood flow of the brunches. After INOUE stent graft was brought to the intended sites, brunches of INOUE stent graft were pulled into major branches of aortic arch by hauling into traction wire with Goose-neck snare wire.

Results: In all cases, stent graft were implanted successfully to the intended sites and brunches had good patency. Mean procedure time was 3.08 ± 1.23 hours. One pt. (7.7%) undergoing TEGP for T-A AA had transient spinal artery syndrome. The mean follow-up was 6 months (range, 1–13 months). Only one pt. (7.7%) has minor residual leakage up to now. There have been no death, no aneurysm ruptures, no surgical conversions to open repair and no late development of endoleakage.

Conclusion: TEGP with Inoue stent graft for TAAs, T-A AAs and DAAs is less invasive and effective especially for high risk pts. Inoue stent can be used in TAA, DAA involving major branches of aortic arch. TEGP with Inoue stent graft is new useful strategy for TAAs, T-A AAs and DAAs.

1064-88 Comparison of Abdominal Aortic Aneurysm Repair by Percutaneous Implantation of Uncovered Wire Mesh Stents and Coil Embolization of the Aneurysm Cavity in Patients With and Without Pre-Existent Thrombus

Ali E. Denktas, Alan M. Cohen, Carlos Cafri, Abid Assali, Stefano Sringola, Michael A. Rhiner, Nabil F. Maklad, Bharat Raval, George Schroth, H.V. Anderson, Oscar R. Rosales, Berdardo de la Guardia, Richard W. Smalling. *University of Texas Medical School and Hermann Hospital, Houston, Texas, USA*

Background: We have previously demonstrated the feasibility of percutaneous placement of uncovered wire mesh stents with trans-stent coil embolization of the aneurysm cavity for the treatment of abdominal aortic aneurysm. Whether pre-existing thrombus in the AAA cavity provided an advantage or disadvantage in this setting was unclear.

Methods: Sixteen patients (pts) (mean age 76 ± 6, 69% males,) with a mean maximum AAA diameter of 52.7 ± 10.3 mm were treated. Maximum sheath size was 12 Fr. Wallstents (3.8 ± 1.2 per patient, size: 24 × 7.5 and 4.5 mm (aorta) and 16 × 9 mm (iliac), mean total length: 25.0 ± 8.8 mm). Fluoroscopy time was 53.4 ± 24.6 minutes and total procedure time was 168.8 ± 46.2 minutes. Total hospitalization time was 23.7 ± 10.5 hours. Coiling of the AAA cavity was required in 9 pts. (Mean 30.7 ± 15 coils) The follow-up was done using bi-monthly abdominal duplex ultrasound and yearly Computerized Tomography (CT). (Mean follow-up: 192 ± 187 days (range 42–720 days))

Results: The success rate of the procedure was 15/16 (94%). There was no thirty-day mortality. Four patients required additional coil placement due to low levels of flow outside the stent determined by ultrasound. No flow outside the stent was found in patients with previously thrombosed aneurysms. One-year or greater CT follow-up was available for 5 pts. (3 non-thrombosed, 2 thrombosed). The overall pro and post stenting diameters were 43.6 ± 5.4 mm, and 43.1 ± 7.1 mm respectively. No patients have died secondary to aneurysm rupture. The results in pts. with thrombosed vs. non-thrombosed aneurysms are given in the table.

	Size before stenting	Size 1 y after stenting
Non-Thrombosed	42.97 ± 4.16 mm	43.13 ± 8.31 mm
Thrombosed	44.50 ± 8.77 mm	43.10 ± 8.06 mm

Conclusion: Patients with abdominal aortic aneurysms with intraluminal thrombus not requiring coil embolization after treatment with uncovered wire-mesh stents demonstrated markedly less peri-stent flow at ultrasound follow-up and a greater tendency for aneurysm shrinkage one year post-implant.

1064-89 Necrotic Vascular Graft-Covered Stents Inhibit Smooth Muscle Migration: A Possible Mechanism of Reducing Intimal Hyperplasia

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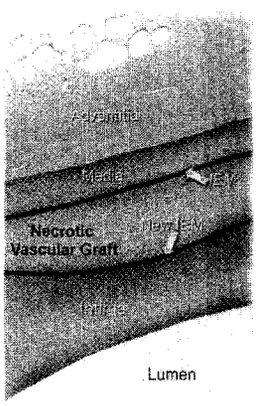
Background: Restenosis after stent implantation is characterized by smooth muscle cell (SMC) migration from the arterial media towards the intimal layer and their subsequent proliferation. The aim of this study was to determine whether the extent of intimal hyperplasia after stenting can be reduced by inhibiting SMC migration.

Methods: A 3–4 cm graft was harvested from the right femoral artery of 12 swines (20–25 kg). The boundary tissues of the graft were removed and it was embedded in 100% pure ethanol solution (Merck KGaA, Germany) for 30 min. After the achievement of cellular desiccation the necrotic arterial graft was washed by Ringer's lactate solution and was stabilised on the external surface of a Multilink™ stent with 3 sutures (Prolene 7.0) at each end of the stent. Covering of stents by this necrotic graft aimed to inhibit SMC migration from the arterial media (figure). Twelve covered stents (group A) and 12 conventional Multilink™ stents (group B) were implanted in the fight and left iliac artery of 12 swines alternatively. Two months after the procedure the animals were sacrificed for histologic evaluation.

Results: Under light microscopy, only rare SMCs were observed in the neointima layer of group A segments, in contrast to numerous SMCs in group B. Both maximal intimal thickness (0.20 ± 0.11 vs. 0.32 ± 0.14 mm, $P < 0.01$) and media thickness (0.12 ± 0.003 vs. 0.17 ± 0.005 mm, $P < 0.02$) were less in group A compared to group B.



Conclusions: The development of intimal hyperplasia may be reduced by the inhibition of SMC migration from the arterial media towards the intima resulting in atrophy of the media. This may be the target of future interventions to prevent restenosis.

1064-90 Transluminal Endovascular Graft Placement With INOUE Stent Graft is Effective for Many Types of Aneurysms

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The feasibility and efficacy of Transluminal Endovascular Graft Placement (TEGP) with INOUE stent graft for treatment of many types of aneurysms was investigated. Since Aug. '97 and Aug. '99, We performed TEGP with INOUE stent graft in 34 patients (pts.) 35 lesion (les.) (27 men and 7 women; mean age 73 ± 9 years). The les. consists of 20 infrarenal Abdominal Aortic Aneurysms (AAAs), 4 Thoracic Aortic Aneurysms (TAAs), 7 Dissecting Aortic Aneurysms (DAAs) (3B), 3 Thoraco-abdominal Aortic Aneurysms (AAs) and 1 Common iliac AA. Twenty (58.8%) of the pts. had medical conditions that excluded them from open repair, 10 high age more than 79 years, 1 Aortic stenosis, 5 sever pulmonary dysfunction, 1 sever renal dysfunc-tion, 1 Hepatic cell carcinoma, 1 paralysis due to prior cerebral infarction and 1 impossibility to have blood transfusion for his faith. INOUE stent graft was inserted through 20–24 Fr. sheath via a femoral artery under local anesthesia and was fabricated as self-expandable with adjunctive balloon expanding. Eighteen (51.4%) of les. had a bifurcated stent graft, 7 (20.0%) had straight graft, 8 (22.9%) had single brunch graft, 1 (2.9%) had dual brunch graft and 1 (2.9%) had three brunches stent graft. In all cases, stent graft were implanted successfully to the intended sites. Mean procedure time was 2.92 ± 1.25 hours. One pt. (2.9%) died due to shower embolism at 5 days after TEGP for AAA. One pt.(2.9%) undergoing TEGP for Thoraco-abdominal AA had transient paraplegia. Nine pts. (26.5%) required transfusion. The mean follow-up was 9 months (range, 1–25 months). One pt. (2.9%) had surgery at 67 days because of graft dislodgement and severe leakage. Only one pt. (2.9%) has minor residual leakage up to now and 1 pt. (2.9%) has late development of endoleakage. Among 23 pts. more than 3 month after TEGP, the maximum diameter of aneurysms decreased in 11 (47.8%) pts. and increased in one (4.3%) pt.

Conclusion: TEGP with Inoue stent graft 1) is less invasive and at least as effective as surgery, 2) is especially useful for high risk pts, and 3) can be used in many types of aneurysms not only AAA, but also TAA, DAA involving major branches of aortic arch. This advantage is due to its high flexibility and side branch availability.

1064-91 Descending Thoracic Aorta Disease Treated by Percutaneous Endoprosthesis: A Brazilian Experience

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Purpose: Surgical treatment of diseases of the descending thoracic aorta still carries high morbidity and mortality. We report our experience with the use of a percutaneous Braile™ stent-graft endoprosthesis as an alternative to surgery in complicated type B aortic dissection (AD – 17 pts), tree descending aortic aneurysm (7 pts) and aortic atherosclerotic penetrating ulcer (AAPU – 6 pts), and 2 pseudoaneurysms. The device is self-expandable and covered with a polyester mesh with a final diameter after expansion varying from 20–24 Fr and delivered by transfemoral approach.

Methods: From Dec/96 to Aug/99 32 pts (ages 18–80, mean 60.7 years old) were treated with stent-graft endoprosthesis. All pts were treated for recurrent pain, expansion or signs of rupture. The procedure was done at the cath lab and the device deployed under angiographic and TEE guidance. General anesthesia was used in most cases (30/32 pts). All pts underwent CT or MRI evaluation 3 to 5 days after the procedure and at 6 months of follow up.

Results: The procedure was successful in 27 patients (84.4%) as the device properly sealed the false lumen, the ulcer or the aneurysm lumen as documented by angiography or TEE. The in-hospital mortality was 6.2% (2/32 – both of multiple organ failure), and elective surgical correction was necessary in 2 pts (a pseudo coarctation as the stent-graft "kinked" and one pt with persistent severe leaking). The mean ICU and hospital length of stay after the procedure was of 3 and 5 days respectively, and blood transfusion was required in 5 pts averaging 0.2 pack of red blood cell/pt. At a mean follow-up of 9.7 months 28 pts are alive (survival rate of 87.5%): One late death was due to an acute myocardial infarction and a sudden death was diagnosed as an aortic rupture at necropsy. Reopening of false lumen was detected in 2 pt and one required surgical correction. Of pts with successful procedure at hospital discharge 88.8% are free of events (death, surgery, and any leak) at follow-up.

Conclusion: Percutaneous treatment of selected cases of AD, true aneurysms of descending aorta and AAPU with the use of an endoprosthesis is feasible with a high success rate, low mortality, shorter hospital stay and less blood utilization. At a mean follow up of 9.7 months results are maintained with a small attrition rate; however, a longer follow-up is needed.

1064-92 The Kit Carson Approach to Chronic Total Occlusions of the SFA

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Background: Long superficial femoral artery (SFA) occlusions have a relatively low success rate because of the tendency for guidewires to take a subintimal course. Consequently, patients with long SFA occlusions are usually referred for surgical revascularization. If one could have a scout looking ahead of the guidewire to warn of impending sub-intimal passage, it should be possible to cross long SFA occlusions on a consistent basis. A new Guidewire System (Safe-Steer™, IntraLuminal Therapeutics, Carlsbad, California), that uses Optical Coherence Reflectometry (OCR), makes it possible to navigate such lesions. We have used this approach in conjunction with Excimer laser angioplasty to treat successfully a 20 cm SFA occlusion.

Description of Device: This new technology is based on the variable absorption and scattering of near-infrared light by substances such as plaque, blood, tissue and thrombus. Algorithms have been devised based on variable absorption rates and different scattering coefficients as a light beam of known intensity is introduced through the guidewire and illuminates adjacent to the tip.

Procedure: A 20 cm occlusion of the (SFA), was treated with a 2.2 mm Spectranetics™ Excimer laser catheter using the step-by-step technique. To avoid misdirection of the laser catheter, the Safe-Steer™ Guidewire was substituted for the usual guidewire. Using the Safe-Steer™ Guidewire as a "scout" to warn of impending sub-intimal passage, the occlusion was crossed quickly and accurately. When laser catheter and guidewire approached arterial wall, real-time feedback from the Safe-Steer™ Guidewire made it possible to redirect the laser catheter, thus avoiding dissection or perforation.

Results: This technique of leading with the guidewire to assure intraluminal maintenance and following with the therapeutic catheter allowed us to successfully traverse the CTO while minimizing the risk of arterial wall perforation. Complete recanalization of the vessel was achieved and enhanced with balloon angioplasty achieving a residual stenosis of 10%.

Conclusion: In this first experience, the Safe-Steer™ Guidewire System was a safe and efficacious complement to standard technique. Real-time feedback allowed for immediate catheter redirection of the laser catheter and confidence that lasing was occurring within the true lumen. Additional studies will need to be undertaken to further support this finding.

POSTER

1065 Restenosis: Basic Research II

Monday, March 13, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1065-115 Percutaneous Transluminal Coronary Angioplasty Results in Stimulation of Monocyte- but Not Eosinophil-Specific Chemotaxis

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Background: Percutaneous transluminal coronary angioplasty (PTCA) leads to the release of inflammatory mediators, including chemokines, as a result of plaque rupture and endothelial injury. Monocyte chemoattractant protein-1 (MCP-1) and eotaxin (EOX) are monocyte- and eosinophil-specific chemokines, respectively, involved in the migration across and the initial adhesion of these cell types to the inflammatory site(s) of endothelium. Aim of this study was to evaluate the significance of circulating soluble forms of MCP-1 and EOX in patients (pts) with coronary artery disease (CAD) undergoing PTCA in a three months follow-up.

Methods: Twenty nine consecutive pts with CAD referred for an initial elective PTCA and obtained primary success (<10% residual diameter stenosis). Twenty CAD pts who underwent elective coronary angiography without PTCA (CA) and 20 healthy subjects (HS) served as controls. Peripheral blood was sampled on the morning of PTCA or CA and at 24 hours (h) as well as 3 months (m) after PTCA or CA and was evaluated for plasma levels of MCP-1 and EOX (both measured by ELISA). In CAD pts undergoing

PTCA, before the procedure, MCP-1 plasma levels (579 ± 97 pg/mL) were similar to those of CA pts (549 ± 87 pg/mL) but significantly higher compared to those of HS (97 ± 12 pg/mL, $p < 0.001$). These levels rose significantly to 618 ± 76 pg/mL after 24 h and to 676 ± 78 pg/mL after 3 m ($p < 0.03$ and $p < 0.001$, respectively, in comparison to values before PTCA). However, in CA pts, MCP-1 plasma levels rose to 589 ± 72 pg/mL after 24 h ($p < 0.002$, in comparison to the respective levels before CA) and declined after 3 m to values similar to those before the procedure (532 ± 76 pg/mL, $p < 0.006$ in comparison to the respective levels after 24 h). EOX plasma levels, before PTCA, were (159 ± 22 pg/mL) similar to those of CA pts (146 ± 28 pg/mL) before the respective procedure but significantly higher compared to those of HS (91 ± 15 pg/mL, $p < 0.002$). These levels rose significantly to 210 ± 27 pg/mL ($p < 0.004$ in comparison to the respective levels before PTCA) and declined after 3 m to values similar to those before the procedure (172 ± 32 pg/mL, $p < 0.007$ in comparison to the respective levels after 24 h). Similarly, in CA pts, EOX plasma levels rose significantly to 191 ± 34 pg/mL after 24 h ($p < 0.03$ in comparison to the respective levels before CA) and declined after 3 m to values (152 ± 28 pg/mL, $p < 0.01$ in comparison to the respective levels after 24 h) similar to those before the procedure.

Conclusions: These data indicate that chemokine-induced monocyte- and eosinophil-specific chemoattraction are both stimulated in CAD pts, probably due to the disease-related endothelial damage. PTCA triggers preferably chemokine-induced monocyte-specific chemoattraction. Since monocytes, in contrast to eosinophils, can form foam cells, this may contribute to the progression of CAD, possibly not only at the site of PTCA-induced endothelial damage.

1065-116 Exochelin Prevents Neointima Formation After Coronary Artery Balloon Injury in a Porcine Model

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Background: Vascular smooth muscle cell proliferation is a critical factor in the neointima formation that causes restenosis following coronary angioplasty (PTCA). Exochelin (EXO), a highly diffusible lipophilic iron chelator secreted by *Mycobacterium tuberculosis*, inhibits proliferation of vascular smooth muscle cells in culture. We hypothesized that treatment with EXO would inhibit neointima formation in balloon-injured vessels *in vivo*.

Methods: Twenty-four pigs were subjected to overstretch coronary artery injury with PTCA balloons. With the investigators blinded, the pigs were randomized to receive via Infiltrator catheter intramural injections of either EXO (n = 14) or saline (control)(n = 10). After euthanasia 30 days later, injured coronary segments were excised and the site of maximal neointima formation identified. An injury score was assigned, neointima thickness was measured, and ratio of neointima area to internal elastic lamina (IEL) area (stenosis index) was calculated.

Results: After adjustment by analysis of covariance for injury score, EXO reduced stenosis index by 47% and corrected neointima thickness by 48%.

	Control	EXO	P value
Stenosis Index*	0.49 ± 0.06	0.26 ± 0.06	0.007
Neointima thickness*	0.29 ± 0.03	0.15 ± 0.02	0.003

Data presented as mean ± standard error, *adjusted for grade of injury, Neointima thickness corrected by IEL area and reported in units 1/mm

Conclusion: EXO substantially reduced neointima formation in this porcine overstretch injury model of restenosis. Therefore, EXO is a candidate for prevention of restenosis clinically.

1065-117 Non-Invasive Ultrasound Induced Heating of Stents: Importance of Stent Composition

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Background: Hyperthermia is known to have anti-proliferative and apoptotic effects, which have been investigated extensively in cancer studies. We demonstrated gentle heating suppresses pro-inflammatory cytokines and promotes macrophage apoptosis, and thus mitigates inflammation in atherosclerotic plaques. We hypothesized that gentle heating can be accomplished using ultrasound (US) and a constant temperature can be maintained using pulsed US. The heating rate of an object under the same US power and frequency is determined primarily by its absorption and reflection rates.

Methods: To test the hypothesis, we used a phantom of 5.08 cm thick layer of pork muscle, in which various annular stent shape materials were placed. To monitor the heating multiple hypodermic thermocouples were used. The heating was induced using FDA-approved levels of therapeutic ultrasound (intensity 0.5–2.5 W/cm^2, frequency 1–3 MHz) in both pulse and continuous modes. It was found that nylon, and some types of PVC, exhibit temperature increases that are larger (2–35° C) and faster (1.5–15 times) than the surrounding tissue, while Lexan, PTFE, Latex, Teflon, Ceramic and Delrin do not display selective heating. A modest heating effect (2° C increase in 15 minutes) was also found in a metal stent.

Conclusion: US heating of tissue adjacent to a prosthesis depends on stent composition, induction of thermal apoptosis by ultrasound may prove to be effective in limiting restenosis in polymeric stents and grafts. Issues that need to be addressed include the optimal biocompatible material and design of stents and the in-vivo effects of phased-array US on the stented artery and its surrounding tissues. We hypothesized that by using fast-heating, non-toxic materials, we could devise US-heated stents.

1065-118 Angiographic and Histologic Effect of Endovascular Irradiation on Normal Pig Coronary Arteries at 6 Months

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Background: Endovascular radiation (ER) reduces neointima formation in balloon-injured vessels. During ER adjacent normal vessel is often irradiated. Since little is known about ER of normal arteries, we studied its effects in pig coronaries.

Methods: Normal right coronary arteries of adult mini-pigs received ER (0, 7, 14, 21, 28 Gy at 2 mm) and animals were given aspirin daily. Reference (ref LD), minimum and maximum lumen diameters were measured by QCA at 6 months and histopathology performed.

Results: On QCA, control sham-irradiated vessels were seen to have a % diameter stenosis of 3.7 ± 5.8. Normal vessels exposed to ER (7, 14 or 21–28 Gy at 2 mm) showed segmental heterogeneity in lumen diameter. Increased % stenosis occurred in ER compared to controls; stenotic areas were associated with a combination of mural thrombus and fibrous neointima. Additionally, focal enlargement (>25% of refLD on QCA) did not occur in the control or 7 Gy groups but tended to occur in vessels receiving 14 or 21–28 Gy (χ^2: $p = 0.11$). These enlarged segments showed medial atrophy, little neointima and occasional small thrombi.

	Group A:0 Gy	Group B:7 Gy	Group C:14 Gy	Group D:21–28 Gy
% Stenosis	3.7 ± 5.8	39.4 ± 0.4‡	28.0 ± 9.4ψ	41.3 ± 5.3*
n Enlargement (≥25%)	0/4	0/2	2/3	2/3

‡$p = 0.001$; ψ$p = 0.008$; *$p = 0.0003$ compared to control (Group A)

Conclusions: Normal non balloon-injured pig coronary arteries treated with ER at low and high doses are associated with 1) increased diameter stenosis related to a combination of thrombosis and neointima formation and 2) a trend towards vessel enlargement for 14–28 Gy. Further study using a more potent antiplatelet agent is needed.

1065-119 Tranilast Reduces Arterial Wall Cell Proliferation After Balloon Angioplasty in Pig Coronary Arteries

Stefan Verheye[1], Mahomed Y. Salame[1], Sugao Ishiwata[1], Hector De Leon[1], Spencer B. King III[1], Keith A. Robinson[2], Nicolas A.F. Chronos[2]. *[1]Emory University School of Medicine, Atlanta, Georgia; [2]Atlanta Cardiovascular Research Institute, Atlanta, Georgia, USA*

Background: Tranilast (T), an anti-keloid and anti-allergic drug, has been shown to reduce restenosis after PTCA in human coronary arteries and inhibit neointima formation in ballooned pig coronary arteries. We therefore investigated whether this result was associated with an antiproliferative effect of T.

Methods: Eighteen pigs were randomized to receive T orally (4 g/d) or placebo. PTCA of the LAD and LCX was performed in all pigs; T was started 3 days prior to PTCA and continued until euthanasia at 3, 7, and 14 days. Bromodeoxyuridine (BrdU) was given 24 h before euthanasia in all pigs. Sections were prepared for BrdU-staining. Proliferating cells in 5 vessel regions (I: media at tear, II: media away from tear, III: adventitia at tear, IV: adventitia away from tear, V: neointima) of 3 sections per vessel were counted and expressed as a % of the total cell count in each region.

Results: T reduced proliferation at 3 days in regions I (17.3 vs 27.7, $p < 0.05$) and IV (13 vs 28.6, $p < 0.05$), at 7 days in regions I (9.8 vs 25.4, $p < 0.01$), III (8.1 vs 36.7, $p < 0.001$) and V (40 vs 60.5, $p < 0.05$). By 14 days the % of proliferating cells was relatively low in the C group and T did not reduce it further (p = ns in all regions).

Conclusions: The inhibitory effect of T on neointima formation after PTCA in pig coronary arteries is associated with an antiproliferative effect, which occurs within the first week after PTCA.

ORAL

825 Covered Coronary Stent

Monday, March 13, 2000, 9:15 a.m.–10:45 a.m.
Anaheim Convention Center, Room 210A

9:15 a.m.

825-1 A Multicenter Registry of the JoStent® PTFE Stent Graft for the Treatment of Arterial Perforations Complicating Percutaneous Coronary Interventions

Alexandra J. Lansky, Gregg W. Stone, Eberhard Grube, Brian Proctor, Victoria Curling, Abdel Brahimi, Mina Nakbeen, Adrian Danchenko, Hui Bui, Martin B. Leon. *The Washington Hospital Center, Washington, D.C., USA*

Background: The incidence of perforations complicating coronary interventions with new devices ranges from 0.15% to 2.5%, accounting for an estimated 4000 cases in the United States annually. Free flowing perforations are associated with an in-hospital MACE rate ranging from 40% to 60% and a mortality rate of up to 20%.

Methods: The JoMed® stent graft, a PTFE stent sandwich ideally suited for treatment of coronary perforations, was assessed in a multicenter international registry of 35 patients. Indications for JoStent® implantation in native coronaries (77.8%) and saphenous vein grafts (22.2%) included perforations complicating coronary intervention (N = 32), AV fistulae (N = 2), and large aneurysm (N = 1).

Results: The mean patient age was 66 years and 65.7% were male. Procedural complications prior to JoStent implantations included pericardial effusion in 22% and tamponade treated with pericardiocentesis in 13.9%. A single patient had a cardiac arrest and was successfully resuscitated. JoStent® deployment was successful with complete perforation sealing in 100% of cases. A total of 28 of the 35 cineangiograms were suitable for independent angiographic assessment. Grade I perforations (contained) (N = 4) were all sealed with a single JoStent®. Grade II perforations (myocardial blush without contrast jetting) (N = 11), were sealed with a single (N = 9) or 3 JoStents (N = 1). One additional patient in this group had acute closure proximal to the JoStent. Grade III perforations (frank perforation with contrast jetting) (N = 7) were sealed with a single (N = 4) or 3 JoStents® (N = 1). 2 cases in this group had a residual grade I perforation, but remained clinically stable. The 2 large AV fistulae and the aneurysm were completely sealed with 2 JoStents®. The final JoStent diameter stenosis was 11%. There were no procedural or in-hospital deaths, and no patient developed a Q-wave MI or required emergency CABG.

Conclusion: In hemodynamically compromising perforations complicating coronary interventions, PTFE covered stents can be used emergently with a high success rate and may be life saving where other conventional treatment modalities are associated with high morbidity and mortality rates.

9:30 a.m.

825-2 Comparison of Procedural and One-Year Outcome With Only Balloon Angioplasty, Covered Stents and Non-Covered Stents In Saphenous Vein Grafts

Aniruddha Dharmadhikari, Carlo Di Mario, Vaios Tzifos, Angelo Anzuini, Margaret Puchala-Borowik, Flavio Airoldi, Georgio Gimelli, Mauro Carlino, Antonio Colombo. *Hospital San Raffaele and Centro Cuore Columbus, Milan, Italy*

Background: Considering the high incidence of thromboembolic complications and restenosis following percutaneous interventions (PCI) on saphenous vein grafts (SVG), we assessed the utility of covered stents to improve the results in these lesion subsets.

Methods: A retrospective comparison of the procedural and one-year follow-up results was made in 186 patients who had undergone a technically successful PCI on the SVGs either by only balloon angioplasty (POBA), non-covered stents or polytetrafluoethylene (PTFE) covered stents – coronary stent graft JoStent (JoMed International AB, Helsingborg, Germany). The baseline clinical characteristics in the three groups were comparable.

Results: There was no statistically significant difference between immediate results in the three groups. However, at the end of one year follow-up period, event-free survival in the covered stent group was significantly better than that in the POBA group (p = 0.04).

Conclusions: There is a definite trend towards lowered incidence of in-hospital and follow-up adverse events with the use of covered stents in diseased SVGs. A large randomized study appears necessary to support the preliminary observations.

	POBA	Non-covered stents	Covered stents	p
n =	31	125	30	
Mean Graft Age	116 ± 64	106 ± 61	120 ± 55	ns
In-hosp MACE	4 (12.9)	11 (8.8)	1 (3.3)	ns
MI	2	11	0	
CABG	1	0	1	
Death	1	0	0	
Follow-up MACE	12 (41.4)	44 (35.5)	7 (24.1)	ns
MI	2	6	0	
Death	1	3	1	
Revascularization	9	35	6	
Event-Free Survival	15 (48.4))	70 (56)	22 (73.3))	0.04

Figures in parenthesis indicate percentages; ns = not significant

9:45 a.m.

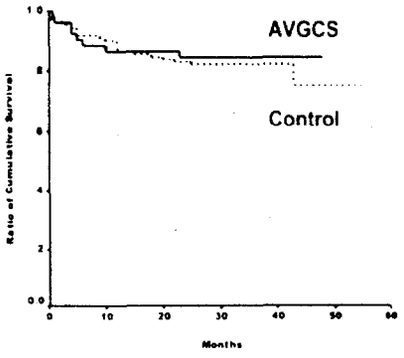
825-3 Feasibility, Immediate and Long-Term Results of the Autologous Venous Graft-Covered Stents: A Retrospective Comparative Analysis

Eleftherios Tsiamis, Christodoulos Stefanadis, Konstantinos Toutouzas, Ioannis Kallikazaros, Costas Stratos, Manolis Vavuranakis, Konstantinos Tentolouris, Costas Tsioufis, Pavlos Toutouzas. *Hippokration Hospital, University of Athens, Greece*

Previous experimental studies with the autologous venous graft-covered stent (AVGCS) have shown favorable results. The aim of this study was to evaluate the feasibility and safety of this new technique in human coronary arteries and to compare the long-term outcome with uncovered stents.

Methods: Conventional stents were covered either completely, both internally and externally, or only externally by autologous venous grafts. Fifty-eight AVGCSs were implanted in 56 patients. Additionally, in 113 patients 138 uncovered stents were implanted serving as a control group.

Results: The procedure was successful in all patients. Acute thrombosis was observed in 3 patients of the control group. One patient with an AVGCS presented with subacute thrombosis. The target vessel revascularization rate was 12% in the AVGCS group vs 14.5% in the control group (p = NS). The restenosis rate was 13.3% in covered stents vs 20.8% (p = NS). The MLD had a trend to be greater in the AVGCS group at follow-up (2.22 ± 0.9 vs 2.10 ± 0.9 mm, p = 0.07). The event-free survival rate at 4 years was 86% in the AVGCS vs 81% in the control group (figure, p = NS). Stents covered by thicker venous grafts were associated with improved clinical outcome (p < 0.02).



Conclusions: Covered stents by autologous venous grafts may be safely implanted without procedure-related complications. This technique may be successfully used for several indications.

10:00 a.m.

825-4 The JOSTENT™ Coronary Stent Graft – Just Another Stent? ... or How Should it be Implanted?

Clemens von Birgelen, Michael Haude, Christoph Altmann, Jörg Herrmann, Heinrich Wieneke, Matthias Jasper, Jens Brinkhoff, Dietrich Baumgart, Stefan Sack, Raimund Erbel. *Universitiy Hospital Essen, Department of Cardiology, Essen, Germany*

Background: Recently, the novel JOSTENT™ Coronary Stent Graft (CSG), consisting of two thin metal stents that fix a thin flexible polytetrafluoroethylene (PTFE) membrane in-between, has been introduced. However, knowledge about the deployment characteristics of this new device are very limited.

Methods and Results: Twenty-four CSG were implanted for treatment of acute coronary rupture, degenerated vein graft lesions, thrombus-containing lesions, lesions with ruptured plaque or adjacent pseudoaneurysm, and stents with recurrent in-stent restenosis. All CSG were easily crimped on high-pressure balloon catheters and introduced without difficulties through mildly curved proximal segments. No CSG was lost and all CSG were successfully implanted at 16 ± 2 atm. In 7 CSG, substantial residual diameter stenosis (DS) (p = 0.01) triggered post-dilatation (PD) with a larger balloon (table). Quantitative angiographic analysis, which included all intermediate steps of the procedure, demonstrated in the PD group that the initial balloon size matched the diameter of the reference segment only. After PD, the final B/A (balloon-to-artery) ratio of all 24 CSG was 1.21 ± 0.20 (at 16 ± 3 atm). Elective CSG implantation was associated with 2 small non-Q-wave myocardial infarctions, resulting from unavoidable side branch occlusion by the membrane.

	PD	No PD	P
B/A Ratio Post Implantation	1.00 ± 0.09	1.24 ± 0.18	<0.01
B/A Ratio Final	1.15 ± 0.15	1.24 ± 0.18	*Ns*
DS Post Implantation (%)	25 ± 10	8 ± 6	<0.005
DS Final (%)	8 ± 5	8 ± 6	*Ns*

Conclusions: The use of *oversized high-pressure* balloon catheters is *mandatory* to achieve an adequate expansion of this new CSG. Implantation of the device is feasible and safe, but the endoprosthesis should be accurately sized and placed to avoid occlusion of side branches originating from the target lesion segment.

10:15 a.m.

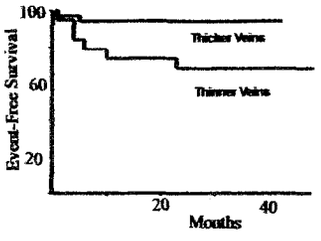
825-5 Four-Year Follow-Up After Autologous Venous Graft-Covered Stent Implantation: Impact of Vein Thickness in the Long-Term Outcome

Konstantinos Toutouzas, Christodoulos Stefanadis, Eleftherios Tsiamis, Ioannis Kallikazaros, Costas Stratos, Manolis Vavuranakis, Konstantinos Tentolouris, Pavlos Toutouzas. *Hippokration Hospital, University of Athens, Greece*

Background: The immediate and mid-term results after the implantation of the autologous venous graft-covered stent (AVGCS) were favorable. However, the long-term outcome remains unknown.

Methods: Conventional stents were covered by autologous venous grafts of different vessel wall thickness. Forty-three grafts were removed from the anterobrachial region (thicker veins) and 15 from the deltoideopectoral sulcus (thinner veins). The stents were covered by the graft. Non-premounted (Palmaz™, a Palmaz-Schatz™) and premounted stems (Multilink™) were used. Fifty-eight AVGCSs were implanted in 56 patients (pts). Follow-up was obtained in all pts until 41.7 ± 12.4 months.

Results: The procedure of AVGCS preparation and delivery to the target vessels was feasible and uncomplicated. Acute thrombosis was not observed. One patient suffered from subacute thrombosis The angiographic restenosis rate was 13.3% and the target lesion revascularization rate was 12% The event-free survival rate at years was 86%. The event-free survival rate was greater in pts with stents covered by thicker venous grafts (94% vs 68% respectively, p < 0.02, figure).



Conclusions: At near 4-year follow-up after the implantation of AVGCS late restenosis was not detected. The clinical outcome is influenced by the thickness of the venous graft used for covering the stents.

10:30 a.m.

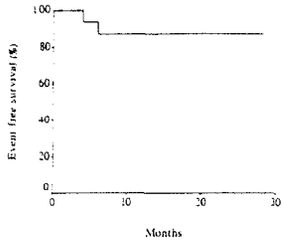
825-6 Stents Covered by Autologous Arterial Grafts in Human Coronary Arteries: Long-Term Angiographic and Clinical Follow-up

Konstantinos Toutouzas, Christodoulos Stefanadis, Eleftherios Tsiamis, Ioannis Kallikazaros, Costas Stratos, Manolis Vavuranakis, Costas Tsioufis, Konstantinos Tentolouris, Pavlos Toutouzas. *Hippokration Hospital, University of Athens, Greece*

A renewed interest for radial artery conduits for bypass surgery has been emerged during the last years. In order to combine a surgical with a percutaneous technique, stents were covered by autologous radial arterial grafts. We evaluated the late outcome of 15 patients (pts) who underwent autologous arterial graft-covered stent (AAGCS) implantation.

Methods: A graft from the radial artery was harvested. Conventional stents were covered by the arterial grafts. Fifteen covered stents were implanted in 15 pts (mean age: 56.12 ± 7.34 yrs). The AAGCSs were implanted in selected lesions, in totally occluded vessels, in ostial lesions, in thrombus-containing lesions, in bail-out cases and in saphenous vein grafts.

Results: Results. The procedure of stent covering was feasible and short in duration. Procedural success was 100% with no in-hospital stent thrombosis, Q-wave myocardial infarction or death. In 14 pts (93.3%), including pts with clinical restenosis, a repeat angiography was performed after 9.8 ± 2.4 (MLD immediately after: 2.92 ± 0.22, follow-up: 2.15 ± 0.54 mm). Target lesion revascularization was required in 2 pts. The event-free survival rate at 3.5 years was 87% (figure).



Conclusions: The clinical experience by using the AAGCS in human coronary arteries was encouraging regarding the immediate and follow-up results. Since covering of stents by an autologous arterial graft may be applied for several indications, the efficacy of this technique needs to be further evaluated.

Conclusions. Intracoronary implantation of stents covered by an autologous arterial graft may be performed safely with excellent long-term results. A multicenter study is required to assess the efficacy.

ORAL

826 New Approaches to Restenosis Prevention

Monday, March 13, 2000, 9:15 a.m.–10:30 a.m.
Anaheim Convention Center, Room 207A

9:15 a.m.

826-1 One-Year Follow-Up of Endovascular Irradiation in Pig Coronary Arteries

Mahomed Y. Salame[1], Stefan Verheye[1], Stephen P. Mulkey[1], Ian R. Crocker[1], Nicolas A.F. Chronos[2], Spencer B. King III[1], Keith A. Robinson[2]. [1]*Emory University School of Medicine, Atlanta, Georgia;* [2]*Atlanta Cardiovascular Research Institute, Atlanta, Georgia, USA*

Background: Previous studies showed vessel enlargement and mural thrombosis resulting in angiographic segmental heterogeneity, in both normal and balloon-injured pig coronaries at six months. In the present study we sought to determine whether these phenomena were resolved by one-year follow-up.

Methods: Six adult mini-pigs underwent overstretch balloon coronary injury in the LAD and LCX. LAD, LCX, and RCA then received ER (14 or 28 Gy to 2 mm from source center) or sham treatment (n = 2 pigs per group). They were given aspirin 81 mg daily for six months, then were euthanatized at one year post-angioplasty for tissue harvest after repeat angiography.

Results: Angiography of control pigs showed smooth vessel contours in both non-injured RCA and ballooned LAD and LCX; ballooned arteries showed medial ruptures associated with fibrous neointima under histologic examination. However in irradiated coronaries whether ballooned or not and especially at 28 Gy, segmental luminal heterogeneity was apparent with alternating regions of enlargement and stenosis. Histologic evaluation showed stenoses corresponded to regions of mural thrombus; little fibrous

neointima formation was observed especially in coronaries treated with 28 Gy. Ballooned irradiated vessels had smaller lumens and larger neointima (composed of poorly organized mural thrombus) than ballooned controls (see table). Even non-ballooned vessels showed mural thrombus, and these also displayed regions of medial atrophy.

Histomorphometry of Ballooned Coronaries

	Lumen	Vessel	Intima	Intima/fracture
Control	2.27 ± 1.10	4.13 ± 0.72	0.8 ± 20.60	0.48 ± 0.18
14 Gy	1.16 ± 0.73	3.73 ± 1.18	1.65 ± 0.67*	0.79 ± 0.17**
28 Gy	1.17 ± 0.49*	4.34 ± 2.16	2.08 ± 2.21	1.07 ± 1.10

*P = 0.06 vs. control, **P = 0.02 vs control

Conclusions: Coronary pathology associated with endovascular irradiation in the presence and absence of balloon overstretch injury in pigs as detected at 6 months persists at one year. Longer-term follow-up is needed to determine the resolution of these phenomena, and further studies are needed to ascertain optimum close and adjunct antiplatelet therapy for clinical implementation.

9:30 a.m.

826-2 Low Versus High Dose Radiation has Divergent Effects on SMC Migratory and Adhesive Behavior

Marvin J. Slepian, Behrooz Dehdashti, Anne Fritz, Keith A. Robinson, Luke Whitesell. *Interventional Cardiology, Sarver Heart Center, University of Arizona, Tucson, AZ, USA*

Background: Ionizing radiation has been shown to limit neointimal thickening following arterial injury. Smooth muscle cell (SMC) migration is a vital step in post-injury neointimal thickening. Little is known of the effects of radiation on SMC migratory and adhesive behavior. We examined the effect of radiation on: 1. post-injury SMC migration 2. integrin-dependent SMC adhesion and 3. quantitative _1 and _3 integrin expression.

Methods: Adult rat aortic SMC monolayers were scrape-wounded, immediately irradiated (Gamma source; 0.1, 1 and 10 Gy) and migration at 48 h was determined as mean area of SMCs emerging from wound edges. SMC monolayers (3×10^4 cell/mm^2) were irradiated (0.1 and 10 Gy), incubated for 24 h, harvested and re-suspended in RPMI + 0.2% BSA and seeded (10^4 SMC/cm^2) on Fibronectin (FN), Vitronectin (VN) or Collagen I (Col) coated dishes. Adherent SMCs/100× field were determined 1 h post-plating. _1 and _3 integrin expression and cell viability were analyzed via flow cytometry on identically irradiated and incubated (24 h) SMCs. For all studies identically treated non-irradiated SMCs were controls.

Results: (As % untreated control) Radiation altered SMC migration, with increased migration detected at low (0.1 Gy) dose and decreased migration at high (10 Gy) dose. (0.1 Gy: 125 ± 6%, $p < 0.001$; 1 Gy: 105 ± 3, $p = 0.13$; 10 Gy: 80 ± 7, $p < 0.001$). Radiation at low dose decreased SMC adhesion to FN (77 ± 18%, $p < 0.03$), VN (40 ± 18%, $p < 0.001$) and Col (75 ± 20%, $p < 0.03$) whereas at high dose it increased adhesion to FN (124 ± 16%, $p < 0.001$) and Col (150 ± 20%, $p < 0.001$). _1 and _3 integrin expression and cell viability were not altered over the studied radiation dosage range at 24 h.

Conclusion: Radiation modulates post-injury SMC migration with divergent effects at low versus high doses. Altered migration involves changes in cell adhesive behavior in a manner mechanistically consistent with the nature of migration alteration, i.e. decreased adhesion in hyper- and increased adhesion in hypomigratory states. The divergent effects of radiation on SMC migration may contribute to the varying extents of neointimal thickening clinically detected at different distances from radiation sources.

9:45 a.m.

826-3 Effect of Gamma-Irradiation on Hydrated Collagen Gel Seeded With Arterial Smooth Muscle Cells

Pierre-Frederic Keller, Thierry Ziegler, Bernadette Mermillod, Patrice Delafontaine, Georges Youri Popowski, Vitali Verin. *University Hospital, Geneva; University Hospital Lausanne, Switzerland*

Background: Vessel wall responses to PTCA include neointimal proliferation and adventitial remodeling which involves both smooth muscle cells (SMC) and fibroblasts. The contraction of a collagen gel is a good in vitro model of wound repair and vascular remodeling. Because irradiation is an important new therapeutic modality capable to prevent restenosis the purpose of this study was to evaluate the effect of irradiation on the contraction of the collagen gel by SMC.

Methods: We studied the effect of different doses (0 Gray (Gy) control, 6 Gy, 12 Gy and 18 Gy) of gamma-irradiation on the contraction of a collagen gel seeded with SMC (calf carotid arteries) over a period of 15 days.

Results: The decrease in the diameter of gels was much more important in the control than in the irradiated groups reaching 6.8 ± 0.5 mm in the control group; 13.7 ± 0.8 mm in the 6 Gy group; 15.5 ± 0.9 mm in the 12 Gy group and 16.1 ± 0.9 mm in the 18 Gy group at 15 days ($p < 0.0001$). The irradiated gels showed an important dose-dependent reduction in SMC proliferation rate ($p < 0.0001$) and increase in the number of non viable SMC ($p < 0.002$) 15 days after irradiation.

Conclusion: Gamma-irradiation with single doses ranging from 6 Gy to 18 Gy produces a significant dose-dependent inhibition of the contraction of collagen gels seeded with arterial SMC. This effect of irradiation is related to a significant decrease in SMC viability and a decrease in the proliferation rate. These findings shed light on mechanisms whereby irradiation may positively affect arterial remodeling after PTCA.

10:00 a.m.

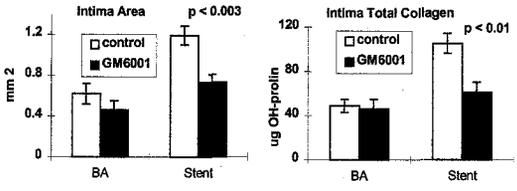
826-4 Matrix Metalloproteinase Inhibitor GM6001 Selectively Reduce Intimal Hyperplasia and Intima Collagen Content in Stented but not Balloon Treated Arteries

Christopher W. Li, Warren J. Cantor, Ranga Robinson, John N. Wylie, Alan W. Barolet, Winston Tsui, Louis Fenkell, Bradley H. Strauss. *St. Michael's Hospital, Univeristy of Toronto, Toronto, Canada*

Background: We have previously shown significant increase in collagen content and synthesis after stenting versus balloon angioplasty (BA). To investigate the role of matrix metalloproteinases (MMP) in such collagen upregulation we studied the effects of a non-specific MMP-inhibitor GM6001 on stented and balloon treated arteries.

Methods: In a double-injury rabbit model, adjacent iliac arteries received BA (3.0 mm) or stenting (NIR, 3.0 × 16 mm). GM6001 was injected s.c. (100 mg/kg/day) × 8 d. At 10 wks arteries were removed for biochemical studies (n = 25) or perfusion fixed for histomophormetry (n = 17). The intima was separated from the medial-adventitial layers. These were incubated ex-vivo in ^{14}C-hydroxyproline for 6 hours. Collagen content and synthesis were determined by assays for total hydroxyproline and ^{14}C-hydroxyproline, respectively. Perfusion fixed arteries with stents were embedded in plastic and cut with a tungsten carbide knife for cross-sectional area measurements.

Results: GM6001 caused a significant 40% reduction in both intima total collagen content and intima cross-sectional area in the stented but not the BA treated arteries (diagram) (mean ± SEM). Stent intima collagen synthesis was 258 ± 69 and 163 ± 51 (cpm/segment) in the control and GM6001 group respectively ($p = 0.38$).



Conclusion: Selective effects of GM6001 on stent intima suggest different mechanisms of intimal hyperplasia in stenting versus balloon angioplasty and MMP-inhibition as a potential therapeutic target for in-stent restenosis.

10:15 a.m.

826-5 Intravascular Sonotherapy Impacts Neointimal Hyperplasia Following Stent Implantation in Swine Femoral Arteries

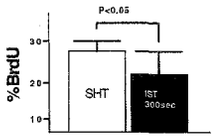
Peter J. Fitzgerald, M. Pauliina Moore, Motoya Hayase, Atsushi Takagi, Frank D. Kolodgie, Doug Corl, Menahem Nassi, Renu Virmani[1], Paul G. Yock. [1]*Armed Force Institute of Pathology, Washington, DC; Stanford University Stanford, CA, USA*

Catheter based ultrasound therapy has been recently applied to clot lysis and plaque ablation. In-vitro studies suggest that the biological effects of ultrasound can impact intimal proliferation in both human and animal cell cultures. Accordingly, we assessed the effect of intravascular sonotherapy (ST) on intimal hyperplasia in a swine stent model.

Methods: Following balloon injury, biliary stents were implanted in femoral arteries of 15 swine. Thirty-six stented sites were randomized to ST or sham therapy (SH) using an 8 Fr. catheter and ST system (URX™, PharmaSonics Inc) Ultrasound energy was delivered at 600 KHz for the duration of 300 sec. The percentage of proliferating smooth muscle cells was assessed using Bromodeoxyuridine histology preparation (%BrdU) at 7 days in 20 stented sites. At 28 days, the absolute change in neointimal thickness and the ratio of neointimal/stent area (%stenosis) was calculated by histopathologic in 16 stented sites.

Results: No vascular complication was observed during the procedures. At 7 days, %BrdU was smaller in the ST group treated for 300 sec than

SHT (24.1 ± 7.0 vs. 31.2 ± 3.0%, p < 0.05). At the 28 days, %stenosis was significantly less in the IST group (36 ± 24%) than in the SHT group (44 ± 27%, p < 0.05). In addition, mean neointimal thickness in IST trended less (417 ± 461 μm) than in the SHT group (643 ± 869 μm, p = 0.26).



Conclusions: In this swine model, intravascular sonotherapy decelerates cellular proliferation which may decrease in-stent hyperplasia. Intravascular sonotherapy may be an effective non-ionizing energy source favorably impacting in-stent restenosis.

ORAL

834 Outcomes With Coronary Stenting

Monday, March 13, 2000, 10:45 a.m.–12:15 p.m.
Anaheim Convention Center, Room 210A

10:45 a.m.

834-1 Predictors of Early Complications and "Optimal" Stent Results After Native Vessel Coronary Stenting. Is the ACC/AHA Lesion System Useful in Predicting Outcomes?

Jeffrey J. Popma, Kalon Ho, Ross Prpic, Satyendra Giri, Ravi Rao, Donald E. Cutlip, Leonid Firer, Alla Lanina, Magdy Badareldin, Richard E. Kuntz. *Brigham and Women's Hospital, Boston, MA, USA*

Background: The ACC/AHA lesion classification system was developed to identifying patients "at risk" for early procedural failure and complications after conventional balloon angioplasty.

Methods: To determine whether the ACC/AHA criteria predict outcome after elective coronary stenting, we reviewed the 30 day clinical events in 4,202 patients undergoing coronary stent placement in several randomized stent clinical trials. All patients were deemed suitable for placement of one or two Palmaz-Schatz coronary stents. 30 day major adverse cardiac events (MACE) included death, myocardial infarction, or urgent revascularization (TVR) and occurred in 3.4% of patients. Procedure success (PROC) was defined as <50% diameter stenosis and no MACE. ACC/AHA lesion complexity was determined using standard definitions. "Optimal" stent implantation was defined a <20% residual stenosis and no MACE.

Results: Lesions were classified as type A lesions in 9.2%, type B1 in 27.1%, type B2 lesions in 53.2%, and type C lesions in 10.5%.

	A	B1	B2	C	A/B1	B2/C	P value
30d MACE, %	3.0	2.7	3.4	5.0	2.8	3.6	0.145
PROC, %	98.1	98.7	97.6	97.3	98.5	97.6	0.046
"Optimal", %	91.5	90.6	87.2	73.4	90.8	84.9	0.001
30d TVR, %	3.0	2.7	3.5	5.3	2.8	3.8	0.089

Multivariable regression demonstrated that lesion length 10–20 mm (odds ratio [OR]: 1.23; p = 0.051), lesion length > 20 mm (OR: 3.04; P < 0.0001), bend > 45–90 degrees (OR: 1.35; p = 0.045), bend > 90 degrees (OR: 2.93; p = 0.067), and calcification (OR: 1.26; p = 0.046) predict a "suboptimal" stent result.

We conclude that: 1) procedural success rates are high (>97%) and 30 day complication rates are low (≤5.0%) in patients undergoing elective stent placement, 2) the ACC/AHA criterion still predicts the occurrence of procedural success, and 3) the ACC/AHA criterion is a strong predictor of an "optimal" stent placement.

11:00 a.m.

834-2 Clinical and Angiographic Restenosis After Stenting of LAD Lesions: Insights From a Large Database of Recent Stent Trials

Manish S. Chauhan, Kalon K.L. Ho, Donald S. Baim, Christine Rizzitano, Janine Schmidt, Doreen Vovcsko, Richard E. Kuntz, Donald E. Cutlip. *Beth Israel Deaconess Medical Center, Boston, MA, USA*

Background: There are limited data on clinical and angiographic restenosis rates for stenting of LAD compared to other vessels especially in the era of newer stents, high-pressure dilation and anti-platelet regimens.

Methods: Of 7,171 patients treated in 7 recent multicenter trials of coronary artery stenting with uniform criteria, 2442 (42%) underwent stenting of the LAD.

Results: Patients undergoing treatment of LAD were more likely to have single vessel disease (71 vs. 59%, p = 0.001), smaller vessels (2.8 vs. 3.1 mm, p = 0.0001) and heavy calcification (21 vs. 14%, p = 0.001) compared to non-LAD. Diabetics were equally distributed. Angiographic and follow-up results are shown below. Clinical restenosis (CR, defined as target lesion revascularization) was significantly higher for LAD. Angiographic restenosis (AR, ≥50% diameter stenosis) was not different, although late loss index (LI) was higher for LAD. In multivariable models, LAD was not an independent predictor of CR or LI after adjusting for vessel size, final lumen diameter (MLD), lesion length and diabetes.

	LAD	Non-LAD	p
Final MLD (mm)	2.68 ± 0.41	2.87 ± 0.43	0.0001
Acute Gain (mm)	1.63 ± 0.48	1.81 ± 0.52	0.0001
Late Loss (mm)	0.88 ± 0.56	0.87 ± 0.63	NS
LI	0.58 ± 0.47	0.50 ± 0.38	0.003
AR (%)	20.8	19.3	NS
CR (%)	12.1	9.6	0.001

Conclusions: CR and LI were higher for LAD, but these may be explained by smaller vessel size and final MLD rather than vessel location per se.

11:15 a.m.

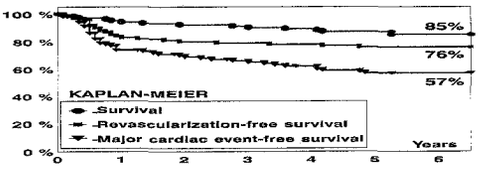
834-3 Percutaneous Coronary Revascularization for Multivessel Disease in the Stent Era. Acute and Long-Term Outcome

Francisco Fernánez-Avilés, Joaquín J. Alonso, Juan M. Durán, Federico Gimeno, Benigno Ramos, Alberto Ortiz, Raquel Palomino, Luis de la Fuente, Olga Sanz, Javier Paniagua. *Hospital Universitario, Valladolid, Spain*

Background: The objective of this study was to assess the efficacy of coronary stenting (CS) in the setting of multivessel disease.

Methods: We followed 583 consecutive pts (62 ± 10 yr., 86% male) with multivessel coronary disease who underwent CS. Indication for PTCA was unstable angina in 63% of pts and 16% were diabetics. Seven percent of pts had previous heart failure and 52% previous myocardial infarction. Mean ejection fraction was 0.59 ± 13 and the mean number of diseased vessels was 2.4 ± 0.5. Clinical follow-up was completed for 94% of pts (mean time of follow-up: 36 ± 18 m., 18–78). In 70% of pts revascularization was accomplished by means of Stent exclusively, while in the remaining 30% the procedure combined CS and balloon.

Results: Initial clinical success (angiographic success without major complication) was 87%. The incidence of angiographic restenosis for any of treated vessels was 34% (Stented vessels: 31%, ballooned vessel: 45%). The long-term evolution is shown in the figure.



The multivariate analysis (logistic regression) showed that diabetes (OR: 1.46, 95%CI: 1.13–1.88), the minimal lumen diameter after PTCA and the occurrence of AMI during the procedure (OR: 2.2 95%CI: 1.15–3.88) were independent predictors of major adverse cardiac events in the long-term follow-up.

Conclusions: Thus, initial outcome and long-term survival and revascularization free survival are acceptable in pts with multivessel disease treated with percutaneous revascularization using Stent.

11:30 a.m.

834-4 A New Score System to Predict Major Cardiovascular Events During Coronary Stenting. Does AHA/ACC Lesion Type Classification Matter?

David Paniagua, William K. Vaughn, R. David Fish. *St Luke's Episcopal Hospital/Texas Heart Institute and Baylor College of Medicine, Houston, Texas, USA*

Background: Predictors of outcomes after percutaneous coronary procedures were developed during the angioplasty (PTCA) era and these variables were extrapolated to the stent population. The best example is the ACC/AHA type of lesion classification. We sought to investigate which variables are pre-

dictive of major adverse cardiovascular events MACE-death, stroke, acute MI, urgent coronary bypass surgery (CABG)- during coronary stenting.

Methods: We studied 5441 patients who underwent stent deployment at St Luke's/Texas Heart Institute in Houston, Texas from January 1994 until December 1998. Baseline demographics, comorbid conditions, AHA/ACC angiographic lesion type, in-hospital outcome were analyzed. A multivariable analysis was performed using a logistic regression model. A score system was created based on the beta coefficiencies from the logistic model. The models were evaluated for predictive accuracy by using receiver operator characteristic (ROC) analysis.

Results: The mean patient age was 62 ± 11 years (range 26 to 92), 24% women, 22% diabetic, 71% hypertensive, 20% CABG, 51% previous myocardial infarction, 13% prior coronary interventions, mean ejection fraction 48% ± 13. MACE occurred in 3.5% of the population. The variables that predict MACE in the multivariate analysis are previous CABG (OR 0.6, 95%CI 0.4–0.9), unstable angina (OR 1.6, 95%CI 1.1–2.3) urgent procedure (OR 3.8, 95% CI 2.6–5.3), congestive failure (OR 3, 95% CI 2.1–4.4), and shock (OR 20, 95%CI 10.3–38.8). No other variable was significant predictor of MACE. The model assigned a score of −1 to previous CABG, 1 for unstable angina, 2 for urgent procedure and 2 for congestive heart failure. The maximal score is 11 and the minimum 0. The in-hospital predictive mortality and MACE have a linear correlation with the score system The ROC predictive accuracy of the model is 0.75.

Conclusion: The ACC/AHA lesion type does not predict major cardiovascular events during coronary stent. This new score system is a simple prediction rule to risk stratify patients who undergo coronary stenting and identifies a group with very high complication rates.

11:45 a.m.

834-5 Risk of Early and Long-Term Events Following Coronary Stenting Are Not Predicted by Traditional Lesion Classification

Leslie A. Webb, Eric R. Powers, Ian J. Sarembock, Lawrence W. Gimple, Lawrence R. Burwell, Michael Ragosta. *University of Virginia Health System, Charlottesville, VA, USA*

Background: The procedural success and risk of balloon angioplasty can be estimated prior to intervention by classification of the lesion using AHA/ACC criteria (Type A, B_1, B_2, and C). The ability of this classification system to predict acute events or target vessel revascularization (TVR) following coronary stenting is unknown. We hypothesized that traditional lesion characterization does not predict acute or long-term outcome after stenting.

Methods: Clinical variables were gathered in 327 consecutive patients (227 males, 100 females) undergoing successful coronary artery stent procedures on 349 lesions. Coronary angiograms were reviewed and lesions classified as Type A, B_1, B_2 or C using AHA/ACC criteria; the presence of specific undesirable features for each lesion was documented. The type, diameter, length and number of stents were noted. The incidence of subacute thrombosis (SAT) at 30 days and TVR at 6 months were determined.

Results: The 349 lesions consisted predominantly of type B lesions: A (n = 45), B_1 (n = 101), B_2 (n = 176) and C (n = 27). Stents were placed to reduce restenosis (n = 229), to treat dissection after balloon angioplasty (n = 91), for abrupt vessel closure (n = 12) or for poor angiographic result (n = 17). SAT at 30 days was observed in 6 patients (1.7%) and TVR at 6 months observed in 60 (18.2%). Lesion classification was not associated with SAT (A = 2.2%, B_1 = 1.0%, B_2 = 2.2% and C = 0%; p = ns) or TVR (A = 9.1%, B_1 = 20.4%, B_2 = 19.2% and C = 20%, p = ns). None of the clinical or angiographic variables assessed predicted SAT. TVR at 6 months was associated with stent type (Gianturco-Roubin II = 32.5%, Palmaz-Schatz = 11.2%, ACS Multilink = 11.0% and Paragon = 4.3%, p = 0.001), stent length (<20 mm = 10.7% vs >20 mm = 24.4%, p = 0.0015) and the presence of a bifurcation stenosis (16.8% no bifurcation vs 40% for bifurcation, $p < 0.02$).

Conclusion: SAT and TVR after coronary stenting are not predicted by lesion characteristics associated with high event rates after balloon angioplasty. Stent design, stent length and bifurcation stenoses are important predictors of TVR. Thus, traditional lesion classification schemes provide no guidance in identifying patients at increased risk for SAT or TVR after coronary stenting.

Noon

834-6 Unrestricted Availability of Coronary Stents Correlates With Decreased Risk of Mortality and Major Adverse Clinical Events

W. Warren Suh, Diane E. Grill, Charanjit S. Rihal, Malcolm R. Bell, David R. Holmes Jr., Kirk N. Garratt. *Mayo Clinic and Foundation, Rochester, MN, USA*

Background: Unrestricted stent availability is associated with decreased abrupt vascular closure rates and improved early adverse events, but whether it is associated with improved late clinical outcomes is unknown.

Methods: A series of consecutive patients was identified retrospectively from our coronary intervention registry. Two cohorts were analyzed: patients treated between 1988 and 1992 (n = 3049) when stents were not generally available and patients treated between 1994 and 1997 (n = 3958) when stents were available on an unrestricted basis.

Results: The late cohort patients consisted of more females, had more comorbidity (diabetes, hypertension, hypercholesterolemia, and history of prior coronary bypass surgery), and were more likely to present with acute myocardial infarction and congestive heart failure prior to procedure.

The unadjusted 1-year survival probabilities for the early and late cohorts were 0.961 and 0.964 (p = 0.1704) while major adverse clinical (death, Q wave myocardial infarction, repeat angioplasty or emergency coronary bypass surgery) event-free probabilities were 0.682 vs. 0.710 (p = 0.0015), respectively.

After performing a multivariate Cox modelling to adjust for the other potential confounding variables, the late cohort had a significantly lower risk of mortality (RR = 0.82, 95% CI = 0.69–0.98; p = 0.0311) and major adverse clinical endpoint (RR = 0.88, 95% CI = 0.81–0.95; p = 0.0017) relative to the early cohort.

Conclusions: The late time period with unrestricted stent availability was associated with decreased adjusted mortality and major adverse clinical event risks. This study suggests that benefits observed with the introduction of coronary stents into clinical practice with respect to reduced abrupt closure rates and improved early adverse clinical endpoints remain unchanged resulting in improvements in important late clinical outcomes.

ORAL

835 Long-Term Outcomes of Percutaneous Coronary Intervention

Monday, March 13, 2000, 11:00 a.m.–12:15 p.m.
Anaheim Convention Center, Room 207A

11:00 a.m.

835-1 Procedural Strategies and Outcomes of Percutaneous Coronary Intervention in 1999: Results of the Dynamic Registry

David O. Williams, Helen Vlachos, Sheryl F. Kelsey, Katherine M. Detre, Michael J. Cowley, David P. Faxon, James Slater, Spencer B. King. *Rhode Island Hospital and Brown University School of Medicine, Providence, RI, USA*

Background: The Dynamic Registry is designed to identify changes in percutaneous coronary interventions (PCI) that occur over time. Two sequential waves of PCI patients (pts) were enrolled from 15 clinical centers in 1997–98, Wave 1 (W1) n = 2526, and in 1999, Wave 2 (W2) n = 1791.

Purpose: Compare the pt characteristics, procedural strategies and in-hospital outcomes of W1 and W2.

Results: Pts in W1 and W2 did not differ in age or gender or in history of diabetes, smoking, hx of CHF, hypercholesterolemia, prior PCI or CABG. Fewer W2 pts had prior MI (W1:39.3% vs. W2:34.6%, $p < 0.01$) but more were hypertensive (59.4% vs. 64.8%, $p < 0.001$). W1 and W2 pts were similar in number of diseased vessels and significant lesions and in the indication for PCI. Less than 2.5% of PCI were non-femoral approaches. The radial artery was used for 1.9% of W2 pts. There was no difference in the site of attempted lesions or in lesion severity although in W2 more lesions had a prior stent (5.2% vs. 7.3%, $p < 0.001$), a smaller reference diameter (3.08 mm vs. 2.99 mm, $p < 0.01$), were longer (12.4 mm vs. 13.0 mm, $p < 0.01$) but were less often calcified (29.7% vs. 26.3%, $p < 0.01$) or ostial (8.6% vs. 7.1%, $p < 0.05$) or total occlusions (14.4% vs. 11.6%, $p < 0.001$). Lesions in W2 were more often treated by stents (59.0% vs. 70.2%, $p < 0.01$) and less often by rotational atherectomy (10.7% vs. 5.9%, $p < 0.001$). Use of any balloon declined from 97.0% to 89.4%, $p < 0.001$. Multiple stents were used with the Duet (32.9%), the NIR (18.8%), the GFX (9.6%) being most common. Beta- and gamma-radiation were the most common investigational devices in W2. Abrupt closure was less common in W2 than W1 (2.0% vs. 1.0%, $p < 0.01$). In W2 AMI (2.8%), emergency CABG (0.4%), and death (1.4%) were not different than W1 although angiographic success was less common in W2 (96.0% vs. 92.2%, $p < 0.001$).

Conclusions: In 1999, PCI was more commonly attempted in lesions with prior stents, longer lesions and those in smaller arteries. Use of stents increased further, abrupt closure was less common and the rate of adverse events remained low. A further increase in lesion success rate was not observed.

11:15 a.m.

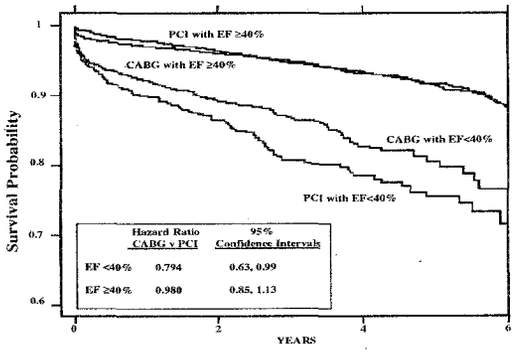
835-2 Longterm Survival Following Surgical Versus Percutaneous Coronary Revascularization in Patients With Low and Preserved Ejection Fractions

David Malenka, Gerald O'Connor, Hebe Quinton, Matthew Watkins, Lawrence Dacey, Samuel Shubrooks, David Charlesworth, John Robb, William Bradley. *John O'Meara for the Northern New England Cardiovascular Disease Study Group, Lebanon, New Hampshire, USA*

Background: Compared to medical management, coronary artery bypass surgery (CABG) provides better survival for patients with multi-vessel coronary artery disease (mCAD) and a low ejection fraction (EF). We examined how survival following percutaneous coronary interventions (PCI) compared to CABG for this patient population.

Methods: Data from 15,678 consecutive revascularizations on patients with mCAD and a measured EF (CABG = 11,804; PTCA = 3,874) performed in Northern New England (NNE) from 1990–1996 were linked to the National Death Index to determine survival. Cox proportional hazard regression adjusting for age, sex, diabetes, prior revascularization, priority, and 3-vessel disease was used to compare survival by procedure and EF (<40% v ≥40%).

Results: There were a total of 1,618 deaths during 39,679 person-years of followup. An EF < 40% was present in 13.8% of PCI and 15.4% of CABG patients. Adjusted survival by procedure and EF is shown below.



Conclusions: In NNE, patients with mCAD and an EF < 40% who undergo CABG have better longterm survival than patients who undergo PCI. Survival for patients with mCAD and an EF ≥ 40% who undergo PCI have a longterm survival similar to patients undergoing CABG.

11:30 a.m.

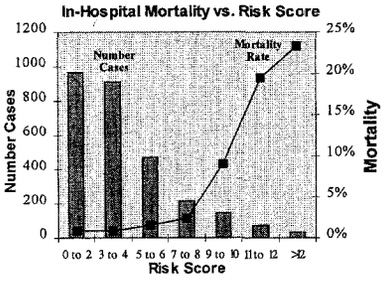
835-3 Modeling the Risk of Major In-Hospital Complications Following Percutaneous Coronary Intervention

Frederic S. Resnic, Lucila Ohno-Machado, Gavin J. Blake, Jimmy Pavliska, Andrew Selwyn, Jeffrey J. Popma. *Brigham and Women's Hospital, Boston, MA, USA*

Background: Prior estimates of the risk of major in-hospital complications following percutaneous coronary intervention (PCI) may no longer be uniformly applicable. Accordingly, we sought to model the risk of in-hospital death and the risk of death, coronary bypass surgery or myocardial infarction (DCMI) in the era of stenting and glycoprotein IIb/IIIa (GP IIb/IIIa) antagonist use.

Methods: We prospectively collected data on 37 clinical and procedural variables for 2,804 consecutive cases from 1/97 through 2/99. The dataset was randomly divided into a training set (1877 cases) and a validation set (927 cases). Multiple logistic regression (LR) models were constructed from variables selected by stepwise, forward, and backward model building algorithms. Simplified risk score models were derived from the beta coefficients of the LR model. Artificial neural network models (ANN) were also developed using all available covariates. Models were assessed by comparing the areas under the ROC curves (ROC).

Results: Independent covariates selected by LR ($p < 0.05$) included age, female gender, occluded vessel, type B2 or C lesion, presenting AMI, congestive heart failure, and left main lesion. The use of a GP IIb/IIIa antagonist and coronary stents were associated with a significantly reduced risk of death and DCMI. The risk score models performed comparably to the complete LR model on the validation set (ROC-death: 0.794 vs. 0.812 for LR; ROC-DCMI: 0.730 vs. 0.760 for LR). ANN models performed slightly better than LR (ROC-death: 0.821; ROC-DCMI: 0.791). There was no significant difference in ROC among LR, ANN and risk score models. Risk scores for the entire dataset versus in-hospital mortality is shown in the figure (p-value for trend < 0.001).



Conclusion: Risk score models can be used to model the risk of major in-hospital complications following PCI with discriminatory power approaching multiple logistic regression. Such models may provide a sound basis for controlling for severity of illness in outcomes studies. Further research is warranted to refine the covariates selected, as well as to confirm these results in a multicenter study.

11:45 a.m.

835-4 It's Quality Not Quantity That Counts! Operator Performance in Coronary Angioplasty – The Utility of One-Month Outcomes

Joseph Lindsay Jr., Ellen E. Pinnow, Augusto D. Pichard. *Washington Hospital Center, Washington, DC, USA*

Background: Institutions must monitor the performance of operators (OP) performing coronary angioplasty (CA). In-hospital complications are too infrequent to provide statistical power to identify OP deviating from the institutional norm. Reasoning that major adverse cardiac events (MACE) within 1-mo of CA reflect baseline and procedural factors, and that such events are more frequent than in-hospital complications, we tested 1-mo MACE for their statistical power to evaluate individual OP performance.

Methods: 37 OP performed 1967 CA in our laboratory 4/1/98 through 9/30/98. The 1882 (95.7%) for whom 1-mo follow-up information was obtained were analyzed. 12 baseline variables were recorded. Multivariate modeling demonstrated that renal failure, recent acute MI, cardiogenic shock, lesion complexity, and multilesion CA were independent predictors of 1-mo MACE (death, MI, CABG, repeat CA of target vessel). From this model an expected 1-mo MACE rate was calculated for each pt and the observed/expected (O/E) ratio for the set of pts treated by each OP, calculated.

Results: The overall 1-mo MACE rate was 7.0%. Of 20 OP performing <30 CA during the 6-mo study period, 5 (25%) had a MACE rate > 2.4 times than expected (O/E > 2.4) for their patient set. In 1 the observed MACE rate exceeded the upper limit of the 95% confidence interval for his patient set. All 17 OP performing ≥30 CA during the 6-mo had an O/E < 1.9. Three had a O/E > 1.5, but in none did the observed rate exceed the upper 95% confidence limit.

Conclusion: 1-mo MACE can be used to identify individual OP whose performance may be substandard and may be useful to laboratory directors as a basis for appropriate corrective action. These data also confirm that though some low-volume OP have good outcomes with CA, less good results are more frequent in that group as a whole.

Noon

835-5 Does Therapy With GP IIbIIIa Receptor Antagonists Improve Late Clinical Outcome Following Percutaneous Coronary Intervention? A Report From the NHLBI Dynamic Registry

Howard A. Cohen, Alice K. Jacobs, Wanlin Yeh, David P. Faxon, David O. Williams, David R. Holmes, Richard Shaw, Anil Mehra, Katherine M. Detre. *University of Pittsburgh, Presbyterian University Hospital, Pittsburgh, PA, USA*

Background: We tested the hypothesis that GP IIbIIIa receptor antagonists (RA) improve late clinical outcome following successful percutaneous coronary intervention (PCI).

Methods: In the 1997–98 first wave of the NHLBI Dynamic Registry, 23% of the 2252 patients from 13 centers received (RA) prior to or during PCI. Since these RA patients (pts) had significantly more risk factors for peri-procedural complications, only RA and non-RA treated pts who achieved procedural success (<50% residual, no CABG, death or MI) were compared.

Results: (table) After adjusting for all significant demographic, clinical, angiographic and procedural inequalities, MI rate remained twice, CABG/PTCA 30% and D/MI/CABG 50% higher in RA pts. 95% confidence intervals were (1.1, 3.6) (1.0, 1.7) (1.1, 2.1).

Clinical Events at One Year In Patients with Initial Success	No IIb/IIIa	IIb/IIIa
Number of patients	1607	453
Death %	2.7	3.7
MI %*	2.3	5.2
CABG %*	5.4	8.6
Repeat PCI %	14.1	17.3
Death/MI %*	4.7	8.8
Death/MI/CABG %**	9.5	14.6
CABG/Repeat PCI %*	18.1	23.7

*p < 0.05, **p < 0.01

Conclusions: We detected no benefit of RA in improving late clinical outcome after PCI.

POSTER

1085 Closure Devices, Complications

Monday, March 13, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1085-75 Is it Safe to Perform Coronary Intervention in Patients With Occult Blood in Stool and Stable Hemoglobin?

Gurkan Taviloglu, Daniel Soffer, Gishel New, Peter Baiocco, Ali Aboufares, Lynne Glasser, Jusuf Zlatanic, Neil Coplan, Jeffrey Moses, Issam Moussa. *Lenox Hill Heart and Vascular Institute, New York, NY, USA*

Background: The potential clinical sequelae of positive occult blood in stool (POBS) of pts undergoing cardiac catheterization (CC) or percutaneous coronary intervention (PCI) is unknown. We sought to determine the incidence of GI bleeding (GIB) in pts with stable hemoglobin (Hb) who had POBS prior to coronary intervention.

Methods: We reviewed the medical records of 164 consecutive pts (91 male, mean age ± SD: 66 ± 11 yrs) who were admitted for CC or PCI and underwent GI endoscopy. These pts were divided into 3 groups. *Group I*; 57 pts who had POBS on admission, *Group II*; 30 pts who initially tested negative but subsequently had POBS after initiation of iv heparin, and *Group III*; (control group) 77 pts who had negative occult blood stool (NOBS). All pts received IV heparin, aspirin and clopidogrel or ticlopidine prior to cardiac procedure. The incidence of sig GIB (>2 g fall in Hb, hematemesis or melena) and requirement of blood transfusion was determined. The results are outlined in the table below.

Results:

	Gr I (n = 57)	Gr II (n = 30)	Gr III (n = 77)
GI Bleeding	13 (23%)	18 (60%)	4 (5%)
Transfusion Requirement	7 (12%)	7 (23%)	1 (1.3%)

Using a Chi-square analysis, there was a sig difference in GIB between all groups (Gr I vs Gr II $p < 0.005$; Gr I vs Gr III $p < 0.005$; Gr II vs Gr III $p < 0.0001$). However, there was a difference in transfusion requirement only between Groups I and III ($p < 0.05$) and II and III ($p < 0.0005$).

Conclusion: Patients with occult blood in stool are at high risk for subsequent GI bleeding following CC or PCI. In particular, those who subsequently test positive for occult blood following heparin administration represent the highest risk sub-group that require prompt GI investigation, if possible, prior to CC or PCI.

1085-76 The Incidence, Management and Outcome After Coronary Artery Perforation During Percutaneous Coronary Intervention: A Single Center Experience

Luis Gruberg, Ellen Pinnow, Roy Flood, Yvonne Bonnet, Mihaela Tebeica, Ron Waksman, Kenneth M. Kent, Augusto D. Pichard, Lowell F. Satler, Martin B. Leon, Joseph Lindsay, Jr.. *Washington Hospital Center, Washington, D.C., USA*

Background: Coronary artery perforation is a rare but dreaded complication during percutaneous coronary intervention (PCI). We have analyzed the incidence, management and outcome of these patients.

Methods: Between June 1990 and August 1999, a total of 23,616 patients underwent PCI at the Washington Hospital Center. Coronary artery perforation was reported in 88 patients (0.37%). Chart review was performed in 84 available charts.

Results: Mean age was 64 ± 13 years (range 32–94), 43% were female. Lesion locations were right coronary artery in 38%, left circumflex 38% and left anterior descending in 24%. Complex B or C type lesions accounted for 92% of the perforations, including 32% with total occlusions. Severe vessel calcification and tortuosity was seen in 38% and 42% respectively. Device use was as follows: balloon angioplasty in 32%, rotational atherectomy in 25%, stenting in 21%, laser angioplasty in 19% and directional atherectomy in 9%. The majority of patients underwent emergency bypass surgery and pericardiocentesis (43%), whereas 34% were treated with perfusion balloon, 8% underwent stent deployment, 5% pericardial window, and one patient coil embolization. A total of 8 patients (10%) died in-hospital. Other major complications included cardiac tamponade in 42% and acute myocardial infarction in 39%. Patients who died were older (74 years vs. 63 years, p = 0.02), developed cardiac tamponade (86% vs. 36%, p = 0.02) and underwent emergency coronary bypass surgery (75% vs. 39%, p = 0.06).

We conclude: Although the likelihood of coronary artery perforation after PCI is low (0.4%), it is associated with high morbidity and mortality, especially elderly patients who develop cardiac tamponade.

1085-77 Myocardial Rupture After Percutaneous Coronary Interventions

Andrew Farb, Allen P. Burke, Renu Virmani. *Armed Forces Institute of Pathology, Washington, DC, USA*

Background: Myocardial rupture (MR) most often occurs 1–4 days after spontaneous thrombotic coronary occlusion and acute MI. However, a series of cases of MR as a complication of elective coronary intervention has not been reported.

Methods: From 201 cases of native coronary interventions (PTCA and/or stenting) referred to us for consultation, 5 cases were identified with MR directly related to the revascularization procedure.

Results: All 5 cases of MR occurred in women (mean age 77 ± 8 years old, range 69–89 years) presenting with unstable angina (n = 4) or non-Q wave MI (n = 1). All cases involved left coronary revascularization (LAD n = 2 with anterior wall MR; LCX n = 3 with lateral wall MR). Acute transmural MI was present in all cases, and hearts otherwise demonstrated either no other MI (n = 3) or a small healed subendocardial MI (n = 2) related to a non-target artery stenosis. Patients had either 1 (n = 2) or 2 (n = 3) vessel disease, and 4 of 5 were hypertensive. The pre-intervention angiographic stenoses were >90% without collateral vessels to the target artery.

Case	Intervention	Pathology	Time to MR
1	LCX Stent	LCX patent; LOM thrombus	4 days
2	LCX PTCA	LCX dissection with lumen compromise	47 hrs
3	LAD stent	Stent thrombus	28 hours
4	LAD stent	Stent thrombus and dissection	<24 hrs
5	LCX PTCA	LCX dissection and thrombus	<24 hrs

Patients were clinically stable at the conclusion of their revascularization procedures, and the target vessel had ≤10% stenosis in 4/5 cases and. Bradycardia preceded cardiac arrest in 4 cases, and 3 patients had chest pain.

Conclusion: Cardiac rupture may occur after initially successful target vessel revascularization complicated by sidebranch occlusion, or by target vessel dissection or thrombosis. Myocardial rupture tends to occur early after infarction post-coronary intervention. Elderly women with hypertension and 1–2 vessel disease without collaterals appear to be at increased risk for this complication.

1085-78 Predictors of Radial Artery Thrombosis After Transradial Approach: A Multivariate Analysis of a Large Series

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Background: Percutaneous transradial approach (*TRA*) is a growing new technique with advantages (immediate ambulation, low vascular complication) and limitations [small catheters, lower success rate, learning curve, radial artery thrombosis (*RAT*)]. Occurrence of *RAT* has been reported in the range of 4–8%, but, except for heparin dosage in univariate analysis in small series, no other predictors has been identified. The purpose of this study was to evaluate the predictors of *RAT* after *TRA* in a large series.

Methods: Stepwise logistic regression analysis was performed using baseline clinical data (gender, age, weight, height, body mass index) and procedural data [Heparin (No heparin, 1–75, >75–125 and >125 u/kg), sheath size (4&5, 6 and 7&8 French)] in a registry of *TRA* patients (pts).

Results: From 01–95 to 01–99, of the 7026 procedures attempted, 1564 pts had 2D echo and doppler evaluation of the ipsilateral radial artery 6–36 hours post procedure. *RAT* occurred in 79 (5%) pts, without clinical sequalae. Predictors of *RAT* were:

	Confidence level (95%)			
Variables	Odds ratio	Lower	Upper	p value
Sheath Size	1.918	1.055	3.486	0.0328
Age	0.979	0.959	0.999	0.0375
Heparin	0.663	0.464	0.945	0.0232

Conclusion: *RAT* is rare (5%) after *TRA* and not associated with clinical sequalae. The strongest predictors of *RAT* after *TRA* are sheath size, low dose of heparin and a younger patient.

1085-79 Do Sealing Devices After Vascular Interventions Make a Difference in Clinical Practice?

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Background: Randomized trials have supported that sealing devices after vascular interventions are associated with lower complication rates. Whether this advantage exists in the setting of un-selected patients and multiple operators is unclear.

Methods: 260 patients undergoing coronary and peripheral procedures were prospectively analyzed, Angio-Seal®: 86 patients (31%); Perclose® device: 111 patients (41%), manual pressure: 64 patients (23%). Clinical characteristics, complication rates and ambulation times were compared.

Results: No significant baseline demographic or clinical differences were observed. Coronary interventions [AS: 90%, PVS: 82%, MP: 69% (p = 0.003)] and prolonged ACT [AS 272 sec, PVS 256 sec, MP 159 sec (p < 0.0001)] were more frequent in the groups receiving sealing devices. The group of patients who had a venous sheath (p = 0.04), any procedural complication (p = 0.03), oozing (p = 0.0002) or in whom a Gp IIbIIIa inhibitor (p < 0.01) was used ambulated late regardless of the sealing device use. The findings are summarized in the table.

	Angioseal®	Perclose®	Manual Pressure	p value
Major bleeding	3.5%	1.8%	4.6%	NS
Any complication	23.3%	23.4%	14.1%	NS
Ambulation < 6 h	34.3%	34.0%	3.4%*	
Ambulation > 6 h	65.7%	66.0%	96.6%*	

*p < 0.0001 (ANOVA, Newman-Keuls test) between Angioseal vs. Manual pressure, and Perclose vs. manual pressure.

Conclusions: In everyday practice, sealing devices did not provide an advantage over manual pressure in decreasing complication rates after vascular interventions. There is a trend towards decrease in major bleeding with Perclose® use. Sealing device use was associated with early ambulation despite higher level of anticoagulation. However, the majority of the patients ambulated after six hours irrespective of device use.

1085-80 Vascular Complications in Patients Who Receive a Glycoprotein IIb/IIIa Inhibitor and Vascular Closure With the Perclose Device

Bonnie L. Hiatt, David P. Lee, Andrew J. Carter, Alan C. Yeung. *Stanford University, Stanford, CA, USA*

Background: Glycoprotein IIb/IIIa inhibitors are increasingly used in percutaneous coronary interventions (PCI). These agents increase the risk of bleeding, most commonly at the local puncture site. Vascular closure devices, including the Perclose arteriotomy device, have also become more frequently used in the catheterization laboratory. These devices may also increase the risk of local vascular complications. The relationship between glycoprotein IIb/IIIa inhibitors and the use of vascular closure devices on the vascular complication rate has not yet been defined.

Methods: A single center retrospective analysis was performed in patients admitted for elective PCI who received glycoprotein IIb/IIIa inhibitor (abciximab or tirofiban) between July 1996 and August 1999. The use of the Perclose device in this patient population was also recorded. A significant hemorrhagic complication was defined as hematoma requiring a transfusion or retroperitoneal bleed.

Results: A total of 2604 patients underwent PCI, of which 463 received a glycoprotein IIb/IIIa inhibitor. In these patients, 124 had femoral arteriotomy closure with the Perclose device. In this subset, 7 (5.6%) patients suffered a hemorrhagic complication (4 hematoma, 3 retroperitoneal bleed). ACT-guided manual compression was used in the remaining 339 patients, of which 3 (1.0%) suffered hemorraghic complications.

	GP IIb/IIIa	patients	complications	%	P
Perclose	–	1191	17	1.4	
No Perclose	–	950	9	0.9	
Perclose	+	124	7	5.6	0.002*
No Perclose	+	339	3	1.0	

* – vs. No Perclose with GP IIb/IIIa

Conclusions: The combination of a vascular closure device and a glycoprotein IIb/IIIa inhibitor may adversely affect the vascular complication rate in patients who undergo elective PCI.

1085-81 Removal of Intra Aortic Balloon Pump in the Cardiac Cath Lab Immediately Following Supported Intervention Using Perclose Vascular Suture Device

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Increasingly, high risk pts undergo coronary intervention use Intra Aortic balloon pump (IABP) for hemodynamic assistance, however, this generally requires transferring these pts to a higher level of care and prolonged hospitalizations. Additionally, vascular complications from IABP may be related to the duration of IABP placement. The Perclose vascular suture (PVS) device is useful in removing vascular access sheaths in anticoagulated pts undergoing intervention but its use for IABP removal has not previously been reported.

Study: we report on 13 consecutive pts who underwent PCI with IABP support. In the first 6 pts a long guidewire was inserted through the IABP catheter and the 10 Fr PVC device was used to close the arteriotomy. However, in subsequent 7 pts, after vascular access was initially obtained, the arteriotomy was dilated with an 8 Fr dilator and a 8 Fr PVS was deployed, the needles removed, but the sutures remained untied. The IABP was placed and the PCI procedure performed. At the conclusion, the IABP catheter removed and arteriotomy closed by tying Perclose sutures. The PCI vascular access sheath was also removed with a PVS device. All pts received Abciximab and had ACTs between 200–300 secs. All 13 pts had successful vascular closures without major complications. All patients were cared for post procedure in intermediate care setting and had early ambulation. Mean length of stay post procedure for this high risk group was 1.9 ± 0.4 days with 7 of 13 discharged within 24 hours.

Conclusion: Perclose vascular suture device allows for safe removal of IABP catheters used for transient hemodynamic support of high risk PCI anticoagulated pts. This approach avoids transfer of these pts to the CCU while shortening hospital stays and minimizing vascular complications.

1085-82 Femoral Vascular Access Complications Following Arteriotomy Closure Devices: A Comparison With Manual Compression After Percutaneous Coronary Interventions

Roxana Mehran, George Dangas, Mun K. Hong, Regina Deible, Hassan Faraj, Sayed El Sayyad, Manuela Negoita, Petros Okubagzi, Michael Astatkie, Augusto D. Pichard, Gregg W. Stone, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

Background: Femoral arteriotomy closure devices (CD) have become available for immediate sheath removal and early ambulation after percutaneous coronary interventions (PCI). However, the frequency of vascular access complications (VAC) after CD versus manual compression (MC) have not been compared yet in real world conditions.

Methods: We analyzed the in-hospital complications following femoral sheath removal with CD (64% collagen- and 36% suture-based; n = 523, 7–8 F sheaths) versus MC (n = 5,936; 7–9 F sheaths), excluding use of Intraaortic balloon pump or thrombolytics. Baseline characteristics and platelet IIb/IIIa inhibitor use was similar between the groups.

Results: (see table) Frequency (CD, MC) of pseudoanurysm (1%, 1%), AV fistula (0.6%, 0.9%) and GI bleeding (0.8%, 0.7%) were similar. By multivariate analysis, independent predictors of major hematoma were: BSA (odds ratio [OR] 0.97, confidence intervals [CI] 0.96–0.99, p = 0.0004) and use of CD (OR 4.3, CI 2.1–8.9, p < 0.0001)

	CD	MC	p
Body surface area (BSA)	2.0 ± 0.2	1.9 ± 0.2	0.03
Hematoma	9.3%	5.1%	<0.0001
Hematocrit drop > 15%	6.2%	3.1%	0.0006
Major Hematoma*	2.2%	0.6%	<0.0001
Transfusion need	8%	6%	0.07
Vascular Surgery	2.5%	1.3%	0.03

* Major Hematoma = Hematoma plus Hematocrit drop > 15%.

Conclusions: Despite smaller body size, MC had lower vascular access complications after PCI compared to CD. Further CD design is indicated and thorough training of operators is warranted to reduce VAC.

1085-83 Percutaneous Thrombin Injection is an Effective Treatment for Iatrogenic Femoral Pseudoaneurysms

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Background: Femoral pseudoaneurysms (FPAs) complicating coronary intervention can be problematic in patients receiving anticoagulant and intensive antiplatelet therapy. In view of the limitations of prolonged compression, we prospectively evaluated percutaneous thrombin injection as an alternative method of treating FPAs.

Methods: 18 patients (10 male), mean age 66 (38–82) years with duplex ultrasound confirmed FPAs (3 arising from the common femoral and 15 from the superficial femoral artery) were assessed. Compression repair was unsuccessful in 9 cases. Femoral cannulation occurred 1–14 (mean 5) days prior to thrombin injection – 10 had undergone 6 Fr diagnostic angiography and 8 percutaneous coronary intervention using 8 Fr catheters (abciximab used in 3 cases). Maximal FPA dimension ranged 16–60 (mean 35) mm. Treatment was performed in 3 patients on warfarin, 7 on aspirin and ticlopidine (or clopidogrel) and 1 on enoxiparin. Under continuous ultrasound imaging a fine bore needle (21–23 G) was inserted into the FPA with position confirmed by injection of saline microbubbles. Bovine thrombin solution (1000 units/ml) was then injected in 0.3–1 ml boluses (to a maximum dose of 2 ml).

Results: Thrombin injection successfully occluded FPAs in all (18/18) cases. Thrombosis was immediate (<10 secs) in 14 FPAs after one injection. Occlusion was achieved within 10 rains after a second thrombin dose in the remainder. Analgesia was required in only 3 patients. There were no cases of FPA recurrence at repeat imaging at 24 hours and in clinical follow-up. No patient experienced fever or allergy however partial thrombotic occlusion of the superficial femoral artery occurred in one patient (excessive thrombin dose administered) necessitating embolectomy.

Conclusions: Percutaneous thrombin injection appears to be a safe and effective method for treating iatrogenic FPAs. The rapid and successful resolution in all cases (without prolonged compression) despite antiplatelet or anticoagulant therapy represents a significant advantage over conventional therapies.

POSTER

1086 Coronary Stenting I

Monday, March 13, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1086-84 Inhibition of In-Stent Restenosis by the Quanam Drug Delivery Polymer Stent, in Humans Followed for up to 8 Months

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Background: The Quanam drug delivery stent (Q-DL) is a non-biodegradable proprietary polymer, seamlessly ensheathing a Quanam metal stent (Q-M), and loaded in its matrix with a slow release microtubule inhibitor. Kinetic studies have shown drug release up to 30 days into subjacent tissues. The metal stent scaffold is a specially designed slotted tube stent made of 316L steel.

Methods: 16 drug delivery (Q-DL) stents were implanted in a randomized pilot trial in 15 patients. 19 control bare metal stents (Q-M) were placed in 16 patients. Stent sizes ranged from 3.0–3.5 mm diameter and from 13–17 mm in length. Patient cohorts and lesions were clinically comparable, 46% type A (AHA/ACC), and 54% types B2 and C. All 31 patients were followed for 3–8 months clinically, angiographically and by IVUS at the study center. QCA and QCU were performed by independent core lab in 25 patients.

Results: Procedural success 100%; Study Center angiographic (binary) restenosis rates (all patients): Q-DL (drug) stent = 0%; Q-M (bare metal) = 54%. IVUS in all 16 restudied Q-DL patients showed near total absence of intimal proliferation within, or at the ends of lesions. Core lab QCA data:

Group	MLD pre	MLD post	MLD f/u	%D f/u	Months
Q-M (n = 12)	1.2 ± 0.7	2.9 ± 0.4	0.9 ± 0.9	64.8 ± 34.3	4.0 ± 1.5
Q-DL (n = 13)	1.4 ± 0.4	2.8 ± 0.5	2.2 ± 0.4	14.2 ± 22.1	4.0 ± 0.2
p	NS	NS	0.003	0.004	NS

Conclusions: These data indicate that drug delivery from a polymer stent is safe, and engenders an extremely low amount of in-stent restenosis, thus justifying the more extensive randomized trial now in progress.

1086-85 Intravascular Ultrasound Assessment of a New Biodegradable Self-Expanding Coronary Stent in Humans

Hidenori Komori, Takafumi Tsuji, Hideo Tamai, Eisho Kyo, Kunihiko Kosuga, Akiyoshi Kawashima, Shigeo Matsui, Tatsuhiko Hata, Seiichiro Motohara, Hiromu Uehata. *Shiga Medical Center for Adults, Moriyama, Japan*

Background: Although metallic stents are effective to prevent acute reocclusion and to reduce late restenosis following coronary angioplasty, the long-term safety remains to be studied. A biodegradable poly-l-lactic acid (PLLA) stent is reported to be absorber for over 12 months. We report results of intravascular ultrasound (IVUS) assessment following PLLA stent implantation in humans.

Methods: The Igaki-Tamai stent is made of PLLA monopolymer (molecular mass 183 kD) with 0.17 mm thickness, and has a zigzag helical coil design with self-expanding ability. Fifteen patients electively underwent successful PLLA stent implantation for coronary artery stenoses. There were 14 males, and 25 stents were implanted in 19 lesions (LAD 8, LCX 7, RCA 4). To evaluate expanding ability and the efficacy of the PLLA stent, IVUS studies were performed immediately after, at 1 day, at 3 months and at 6 months using 40 MHz IVUS catheter with motorized pullback system. We measured the stent cross-sectional area (CSA), the lumen CSA and the neointimal area in all stents.

Results: There was no significant difference in the stent CSA between immediately after and at 1 day (7.42 mm^2 vs 7.37 mm^2). The stent CSA tended to be larger at 3 months than immediately after stenting (8.18 mm^2 vs 7.42 mm^2, p = 0.086). There was no difference between stent CSA at 3 months and at 6 months (8.18 mm^2 vs 8.13 mm^2). Lumen-CSA at 6 months was similar to that of at 3 months (5.63 mm^2 vs 5.67 mm^2, NS) without further increase of neointima (2.51 mm^2 to 2.50 mm^2, NS). Stent struts still remained at 6 months.

Conclusions: The Igaki-Tamai stents self-expand up to 3 months with limited intimal hyperplasia thereafter. This unique feature of the stent may be promissing to reduce restenosis after coronary angioplasty.

1086-86 Antiplatelet Effect of Abciximab, Tirofiban and Eptifibatide With Coronary Stent Placement

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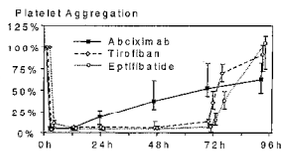
Background: The GP IIb/IIIa antagonists abciximab (A), tirofiban (T) and eptifibatide (E) differ in chemical structure, molecular target, and pharmacokinetics. We investigated, whether A, T, and E achieve a comparable antiplatelet effect with coronary stenting.

Methods: Sixty patients undergoing coronary stenting were randomly assigned to A (bolus 0.25 mg/kg, infusion 10 μg/min for 12 h), T (bolus 10 μg/kg, infusion at 0.15 μg/kg/min for 72 h), or E (bolus 180 μg/kg, infusion 2 μg/kg/min for 72 h). Platelet inhibition was assessed by the rapid platelet-function assay (RPFA, Accumetrics).



Results: As shown in the figure, A, T and E achieved >80% inhibition of platelet aggregation during infusion. Recovery of platelet aggregation was delayed after A, but rapid after T and E. Conventional platelet aggregometry confirmed the results of RPFA. Flow cytometry revealed that A, T and E caused a similar inhibition monocyte-platelet interaction and a similar increase in P-selectin suface expression.

Conclusion: A, T and E at currently recommended doses achieved an adequate inhibition of platelet aggregation. Prolonged infusions of T and E can mimic the tapering antiplatelet effect of A.

1086-87 Abciximab Reduces Early Mortality but not Late Adverse Outcomes in Unselected Diabetics Undergoing Stent Implantation

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Background: Percutaneous coronary intervention (PCI) in patients with diabetes mellitus (DM) is associated with higher rates of adverse cardiac events. Recent data suggest that target lesion revascularization rates are reduced in DM patients treated with combined stent placement and abciximab.

Methods: We performed an analysis of the Mayo Clinic PCI registry for all DM patients (n = 570) who underwent stent implantation with (n = 157) and without (n = 413) abciximab from 1995–98. Patients with acute infarction (MI) were excluded.

Results: The baseline clinical and angiographic characteristics differed between the two groups. The abciximab patients were more likely to be male, have prior MI, lower ejection fraction, prior thrombus, multivessel and graft intervention. High rates of bypass graft interventions occurred (15.7%) overall. See table for event rates between the groups.

Events (%)	Abciximab		No Abciximab		p-value	
	30-d	1-yr	30-d	1-yr	30-d	1-yr
Death	0.6	8.9	3.0	8.8	0.03	0.97
Any MI	9.0	13.3	5.6	11.4	0.18	0.57
Repeat PCI	0	14.7	1.1	15.9	0.03	0.76
CABG	0	10.3	0.3	6.2	0.32	0.20
Composite	9.6	30.4	8.6	26.7	0.72	0.43

Conclusion: DM patients with stents who received abciximab had more adverse clinical and lesion characteristics than those not receiving abciximab. Death and repeat PCI were reduced at 30-days, but there was no difference at 1-year. Multivariate analysis revealed no associated long-term benefit of abciximab in unselected DM patients receiving stents.

1086-88 Striking Reduction of Mortality and Target Vessel Revascularization With Stent-Abciximab in Diabetic Women

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Background: Diabetic women have a particularly higher risk of death and nonfatal MI after percutaneous coronary intervention (PCI). However, there have been little data regarding the outcome of diabetic women in the current era of PCI with stenting and abciximab.

Methods: We used the EPISTENT database which enrolled 2399 patients referred for elective or urgent PCI who were suitable candidates for either conventional angioplasty or stent implantation with or without abciximab. The primary endpoint for the study was a composite of death, MI or target vessel revascularization at 1 year.

Results: There were 143 diabetic women. Demographics were similar for the 3 groups. Results are summarized.

Table 1

	Stent + Placebo	Stent + abciximab	p-value*	Balloon + abciximab	p-value**
Death/MI/TVR	34.5%	13.3%	0.02	28.9%	0.04
Death	7.7%	0.0%	0.06	4.4%	0.10
TVR	21.4%	4.5%	0.02	26.7%	0.02

* p-value for stent-placebo vs. stent-abciximab; ** p-value for balloon-abciximab vs. stent-abciximab

Conclusion: These data demonstrates dramatic reduction in mortality, MI or TVR at 1 year for diabetic women treated with stent and abciximab compared to stent alone or balloon with abciximab.

1086-89 Left Internal Mammary Artery Grafting Comparing to Endoluminal Reconstruction With Less-shortening Wallstents in Patients With a Diffusely Degenerated Saphenous Vein Graft Implanted to the Left Anterior Descending Coronary Artery

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Background: The optimal treatment strategy for patients with diffusely degenerated saphenous vein graft (SVG) to the left anterior descending coronary artery (LAD) is controversial. "Endoluminal reconstruction" by stent implantation and coronary grafting with the use of the left internal mammary artery (LIMA) are two proposed treatments. However, there is no data comparing these two treatments. The aim of our study was therefore to evaluate the immediate and long-term clinical results of these two treatments' strategy.

Methods: Between May 1995 and September 1998, 72 consecutive patients (pts) in our institution with diffusely degenerated SVG to the LAD were treated by "Endoluminal reconstruction", by Wallstent implantation (n = 44), or by coronary artery grafting with the use of the LIMA (n = 28). End points were death, myocardial infarction (MI), need for additional revascularization (target vessel and non-target vessel).

Results: Follow-up (mean duration 21.6 ± 11.3 months) was obtained in all patients. There were 4 deaths and 3 MI in the percutaneous transluminal coronary angioplasty (PTCA) group comparing to 1 death and 1 MI in the coronary artery bypass surgery (CABG) group (p = 0.22 and p = 0.36 respectively). Target vessel and nontarget vessel revascularization occurred in 13 and 7 pts in the PTCA group comparing to 0 patient in the CABG group (p = 0.005 and 0.05 respectively). The combined end-point of death, MI, target and non-target vessel revascularization occurred in 19 pts (43.2%) in the PTCA group versus 2 pts (7.1%) in the CABG group, p = 0.0001. The estimated 3-year event-free survival rates (freedom from death/MI/target and non-target vessel revascularization) were (mean ± SEE) 46.5 ± 20.3% in the PTCA group comparing to 92.9 ± 10.5% in the CABG group (p = 0.002).

Conclusion: Despite the lack of randomization between the two treatments' strategy, pts undergoing endoluminal reconstruction of diffusely degenerated SVG to the LAD were more likely to underwent major cardiac events than those treated by repeat CABG surgery using LIMA grafting.

1086-90 Direct Stenting vs. Stenting With Pre-Dilation in Selected Coronary Lesions. Immediate and In-Hospital Results of a Multicenter, Prospective and Randomized Study. The DIRECT STUDY

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Background: Coronary stenting without the conventional pro-dilation is now possible with the new low profile stents (ST). This new strategy may reduce costs, procedural time and injury to the vessel wall, positively influencing acute and late results.

Purpose: To evaluate the efficacy and safety of the technique of direct coronary stenting (direct_ST) in selected eases, and its influence on costs and duration of the procedure.

Methods: Between 2/99 and 8/99, 112 lesions (107 patients) were randomized in 7 hospitals to have direct_ST (60 lesions) or conventional ST implantation (52 lesions). Lesions with significant calcification and/or angulation were excluded from randomization.

Results: Demographic, clinical and angiographic factors were similar in both groups. Stenosis (visual analysis) was ≥90% in 30 (50%) lesions in the direct_ST group and in 23 (44.2%) in the conventional group (p = 0.672). Unstable lesions were frequent in both groups (direct_ST: 55% vs. pre-dilation: 44.2%; p = 0.342). Direct_ST was successful in 58 of 60 lesions (96.7%). Two failures (with no ST embolization) occurred because of impossibility to cross the lesion with the ST (1 lesion with mild calcification). No complications occurred in this group. In the pre-dilation group, all ST were successfully implanted, although an acute MI followed by elective CABG occurred after ST thrombosis. Multilink Duet was the most commonly used ST in both groups (direct_ST: 58.3% vs. pre-dilation: 57.7%; p = 0.898). Fluoroscopy time (direct_ST: 7 ± 5.5 min vs. pre-dilation: 7.4 ± 4.7 min; p = 0.682), contrast volume (114 ± 57 ml vs. 130 ± 45 ml; p = 0.106) and peak CKMB (13.5 ± 7.8 vs. 16.8 ± 16.3; p = 0.166) were similar in both groups. In the direct_ST group, only 11 PTCA balloons were used, mainly for post-dilation, while 55 balloons were used in the conventional group (0.18 vs. 1.06 balloons/lesion; p < 0.0001).

Conclusions. Direct_ST is a feasible and safe technique when used in selected coronary lesions, without significant calcification and/or angulation. The degree of stenosis is not an important limitation, especially when treating unstable lesions, where thrombus plays an important role. Procedural

costs are lower with this strategy, because it reduces the use of PTCA balloons, although it does not seem to significantly reduce the duration of the procedure.

1086-91 Vessel Wall Passivation to Platelets and Neutrophils is not Complete One Month After Stenting

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Background: After balloon angioplasty (PTCA) and stenting, complete vessel wall passivation to platelets (PLT) and neutrophils (PMN) is critical to achieve optimal clinical outcome. We have shown that compared to PTCA, stented vessels remained significantly more attractive to PMN up to 24 hours. In this study we evaluated the *in vivo* vessel wall reactivity at one month in a porcine coronary artery model.

Methods: Each animals (n = 8) was pretreated with ASA and heparin before PTCA and stenting of each coronary artery. Animals were euthanized at 24 h and one month after the procedure. Adhesion was quantified using ^{51}Cr-PLT and ^{111}In-PMN. After *in vivo* fixation, the stented, dilated and normal uninjured segments were harvested for gamma counting.

Results:

PLT$\times 10^6$cm^2	24 h	1 month	PMN$\times 10^3$/cm^2	24 h	1 month
PTCA (n)	3.0±1.1 (10)	1.4±0.6 (12)	PTCA (n)	70±17 (14)	64±17 (12)
Stent (n)	6.1±0.8 (5)	3.9±0.9 (12)	Stent (n)	225±44 (7)	194±59 (12)
p	NS	0.02		0.001	0.04

Conclusions: Normal uninjured segments were thromboresistant to PLT and PMN adhesion. Stented vessels are more attractive to PLT and PMN. At one month, vessel wall passivation is not complete compared to PTCA and suggest ongoing thrombotic and inflammatory reactions after stenting. These findings may have important clinical and therapeutic implications.

1086-92 Protection Against Restenosis From an Interleukin-1 Receptor Antagonist Gene Polymorphism in Patients Treated With Coronary Stenting

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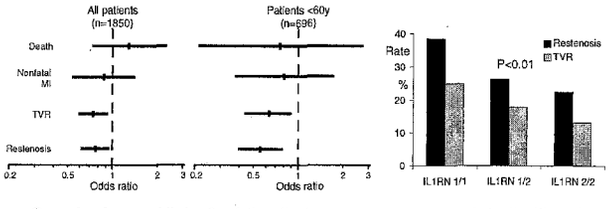
Background: Cytokines of the interleukin-1 (IL-1) family play a central role in regulating inflammatory responses. There is a strong evidence to support IL-1 regulation of smooth muscle cell mitogenesis and extracellular matrix production. IL-1 receptor antagonist (IL-1ra) counters the proinflammatory effects of IL-1. IL-1ra is the product of a polymorphic gene. The rare allele 2 in its gene (IL-1RN*2) correlates with altered IL-1ra protein levels. We assessed the association between IL-1ra polymorphism and restenosis after coronary stenting.

Methods: In 1850 consecutive pts, clinical and angiographic (6-month reangiography rate: 84%, restenosis as a ≥50% diameter stenosis) outcome measures were evaluated over 1 year after the intervention. Genotyping for an exon 2 polymorphism (+2018) of IL-1RN (alleles 1 and 2) was based on a PCR technique.

Results: Allele 2 frequency was 0.28. Allele 2 was associated with a significant decrease in the risk for restenosis and reintervention (TVR), especially in younger pts <60 yrs (odds ratios in the Figure). The younger pts showed a significant gene dose effect, with rates of restenosis and TVR decreasing progressively with heterozygosity and homozygosity for allele 2 (bar graphs on the right).



Conclusions: Allele 2 of the IL-1ra gene was associated with a lower incidence of restenosis after coronary stenting. This may offer the rationale for future studies to test recombinant IL-1ra for prevention of restenosis.

POSTER

1087 Restenosis: Basic and Clinical

Monday, March 13, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1087-115 Balloon Dilation of MMP Inhibited Porcine Arteries: The Bigger the Better

Marion J. Sierevogel, Gerard Pasterkamp, Evelyn Velema, Dominique P. de Kleijn, Cornelius Borst. *Department of Cardiology, University Medical Center, Utrecht, The Netherlands*

Background: Late Lumen Loss (LLL) after balloon dilation is the result of constrictive remodeling (REM) and intimal hyperplasia (IH). Previously, we demonstrated that inhibition of Matrix Metalloproteinases (MMPs) reduces LLL after balloon dilation by inhibition of constrictive REM. In the present study IH and REM were assessed with and without MMP inhibition and related to acute luminal gain (ALG).

Methods: In 22 pigs, balloon dilation was performed in 41 femoral and 30 internal lilac arteries. Pigs were randomly divided into 4 groups: a control group (n = 22 vessels) and three groups in which Marimastat, an oral MMP inhibitor, was administered for 2 weeks (n = 15), 4 weeks (n = 18) or 6 weeks (n = 16). Pigs were terminated 42 days after intervention. Intravascular ultrasound (IVUS) was performed at all time-points. At 0.5 cm intervals, IVUS images of the dilated segment were matched pre-, post intervention and at follow-up. For each artery, the location with the smallest lumen at follow up was selected for further calculations. REM and IH were plotted versus ALG. Data of the three Marimastat groups were pooled because no significant differences were observed.

Results:

* p = 0.01	Control	Marimastat
REM (mm^2)	2.43 ± 4.19	−0.23 ± 2.82*
IH (mm^2)	2.23 ± 1.59	2.74 ± 1.86
IH vs ALG	y = 0.20X + 1.34, r = 0.44	y = 0.23X + 1.70, r = 0.38
	CI slope: 0.01 to 0.38	CI slope: 0.07 to 0.40
REM vs ALG	y = 0.78X−1.09, r = 0.66	y = 0.05X−0.47, r = 0
	CI slope: 0.36 to 1.18	CI slope: −0.22 to 0.32

Conclusions: Marimastat blocked constrictive REM irrespective of acute luminal gain. The impact of luminal gain on IH was relatively small. Thus, the motto 'the bigger the better' applies to balloon dilation in MMP inhibited arteries.

1087-116 Intravenous AR-C69931MX, a Novel P2T Platelet Receptor Antagonist, in Patients Undergoing Percutaneous Coronary Interventions-Preliminary Results from a Placebo or Active Controlled Trial

W. Douglas Weaver, Robert A. Harrington, Cindy L. Grines, Ellen C. Keeley, Dean J. Kereiakes, John A. Bittl, Donna R. Grogan, Hakan Emanuelsson. *Henry Ford Heart and Vascular Institute, Detroit MI, USA*

Background: We performed a double-blind, placebo-controlled, dose-response trial of AR-C69931MX, an inhibitor of ADP-mediated platelet activation and aggregation, in patients undergoing percutaneous coronary intervention (PCI) to assess tolerance and safety.

Methods: Patients were randomized to an 18–24 hour infusion of AR-C69931MX (1.0 μg/kg/min, 2.0 μg/kg/min or 4.0 μg/kg/min) or placebo in addition to aspirin and heparin during PCI. Primary endpoints included major bleeding and major adverse cardiac events (MACE).

Results: Baseline demographics and procedural characteristics between groups were similar except less unstable angina (29%) and more frequent abciximab use (6%) in the 4.0 μg/kg/min group. Mean duration of infusion was 20.5 hours.

Endpoint	A (n = 53)	B (n = 53)	C (n = 52)	D (n = 51)
MACE*	14%	9%	17%	12%
Bleeding				
TIMI Minor	4%	8%	6%	12%
TIMI Major	0%	0%	0%	2%

*Death, infarction or repeat revascularization

Conclusions: The addition of AR-C69931MX to aspirin and heparin during PCI was tolerated to a dose of 4.0 μg/kg/min and not associated with any significant increase in major bleeding or MACE. An open-label follow-up

study comparing the 4 μg/kg/min dose directly with abciximab is presently enrolling patients. This class of platelet inhibitors may be important in the future treatment of acute coronary syndromes. The unblinded final results will be presented.

1087-117 Quinapril With High Affinity to Tissue Angiotensin-Converting Enzyme Inhibitor Reduces Restenosis After Percutaneous Transcatheter Coronary Revascularzation

Tomokazu Okimoto, Michinori Imazu, Yasuhiko Hayashi[1], Kotaro Sumii, Mamoru Toyofuku, Kenji Kajiwara, Yoshito Shimizu, Michio Yamakido. *Hiroshima Univ. Sch. of Med.; [1]Tsuchiya General Hospital, Hiroshima, Japan*

Background: Experimental studies demonstrated that vascular injury resulted in an induction of vascular angiotensin-converting enzyme (ACE), and suggested that inhibition of vascular ACE was important in the prevention of restenosis. These results suggest a possible pharmacological effect of quinapril, an ACE inhibitor with high affinity to tissue ACE, on restenosis after coronary angioplasty. The present study aimed to determine a benefit of quinapril on the restenosis.

Methods: Patients (pts) with ischemic heart disease were enrolled after successful percutaneous transluminal coronary angioplasty or stent implantation at 7 participating institutions. Two hundred fifty-five pts (acute myocardial infarction 35%, unstable angina 19%) with 294 lesions were randomly assigned to the quinapril (Q) group (10–20 mg/day) or control (C) group. Administration of quinapril was continued for 3–6 months of follow-up (FU). Quantitative coronary angiography was performed before and after angioplasty and at FU.

Results: Eligible FU angiography was performed in 108 pts with 124 lesions (stent 56%) in Q group and in 107 pts with 130 lesions (stent 53%) in C group. The baseline characteristics and results of angioplasty showed no significant differences between the two groups. However, minimal lumen diameter at FU and net gain were significantly larger (1.62 ± 0.72 vs. 1.44 ± 0.70 mm, $p < 0.05$ and 1.12 ± 0.77 vs. 0.87 ± 0.81 mm, $p < 0.05$) in Q group. In Q group, restenosis per patient and per lesion was significantly lower (34.3% vs. 44.9%, $p < 0.05$ and 30.6% vs. 43.8%, $p < 0.05$). Multivariable analysis revealed that administration of quinapril independently contributed to reducing the restenosis per patient and per lesion (odds ratio = 0.73, $p < 0.05$ and odds ratio = 0.75, $p < 0.05$).

Conclusions: Quinapril significantly reduces restenosis after coronary angioplasty.

1087-118 Intravascular Delivery of Neutrally Charged Antisense Phosphorodiamidate Compound-Resten-NG inhibits Myointimal Hyperplasia Following Balloon Angioplasty

Patrick Iverson, Victor Skrinska, Eamone Keane, Latha Raja Shankar, Jeffrey Moses, Paramjith Chawla, Michael H. Keelan, Nicholas Kipshidze. *Medical College of Wisconsin, Milwaukee, WI; University of Wisconsin, Milwaukee, WI; AVI Biopharma, Corvallis, OR; Lenox Hill Hospital, NY, NY, USA*

Background: Myointimal Hyperplasia following percutaneous transluminal coronary Angioplasty (PTCA) is a key component of the restenotic process. We evaluated the long term impact of local delivery of new neutrally charged antisense phosphorodiamidate compound Resten-NG upon myointimal hyperplasia following PTCA in a rabbit model.

Methods: Twenty four New Zealand white rabbits were anaesthetized, transport catheter inserted in the iliac artery and PTCA performed (8 atm for 30 seconds, three times). The endoluminal delivery of saline (n = 10) or 500 μg Resten-NG to the PTCA was 2 atm via the outer balloon for two minutes. The diet was supplemented with 0.25% cholesterol for ten days before and eight weeks following treatment.

Results: Angiography was performed at the harvest and vessels were fixed in formalin, processed and stained with Hematoxylin and Eosin, Movat's and for PCNA. The area of intima and media were determined by planimetry.

	Control	Antisense	P Value
Lumen (mm^2)	0.62 ± 0.73	1.89 ± 0.35	0.003
Intima (mm^2)	1.67 ± 0.44	0.82 ± 0.32	0.002

Conclusion: Histological analysis revealed that local delivery of Antisense prevented balloon induced changes. We conclude that local delivery of Resten-NG inhibited myointimal Hyperplasia following PTCA in a rabbit for up to eight weeks.

1087-119 Low-Power Red Laser Light Promotes Proliferation of Cardiomyocytes In Vitro

Nicholas Kipshidze, Ashwani Khanna, Jeffrey Moses. *Medical College of Wisconsin, Milwaukee, WI; Lenox Hill Hospital, New York, NY, USA*

Background: We previously reported that endoluminal low power Red Laser light (LPRLL) promotes post angioplasty wound repair in vitro and in vivo. We hypothesized that LPRLL may contribute to tissue repair following myocardial injury. Accordingly, we studied the effect of LPRLL irradiation in the fetal cardiomyocytes in vitro.

Methods: All cell cultures were irradiated with a single dose (5 mW) using a He-Ne continuos wave laser (630 nm) for 5, 10, 15 and 20 min. Assessment of effect was performed after 18 hours following irradiation. Effect of LPRLL on new DNA synthesis was studied by 3H-Thymdine incorporation assay; VEGF and TGF-β expression was studied by RT-PCR.

	5 min	10 min	15 min	20 min
TGF-β	0.25 ± 0.25	0.71 ± 0.17	0.80 ± 0.05	0.38 ± 0.11
VEGF	0.12 ± 0.08	1.10 ± 0.12	1.31 ± 0.80	0.20 ± 0.32

Results: It was found that (1) increased cardiomyocyte proliferation (10–60%) can be obtained with LPRLL and this effect is dose dependent; (2) there is a significant dose dependent increase in VEGF and TGF-β mRNA expression..

Conclusion: This preliminary data suggests that LPRL induces increased proliferation of Cardiomyocytes and increases the production of, VEGF and TGF-β in vitro. Further in vivo studies are warranted, hence this data may have significant importance leading to the establishment of the new methods for myocardial photo-regulation and photo-angiogenesis.

POSTER

1088 Novel Catheter-Based Imaging Methods to Assess Plaque Stability I

Monday, March 13, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1088-109 Design of an Infrared Fiber Catheter for Thermal Imaging of Atherosclerotic Plaques

Bujin Guo, James T. Willerson, Greg Bearman, Janice McNatt, Basit Malik, Khawar Gul, Ward Casscells. *The University of Texas, Medical School, Houston, TX, USA*

Infrared thermal imaging has proven to be very sensitive in measuring small temperature differences. We have demonstrated *in vitro* that heat accurately locates inflamed plaques are those significantly warmer than atherosclerotic plaques without inflammation. In order to develop a non-surgical method of locating these plaques, a novel infrared fiber optic imaging system has been developed. The infrared fiber optical imaging bundle consists of an array formed with 100 μm individual As_2S_3 chalcogenide glass fibers which transmit infrared radiation from 0.7 μm to 7 μm with little energy loss. The first prototype consists of a 30 × 30 (6 mm O.D.) square array and the second consists of a 10 × 10 (3 mm O.D.) square array. By combining the infrared fiber bundles with a highly sensitive Indium Antimonide (InSb) infrared focal plane array (FPA) detector, we are able to obtain *in vivo* thermal graphic images in the aortas of Watanabe hereditable hypercholesterolemic rabbits. These images have clearly shown temperature differences over a 2 mm^2 area, with ~100 μm spatial and better than 0.1 ºC thermal resolution.

We conclude that 1) thermal heterogeneity of atherosclerotic plaques is detectable *in vivo* and 2) an infrared catheter may be useful for studying the causes and natural history of heterogeneity of plaque temperature and eventually for clinical localization and locally delivered therapy.

A new design using a "ring type" fiber array to direct the IR fiber towards the circumferential of the lumen wall will be presented. Several different curvatures have been considered to optimize the photon receiving angle. By using microbolometers as IR detectors and new IR fiber, we can extend the wavelength range up to 12 μm, which increase sensitivity.

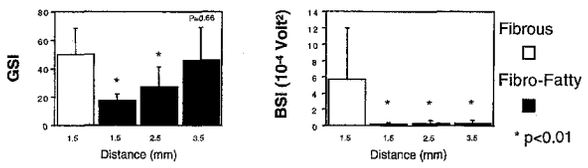
1088-110 Depth Distortion in Intravascular Ultrasound Tissue Characterization: A Major Pitfall in Gray Scale Interpretation

Atsushi Takagi, Akiko Maehara, Brian K. Courtney, Abel L. Robertson, Paul G. Yock, Peter J. Fitzgerald. *Stanford University, Stanford, CA, USA*

Plaque morphology, as assessed by intravascular ultrasound (IVUS), may impact coronary disease management. Conventional approach to tissue characterization is based on the gray-scale intensity (GSI) of a plaque. However, intensity is modified by time-gain compensation (TGC), and the effect of distance between the IVUS catheter and a region of interest (ROI) is not well characterized. Accordingly, we assessed the GSI and radio-frequency back scatter intensity (BSI) in plaque using a depth-controlled model.

Methods: Twenty-five non-calcified human coronary plaques were imaged using a 30 MHz IVUS system in a water bath. BSI was measured in a ROI, changing the depth of 1.5, 2.5 and 3.5 mm from catheter. Images were digitized, and the GSI in the-ROI was measured in each identical sequence. Fibro-fatty plaques (n = 8) were compared to fibrous plaque (n = 18) as reference at a given depth. Each plaque was classified histo-pathologically.

Results: The GSI values of fibro-fatty plaques were significantly lower at the depth of 1.5 and 2.5 mm, comparing to the GSI of fibrous plaques obtained at 1.5 mm depth. However, at 3.5 mm, the GSI trended to increase more in fibro-fatty plaques than in fibrous plaques (152 ± 109% vs. 90 ± 54%, p = 0.07). This resulted in difficulty of discrimination between the fibro-fatty plaque at 3.5 mm and fibrous plaque at 1.5 mm (p = 0.66). Using BSI analysis, fibro-fatty plaque was constantly distinguished from fibrous plaque through the different depth-settings (p < 0.01).



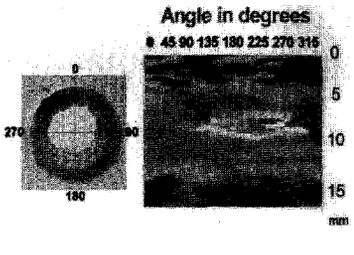
Conclusions: To accurately classify the plaque characteristic in gray IVUS images, the depth of the plaque and the effect of TGC should be factored into the evaluation. Radio-frequency analysis appears to be better suited for tissue characterization of plaque type than gray-scale interpretation.

1088-111 360º Thermal Color Mapping of the Atherosclerotic Plaque by Means of a Special Thermography Catheter and Computer Software

Leonidas Diamantopoulos, Christodoulos Stefanadis, Konstantinos Toutouzas, Charalambos Vlachopoulos, John Demellis, Pavlos Toutouzas. *Hippokration Hospital, Athens University, Athens, Greece*

Background: We have previously shown (Circulation 1999;99:1965–71) that atherosclerotic coronary arteries show temperature (T) heterogeneity, which is detectable in vivo. The aim of this study was to obtain a 360º thermal mapping of the plaque.

Methods and Results: We studied 7 patients (pts) with stable angina who underwent elective coronary angioplasty in the right coronary artery and 10 patients with normal coronary arteries. T measurements were made with a special thermography catheter that was designed in our laboratory (accuracy:0.05 ºC, time constant: 300 msec, spatial resolution 0.5 mm). The thermal mapping of the lesions was achieved by low-speed retraction of the catheter using a modified IVUS retraction system. In each plaque, 8 linear thermal scans were performed in progressively increasing angles: 0-45-90-135-180-225-270-315º (angle step 45º). Recordings were fed in real time to a PC Pentium computer, equipped with special software that was developed for the purpose of the study. Individual temperatures were coded to colors based on the Red-Green-Blue (RGB) code (Flashing Red for 43ºC and Dark Blue for 33ºC), and, thus, thermal image of the area under measurement was constructed. Stable angina patients had increased T heterogeneity (figure) whereas T was stable in normal coronary arteries.



Conclusions: The 360º color-coded thermal mapping of the atherosclerotic plaque demonstrated T heterogeneity in stable angina pts. In contrast, no heterogeneity was found in the normal coronary arteries. This method may provide important information for 3-dimensional T distribution of coronary arteries.

1088-112 Detection of Simulated Vulnerable Plaque Using a Novel Near Infrared Spectroscopy Catheter

William E. Charash, Robert A. Lodder, Pedro R. Moreno, K. Raman Purushothaman, Julie A. Swain, William N. O'Connor, James E. Muller. *Gill Heart Institute, University of Kentucky, Lexington, KY; Massachusetts General Hospital, Boston, MA, USA*

Background: A method is needed to identify vulnerable coronary plaques in humans. Although it has been demonstrated that near infrared (NIR) reflectance spectroscopy can identify vulnerable plaques in autopsy specimens, clinical utility requires identification through blood via a coronary catheter. We constructed a novel NIR catheter, and tested its ability to detect a cholesterol target in the rabbit aorta in-vivo, and also through blood in-vitro.

Methods: NIR light from a tunable laser was transmitted via a 2.5 mm fiberoptic catheter. Reflectance was detected at the catheter tip. Spectral measurements were obtained at 1730, 1745, and 1760 nm. Abdominal aortas of two anesthetized rabbits were catheterized. Data were obtained from normal aorta, from aorta injected with cholesterol, and from three blinded sites with cholesterol or sham injections. Principal component (PC) analysis was used. Additionally, the catheter tip was placed in a beaker filled with heparinized rabbit blood, and moved away from a cholesterol target in 1 mm increments. PC analysis for distance was performed using linear regression analysis.

Results: PC analysis correctly characterized all cholesterol and sham injections in the aorta of the rabbit. In the in vitro test, linear regression of PC1 versus distance yielded a fit with an r^2 of 0.99, a slope of 1.00, and a standard error of 0.2 mm, through up to 3 mm of blood.

Conclusions: A NIR catheter small enough for use in a rabbit aorta has been developed. This system can detect cholesterol in the aorta of the living rabbit, and can penetrate through 3 mm of blood. These findings support continued development of a NIR coronary catheter for human detection of vulnerable plaques.

1088-113 Assessment of Lipid Content of Atherosclerotic Plaque by Intravascular Ultrasound Using Fractal Analysis

Takafumi Hiro, Takashi Fujii, Shinji Yoshitake, Tetsuya Kawabata, Kyounori Yasumoto, Masunori Matsuzaki. *Yamaguchi University, Ube, Yamaguchi, Japan*

Fractal analysis is a new mathematical model for assessing complexity of two-dimensional video-intensity profile. This study investigated the feasibility of the fractal analysis in IVUS tissue characterization especially for assessing lipid content of atherosclerotic plaque.

Methods: Ten formalin-fixed noncalcified atherosclerotic plaques from human necropsy were imaged in vitro with a 30 MHz IVUS catheter. We first selected 19 regions of interest (ROI, 1–2 mm^2) from the IVUS plaque images to obtain a video-intensity profile of each ROI. To examine the inhomogeneity of the profile, an index (fractal index, F.I.) was obtained from the slope of the regression line between the mean differences in pixel intensity and the logarithm of distance between pixels. The plaque segment corresponded to each ROI was also examined histologically by Masson's Trichrome stain. Each segment was first classified as fibrous and fatty areas. Then, we measured %fraction of fibro-acellular (Pfb), fibro-cellular (Pfc), fibro-fatty (Pff), and nonfibrous lipid core (Plc), within the area of each segment.

Results: F.I. was significantly greater in fatty area (n = 9) than that in fibrous area (n = 10) (0.21 ± 0.05 vs. 0.14 ± 0.03, p < 0.005). A multiple stepwise regression analysis derived a significant correlation as: F.I. = 0.11Plc + 0.08Pff + 0.13 (R = 0.83, adjusted R^2 = 0.66, p < 0.0005). Pfb and Pfc was statistically excluded in this multivariate analysis.

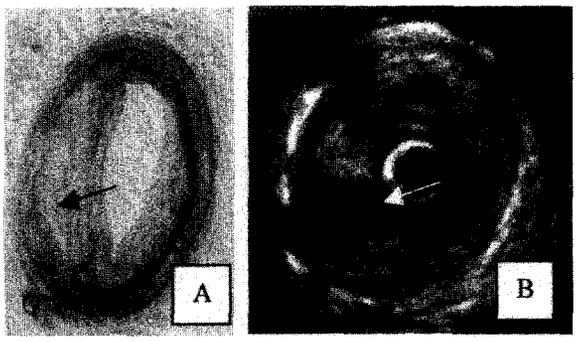
Conclusions: The IVUS video-intensity profile was more inhomogeneous in fatty area than that in fibrous area. The multivariate analysis suggested that F.I. might reflect lipid content of atherosclerotic plaque. Therefore, tissue characterization by fractal analysis using IVUS images may be useful in assessing plaque instability in patients with coronary artery disease.

1088-114 High Frequency Intravascular Ultrasound Identifies Atherosclerotic Lipid Lakes With High Accuracy

Francesco Prati, Eloisa Arbustini[1], Antonella Labellarte, Barbara Dal Bello[1], Federica Marsico[2], Maria Teresa Mallus, Antonio Pagano, Luigi Sommariva, Alessandro Boccanelli. *Cath Lab S Giovanni Hospital, Rome; [1]Istituto Anatomia Patologica, Pavia; [2]S. Raffaele Hospital, Milano, Italy*

Previous intravascular ultrasound (IVUS) studies on atherosclerotic plaque characterization were limited by use of low-frequency transducers that did not define accurately soft components. The present study tested the effectiveness of high frequency IVUS transducers in identification of lipid/necrotic pools in atherosclerotic plaques.

Methods: Forty MHz transducers were used for in-vitro IVUS assessment of 12 arterial segments (10 coronary arteries and 2 carotids dissected from 5 different autopsy cases). IVUS acquisition was performed at a 0.5 mm/s speed after ligature of the branching points to generate a closed system. Lipid necrotic areas were defined by IVUS as large echolucent intra-plaque areas surrounded by tissue with higher echodensity. To obtain histopathologic sections corresponding to IVUS cross-sections, vessels were divided into consecutive 3 mm-long segments using the most distal recorded IVUS image as starting reference. Then, samples were fixed with 10% buffered formalin, processed for histopathologic study, serially cut and stained with Movat penthacrome method.



Results: On histopathologic study, intra-plaque lipid lakes were present in 30 of 122 cross-sections (25%) (arrow in figure A). Corresponding IVUS cross-sections identified lipid lakes with a sensitivity and specificity of 67% and 94% respectively (arrow in figure B).

Conclusions: High frequency ultrasound transducers enable an accurate identification of lipid/necrotic pools leading to a more precise characterization of atherosclerotic plaques.

ORAL

843 Acute Coronary Syndromes

Monday, March 13, 2000, 2:00 p.m.–3:30 p.m.
Anaheim Convention Center, Lecture Hall A2

2:00 p.m.

843-1 Percutaneous Coronary Intervention for Non-ST Elevation Myocardial Infarction: A Report From the NHLBI Dynamic Registry

David O. Williams, Wanlin Yeh, Katherine M. Detre, Sheryl F. Kelsey, Howard Cohen, Michael J. Cowley, Mahdi Al-Bassam, Alice K. Jacobs, Martial Bourassa. *Dynamic Registry Investigators; Rhode Island Hospital, Brown University School of Medicine, Providence, Rhode Island, USA*

Background: The value of an aggressive strategy including catheterization and percutaneous coronary intervention (PCI) for patients (pts) with non-ST elevation (i.e. non-Q-wave) acute myocardial infarction (AMI) has been questioned.

Purpose: To determine the baseline features, procedural strategies and in-hospital outcomes of AMI pts in the 1999 enrollment wave of the Dynamic Registry with and without ST-elevation on initial ECG.

Results: Of 458 AMI pts, 275 (60.0%) had ST-elevation (ST↑) and 183 (40.0%) did not (non-ST↑). Non-ST↑ pts did not differ from ST↑ pts in age, gender, hx diabetes or risk for PCI. Compared to ST↑ pts, non-ST↑ pts more often had prior CABG (ST↑: 2.5% vs. non-ST↑:16.4%, $p < 0.001$), prior MI (17.0% vs. 29.4%, $p < 0.01$), hx. of CHF (5.9% vs. 14.9%, $p < 0.001$), multivessel CAD (51.3% vs. 55.8%, $p < 0.001$) and on average more significant lesions (2.3 vs. 3.0, $p < 0.01$). Attempted lesions in non-ST↑ pts were more often in a vein graft (0.9% vs. 6.6%, $p < 0.001$) or in the LCX (14.4% vs. 32.6%, $p < 0.001$) and less likely to be a total occlusion (35.2% vs. 14.9%, $p < 0.001$). There was no difference between the groups in the use of stents although ST↑ pts more often received IIbIIIa antagonists (54.9% vs. 44.8%, $p < 0.05$). Non-ST↑ pts were more likely to achieve TIMI 3 flow (90.2% vs. 95.3%, $p < 0.05$) although final stenosis, angiographic success, subsequent MI and CABG rates were similar. In-hospital death was 4.0% for ST↑ pts and 2.7% for non-ST↑ pts ($P > 0.05$).

Conclusions: Despite having more multi-vessel and multi-lesion CAD, hx CHF, vein graft lesions attempted and less IIbIIIa ancillary therapy, non-ST↑ pts achieved better angiographic results and similar clinical outcomes as ST↑ pts with PCI. These findings provide further support for the aggressive strategy in the management of pts with non-ST↑ MI.

2:15 p.m.

843-2 Primary Stenting Versus Balloon PTCA for the Treatment of Acute Vein Graft Occlusion in Myocardial Infarction: In-Hospital Results From the Brazilian Coronary Interventional Registry (CENIC)

Luiz Mattos, Amanda Sousa, Cantideo C. Neto, Fausto Feres, Milton Soares, André Labrunie, Cláudia Alves, Jamil Saad. *Brazilian Society of Interventional Cardiology, São Paulo, Brazil*

Background: There is few data regarding contemporary results of primary percutaneous coronary treatment of vein graft occlusion occurring in the first hours of AMI.

Methods: Brazilian Percutaneous Coronary Interventional Registry (CENIC) has gathered 39.721 consecutive pts from 1996 to 1998; 4.777 patients underwent primary coronary procedures in the first 24 hours of AMI. From these MI cohort, we compared the in-hospital outcome of 158 consecutive patients with acute vein graft occlusion submitted to routine stenting or primary balloon PTCA. The primary coronary device selection was left to operator discretion.

Results: (table)

Variables (%)	Stent (74)	PTCA (84)	P
Mean age	63 ± 12 years	63 ± 11 years	1.0
Mean time CABG to AMI	7.1 ± 3 years	6.5 ± 4 years	0.6
Anterior MI/LAD Graft	44	41	0.7
Triple vessel disease	79	68	0.09
Baseline EF < 45%	48	68	*0.05*
Lesion length > 10 mm	57	64	0.2
Abciximab usage	6	4	0.5
Success (TIMI 3)	96	72	*0.0001*
Mean stenosis post	11	41	*0.0001*
Reinfarction	6.8	5.3	0.5
Death	6.8	7.1	0.6

Conclusions: Primary percutaneous treatment of AMI related to acute vein graft occlusion is still uncommon in these recent analysis of a large national consecutive cohort of patients. In this scenario of adverse angiographic variables, primary stenting improved luminal diameter plus success rate compared to balloon PTCA, but without reducing in-hospital reinfarction or death.

2:30 p.m.

843-3 Hirudin Significantly Reduces Ischemic Events Following Coronary Intervention for Acute Coronary Syndromes

Matthew T. Roe, Christopher B. Granger, E. Magnus Ohman, Robert M. Califf, Anne Hellkamp, Eric J. Topol, Harvey D. White, Judith Hochman, Frans Van de Werf. *Duke Clinical Research Institute, Durham, NC; Cleveland Clinic Foundation, Cleveland, OH, USA*

Background: Potential advantages of direct thrombin inhibitors for use during percutaneous coronary intervention (PCI) include an enhanced anticoagulant response and improved safety profile compared with heparin. However, the relative benefits of the direct thrombin inhibitor hirudin for patients with evolving acute coronary syndromes (ACS) undergoing PCI have not been well characterized.

Methods: Patients with ACS enrolled in the GUSTO-IIb trial were randomized to hirudin or heparin. All patients who underwent PCI during blinded study drug administration were evaluated. Incremental doses of either drug were given during PCI to achieve a target activated clotting time (ACT) of 300–350 seconds and study drug was to be continued after PCI for a total of 72 hours.

Results: Patients treated with hirudin (n = 671) and heparin (n = 733) had similar baseline characteristics. Approximately 30% of patients in both groups underwent primary angioplasty for acute ST-segment elevation myocardial infarction (MI). The median time to PCI was 9 hours in the hirudin-treated

group and 14 hours in the heparin treated group (p = NS). The median duration of study drug administration was 74 and 75 hours, respectively.

30 Day Outcomes	Hirudin	Heparin	p-value
Death (%)	0.1	0.1	0.95
MI (%)	1.9	3.7	0.05
Death/MI (%)	2.1	3.8	0.05
Bleeding (%)	3.4	2.6	0.75

Conclusions: Hirudin appears to more effectively reduce ischemic events following PCI in patients with ACS compared with heparin and is not associated with a significant increase in bleeding events.

3:00 p.m.

843-5 Elevated CK-MB Following Coronary Intervention in Patients With Acute Coronary Syndromes is Associated With a Four-Fold Increase in Mortality: Results from the GUSTO-IIb and PURSUIT Trials

Matthew T. Roe, John H. Alexander, Cindy M. Pacchiana, Robert A. Harrington, Christopher B. Granger, Robert M. Califf, Eric J. Topol. *Duke Clinical Research Institute, Durham, NC; Cleveland Clinic Foundation, Cleveland, OH, USA*

Background: Multiple studies have demonstrated that elevation of the creatine kinase MB subfraction (CK-MB) following percutaneous coronary intervention (PCI) is associated with increased mortality. However, the prognostic significance of CK-MB elevation following PCI in patients with acute coronary syndromes (ACS) has not been specifically characterized.

Methods: Patients with ACS without persistent ST-segment elevation from the GUSTO-IIb and PURSUIT trials who underwent in-hospital PCI were evaluated. 6 month death and re-MI (>24 hrs. post-PCI) were evaluated based on the presence or absence of CK-MB elevation (≥3X upper limit of normal [ULN] within 24 hrs. after PCI). Patients who had elevated CK or CK-MB levels above the ULN within 24 hrs. prior to PCI were excluded.

Results: CK-MB levels following PCI were recorded in 1819 of 4239 patients (43%). The frequency of mortality at 6 months was similar in patients who did and did not have CK-MB levels recorded after PCI (3.0% vs. 3.2%, p = 0.75). After excluding 544 patients with elevated CK/CK-MB prior to PCI, outcomes are shown for patients with CK-MB levels measured after PCI.

	CK-MB ≥ 3X ULN	No CK-MB↑	p-value
N	220	1055	
Death (%)	8.6	2.4	0.001
Re-MI (%)	4.1	2.0	0.06
Death/Re-MI (%)	11.4	4.2	0.001

Conclusions: CK-MB elevation following PCI is associated with an increased frequency of death and death/re-MI through 6 months in patients with ACS. Further analyses may help determine the longer term significance and independent prognostic value of these findings.

3:15 p.m.

843-6 Abciximab Improves Microvascular Function After Rescue PCI: A TIMI 14 Substudy

James A. de Lemos, C. Michael Gibson, Elliott M. Antman, Sabina A. Murphy, Robert P. Giugliano, David A. Morrow, Kristin C. Schuhwerk, Carolyn H. McCabe, Eugene Braunwald. *Brigham and Women's Hospital, Boston, MA, USA*

Background: Patients with incomplete ST resolution (STRES) after primary PCI are at high risk for left ventricular dysfunction and death, likely due to extensive tissue and microvascular injury. We tested the hypothesis that adjunctive treatment with abciximab would improve microvascular function after PCI, as evidenced by greater STRES.

Methods: In this retrospective analysis of the TIMI 14 study, we evaluated all 92 patients who had interpretable baseline, 90, and 180 minute ECGs and who underwent PCI between 90 and 180 minutes after thrombolysis. We compared mean STRES from 90 to 180 min (pre- and post-PCI) between patients who received abciximab (n = 29) and those who did not (n = 63).

Results: Mean STRES following PCI was significantly greater in patients who received abciximab than in those who received tPA alone (50 ± 48% vs 23 ± 77%; p = 0.02). In a multivariate model incorporating infarct location, time from symptom onset to PCI, 90 minute TIMI frame count, 90 minute ST resolution, and residual stenosis post PCI, abciximab remained an independent predictor of greater STRES following PCI (p = 0.01).

Conclusions: In patients who receive early adjunctive (rescue) PCI after thrombolytic therapy, abciximab appears to enhance microvascular and tissue level reperfusion, as evidenced by improved ST resolution. These findings extend our previous observations of the specific benefit of abciximab on the microcirculation, and suggest a mechanism by which abciximab may improve outcomes in patients receiving adjunctive PCI after thrombolysis.

ORAL

844 New Devices for Coronary Intervention

Monday, March 13, 2000, 2:00 p.m.–3:30 p.m.
Anaheim Convention Center, Room 207A

2:00 p.m.

844-1 A Novel Guidance System for Facilitating the Crossing of Plaque and Chronic Total Occlusions

Jacques Koolen, Hans Bonnier, Eberhard Grube[1]. *Catharina Hospital, Eindhoven, The Netherlands; [1]Heart Center Siegborg, Siegborg, Germany*

Background: Crossing chronic total occlusions (CTOs) and complex lesions is a complicated, time and material consuming process. A new, novel guidewire system that utilizes Optical Coherent Reflectometry (OCR) to guide the guidewire through the occlusion was used in a clinical protocol at two sites.

Description of Device: This new technology is based on the variable absorption and scattering of near-infrared light by substances such as plaque, blood, tissue and thrombus. Algorithms have been devised based on variable absorption rates and different scattering coefficients as a light beam of known intensity is introduced through the guidewire and illuminates adjacent to the tip.

Procedure: The direction of the tip of the guidewire system is shown on a small monitor that is used to maintain the navigation of the guidewire system through the chronic occlusion minimizing the possibility of perforating the arterial wall. The direction of the guidewire may be changed utilizing a 3.5F bi-directional catheter that also yields additional pushability for the guidewire.

Results: To date, we have performed ten clinical cases (mean age 71 ± 10) under a protocol designed to prove safety and clinical efficacy of the IntraLuminal Safe-Steer™ Guidewire System. One LCX (75%), one LAD (80%) and eight CTOs (five LAD, two RCA, one LCX). All ten stenoses were successfully crossed, without complications, using the guidewire system. PTCA was performed on all ten patients with eight being stented.

Conclusions: Our preliminary clinical experience using the Safe-Steer™ Guidewire System has shown that this technology is both clinically safe and efficacious in guiding the guidewire through both plaque and CTOs. This procedure also shows a reduction in the time required to cross these stenoses as well as an "early warning system" for detecting the arterial wall therefore minimizing the risk of perforation.

2:15 p.m.

844-2 First United States Experience With a Novel Atherectomy and Thrombectomy Device in Thrombotic Lesions in Native Coronary Arteries and Saphenous Vein Grafts

Gregg W. Stone, David Cox, Reginald I. Low, Ray Matthews, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

Background: Percutaneous intervention in patients with acute ischemic syndromes and saphenous vein grafts results in peri-procedural myocardial infarction in up to 30% of patients, most frequently due to macroscopic or microscopic distal thromboemboli. A new thrombectomy/atherectomy catheter, the EndiCOR X-SIZER™, may improve the early safety profile of intervention in these patients by removing friable thrombus and grummous material prior to definitive PTCA/stenting.

Methods: The X-Sizer system consists of a unibody 6F dual lumen catheter (9F guide compatible) with a battery driven hollow torque cable attached to a distal helical cutter. Catheter rotation over any 0.014 inch guide wire under saline flush results in extraction atherectomy into a proximal vacuum chamber. A phase I IDE study (X-TRACT) is currently being performed in 50 pts at 10 sites to test the safety and efficacy of this device in saphenous vein grafts and thrombotic lesions in native coronary vessels.

Results: To date, the X-SIZER has been used in 14 pts at 4 sites, including 6 native coronary arteries with thrombus and 8 vein grafts. GP IIb/IIIa agents were used in only 1 pt (7.1%). The cutter successfully crossed the lesion in 12 pts (86%). Device related complications consisted of 1 perforation (due to a manufacturing defect, since corrected), which was treated conservatively without sequelae. Following atherectomy, stents were implanted in all pts. No episodes of no/slow reflow or distal thromboemboli were noted. There were no in-hospital deaths, MI, or need for CABG or repeat TVR. Specifically, there were no elevations in serial CPK and CPK-MB levels (assessed q8 hrs

× 3 post procedure). During 30 day follow-up, 1 pt has had subacute stent thrombosis.

Conclusions: These preliminary data suggest that use of the X-SIZER in thrombotic lesions in native coronary arteries and saphenous vein grafts is feasible, and has been associated with a low rate of peri-procedural MI and angiographic complications in an otherwise high risk population. Adjudicated data from all 50 pts, including angiographic core laboratory analysis, will be presented.

2:30 p.m.

844-3 A Novel Device for Removal of Thrombus From Coronary Arteries: The X-SIZER Multicenter Trial

Thomas A. Ischinger. *On behalf of the X-SIZER Study Group; Klinikum Bogenhausen, Division of Cardiology, Munich, Germany*

Thrombo-occlusive coronary disease continues to be a challenge for interventional techniques. The X-SIZER catheter is a novel single use device designed to remove thrombus from coronary arteries and SVGs using standard catheter techniques, compatible with 8 Fr guides and 0.014 inch wires. The clinical trial to date includes 106 pts (age 31–82 years, male 89 (84%) at 14 centers. Target vessels were: LAD 31, RCA 40, LCX 12, SVG 23, with ref.diameter range 2.0–5.5 mm. Clinical indication was unstable angina in 54 and acute MI in 30 pts. Angiographic indication included angio-identified or suspected thrombus in 53 pts (15 of them instent occlusions), and instent restenosis in 39 pts. The X-SIZER reached target lesion (successful deployment) in 76% of attempted pts and achieved success (X-SIZER success = stenosis reduction and/or ≥1 TIMI flow grade improvement without MACE) in 62% of all attempted cases (and in 81% of successful X-SIZER deployments), with X-SIZER stand alone success in 2 pts, and total procedural success (<30% final stenosis with use of routine adjunct devices, no MACE) in 92% of all attempted cases. Mean pre X-SIZER stenosis was 87 ± 15%, post X-SIZER 61 ± 29%, and final 12 ± 17%, MeanTIMI flow grade pre X-SIZER was 1.5, post X-SIZER 2.3, final 2.8. CK rise (in 3 cases attributable to ongoing MI) occurred in 5 pts (1 thrombus dislodgement & partial sidebranch occlusion, 1 distal embolization, 1 vessel damage) with 2 MACE in total. Failures of X-SIZER were mostly due to inability to reach or pass lesions or (only early cases) technical deficits. Mean procedural duration was 15.2 min, blood loss to vacuum bottle was small (mean 50.9 ml). No other vascular, clinical or access site complication have occurred acutely or during FU (2 to 16 mos) to date. In 26 pts retrieved tissue particles were histologically examined and identified as fresh and partially organized thrombus and hyalin fragments. In conclusion, the X-SIZER is a novel, simple to use device which has demonstrated safety and efficacy for removal of thrombus from native coronary arteries, SVGs and stents in selected pts. Further investigation, including proliferative restenosis, is necessary.

2:45 p.m.

844-4 Recanalization of Total Coronary Occlusions Using a the Sonicross Low Frequency Ultrasound Catheter

Louis Cannon, Robert Siegel, Joel Greenberg, Ravi Rao, Ross Prpic, Shirley Chan, Jeffrey J. Popma. *Brigham and Women's Hospital, Boston, MA, USA*

Background: Coronary occlusion refractory to conventional coronary guidewire crossing remains a clinical challenge, often resulting in chronic ischemia despite medical therapy or coronary bypass surgery. A novel, over-the-wire, 3.0 Fr (tip diameter, 1.2 mm) low-frequency (20 kHz) ultrasound catheter powered at 20 Watts has been developed to sonicate the occluded segment allowing facilitated guidewire passage.

Methods: To evaluate the utility of this device in "refractory" total coronary occlusions, we used the Sonicross catheter in 14 pts with total occlusion (TIMI 0,1 flow) in whom there was failure to cross into the distal vessel with conventional wires after ≥15 minutes of flouroscopy. Baseline quantitative angiography was available in 12 patients.

Results: Either the guidewire or Sonicross catheter crossed the stenosis in 10 (71.4%) patients; procedural success (<50% final diameter stenosis and no death, infarction, or urgent revascularization) was obtained in 6 (42.8%) pts; stents were used in all successfully treated patients, resulting in a 2.6% final diameter stenosis. No patient died or required emergency coronary bypass surgery. In those undergoing quantitative angiography (N = 12), the Sonicross guidewire use was performed in the right coronary artery in 6 pts (50%), circumflex in 3 pts (25%), left anterior descending in 2 pts (17%), and left main in 1 pt. The average lesion length was 10.26 mm. There were bridging collaterals in 42% and average collateral grade of 1.6. Mean angiographic reference diameter was 2.80 mm. Localized coronary perforation occurred in two pts and dissection developed in 4 pts.

Conclusion: The Sonicross catheter is a safe and effective therapy for the treatment of "refractory" total occlusions, resulting in recanalization > 40% of vessels attempted. Longer term restenosis surveillance is ongoing.

3:00 p.m.

844-5 Helixcision Atherectomy for In-Stent Stenosis: Initial *In Vivo* Experience

Charles J. Davidson, Gary Gershony, Sidney Lo, Andrew J. Carter, Alan C. Yeung, Paul G. Yock, James Passafaro. *Northwestern University Medical School, Chicago, IL; John Muir Medical Center, Walnut Creek, CA; Stanford University Medical Center, Palo Alto, CA; Prolifix Medical, Inc., Sunnyvale, CA, USA*

Current therapy for in-stent stenosis is suboptimal. The purpose of this study was to determine the efficacy of a new Helixcision atherectomy device for treatment of in-stent stenosis in a porcine *in vivo* model. In-stent stenosis was created by overstretch injury with a balloon followed by deployment of a balloon expandable stent (3.2 mm to 4.0 mm). After 4–6 weeks, animals were evaluated for restenosis with angiography and intravascular ultrasound (IVUS). 8 lesions were treated in 8 pigs.

Helixcision utilizes a 4.0F Helixcisor Catheter (Prolifix Medical Inc., Sunnyvale, CA) placed over a 0.014 inch lumen conforming helical guidewire. The Helixcisor catheter is rotated at 17,500 rpm with internal aspiration of tissue contents. Lumen size is increased by passive mechanical expansion of the guidewire coil diameter. Device sizing is accomplished by varying the guidewire coil diameter, pitch and length. IVUS minimal lumen area, maximal plaque area, vessel area, % area stenosis (plaque area ÷ vessel area) were measured pre and post Helixcision at 5 segments and averaged. All post-Helixcision IVUS results were accomplished without balloon dilatation.

Results:

IVUS Data	Pre-Helixcision	Post-Helixcision	p
Minimum Lumen Area (mm^2)	4.0 ± 1.1	6.8 ± 1.1	<0.001
Max Plaque Area (mm^2)	6.0 ± 1.4	3.5 ± 0.1	<0.001
Area Stenosis (%)	60 ± 10	34 ± 5	<0.001

Atherectomy was accomplished within 20 minutes in all lesions. Guidewire diameters ranged from 2.5 mm to 4.1 mm. One neointimal flap was observed with IVUS post Helixcision, which was removed with subsequent cuts. There was no evidence of distal embolization.

Conclusion: In this initial experience with Helixcision atherectomy, successful and efficient debulking of in-stent stenosis was accomplished with preservation of stent integrity. Additional acute and chronic *in vivo* studies are in progress.

3:15 p.m.

844-6 Clinical Safety and Efficacy of the PercuSurge Guardwire in the Saphenous Vein Graft Angioplasty Free of Emboli (SAFE) Study

Eberhard Grube, John Webb, Ross Prpic, Satyendra Giri, Ravi Rao, Richard E. Kuntz, Lisa Beck, Shirley Chan, Alla Lanina, Leonid Firer, Jeffrey J. Popma. *Brigham and Women's Hospital, Boston, MA, USA*

Background: Distal embolization resulting in myocardial necrosis remains a significant limitation associated with saphenous vein graft (SVG) angioplasty.

Methods: To determine whether distal SVG occlusion and aspiration of SVG embolic debris reduces the occurrence of complications during SVG angioplasty, we used the PercuSurge Guardwire system in 105 patients. The Guardwire permits simultaneous distal SVG occlusion and SVG angioplasty followed by removal of embolic debris using a 20 cc, low pressure (<1 atm) aspiration syringe. 30 day major adverse cardiac events (MACE) were defined as the occurrence of death, myocardial infarction [(MI) defined as >3 × normal CK-MB], or revascularization. Angiographic complications were defined as transient or sustained abrupt closure (TIMI 0,1 flow), distal embolization, or no reflow.

Results: Baseline findings are shown.

Clinical	%	Angiographic	%
Age	67 yrs	SVG Reference, mm	3.39 ± 0.71
Male Gender	87.4	Pre MLD, mm	1.07 ± 0.72
Diabetes mellitus	17.5	Pre % stenosis	68.3 ± 18.9
Graft age, years	8.9	Final MLD	2.80 ± 0.66
In-Hospital MACE	2.8	Final % stenosis	17.1 ± 14.0
Death	0.9	Distal Embolus	3.3
MI	2.8	No reflow	3.3
30 day MACE	3.8	Angiographic Compls	3.3

MLD = minimum lumen diameter.

Any CPK-MB (>1) elevation occurred in 9.5% of patients. Failure to deploy the Guardwire device occurred in <2.8% of patients.

Conclusion: The Guardwire is a safe and effective adjunct to prevent complications in patients undergoing "high-risk" SVG intervention.

POSTER

1107 Adjunctive Therapy, Antithrombotic, Cardiac Enzymes

Monday, March 13, 2000, 3:00 p.m.–5:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 3:00 p.m.–4:00 p.m.

1107-75 Prognostic Influence of Cardiac Troponin I After Coronary Angioplasty

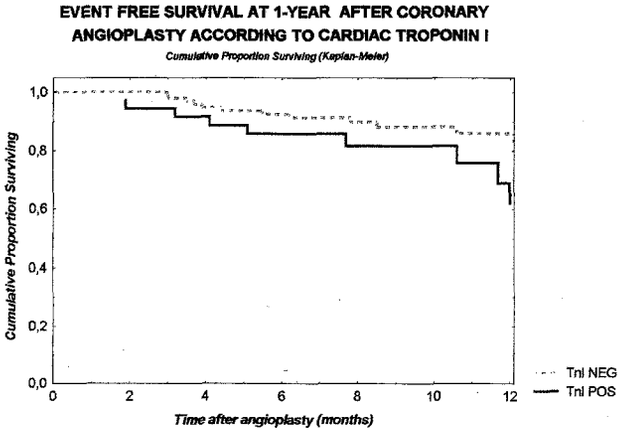
R. Teles, L. Arrieta, J. Ferreira, A. Mesquita, M. Sousa, J. Figueira, E. Melo-Gomes, R. Seabra-Gomes. *Cardiology Department, Santa Cruz Hospital, Lisbon, Portugal*

Background: Cardiac troponins (Tn) are valuable tools in unstable angina (UA). However, its mid-term prognostic value after coronary angioplasty remains controversy.

Aim: To examine the prognostic influence of Tn I (TnI) in patients submitted to an elective coronary intervention procedure.

Methods: Blood samples for cardiac enzymes and TnI were collected in 145 pts before, at 6 and at 12 h after angioplasty. Serum TnI was determined by chemiluminescent immunoassay method (Access®/Sanofi Pasteur). The primary endpoint was determined at F-Up (9 ± 3 months) as the composite occurrence of death, myocardial infarction, recurrent angina, repeated revascularization procedure and angiographic reestenosis.

Results: At the end of F-Up pts with a least one elevated (>0.1 μg/L) TnI determination had a higher event rate compared with those pts whose values were always below cut-off value: 38.9% versus 16.2%, p = 0.004, Cox-F. test).



Conclusions: These data show that TnI is an important prognostic marker in patients submitted to coronary angioplasty. It should be considered a potential useful tool to identify those patients who may be benefit from a tighter follow-up.

1107-76 The Prognostic Value of a Single Creatine Phosphokinase Measurement After Percutaneous Coronary Interventions

Abdul M.A. Hasnie, Mamtha Balasubramanian, Robert D. Safian, Cindy L. Grines, Aaron D. Berman, James A. Goldstein, William W. O'Neill. *William Beaumont Hospital, Royal Oak, Michigan, USA*

Objective: This prospective study was undertaken to determine in-hospital prognostic significance of single creatine phosphokinase (CPK) measurement, obtained 8 hours after percutaneous coronary intervention (PCI) in a tertiary care referral center.

Background: Frequent cardiac isoenzyme measurements have been used in randomized PCI trials. We tested the prognostic value of a simpler, less costly strategy.

Methods: CPK levels were obtained 8 hours after PCI in 3786 consecutive patients, excluding patients with acute myocardial infarction < 24 hours. Outcomes were analyzed based on normal CPK level (Group 1), 1–2 × normal (Group II) and >2 normal (Group III). In hospital major cardiovascular events were: death, ventricular arrhythmia (VT/VF), stroke (CVA) and urgent surgical revascularization (CABG).

Results: Increase in CPK was independent of age, ejection fraction, diabetes mellitus, hypertension, congestive heart failure, peripheral vascular disease, chronic renal insufficiency and prior stroke. Clinical and procedural variables associated with elevated CPK value post PCI included: unstable/stable angina (p = 0.001), single or multivessel (p = 0.034), prior CABG (p = 0.027), abrupt closure (p < 0.0001), no reflow (p < 0.0001), coronary perforation (p < 0.001) and intra-aortic balloon pump (p < 0.0001).

	Group-I	Group-II	Group-III	P-Value
Event	n-3444 (%)	n-211 (%)	n-131 (%)	
VT/VF	11 (0.32)	4 (1.90)	8 (6.11)	<0.0001
CVA	6 (0.18)	1 (0.48)	1 (0.77)	0.1590
CABG	16 (0.47)	2 (0.96)	1 (0.77)	0.2840
Death	4 (0.12)	6 (2.84)	7 (5.34)	<0.0001
Combined event	37 (1.08)	12 (5.74)	15 (11.54)	<0.0001

A multiple logistic regression analysis using a total of 17 baseline demographic and procedural variables showed that CPK was a significant independent predictor of death (p = 0.0001 odds ratio [OR] = 3.75, 95% confidence interval [CI] [1.91–7.37]) and combined event (p = 0.002, OR = 2.07, 95% C1 [1.28–3.33]) respectively.

Conclusion: A single CPK value 8 hours post PCI can be used to identify a patient population for adverse in hospital events.

1107-77 Routine Heparinisation during Coronary Arteriography: Is it Still Indicated?

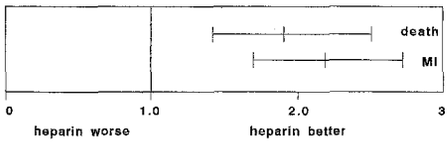
Erwin Zegers, Bart Jan Meursing, Freek W.A. Verheugt. *Dpts of Cardiology, Canisius-Wilhelmina Hospital and Heartcenter, University Hospital Nijmegen, Nijmegen, The Netherlands*

Background: Though not specifically recommended in the 1987 ACC/AHA guidelines systematic heparinisation is often used during coronary angiography. But with the introduction of chronic antiplatelet therapy and small-sized catheters heparinisation with its inherent risks and poor bioavailibility can be questioned.

Methods: We analysed 6 observational and 9 controlled studies on routine heparinisation during diagnostic coronary arteriography (CAG) published between 1971 and 1995 including 121,974 patients. Procedural death and infarction (MI) were scored.

Results: Death occurred in 193 (0.16%) patients, MI in 248 (0.20%) patients and were divided as follows:

	Heparin (n = 83,085)	No heparin (n = 38,889)	RR (95% CI)	p
Death	102 (0.12%)	91 (0.24%)	1.91 (1.43–2.52)	0.0001
MI	127 (0.15%)	121 (0.31%)	2.03 (1.59–2.61)	0.0001



Conclusion: Withholding heparin in diagnostic CAG is associated with a twofold increase in death and MI. Routine heparinisation still seems indicated in patients undergoing diagnostic CAG.

1107-78 Very Low Dose Heparin (30 UI/kg) for Routine Coronary Angioplasty With Immediate 6F Sheath Ablation

Patrick Godon, Gilles Rioufol, Gérard Finet, Pierre Chirossel, Guy de Gevigney, Ricardo Roriz, Xavier André-Fouët, Eric Bonnefoy, Michel Ovize, Rolland Rossi, Jacques Beaune. *Department of Hemodynamics Cardiovascular Hospital, Lyon, France*

Background: Platelet inhibition is sought to be the major outcome determinant for endoarterial procedures, while heparinization seems to have only an adjunctive effect. In our institution, we routinely perform (except for acute myocardial infarction) femoral access 6F coronary angioplasty (PTCA) with unique bolus of 30 UI/kg non fractionned heparin and immediate 6F sheath ablation with manual compression.

Methods: Between 1/1/99 and 8/1/99 all patients referred for PTCA were consecutively evaluated. Major adverse cardiac event (MACE), Troponin I elevation, and echographic groin complication were systematically monitored.

Results: 380 patients (89% of routine activity, 81% male, 63 ± 11 years old, 76% stenting) were included. The heparin bolus was 2240 ± 1120 units with a PTCA duration of 25 ± 16 min and end procedural clot time of 155 ± 88 sec. Groin compression lasted 7 ± 4 min. MACE was 2.6% for a post PTCA in-hospital stay of 1.8 ± 1.4 days. A 1-month follow-up detected 1.3% additional MACE. Troponin I elevation (>3 × upper level) appeared in 4.7%. Echographic groin examination (80% of patients) detected 9% anomalies (8 false aneurysms, 19 hematoma) with mean haematoma diameter of 1.4 ± 0.9 cm.

Conclusions: Very low dose heparin for routine 6F PTCA: i) is safe and as effective as standard-dose heparinization protocol; ii) dramatically decreases groin complications; iii) allows rapid mobilisation and shorter hospitalisation.

1107-79 Comparative Effects of Low Molecular Weight Heparin (With and Without Abciximab) and Unfractionated Heparin on Antithrombin Activity During Coronary Angioplasty

William H. Matthai, Jr., Dean J. Kereiakes, Cindy L. Grines, Jamie E. Siegel. *University of Pennsylvania, Philadelphia, USA*

Background: We have shown that antithrombin activity (AT) falls when unfractionated heparin (UFH) is used for anticoagulation during angioplasty and through the night of the procedure, sometimes falling to clinically important levels. Whether enoxaparin (E), a low molecular weight heparin, will have the same effect is unknown. In addition, we hypothesized that the addition of abciximab (AB) might reduce activation of coagulation and have independent benefit on AT.

Methods: This study is a substudy of the NICE trials, multicenter, prospective registries of angioplasty in which E was used for anticoagulation with (NICE 4, n = 81) or without (NICE 1, n = 48) planned use of AB. E was administered as a single weight based intravenous bolus (0.75 mg/kg with AB, 1.0 mg/kg without AB). AT samples were drawn at the start of the procedure (before E), within 4 hours of the bolus (to evaluate the change in AT over the course of the procedure), and 12 hours after the bolus. Our published data of AT during angioplasty with UFH (n = 250) served as a reference population.

Results: AT fell over the course of the procedure with both E and UFH (7.2 ± 14.8% vs 7.4 ± 7.8%, p = 0.8). Following the procedure, AT continued to decline in the population given UFH but stabilized in the E group (4.5 ± 8.2% vs 0 ± 11.8%, $p < 0.001$). Much of the decline in AT over the course of the angioplasty occurred in those who received AB. Patients given E alone had less decline in AT (2.9 ± 8.4%) than those given E and AB (9.7 ± 17.1%, $p < 0.05$ vs E alone) or than those given UFH (7.4 ± 7.8%, $p < 0.05$ vs E alone, p = NS vs E + AB).

Conclusions: Use of E during angioplasty does not prevent a decline in AT over the course of the procedure, but AT does not continue to fall thereafter as it does in those in whom UFH is continued. The addition of AB to E does not reduce the decline in AT as we initially hypothesized and appears to increase the acute fall in AT. Use of E alone had the least acute effect on AT. While the clinical importance of the decline in AT in this population is not known and may not be the same as in those given UFH, these data raise questions regarding the combination of AB and E during angioplasty.

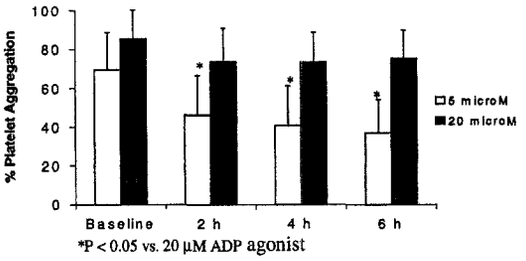
1107-80 Rapid Platelet Function Assessment Using Two Concentrations of Adenosine Diphosphate After Clopidogrel Loading Dose in Patients Undergoing Cardiac Catheterization

Wei C. Lau, Eric R. Bates, David G.M. Carville[1], Kirk E. Guyer[1], Charlene J. Neer, Elke G. Marksteinerbs, Dan Zoller. *University of Michigan Medical Center, Ann Arbor, Michigan; [1]Array Medical Laboratories, Indiana University, South Bend, Indiana, USA*

Background: Platelet activation is a contributing factor to early thrombotic occlusion in patients undergoing percutaneous coronary artery intervention. Clopidogrel, an ADP receptor antagonist, has been shown to inhibit platelet aggregation within 1 hour of a 375 mg loading dose, with peak effect at 5 hours, using a 5 μM ADP agonist. This study examined the inhibition of platelet aggregation after a 300 mg loading dose of clopidogrel using the bedside ICHOR platelet analyser with 5 μM and 20 μM ADP agonists.

Methods: Twenty patients undergoing cardiac catheterization were randomized to platelet function analysis using 5 μM (n = 10) or 20 μM (n = 10) ADP agonist. Platelet aggregation was analyzed at baseline, 2, 4, and 6 hours after a loading dose of 300 mg of clopidogrel. Data were compared using ANOVA with Bonferroni's correction.

Results: see figure.



Conclusion: These data suggest that the 300 mg clopidogrel loading dose commonly used with endoluminal stenting does not reach maximal platelet inhibition at 5 hours. Earlier treatment or higher loading doses may be required to optimize platelet inhibition in the periprocedural period.

1107-81 Final Report of Six Month Outcomes After Bivalirudin Versus Heparin During Coronary Angioplasty: Kaplan-Meier Statistical Analysis

J.A. Bittl. *On behalf of the Bivalirudin Angioplasty Investigators; Ocala Heart Instute, Ocala, FL, USA*

Background: Bivalirudin is a direct thrombin inhibitor under investigation as an anticoagulant for use during PTCA. Bivalirudin was evaluated in patients undergoing PTCA in 2 large, randomized, double-blind, multicenter studies governed by the same protocol.

Methods: A total of 4312 patients (All Patients) with unstable angina, including a pre-stratified subgroup of 741 patients (Post MI) who had an MI within the prior 2 weeks, between the ages of 29 and 90 years, were randomized 1:1 to either bivalirudin or heparin.. Bivalirudin was administered by IV bolus (1.0 mg/kg) immediately before PTCA. An infusion of 2.5 mg/kg/h was commenced at the same time and continued for 4 hours. An infusion of bivalirudin (0.2 mg/kg/h) was then continued for up to an additional 20 hours. Heparin was administered to achieve a target ACT of >350 seconds. The bivalirudin dose was not titrated to ACT.

Results: The incidences of any of the following, death, MI, and urgent revascularization occurring through 180 days are shown in Table 1.

Table 1. Incidences Clinical Endpoints In Randomized Clinical Trials Occurring through 180 Days of Follow-up

	Bivalirudin	Heparin
All Patients	n = 2161	n = 2151
Death, MI, Revascularization	23%	24.7%
Death	1.7%	1.2%
MI	5.3%	6.1%
Revascularization	20%	21.8%
Post MI Patients	n = 369	n = 372
Death, MI, Revascularization	18.7%	25.3%
Death	1.6%	2.2%
MI	5.4%	8.3%
Revascularization	15.2%	20.4%

Conclusion: As compared with heparin treatment, bivalirudin treatment was associated with an equivalent rate of ischemic complications in the study group as a whole and a lower rate of ischemic complications in patients with postinfarction angina.

1107-82 The Impact of Clinical Presentation on the Degree of Platelet Inhibition at Baseline and Following Glycoprotein IIb/IIIa Receptor Blockade in Patients Undergoing Percutaneous Coronary Intervention

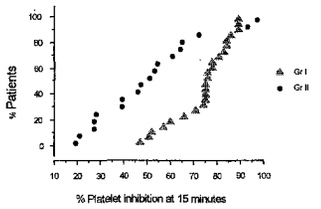
Daniel Soffer, Gurkan Taviloglu, Gishel New, Edward Kreps, Michael Collins, Sriram Iyer, Gary Roubin, Jeffrey Moses, Neil Coplan, Issam Moussa. *Lenox Hill Heart and Vascular Institute, New York, NY, USA*

Background: Glycoprotein (GP) IIb/IIIa platelet receptor antagonists have been shown to improve outcomes in acute coronary syndromes (ACS) and percutaneous coronary interventions (PCI). The impact of clinical presentation on the degree of platelet inhibition (PI) with GPIIb/IIIa inhibitors is still controversial. We sought to investigate the extent of variability in PI between pts with ACS and pts with stable angina who undergo PCI requiring a GPIIb/IIIa inhibitor.

Methods: We measured PI in 42 pts who underwent PCI and required GPIIb/IIIa inhibitor tirofiban (bolus; 10 μg/kg, infusion; 0.15 μg/kg/min) or abciximab (bolus; 0.25 mg/kg, infusion 0.125 μg/kg/min). Pts were classified according to the Braunwald unstable angina (UA) classification. Group 1 included 24 pts with stable or class I UA; Group II included 18 pts with class II or III UA. PI was measured with the Ichor CBC analyzer (Array Medical), using 20 micromole of ADP. All pts received ASA and clopidogrel prior to

procedure. Baseline PI was measured prior to GPIIb/IIIa administration and at 15 min post bolus.

Results: Baseline characteristics and risk factors did not differ between groups. Gr I had *higher* PI compared with Gr II at baseline (mean ± SE: 26 ± 4% vs 13 ± 4% for Gr I and Gr II respectively, $p < 0.05$) and at 15 minutes following GPIIb/IIIa administration (74 ± 3% vs 50 ± 5% for Gr I and Gr II respectively, $p < 0.0001$, see fig). In multivariate regression analysis, angina class was the only predictor of PI of >70% ($p < 0.0005$).



Conclusions: Pts with acute coronary syndromes have lower platelet inhibition than pts with stable angina, both at baseline and following GPIIb/IIIa blockade. Further studies are needed to establish whether dose adjustment is necessary in pts with acute coronary syndromes undergoing coronary intervention.

1107-83 A Prospective Multicenter Study to Determine the Optimal Level of Platelet Inhibition With GPIIb/IIIa Inhibitors in Patients Undergoing Coronary Intervention – The GOLD Study

Steven Steinhubl, David Talley, Dean Kereiakes, Gregory Braden, James Tcheng, Peter Casterella, David Moliterno, Peter Berger, Jeff Popma, George Dangas, Richard Gallo, Frank Navetta, David Sane, David Holmes, Paul Teirstein, Eric Topol. *Wilford Hall Medical Center, San Antonio, TX; Cleveland Clinic Foundation, Cleveland, OH, USA*

Limited data are available regarding the optimal dosing of the GPIIb/IIIa inhibitors. Early animal studies with these agents found that >80% receptor blockade, which correlated with a decrease in ADP-induced aggregation to <20% of baseline, was required in order to prevent thrombus formation in a highly thrombogenic environment. Although small studies have demonstrated substantial inter-patient variability in response to standard dosing of GPIIb/IIIa inhibitors, the clinical significance of this has not previously been evaluated.

Methods: 500 patients undergoing a percutaneous coronary intervention (PCI) with elective GPIIb/IIIa inhibitor use at 13 sites had platelet function monitored at baseline, and then 10 min, 1 hr, 8 hr and 24 hours following the bolus of a GPIIb/IIIa inhibitor using the Accumetrics Ultegra-RPFA – a point-of-care, rapid platelet function assay. Adverse events (death, MI, urgent revascularization) following PCI were systematically monitored in all patients. Non-Q MI was defined as a CKMB elevation > 2 × normal.

Results: 98% of all patients achieved >80% inhibition of platelet function immediately following the GPIIb/IIIa antagonist bolus. By 8 hours after the bolus, while patients were still receiving an infusion, there was substantial variability among patients. Inhibition of ≤70% of baseline of platelet function at 8 hours, seen in 7% of patients, was associated with a significantly higher risk of an adverse event compared with those >70% inhibited (32% vs 12%, $p = 0.02$).

Conclusion: This trial is the first ever to prospectively correlate the degree of platelet blockade achieved with standard dosing of GPIIb/IIIa inhibitors with clinical outcomes following a PCI, and demonstrates that platelet function, as determined by a simple point-of-care instrument, can identify a subgroup of patients at significantly higher risk for adverse events. The clinical benefit of titrating GPIIb/IIIa inhibitor therapy based on the monitoring of platelet blockade requires further evaluation.

POSTER

1108 IVUS Insights Into Coronary Stenting

Monday, March 13, 2000, 3:00 p.m.–5:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 3:00 p.m.–4:00 p.m.

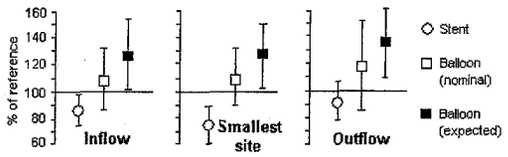
1108-84 Stent Underexpansion With Intermediate Inflation Pressures

Dirk Hausmann, Dieter Fischer, Matthias Sturm, Arndt Schaefer, Burkhard Hornig, Helmut Drexler. *Division of Cardiology and Angiology, Hannover Medical School, Hannover, Germany*

Background: Current stent types are frequently implanted with intermediate pressures (10–14 ATM); stent expansion may be not sufficient.

Methods: Fifty consecutive pts. (35 m, 15 f; age 62 ± 10 yrs.) underwent elective NIR stent implantation (33 LAD, 4 CX, 13 RCA). After predilatation, semi-compliant balloons (10–14 ATM) were used for stenting. After angiographic completion (stenosis < 10%), IVUS was used to measure stent lumen at the in- and outflow (% proximal or distal reference) and smallest site (% of average reference). Nominal and expected (according to compliance) balloon cross-sectional areas were calculated.

Results: All stents were successfully implanted (no stent thrombosis). IVUS showed complete apposition. Stent in- and outflow were only slightly underexpanded (87 ± 13% and 92 ± 14% of reference, Fig.). The smallest stent site reached only 73 ± 12% of the reference despite significant balloon oversizing (nominal, 110 + 21%; expected, 127 + 23%) (Fig.). Small (<7.0 mm^2 CSA) and large vessels showed similar stent expansion (75 ± 9 vs. 71 ± 14%); however, more oversizing was required for small vessels (122 ± 17 vs. 96 ± 17%; $p < 0.05$). Post-dilatation based on IVUS improved stent expansion (65 ± 11 vs. 77 ± 10%; $p < 0.05$); higher inflation pressures (11 ± 2 vs. 14 ± 2 ATM) diminished ballon/stent ratios.



Conclusions: Despite adequately (i.e. over-) sized balloons and angiographic completion, stent expansion remains inadequate with intermediate inflation pressures in current stent types.

1108-85 Is High Pressure Optimization Necessary in Second Generation Stents? Results From the IVUS DUET Study

Andreas König, Volker Klauss, Evelyn Regar, Johannes Rieber, Ulrike Buchmeier, Karl Theisen, Hans U. Stempfle, Harald Mudra[1]. [1]*Dpts. of Cardiology, Klinikum Innenstadt, University of Munich and Städtisches Klinikum Neuperlach, Munich, Germany*

Background: Presently, there is no consensus with regard to the optimal stent implantation pressure in second-generation stents. To assess the stent expansion of the ACS Multi-Link RX DUET stent system (Guidant Corp.), we performed quantitative coronary angiography (QCA) and intravascular ultrasound (IVUS) after predefined inflation pressures.

Methods: In 36 pts. with stable angina elective stent implantation (reference vessel diameter 3.1 ± 0.47 mm; MLD 0.94 ± 0.38 mm, lesion length 12.5 ± 4.8 mm) was performed in native coronary arteries. Stent expansion was assessed by QCA and IVUS (motorized pullback; 0.5 mm/s; 2.9 F; 30-MHz transducer) after stent delivery at 12 atm. using a balloon to artery ratio of 1.1. If predefined QCA-criteria (≤10% residual stenosis) and IVUS criteria (according to the MUSIC study) of stent expansion were not fulfilled, the measurements were repeated after redilatation at 16 atm. With IVUS, the reference lumen areas and the proximal and minimal stent area were measured. The symmetry index was calculated at the tightest stent site after 12 atm and 16 atm. Relative changes for each parameter were calculated and compared (Mann-Whitney, CI < 0.05).

Results: All stents were successfully implanted. Mean diameter stenosis (DS) was reduced from 69.8 ± 11.3% before intervention to −3.3 ± 13.8% after 12 atm and further reduced to −7.8 ± 12.2% after 16 atm. After 12 atm., the angiographic criterion of optimal stent expansion was reached in 30 pts.(83%), whereas only 6 pts. (17%) met the IVUS criteria. After the IVUS assessment, 30 pts. underwent a second balloon inflation at 16 atm. This IVUS optimization strategy lead to a further gain in stent area from 7.7 ± 2.6

mm^2 to 8.5 ± 2.8 mm^2 or 13.2 ± 19% ($p < 0.05$). The symmetry index was improved from 0.85 after 12 atm. to 0.92 after 16 atm.

Conclusion: Despite fulfilled angiographic success criteria after MultiLink stent implantation at 12 atm in 83% of the patients, IVUS criteria were reached in only 17%. Additional balloon inflation at 16 atm could markedly improve both, the stent area and stent symmetry index with 78% of the patients reaching the IVUS criteria.

1108-86 Intravascular Ultrasound Analysis of the Effect of Post-Dilation With Non-Compliant Balloons Following Initial High Pressure Stent Implantation Using Newer Generation Stent Delivery Systems

Tejan Patel, Donald E. Cutlip, Christopher J. Cove, Richard M. Pomerantz, Frederick S. Ling. *University of Rochester, Rochester, New York, USA*

Background: Adjunctive high pressure (>12 Atm) inflation using noncompliant balloons to obtain satisfactory stent expansion after initial stent implantation has become routine because of prior intravascular ultrasound (IVUS) studies. Newer generation stent delivery balloons are now capable of high pressure inflation potentially obviating the need for adjunctive inflation, although current stent delivery balloons are semi-compliant. This study uses IVUS to assess the effect of adjunctive inflation using non-compliant balloons following initial high pressure stent implantation using semicompliant delivery balloons.

Methods: Lesions underwent high pressure stent implantation followed by adjunctive inflation using non-compliant balloons at the same maximal pressure and of the same balloon diameter as the delivery balloon. IVUS of stent minimal cross-sectional area (CSA), minimal luminal diameter (MLD), and symmetry index (SI) was measured after high pressure stent implantation and again after adjunctive inflation. The results of the first 15 of a planned total of 30 lesions are reported below. Stents were implanted using a balloon diameter of 3.12 ± 0.34 mm at a maximal inflation pressure of 14.9 ± 1.6 Atm.

IVUS Results:

	Post Stent	Post Adjunctive Inflation	p
CSA (mm^2)	6.93 ± 1.32	7.60 ± 1.82	0.0008
MLD (mm)	2.84 ± 0.20	2.97 ± 0.24	<0.0001
SI	0.93 ± 0.05	0.95 ± 0.06	NS

Conclusion: IVUS data suggest that adjunctive inflation with non-compliant balloons improves stent expansion despite high pressure stent implantation using semi-compliant delivery balloons. Final results will be presented.

1108-87 High-Pressure Stent Implantation is Requested Even With Less Rigid Second-Generation Stents to Obtain Large Follow-up Lumen Dimensions. An Intravascular Ultrasound Study

Rainer Hoffmann, Philipp Haager, Gregor Kerckhoff, Rüdiger Schwarz, Andreas Franke, Jürgen v. Dahl, Peter Hanrath. *University RWTH Aachen, F.R.G.*

Background: The need for high-pressure stent implantation using second-generation stents and the extent of resulting tissue proliferation as compared to low-pressure techniques are not resolved.

Methods: In a prospective, randomized study 109 native lesions were assigned to either low pressure (10 atm, n = 54) or high pressure (16–18 atm, n = 55) implantation of the ACS HP MultiLink stent (15 mm length) mounted on a non-compliant balloon. To study lumen dimensions and tissue proliferation serial angiographic (QCA) and intravascular ultrasound studies (IVUS) were performed after stent implantation and at follow-up (@5.6 ± 1.3 months). Lumen cross-sectional area (CSA) and stent CSA were measured by IVUS at 1 mm increments. Intimal hyperplasia CSA (IH CSA = stent CSA-lumen CSA) was calculated. IVUS data are reported as average of the total stent length.

Results: Restenosis rate was 23% for the total study group. IH CSA was 16% greater in the high-pressure group.

	High-pressure	Low-pressure	P
QCA reference diameter (mm)	2.9 ± 0.9	2.9 ± 0.8	0.394
QCA acute gain (mm)	1.8 ± 0.7	1.5 ± 0.7	0.024
QCA MLD Follow-up (mm)	1.7 ± 0.7	1.6 ± 0.7	0.784
Stent CSA (mm^2)	8.5 ± 2.7	7.2 ± 1.6	0.011
Lumen CSA follow-up (mm^2)	6.8 ± 2.4	5.6 ± 1.7	0.018
IH follow-up (mm^2)	1.7 ± 1.2	1.5 ± 0.9	0.488

Conclusion: High-pressure implantation techniques are requested even with the less rigid Mulitlink stent to obtain good stent expansion. At follow-up, larger lumen dimensions persist in the high-pressure group while intimal hyperplasia is only non-significantly larger.

1108-88 Incomplete Stent Apposition as Determined by Post-Procedure Intravascular Ultrasound Does Not Effect Clinical Outcome After Elective Coronary Stent Placement: A Report From AVID and CRUISE

Akiko Maehara, Joseph C. Apostol, Michael J. Attubato, Charles J. Davidson, Anthony C. DeFranco, James B. Hermiller, Robert A. Iaffaldano, Martin B. Leon, Neil J. Weissman, Frederick S. Ling, George J. Smith, Paul S. Teirstein, Paul G. Yock, S. Chiu Wong, David M. Zientek, Peter J. Fitzgerald, Robert J. Russo. *Stanford University, Stanford, CA; Scripps Clinic, La Jolla, CA, USA*

Background: AVID (Angiography Versus Intravascular Ultrasound [IVUS]-Directed stent placement) and CRUISE (Can Routine Ultrasound Influence Stent Expansion) are multicenter studies designed to assess the effect of IVUS on patient outcome after elective coronary stent placement.

Methods: To evaluate the effect of stent non-apposition as determined by IVUS, on 6-month clinical event rates, IVUS core laboratory and clinical outcome data were analyzed for 1081 patients enrolled in AVID (706 patients) and CRUISE (375 patients). IVUS imaging was performed after a final result was obtained.

Results: A total of 9.7% (105/1081) of stents were not apposed to the vessel wall on final IVUS core laboratory evaluation. The overall rate of target lesion revascularization for both groups, at 6-months was 8.2%. The incidence of stent non-apposition was 6.5% for vessels with a final minimum stent area of <6.0 mm^2, 10.2% with a minimum stent area of 6.0–9.0 mm^2, and 13.7% with a minimum stent area of >9.0 mm^2 (chi-square test, p = 0.02; test for linear trend, p = 0.004). A comparison of apposition and non-apposition groups is presented below.

	Non-Apposition group	Apposition group	P
Number of patients	105	976	
Minimum stent area (mm^2)	8.08 ± 2.91	7.29 ±2.43	0.002
Incidence of stent thrombosis	1.0%	1.0%	0.95
6-month target lesion revascularization	7.6%	8.3%	0.81

Conclusion: Non-apposition of stent to vessel wall, as determined by post-procedure IVUS imaging, is not associated with an increase in the rate of stent thrombosis or target lesion revascularization at 6-months. Non-apposition is more common in vessels with a minimum stent cross-sectional area of >9.0 mm^2.

1108-89 Intravascular Ultrasound-Guided Stent Placement Improves Clinical Outcome for Patients With High-Grade Lesion Severity: Observations from AVID

Joseph C. Apostol, Michael J. Attubato, Charles J. Davidson, Anthony C. DeFranco, Peter J. Fitzgerald, James B. Hermiller, Robert A. Iaffaldano, Martin B. Leon, Neil J. Weissman, Frederick S. Ling, George J. Smith, Paul S. Teirstein, S. Chiu Wong, David M. Zientek, Patricia D. Silva, Robert J. Russo. *Scripps Clinic La Jolla, USA*

Background: AVID (Angiography Versus Intravascular Ultrasound [IVUS]-Directed stent placement) is a multicenter, randomized study designed to assess the effect of IVUS on clinical outcome after elective coronary stent placement in 800 patients.

Methods: To evaluate the effect of IVUS-directed stent placement in vessels with high-grade lesion severity (≥70% stenosis by angiography prior to stent placement), 12-month clinical event rates and core lab angiographic and IVUS data were analyzed for 228 patients.

	IVUS group (n = 114)	Angio group (n = 114)	P
Stents per patient	1.7 ± 1.0	1.4 ± 0.7	0.01
Angio Preprocedure average RVD (mm)	3.13 ± 0.58	3.01 ± 0.53	0.15
Preprocedure lesion MLD (mm)	0.69 ± 0.22	0.63 ± 0.25	0.04
Preprocedure stenosis (%)	78 ± 6	79 ± 7	0.10
Final stent MLD (mm)	2.97 ± 0.51	2.87 ± 0.44	0.13
Acute gain (mm)	2.28 ± 0.50	2.25 ± 0.44	0.63
IVUS Final CSA (mm^2)	7.50 ± 2.81	7.07 ±2.46	0.24
Final distal RVD (mm)	3.22 ± 0.63	3.27 ± 0.69	0.63
Final CSA stenosis (%)	9 ± 19	15 ± 22	0.04
12-month target lesion revascularization	3.5%	14.9%	0.003
12-month major adverse cardiac event	10.5%	19.3%	0.06

Results: (table) Preprocedure lesion severity was independent of reference vessel diameter (RVD; $r^2 = 0.01$). A comparison of IVUS and angiography groups is presented below. In the IVUS group, 45% of patients required further therapy to fulfill IVUS criteria for optimal stent placement despite an adequate angiographic result (<10% stenosis). Indications for further therapy were: residual stenosis (n = 35), non-apposition (n = 13), and dissection (n = 7). Further therapy resulted in a gain of 20 ± 14% in cross-sectional area (CSA) and 0.33 ± 0.23 mm in diameter. Placement of an additional stent was required in 12% of patients.

Conclusion: In vessels with high-grade preprocedure lesion severity, IVUS-directed stent placement resulted in larger acute stent dimensions and a significantly lower 12-month target lesion revascularization rate compared to angiography alone.

1108-90 Intracoronary Ultrasound Volumetric Assessment of Stent Expansion and Plaque Redistribution After Direct Stenting

Jacek Legutko, Dariusz Dudek, Pawel Zymek, Krzysztof Zmudka, Marcin Wizimirski, Jacek S. Dubiel. *Jagiellonian University, Krakow, Poland*

Background: Intracoronary ultrasound (ICUS) assessment of stent expansion is the best predictor of in-stent restenosis. Direct stenting without balloon predilatation is a new technique of stent implantation and long term follow up is unknown. There is also no data comparing stent expansion and the mechanism of lumen enlargement after direct stenting and stenting with balloon predilatation.

Methods: In vessels > 3 mm in diameter without heavy calcification, we assessed 31 lesions before and after direct stenting and 30 lesions before and after stenting with optimal predilatation ("optimal" stenting: balloons sized by ICUS media – media diameter inflated up to 8 atm). Using automatic motorized pullback we analyzed lumen (L), vessel (V) and plaque + media (P + M) cross-sectional areas (CSA) every 1 mm of along the axial stent length plus 3 mm long proximal and distal reference segments. The minimal stent CSA, minimal stent CSA/mean reference lumen CSA (in-stent ratio), proximal stent CSA/proximal reference lumen CSA (prox ratio) were measured as ICUS parameters of stent expansion. We also calculated L, V, and P + M volumes (vol.) using Simpson's formula.

Results: ICUS parameters of stent expansion were similar in both groups. An increase in total L vol. and in total V vol. of the stent plus reference sites occurred without significant changes in total P vol. (table, value ± SD).

	Direct stenting	"Optimal" stenting	p
Minimal stent CSA (mm^2)	8.3 ± 1.2	8.1 ± 1.0	NS
In stent ratio	0.97 ± 0.11	0.95 ± 0.13	NS
Prox ratio	1.16 ± 0.22	1.08 ± 0.10	NS
Change in L vol. (mm^3)	58.2 ± 13.1 ($p < 0.001$)	53.0 ± 10.4 ($p < 0.001$)	NS
Change in V vol. (mm^3)	55.8 ± 18.1 ($p < 0.01$)	47.2 ± 19.9 ($p < 0.01$)	NS
Change in P vol. (mm^3)	−3.1 ± 4.2 (NS)	−5.3 ± 8.1 (NS)	NS

Detailed P vol. analysis disclosed a decrease of P vol. in stented region in contrast to an increase of P vol. in the reference sites, and this pattern of plaque redistribution was identical in both groups.

Conclusions: In noncalcified, large vessels there is no difference in stent expansion between direct stenting and stenting with optimal predilatation. Regardless of stent implantation technique, longitudinal plaque redistribution and vessel expansion without significant plaque compression are the mechanisms of lumen enlargement after stenting.

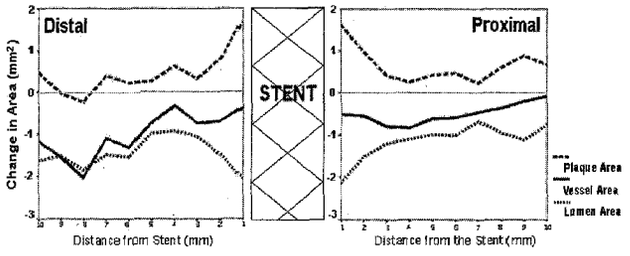
1108-91 Edge Effect in a Non-Select Stent Population: Results from 6-Month IVUS Examination in the HIPS Trial

Neil J. Weissman, Daniel Canos, Harish Rudra, Gary S. Mintz, Jean-Francois Tanguay, Jack L. Martin, Aaron V. Kaplan, Robert L. Wilensky. *Washington Hospital Center, Washington, DC, USA; Montreal Heart Institute, Montreal, Canada*

Background: Stent edge restenosis has been described after brachytherapy, but may also occur after stenting without radiation. We therefore determined the extent and magnitude of intimal hyperplasia (IH) and vessel remodeling along the stent edge in non-select patients (pts) scheduled for 6 month IVUS as part of a multicenter trial of heparin infusion prior to stenting (HIPS).

Methods: Planar measurements 1 mm apart were performed over a length of 10 mm proximal and distal to the stent at index and follow-up.

Results: Lumen loss within 3 mm of the stent edge was due primarily to intimal proliferation (figure). Beyond 3 mm, negative remodeling contributed more to lumen loss. Gender, age, vessel location, index plaque burden, hypercholesterolemia, diabetes and tobacco did not predict edge IH. IH tended to correlate with the magnitude of deep vessel wall stent penetration ($p = 0.07$).



Conclusion: In a nonradiation stent population, lumen loss at the stent edge is due primarily to intimal proliferation. These data may be helpful assessing the degree of edge effect due to radiation therapy.

1108-92 A Prospective, Multicenter Trial of the Safety, Feasibility, and Efficacy of Ultrasound Guided "Maximal" Stenting to the Media-Adventitial Border Final Late Clinical and Angiographic Results From the OSTI-2 Study

Gregg W. Stone, Steven Bailey, David K. Roberts, Tom J. Linnemeier, Frederick G. St. Goar, Timothy Sanborn, Peter J. Fitzgerald, Edwin L. Alderman, Stefan Kiesz. *Washington Hospital Center, Washington, DC, USA*

The minimal luminal dia. (MLD) and area (MLA) after stenting are strong predictors of freedom from restenosis. Routine balloon oversizing to increase stent expansion results in unacceptable rates of dissection and perforation. In contrast, IVUS imaging often reveals variable degrees of positive remodeling which may permit a selective stent overexpansion strategy, resulting in larger lumens and improved late outcomes.

Methods: 220 *unselected* consecutive pts (254 lsns) were prospectively enrolled in a controlled study at 7 sites. Stents (88% JJIS, 10% Guidant) were expanded to the media-adventitial border determined by IVUS. To protect the stent edges, a novel focally expanding balloon which grows 0.5 mm larger centrally within the stent (the Radiance FACT™) was used for post dilatation at 16 atm. Cinefilms and IVUS tapes were read at independent core labs (Stanford).

Results: High risk lesion features included reference vessel dia. < 3.0 mm in 64% and calcification requiring atherectomy in 19%. By QCA, the median ref. dia. was 2.89 ± 0.51 mm. By IVUS, however, the true reference vessel size was 3.90 ± 0.62 mm. Stent expansion was performed with mean balloon dia. 3.52 ± 0.49 mm (balloon/artery ratio 1.27 ± 0.21). Final MLD was 2.74 ± 0.50 mm (DS 1.3% ± 12.1), and MLA 6.96 ± 2.02 mm^2. No perforations occurred, and core lab dissections were noted at only 2.7% of stent edges; only 3 pts (1.4%) required additional stents for dissection. Follow-up was 98.6% complete at 9.0 ± 4.4 months, including late angiography in 64%. TVR was required i in 12.4% of pts, and binary restenosis was present in 25.6% of lesions. By multivariate analysis, the MLD achieved was a powerful determinant of freedom from restenosis. Of note, both TVR and restenosis rates were similar in vessels < 3.0 mm vs. >3.0 mm diameter (12.7% vs. 12.0%, p = 0.87, and 25.9% vs. 26.1%, p = 0.98).

Conclusions: Maximal stent expansion may be safely performed with IVUS guidance in remodeled vessels using focal balloons typically considered oversized. The large resultant lumens may be particularly beneficial in ameliorating restenosis in small vessels. Randomized trials vs. standard stent technique are warranted.

POSTER

1109 IVUS: Insights Into Methodology and Pathogenesis

Monday, March 13, 2000, 3:00 p.m.–5:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 3:00 p.m.–4:00 p.m.

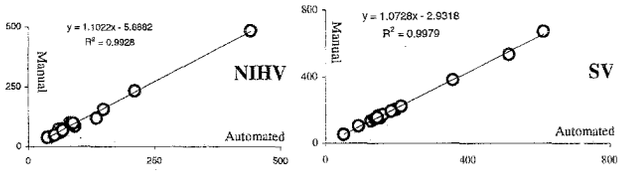
1109-115 Validation of IVUS Volumetric Assessment of Instent Neointimal Hyperplasia: A Comparison Between Manual and Automated Processing

Ali H.M. Hassan, Atsushi Takagi, Hiroyuki Okura, Thosaphol Limpijankit, Paul G. Yock, Peter J. Fitzgerald. *Stanford University Medical Center, Stanford, California, USA*

Background: The development of neointimal hyperplasia (NIH) after coronary stent placement continues to be a limiting factor. To date, IVUS morphometric analysis of stented segments involves manually selected intrastent frames which are compared to the reference. A more objective approach is to integrate the complete set of IVUS images covering the entire arterial segment, thereby providing volumes within the stent (i.e. lumen volume, LV; NIH volume, NIHV; stent volume, SV). So far, this approach has not been validated. The aim of the present study is to compare an automated approach for volumetric IVUS assessment of instent NIH using a contour detection algorithm (Echoplque™: INDEC Systems, CA) to the manual approach using Simpspons' rule.

Methods: Fifteen patients, who underwent motorized (0.5 or 1.0 mm/sec) IVUS imaging of instent restenosis, were enrolled in the present analysis. Sequential IVUS images of stented segments were analyzed for the assessment of LV, NIHV and SV by two observers independently utilizing both methods (automated vs. manual). Vessels enrolled in the analyses were LAD (n = 9), RCA (n = 4) and LCX (n = 2). The following results (mean ± SD) were obtained:

Method	Seg. Length	LV	NIHV	SV
Simpson	23.16 ± 11.24	104.80 ± 77.64	111.91 ± 1001.92	216.60 ± 157.58
Echoplaque	23.59 ± 10.61	112.01 ± 81.23	117.46 ± 112.74	229.45 ± 169.23



Conclusions: Assessment of NIHV LV, and SV using automated contour detection is comparable to the manual approach. Automated contour detection is a time-efficient, objective assessment of target segment volume.

1109-116 Improved Contour Detection for Three-Dimensional Intravascular Ultrasound; An In-Vivo Validation Study

Gerhard Koning[1], Jouke Dijkstra[1], Clemens von Birgelen[3], Sören Melsa[3], Christian Sieling[3], Johan H.C. Reiber[1,2]. *Department of [1]Radiology and [2]Cardiology, Leiden University Medical Center, The Netherlands; [3]Department of Cardiology, University Hospital Essen, Germany*

Background: IVUS provides real-time high resolution images of the arterial wall. By performing a 3D pullback and reconstruction, an advanced assessment of the vessel, lumen and wall morphology becomes available. To reduce the required analysis time and the subjectivity of boundary tracing, automated segmentation of the pullback sequence of images is required.

Methods: We developed a (semi-)automated contour detection approach using a combination of transversal and longitudial model- and knowledge-guided contour detections, based upon the minimum cost algorithm (MCA). In multiple (4 or more) longitudinal cutplanes (LCPs) through the pullback stack, the vessel contours are detected simultaneously, allowing mutual guidance of the detection in difficult areas like behind calcified plaque. Next, the lumen contours are detected (and possibly corrected) in these LCP images. These vessel and luminal contour points are transformed to the individual cross sections, where they guide the vessel and lumen contour detection in these transversal images. Using more LCPs helps to reduce the number of corrections needed in the transversal images.

A set of 14 pullback sequences of coronary vessels with obstructive coronary artery disease (acquired in-vivo with a mechanical rotating catheter) were analyzed using our analytical software and the validated analytical software on the Tomtec system. Intervals of on average 60 images were used for comparison of the individual vessel and lumen cross-sectional areas (CSAs).

Results: The CSAs detected with our system (y) were correlated with those of the Tomtec system (x). The vessel and lumen CSAs (mm^2) correlated highly: $y = 1.03x + 0.41$, $r = 0.995$ and $y = 0.98x + 0.01$, $r = 0.978$, respectively, N = 877. The average number of vessel and lumen corrections per image after LCP contour detections was 0.34 and 0.64, respectively.

Conclusion: Due to the flexible use of more longitudinal cutplanes and the advanced knowledge guided contour detection, the new quantitative IVUS analysis package performs well, making the package suitable for clinical research studies.

1109-117 The Influence of De Novo Atherosclerotic Remodeling on Luminal Narrowing Follows a Normal Distribution. An Intravascular Ultrasound Study

Gerard Pasterkamp, Allen Jeremias, Aryan Vink, Alan Yeung, Peter Fitzgerald, Kiyoshi Hibi, Peter de Jaegere, Cornelius Borst. *Heart Lung Institute, University Medical Center Utrecht, the Netherlands; Department of Cardiology, Stanford University, San Francisco, USA*

Background: In de novo atherosclerotic disease, luminal narrowing is determined by both plaque mass and the mode of remodeling. Expansive remodeling prevents and constrictive remodeling accelerates luminal narrowing. It is unknown whether constrictive and expansive remodeling are different disease entities or if they are extremities of a normal distribution. Aim of the present study was to investigate whether the mode of remodeling follows a bimodal or normal distribution.

Methods: An intracoronary ultrasound pull back maneuver was performed in 606 patients (610 lesions) prior to intervention. In each pull back, the lumen area (LA), plaque + media area (PA) and vessel area (VA) were measured at the lesion site and a proximal and distal reference site.

For each lesion, the change in VA, PA and LA was calculated by comparing the measured values at the lesion site with the values of the reference sites (ΔVA, ΔPA and ΔLA, respectively). For each lesion, ΔVA was expressed as % of ΔLA.

Results:

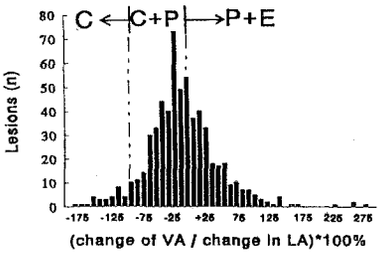


Figure: P + E: ΔPA accounts for ΔLA and part of the plaque is compensated for by Expansive remodeling.

C + P: Both ΔVA (Constrictive remodeling) and ΔPA contribute to ΔLA.

C: Constrictive remodeling is responsible for ΔLA. Plaque area at the lesion site is smaller compared with the reference sites

Median value = −16.5%, indicating that 16.5% and 83.5% of ΔLA was due to ΔVA and ΔPA, respectively.

Conclusion: de novo atherosclerotic remodeling is not bimodally distributed. This observation supports the idea that expansive and constrictive remodeling are the extremities of a normally distributed response to plaque formation.

1109-118 Intravascular Ultrasound Measurement of Plaque Volume: Validation of a Method for Serial Regression-Progression Studies

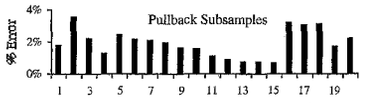
Khaled M. Ziada, Amrik Shah, Samir R. Kapadia, Timothy D. Crowe, Mandish Rai, Ivan Casserly, Steven E. Nissen, E. Murat Tuzcu. *The Cleveland Clinic Foundation, Cleveland, OH, USA*

Background: Intravascular ultrasound studies of atherosclerosis regression-progression require plaque volume determination at two or more time points. However, repeated motorized pullbacks of the same segment often contain a different number of frames.

Methods: Motorized pullbacks over an average vessel length of 33 ± 12 mm were performed at 0.5 mm/sec in 20 patients. Plaque area was measured by manual planimetry at cross-sections every 1.0 mm. Plaque volume was computed using Simpson's rule. To simulate the effect of varying

the number of frames in the pullback, twenty random subsamples of 95% of the cross-sections were used to calculate total plaque volume. In each subsample, plaque volume was computed by multiplying the average plaque area by the actual pullback length.

Results: The true volume using all data points was compared to the volume estimated from each subsample and percent error calculated. The percent error in plaque volume was 1.9 ± 0.9 (range 0.68–3.5).



Conclusions: The average error in plaque volume calculation is at most 3.5% even when there is up to 5% variation in the number of frames between pullbacks. Thus small variation in motorized pullbacks does not affect the accuracy of plaque volume measurements.

1109-119 Diet and its Relation to Early Atherosclerosis in Teenagers

Albert Sanchez, Jacques D. Barth, Ling Zhang. *Pacific Health Education Center, Bakersfield, California; Prevention Concepts, Inc., Los Angeles, California, USA*

Background: Atherosclerosis is known to begin early in life, and it has been assumed that the risks of diet and other risks of cardiovascular disease are the same at the initial stages of atherosclerosis in youth as they are in adults. We tested this assumption in high school students with varying lifestyle and ethnic backgrounds.

Methods: A total of 249 students volunteeredm, 13–18 years old males and females, were students from a typical high school, a Hispanic high school, and from a high school of a health conscious population (Seventh-day Adventists). They were measured for the typical risk factors of age, sex, height, weight, blood pressure, and fasting blood cholesterol (total, HDL, LDL), triglycerides, glucose, and uric acid. The thickness of the common carotid artery wall was measured with ultrasound by the quantitative intima-media thickness test (QIMT) as a measure of the earliest morphologic evidence of atherosclerosis.

Results: The majority, over 80%, were above the dietary recommendations for total or saturated fat, and 49% exceeded the recommended cholesterol intake. Cholesterol intake was correlated with QIMT ($p < 0.005$). Although the mean serum cholesterol level was 161 mg/dL, there were hypercholesterolemics according to recommendations for teenagers (37% for total cholesterol, 29% for LDL). Also, there was hypertension (11% for systolic, 3% for diastolic). BMI correlated directly ($p < 0.0029$) with total cholesterol, LDL cholesterol, total-cholesterol/HDL-cholesterol ratio, triglycerols, uric acid, and systolic blood pressure.

Conclusions: These data support the assumption that diet is important in the etiology of atherosclerosis in its beginning stages in teenagers, as it is with atherosclerosis in the adult. This knowledge, along with the evidence that teenagers are choosing atherogenic diets, provides the basis for further research, and the incentive for health educators to develop strategies to reduce atherosclerosis among teenagers in order to prevent later adult cardiovascular disease.

POSTER

1110 Restenosis: Basic Research III

Monday, March 13, 2000, 3:00 p.m.–5:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 3:00 p.m.–4:00 p.m.

1110-109 Metalloproteinase Inhibition and alpha-v-beta-3 Receptor Blockade Synergistically Inhibits Neointimal Formation and Constrictive Remodeling After Balloon Angioplasty in Rats

Leonid Margolin, Ilia Fishbein, Shmuel Banai, Gershon Golomb, Reuven Reich, Louise S. Perez, S. David Gertz. *The Hebrew University, Jerusalem, Israel*

Injury-associated release of proteolytic enzymes from smooth muscle and foam cells is thought to alter extracellular matrix proteins facilitating cell migration, neointima formation, and vessel wall remodeling. Blockage of the vitronectin receptor ($\alpha_v\ \beta_3$) with a synthetic RGD peptide has been shown to interfere with matrix proteolytic activity and inhibit cell invasion. This study tests the effect of metalloproteinase (MMP) inhibition combined with vitronectin receptor inhibition on neointimal formation and vascular wall remodeling after balloon injury *in vivo.*

Methods: Male Sabra rats were treated with a competitive, reversible MMP inhibitor, Batimastat (BB-94, British Biotech, Pharmaceuticals Ltd., Oxford, U.K.) (30 mg/kg, ip), separately and in combination with an $\alpha_v\beta_3$ receptor inhibiting RGD peptide (GIBCO BRL, # 12148-011) (0.1 μmol) applied perivascularly within a pleuronic gel to the common carotid artery immediately after balloon injury. Animals were sacrificed on day 3, 14, 25 and 75 (n = 24 each) after balloon.

Results: Animals treated with BB-94, peptide, or both had markedly reduced luminal cross-sectional-area narrowing by neointima (%CSAN-N) and intima-to- media area ratio (I/M-R) at all time points except for 3 d after balloon injury vs. non-treated, ballooned animals. Constrictive vessel wall remodeling, estimated by determining the ratio of the total wall area of the ballooned segment to that of adjacent non-injured, reference segment (EEA/EEAr), was found in control arteries 75 d after balloon injury but not in treated animals.

Group (75 d)	%CSAN-N	I/M-R	EEA/EEAr
Vehicle	71 ± 8%	2.2 ± 4	0.67 ± 0.1
BB-94	21 ± 4%**	1.2 ± 0.3**	1.12 ± 0.1*
Peptide	27 ± 5%***	1.3 ± 0.5**	1.32 ± 0.2**
BB-94 + peptide	10 ± 3%***	0.4 ± 1***	1.56 ± 0.4***

Mean ± SD, *p = 05, **p = 0.001, ***p = 0.0001 by 1-way ANOVA

Conclusion: Inhibition of MMP activity and vitronectin receptor blockade markedly reduces neointimal formation (>80%) and prevents constrictive remodeling 2.5 months after balloon injury in rats. Confirmation of the efficacy of this strategy in larger animals should be the next step toward testing the applicability of this novel approach to the interventional setting.

1110-110 Myxoid Tissue in Stent Restenosis May Be a Provisional Tissue in Which Active Cell Migration and Synthesis of Extracellular Matrix (ECM) Occur

Ick-Mo Chung, Yangsoo Jang, Seung J. Park, Seung-Yun Cho, Seong W. Park, Cheol W. Lee, Sang H. Cho, Paraskevi Heldin, Herman K. Gold, Stephen M. Schwartz. *Ewha Womans Univesity, Seoul, Korea; University of Washington, Seattle, WA, USA*

Background: Since we have shown that coronary arterial stent restenotic tissue (CASR) has a low cell replication rate, other mechanisms may be important for stent restenosis. We did the histological studies of ECM, myxoid tissue, and expressions of molecules implicated in cell migration and ECM synthesis in CASR comparing to primary coronary atherosclerotic plaques (PCAP).

Methods: Atherectomized samples were obtained from CASR (n = 32, 28 patients 0.5–23 mo after stenting) and from PCAP (n = 21, 21 patients). We used modified Movat staining for ECM analysis and immunocytochemical staining for the expressions of molecules implicated in cell migration (PDGF-B, PDGF receptor β, MMP-1, and MMP-9) and in ECM synthesis (hyaluronan synthase (HAS)-1 and TGF-β1).

Results: Myxoid tissue in CASR tends to be found decreasingly in time after stenting: 86% vs 29%, $p < 0.05$ (<6 mo vs ≥6 mo after stent). There was a general tendency of ECM transition in CASR to change from proteoglycan rich to collagen i rich in time after stenting. Comparing to PCAP molecules such as PDGF receptor β, MMP-1, and HAS-1 tend to be expressed more abundantly, especially on the cytoplasm of stellate cells in myxoid tissue, in CASR.

Conclusion: Myxoid tissue and proteoglycans in CASR may be provisional tissues in which active cell migration and synthesis of ECM occur.

1110-111 Six-Month Follow-up of Endovascular β-Irradiation in Balloon-Injured Pig Coronary Arteries

Mahomed Y. Salame[1], Stefan Verheye[1], Stephen P. Mulkey[1], Ian R. Crocker[1], Nicolas A.F. Chronos[2], Spencer B. King III[1], Keith A. Robinson[2]. [1]*Emory University School of Medicine, Atlanta, Georgia;* [2]*Atlanta Cardiovascular Research Institute, Atlanta, Georgia, USA*

Background: Little is known about the long-term effects of endovascular irradiation (ER). We evaluated angiographic (QCA) and histologic effects of ER at 6 months after PTCA.

Methods: Adult mini-pigs received PTCA followed by ER (0, 7, 14, 21, or 28 Gy at 2 mm) in LAD and LCX and aspirin daily. Reference (refLD), minimum and maximum lumen diameters were measured by QCA at 6 months, and histopathology performed.

Results: Non-irradiated control vessels developed a fibrous neointima with a % diameter stenosis of 9.7 ± 3.4. ER resulted in segmental het-

erogeneity of lumen diameter with both greater % stenosis (see table) and increased number of vessels with focal enlargement (≥25% of refLD; χ^2: $p < 0.005$). Segments with angiographic stenoses consisted of poorly organized but stratified mural thrombi and very little neointima, whereas enlarged segments showed infrequent small mural thrombi, little fibrous neointima and medial atrophy. No vessels in control or (low dose) 7 Gy groups had focal enlargement. However, 30% of vessels treated with intermediate (14–21 Gy) and 100% of vessels treated with high dose (30 Gy) had segmental enlargement.

	Group A: 0 Gy	Group B: 7 Gy	Group C: 14–21 Gy	Group D: 28 Gy
% Stenosis	9.7 ± 3.4	39.2 ± 10.5‡	26.1 ± 17.4ψ	34.0 ± 1.8‡
n Enlarged ≥25%	0/9	0/3	3/10	2/2

‡$p < 0.0001$; ψ$p = 0.01$ Compared to control (A).

Conclusions: Medium and high dose ER at 6 months in adult Yucatan pigs treated only with aspirin is associated with angiographic stenoses histologically related to mural thrombi rather than neointima, and segmental vessel enlargement with medial atrophy. Further study with potent antiplatelet therapy is needed.

1110-112 Mammalian Suppressor of sgv-1 (MSS1), a Putative Transcription Factor and Differentiation Related Gene, is Upregulated in Explant Derived Compared With Enzyme Dispersed Human Aortic Vascular Smooth Muscle Cells *In Vitro*

Catherine F. Townsend, Sheila E. Francis, Christopher M. Newman. *Section of Cardiovascular Medicine, Division of Clinical Sciences NGHT, University of Sheffield, UK*

Background: It has previously been reported that human aortic vascular smooth muscle cells (VSMCs) cultured by the explant (EX) technique exhibit a more differentiated phenotype and faster proliferation rates than cells cultured by the enzyme dispersal (ED) technique. We have investigated differences in gene expression between the two culture types in an attempt to identify genes involved in human VSMC proliferation and/or differentiation.

Methods: Differential Display Reverse Transcription Polymerase Chain Reaction (*dd* RTPCR) was performed, using 2 μg total RNA from paired EX and ED cultures from the same aorta at passage 2, and one base anchored oligo dT primers for reverse transcription. PCR was performed separately using eight different arbitrary primers, incorporating ^{35}S. The PCR products were then electrophoresed on adjacent lanes of denaturing polyacrylamide gels, with appropriate negative controls. Banding patterns were compared, and those exhibiting differential expression were reamplified by heat-soak PCR. False positives were screened out by dotting reamplified PCR products in duplicate onto nylon membranes, which were than hybridised with ^{32}P labelled cDNA from the two original cultures. Spots which still exhibited differential gene expression were cloned and sequenced. Western Blotting and immunocytochemistry were performed using a polyclonal antibody to human MSS1, to confirm differences in gene expression.

Results: In total, 63 bands exhibiting differential expression were extracted from the *dd* RTPCR gels. 13 of these were confirmed to be differentially expressed by hybridising with radiolabelled cDNA. After cloning and sequencing, one of these gene fragments was found to exhibit extremely high homology (98% over 272 bases) to the mRNA for human MSS1. Differential expression of MSS1 protein in paired EX and ED cultures was confirmed by Western Blotting and immunocytochemistry.

Conclusion: VSMCs cultured by the EX method are highly proliferative during early passages, whereas ED VSMCs are relatively quiescent. MSS1 was found to be upregulated in EX VSMCs, as compared with the ED cells. MSS1 has been ascribed several functions, including acting as a transcription factor, and being upregulated immediately prior to skeletal muscle differentiation. It is also the 7th subunit of the 26S proteasome, which is involved in degradation of ubiquitinated proteins. Although the function of MSS1 in VSMCs remains to be investigated, it is possible that it is involved in VSMC proliferation, and, if so, could be a potential target for therapeutic inhibition of VSMC proliferation to prevent restenosis. It is also a potential new marker for human VSMC differentiation and/or proliferation *in vitro.*

1110-113 Successful Non-Viral Gene Transfer Using a Novel Thermosensitive Gel Stent Coating

Iris Haehnel, Ulrike Pfeifer, Christian Seeliger, Eckhard Alt. *I. Med. Klinik, Klinikum Rechts der Isar, and Deutsches Herzzentrum, Technische Universität München, Germany*

Background: Gene transfer to the arterial wall has been proposed for reduction of restenosis after stent implantation. Catheter-based gene delivery mainly employing adenoviral tranfer is limited, however, by procedural problems and the prevalence of preexisting immunity to adenovirus. Other methods are hampered by low transfection efficiencies. We have developed a stent coating on the basis of a water-soluble thermosensitive gel enabling the incorporation of DNA plus a non-liposomic transfection enhancer.

Method: Plasmid-DNA encoding the reporter gene GFP were combined with transfection enhancer in the thermosensitive gel, which is fluid at 4ºC and solid at RT. Sixteen 10 mm-multicellular stainless steel stents were longitudinally cut, flattened and dipcoated in the liquid coating at 4ºC and brought to RT for solidification (6 μg DNA/stent). Primary SMC from porcine aortas were seeded at a density of 3000 cells/cm^2 in Waymouth/Ham F12 growth medium containing 10% FBS. After 12 hours the stents were placed onto the cells and incubated at 37ºC. Transgene protein expression was evaluated after 24 hours by fluorescence microscopy.

Results: Reporter transgene expression was observed in 28.7 ± 5.8% in the coated stent treated samples, comparing to a transfection efficiency of 31.4 ± 6.2% in the conventionally transfected control cells.

Conclusion: Our results demonstrate the technical feasibility of an efficient non-viral gene transfer via a DNA-eluting stent coating into vascular smooth muscle cells in vitro. To investigate the in-vivo applicability, animal studies are currently performed and will be reported. This transfection system may hold promise to target in-stent restenosis.

1110-114 Does Aging Effect Vascular Responses Following Balloon Angioplasty or Stenting?

Sweta Shroff, Andrew Farb, Renu Virmani. *Armed Forces Institute of Pathology, Washington, DC, USA*

Most coronary interventions are preformed in middle age individuals, but animal models examining revascularization therapies typically utilize young animals. Few data are available on age-associated vascular changes following balloon angioplasty (BA) or stenting.

Methods: Stents were placed in iliac arteries of young (4–6 months, n = 15) and older (24–26 months, n = 15) NZW rabbits and the contralateral iliacs underwent BA. At 3 or 30 days, arteries were processed for light or scanning electron microscopy (SEM). Pre-treatment arterial lumen diameters were similar among all groups.

Results:

	Rabbit Age	Cell Proliferation (%)	Intima Cell Density (cell/mm^2)	Intima Thickness (mm)	Intima Thickness (mm)	% Stenosis	Intimal Cell Proliferation (%)
	3 days	3 days	3 days	30 days	30 days	30 days	
BA	Young	20.2±2.8	4839±1349	0.010±0.003	0.16±0.01	35.8±3.5	0.4±0.2
	Old	12.9±0.7	1369±754	0.009±0.001	0.13±0.01	18.4±3.8	1.3±1.0
	p value	$p < 0.05$	$p = 0.07$	$p = NS$	$p < 0.05$	$p < 0.005$	$p = NS$
Stent	Young	26.7±2.2	5132±839	0.013±0.002	0.085±0.008	21.5±1.5	1.2±0.6
	Old	19.2±4.3	1943±525	0.021±0.001	0.072±0.009	19.6±0.9	1.4±0.3
	p value	$p < 0.18$	$p < 0.01$	$p < 0.005$	$p = NS$	$p = NS$	$p = NS$

BA lead to greater adventitial thickening in young than old animals (0.074 ± 0.007 vs. 0.062 ± 0.013 mm, $p < 0.05$). At 3 days, stenting in older animals was associated with increased accumulation of a fibrin-rich hypocellular intima, which was similar in size to young animals at 30 days. This finding suggests older animals exhibit fibrinolytic activity after stenting. Three days following stenting or BA, SEM showed no significant age dependent differences in percent arterial surface endothelialized.

Conclusions: Following BA, negative remodeling and a large proliferative response caused greater luminal narrowing in young versus old rabbits. Age had no effect on restenosis after stenting. These results indicate that when using animal models to simulate vascular responses in man, age may be an important determinant of outcome.

ORAL

854 Brachytherapy for Prevention of Restenosis

Monday, March 13, 2000, 4:00 p.m.–5:30 p.m.
Anaheim Convention Center, Room 207A

4:00 p.m.

854-1 Single-Session Radiation of Two Coronary Arteries for Prevention of Restenosis in De-Novo Lesions: Safety Using a 6 Months Protocol of Clopidogrel

Sigmund Silber, Ingeborg Krischke, Norbert Seidel, Armin Schneider, Peter von Rottkay. *Dr. Müller Hospital, Munich, Germany*

One advantage of beta over gamma radiation is the possibility to radiate

several coronary arteries in a single session without the risk of overdosing adjacent vessels. There is, however, concern that radiating two arteries in a single-session could double the risk for late coronary occlusion related to the hampered endothelialization. The risk of "delayed acute thrombosis" may be even higher when stents have been implanted during brachytherapy. To assess the safety and efficacy of single-session beta radiation in patients with multi-vessel disease, we performed a prospective evaluation with the Novoste™ Beta-Cath system in pats with stable angina, objective signs of myocardial ischemia and at least 75% diameter stenoses in two of the major coronary arteries. Starting three days before, all pats received ASS (300 mg o.d.) and Clopidogrel (75 mg o.d.) for 6 months. Mean pats age was 56 ± 7 y with a mean LV-EF of 58 ± 13%. A total of 36 de-novo lesions were treated in these 18 pats with two vessel disease; LAD/RCx/RCA lesions were radiated in 39%/33%/28%. For a mean lesion length of 12.4 ± 4.4 mm and a reference diameter of 3.1 ± 0.4 mm, the mean MLD was 1.2 ± 0.6 mm before and 2.7 ± 0.3 mm after the intervention. After radiation, stents were implanted in 89% of the lesions with an average stent length of 17 ± 4.4 mm at 10.4 ± 2.2 bar. The administered dose of the Strontium/Yttrium-90 radiation source trains with 12 pellets (30 mm) or 16 pellets (40 mm) was 15 ± 2 Gy (14–18) with an exposure time of 181 ± 22 s (169–224). No complications ocurred during PTCA, radiation or stent implantation. All radiation procedures could be finished as planned. Clinical follow-up did not reveal ischemic events, so far.

Conclusions: Beta radiation of two major coronary arteries in a single session is feasible and safe. On a prolonged 6 months protocol for clopidogrel intake, no late coronary occlusions ocurred. The data for MACE and angiographically determined restenosis will be presented.

4:15 p.m.

854-2 The Effect of Catheter-Based β-Radiotherapy on Coronary Artery Remodeling and Plaque Formation After Percutaneous Interventions

Ken Kozuma, Marco A. Costa, Manel Sabaté, Willem J. van der Giessen, Jurgen M.R. Lighhart, Veronique L.M.A. Coen, Pedro Serrano, I. Patrick Kay, Alexander J. Wardeh, Peter C. Levendag, Patrick W. Serruys. *Thoraxcenter and Daniel den Hoed Cancer Center, University Hospital Rotterdam, The Netherlands*

Background: Recent reports have shown intracoronary radiation affects not only neointimal formation but vessel remodeling. The aims of this study were to quantify the change in lumen volume (LV), total vessel volume (TVV) and plaque volume (PV) by means of three-dimensional IVUS analysis and to compare the difference between irradiated and non-irradiated segments. In the irradiated group, we also compare the balloon angioplasty (BA) with stent group.

Methods: From April/97 to March/99, we successfully treated 96 *de novo* lesions of 90 patients with intervention followed by intracoronary β-radiation or dummy source wire. Of these, 66 patients (72 lesion) have completed 6–8 month IVUS follow-up (FU). Patients who received multiple stents were excluded from this study. IVUS images were acquired by means of ECG-triggered pullback, and 3-D reconstruction was performed by semi-automated edge detection system. Both $^{90}Sr/^{90}Y$ (n = 38, dose 12–18 Gy) and ^{32}P sources (n = 17, dose 28–42 Gy) were used for radiation.

Results: Sixty-seven lesions (62 patients) were assessed by 3-D volumetric IVUS. Twelve lesions were treated (7 BA and 5 stent) with dummy source (placebo group). Thirty-six lesions were treated by BA, and 19 lesions by stent in the irradiated group.

	LV, mm³			TVV, mm³			PV, mm³		
	Post	FU	Delta	Post	FU	Delta	Post	FU	Delta
Radiation	233	231	−2	446	481	+35*	214	250	+36*
Placebo	220	163	−57†	436	419	−17	216	234	+18‡
p value	NS	NS	0.015	NS	NS	0.003	NS	NS	NS

* $p < 0.001$, † $p < 0.014$, ‡ $p < 0.064$, Delta = FU – Post-procedure (Post)

Delta TVV and delta PV were similar between BA and stented patients in the irradiated group (+35 *versus* +35 mm³, and +32 *versus* +42 mm³, respectively). Delta LV was also comparable between both groups (+3 *versus* −12 mm³, respectively, p = NS).

Conclusion: Radiation appears to stimulate positive vessel remodeling after percutaneous intervention with no effect on plaque increase. There was no difference in 3-D IVUS parameters between BA and stented patients in the irradiated group, suggesting that stent did not play a main role in the remodeling process after catheter-based brachytherapy.

4:30 p.m.

854-3 Geographical Miss: A Cause of Treatment Failure in Radio-Oncology Applied to Intracoronary Radiotherapy

Manel Sabaté, Marco A. Costa, Ken Kozuma, I. Patrick Kay, Willem J. van der Giessen, Veronique L.M.A. Coen, Jurgen M.R. Ligthart, Pedro Serrano, Peter C. Levendag, Patrick W. Serruys. *Thoraxcenter and Daniel den Hoed Cancer Center, University Hospital Rotterdam, The Netherlands*

A recognized limitation of endovascular β-radiation therapy is the development of new stenosis at the edges of the irradiated area, which may be caused by the combination of low-dose radiation and injury. We translated the radio-oncological concept of "geographical miss" to define those cases in which the radiation source did not fully cover the injured area. The aims of the study were to determine the incidence and causes of geographical miss and evaluate the angiographic impact of this inadequate treatment on the outcome of patients treated with intracoronary β-radiation.

Methods: We analyzed 55 consecutive patients treated for *de novo* lesions (n = 39) or recurrent in-stent restenosis (n = 16) with β-radiation after percutaneous coronary intervention using $^{90}Sr/^{90}Y$ source, Prescribed dose ranged between 12 and 20 Gray at 2 mm from the source axis. By means of off-line quantitative coronary angiography (CAASII system), the irradiated area (IRA) and both edges (5-mm distal and proximal to the irradiated segment) were studied prior to, after intervention and at 6-month follow-up. Those edges, which were injured during the procedure constituted the geographical miss edges.

Results: After excluding 32 edges due to ostial location (n = 14) or overlapping of one of the edges with sidebranches (n = 18), 78 edge areas and 55 IRA were finally studied. We found 23 (29.5%) geographical miss edges induced by balloon dilatation (n = 14) or additional stent implantation (n = 9) outside the IRA. These edges were injured during the intervention mainly due to: (1) development of procedural complications which extended the treatment beyond the margins of the IRA (unexpected geographical miss, n = 9); (2) lack of availability of longer radiation source (>30 mm) in the context of patients with diffuse recurrent in-stent restenosis (n = 8); and (3) the injured area of prior balloon inflation was not appropriately covered by the source (n = 6). Late loss was significantly higher in geographical miss edges, as compared to both IRA and not-injured edges (0.84 ± 0.6 versus 0.16 ± 0.4 and 0.09 ± 0.4 mm, respectively; $p < 0.0001$). Similarly, restenosis rate was significantly higher in those injured edges (9% within IRA, 39% in geographical miss edges, and 0.02% in not injured edges; $p < 0.001$). No difference in the pattern of the late loss between the 3 areas were observed in *de novo* lesions as compared to recurrent in-stent restenotic lesions. Relative late loss was comparable between geographical miss edges located proximally or distally from the IRA (0.31 ± 0.2 versus 0.34 ± 0.2, respectively; p = NS).

Conclusion: Geographical miss is a novel and frequent phenomenon after intracoronary radiotherapy. It was related to either lesional or procedural factors associated with the lack of longer radiation sources. Considering that this inappropriate treatment may lead to an untoward angiographic outcome, the occurrence of this phenomenon should be avoided.

4:45 p.m.

854-4 The Gamma II Trial of Localized Radiation Therapy to Inhibit Restenosis After Coronary Stenting

Martin B. Leon, Paul S. Teirstein, Jeffrey W. Moses, Alexandra J. Lansky, S. Chiu Wong, James Willerson, David R. Holmes, Dean Kereiakes, Bryan Kluck, James B. Hermiller, Barry S. George, Stephen Ellis, Dilsher M. Nawaz, Richard E. Kuntz. *Washington Hospital Center, Washington, D.C., USA*

Background: A recent multicenter double-blind randomized trial (Gamma I) demonstrated a very significant (>50%) reduction in angiographic restenosis after interventional treatment of native coronary in-stent restenosis (ISR) lesions followed by gamma (Ir-192) coronary radiation therapy (CRT). Importantly, a clear dose-response relationship was present using a variable radiation dosing regimen (mean 13.5 Gy) based upon intravascular ultrasound measurements.

Methods: To determine if a slightly higher fixed dose regimen (14 Gy @2 mm from the source center) improves simplicity and efficacy of CRT for ISR, 125 patients with the same inclusion criteria were enrolled in the same 12 investigational sites for comparison with the CRT and placebo arms of the previous Gamma I trial (252 pts). Follow-up includes angiography @6 mos and clinical events @30 days and 9 mos.

Results: Baseline demographics and lesion characteristics were well matched between the Gamma *I and II* patient cohorts. Mean age was 60 years, 78% were men, 38% were diabetics, 35% had prior MI, and 57% had FC III or IV angina. Lesion length was 20.3 ± 11.8 mm and reference

vessel size was 2.76 ± 0.50 mm. After ISR treatment with combinations of balloon PTCA, athero-ablative techniques, and additional stents (at the operator's discretion), final in-stent % diameter stenosis was 17.2 ± 17.3% and minimal lumen diameter was 2.37 ± 0.52 mm. In hospital and 30-day clinical events were infrequent (death, MI, and repeat revascularization was 1.6% in-hospital and 4% @30 days) and similar to Gamma I patients.

Conclusions: A slightly higher fixed dose radiation regimen used in the Gamma II trial, simplified the application of CRT and was safe with few early clinical events. Long-term angiographic and clinical outcomes will be presented and compared with similar CRT and placebo patient cohorts from Gamma I.

5:00 p.m.

854-5 One Year Follow-Up After Intravascular Radiation Therapy Following Balloon Angioplasty of Narrowed Femoral-Popliteal Arteries. Results of the PARIS Feasibility Clinical Trial

Ron Waksman, John R. Laird, Alexandra J. Lansky, Abdel Brahimi, Larry R. White, Claudine T. Jurkovitz, Andrej S. Kosinski, Nancy Murrah, William S. Weintraub. *For the PARIS Investigators; Washington Hospital Center, Washington, DC; Emory University, Atlanta, GA, USA*

Restenosis is a major limitation of the clinical utility of Percutaneous Transluminal Angioplasty (PTA) of superficial femoral-popliteal arteries (SFA). The feasibility trial of the PARIS (Peripheral Arteries Radiation Investigational Study) is a multicenter open label registry.

Methods: Forty-one patients with claudication were enrolled in the study and 6 were excluded (5 due to technical problems in delivering the radiation to the PTA site). Mean lesion length was 9.8 ± 3.0 cm and mean reference vessel diameter was 5.2 ± 3.1 mm. Following successful PTA, a segmented centering balloon catheter was positioned to cover the PTA site. The patients were transported to the radiation oncology suite and treated with a High Dose Rate microSelectron Afterloader using 192-Ir source with a prescribed dose of 14 Gy, 2 mm into the vessel wall. Ankle Brachial Index (ABI) was evaluated at 1, 6, and 12-month and angiographic follow-up was performed at 6 month.

Results: Radiation was delivered successfully to 35/40 patients. There were no procedural complications. Exercise and rest ABI were higher at one year (0.74 ± 0.26; 0.89 ± 0.18) compared to the baseline prior to PTA (0.55 ± 0.28; 0.67 ± 0.19) ($p < 0.03$). Maximum walking time on treadmill increased from 3.56 ± 2.7 to 4.62 ± 2.7 minutes at 30 days and was 4.04 ± 2.8 minutes at 12 months, P = 0.01. Angiographic binary restenosis at 6 months was 10% and the clinical restenosis at 12 months was 13.3%. There were no perforations, aneurysms or any other adverse events related to the radiation.

Conclusions: Intra-arterial radiation following PTA to SFA lesions using high dose rate gamma radiation is feasible and safe. The angiographic and clinical improvements are sustained at one year and promise to be a potent anti restenotic therapy for the treatment of peripheral arteries.

5:15 p.m.

854-6 A New Phosphorus-32 Balloon Catheter Device for Intracoronary Brachytherapy – Results From the Porcine Stent Model

Jörg Hausleiter, Maurice Buchbinder[1], Brett Trauthen[2], Lisa Tam[2], Alex Li, James Whiting. *Cedars-Sinai Medical Center, Los Angeles, CA; [1]Sharp Memorial Hospital, San Diego, CA; [2]Radiance Medical Systems, Irvine, CA, USA*

Background: Intracoronary radiation devices using β- and γ-emitting sources, have been shown to reduce neointima formation in porcine models of restenosis. However, most devices have drawbacks with respect to dose uniformity, centering within the coronary artery, personnel exposure or risk of isotope leak or spill. We have developed a new radiation delivery catheter system using an ultra-thin, β-emitting P^{32} sheet source, which is encapsulated into the balloon material to form a flexible cylindrical radioactive balloon source. The feasibility, safety and efficacy of this new balloon device is evaluated in a porcine stent model of restenosis.

Methods: The non-blinded, controlled study protocol included oversized coronary stent placement followed by radiation therapy or sham treatment in 17 LAD arteries. For radiation therapy a dose of 20 Gy at 1.0 mm distance from the balloon surface was given using the new P^{32} balloon system in 9 arteries. Sham treatment with identical but non-radioactive balloon catheters was performed in 8 arteries. Follow-up angiography and histomorphometric analysis will be performed after 28 days.

Results: Radiation treatment with the new P^{32} balloon device was performed without complications. One pig in the radiation group died within 24 hours after the procedure. No leakage of isotope was detected. The radiation dose at the chest of the pig was 1 to 1.2 mR/hr, the personnel exposure was 0.01 mR/hr.

Conclusions: Intracoronary radiation therapy using a new P^{32} balloon catheter device is feasible and safe. The radiation exposure to the catheterization laboratory personnel is negligible. Final angiographic and histomorphometric analysis will be presented.

ORAL

862 Novel Catheter-Based Imaging Methods to Assess Plaque Stability II

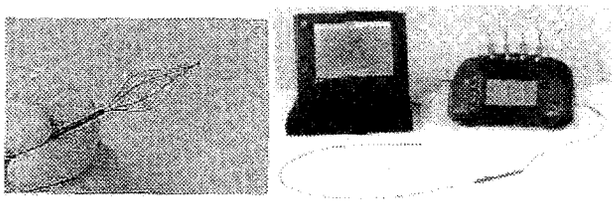
Tuesday, March 14, 2000, 8:30 a.m.–10:00 a.m.
Anaheim Convention Center, Room 207A

8:30 a.m.

862-1 Thermosensor Catheter; a Nitinol Shape Memory Basket Catheter to Measure Temperature of Vessel Wall With Continuous Blood Flow

Morteza Naghavi, Said Siadaty, James T. Willerson, Ward Casscells. *University of Texas Houston, School of Medicine, TX, USA*

We have previously correlated temperature of atherosclerotic plaque with histopathological characteristics of vulnerability to rapture. We found that inflamed unstable plaques give off more heat. Others have recently correlated plaque temperature with patients' clinical presentation. In order to monitor temperature of vessel wall without occluding blood flow we have developed an intravascular thermosensor catheter. Here we report the specifications of the catheter along with proof of principle m our canine model of atherosclerosis. The system comprises a 3F catheter, an ultra-thermometer, and a PC for thermographic imaging. An expandable basket is made of 4 hollow nitinol wires (ID:0.008 inch, OD:0.012 inch) with 0.005 inch NTC thermistor built-in at the end of a hollow shaft connecting the basket to the ultra-thermometer and carrying insulated wires. Having an extra thermister on the shaft of the catheter enables monitoring temperature of blood simultaneously. The system has a temperature resolution of 0.005 C and spatial resolution of 0.5 mm with 0.01 sec acquisition time. The blood side of the lead wires and the thermistors are coated with thermal insulating material. Upon release from a guiding or a delivery catheter, the basket opens, expands and contacts the wall to measure its temperature. The number and size of wires m the basket can be modified to pass through a guide wire lumen of an angioplasty catheter allowing measurement of temperature before and after occlusion of blood flow.



We have, thus far, tested the catheter in 5 atherosclerotic canine peripheral and coronary, arteries in vivo. The catheter detected significant temperature heterogeneity in areas with lesions and no complications have been noted.

8:45 a.m.

862-2 Efficacy of Intravascular Ultrasound Radio-Frequency Signal Analysis in Evaluation of Coronary Atherosclerotic Plaques Compared With Conventional Video Images

Nobuyuki Komiyama, Yutaka Yamamoto, Yoshiaki Masuda, Gerald J. Berry, Paul G. Yock, Peter J. Fitzgerald. *Chiba University Hospital, Chiba, Japan; Stanford University School of Medicine, Stanford, CA, USA*

Background: Conventional gray-scale intravascular ultrasound (IVUS) images cannot accurately differentiate histologic subtypes of sonolucent coronary plaques with or without a lipid core. To overcome this limitation, we applied radio-frequency (RF) signal analysis to IVUS.

Methods: Five atherosclerotic human coronary artery specimens were harvested at five transplanted hearts and pressure-fixed by formalin. RF signals were obtained from 24 regions of interest (ROI) within plaques acquired by a 30 MHz catheter-based IVUS system and digitized at 500 MHz in 8-bit resolution. The ROIs were histologically categorized into 12 preatheroma without a lipid core (Core (−)) and 12 atheroma with a lipid core ± a fibrous cap (Core

(+)). Integrated backscatter (IB) and parameters of RF envelope probability distribution function (mean-to-standard-deviation ratio (MSR), skewness and kurtosis) were calculated by off-line analysis of RF from 347 vectors of Core (–) and 362 vectors of Core (+). In Core (+), %area of a lipid core (%CoreArea) in each ROI was measured in a digitized histologic image by a computerized planimeter. On the other side, IVUS video images of all ROIs were visually classified into two groups with or without a lipid core by 5 interventional cardiologists blinded to both RF signals and histology.

Results: 1) Sensitivity and specificity for a lipid core were shown below:

cut-off value	IB −54.5 dB	MSR 1.80	skewness 0.5	kurtosis −0.35	visual video-image analysis
Sensitivity (%)	58.3	83.3	100	100	53.3
Specificity (%)	75.0	91.7	91.7	91.7	71.7

2) % CoreArea was significantly correlated to IB, MSR, skewness and kurtosis ($r = -0.64, -0.73, 0.78$ and 0.63; $p < 0.05$).

Conclusion: Compared with IVUS video images, the parameters of RF signal analysis can be used for more accurate detection and quantitative evaluation of a lipid core, one of major factors of a "vulnerable" coronary plaque.

9:00 a.m.

862-3 Unstable Coronary Atherosclerotic Plaques: Intracoronary Ultrasound Characteristics With In Vivo Measurement of Culprit Lesion Temperature

Konstantinos Toutouzas, Christodoulos Stefanadis, Manolis Vavuranakis, Leonidas Diamantopoulos, Eleftherios Tsiamis, Pavlos Toutouzas. *Hippokration Hospital, University of Athens, Greece*

Background: Recent studies have shown positive remodeling to be present in the majority of culprit lesions of patients (pts) with acute coronary syndromes (ACS). Moreover, inflammatory process has been documented in these lesions which is associated with increased cellular and matrix expression leading to heat production. Therefore, we assessed culprit lesions characteristics in pts with stable angina and ACS, and correlated coronary arterial remodeling findings with the temperature (T).

Methods: Twelve coronary lesions of pts with ACS and 13 lesions of pts with stable angina were studied. Lumen and external elastic membrane (EEM) areas were measured at both target lesion and proximal reference sites by intracoronary ultrasound before intervention. The remodeling index was defined as the ratio of the EEM area at the lesion to that at the proximal site. Positive and negative remodeling were defined as indices of >1.05 and <0.95, respectively and plaque area as: EEM area-lumen area at the lesion. Additionally, in all pts T was measured at the culprit lesion and at the normal vessel wall by a thermography catheter that was developed in our institution and the T difference was calculated.

Table: Pts With Positive Remodeling

	ACS	Stable Angina	p value
EEM Proximal Area (mm^2)	14.2 ± 3.6	19.9 ± 9.1	0.07
Plaque Area (mm^2)	12.08 ± 4.1	9.97 ± 3.2	0.05
EEM Stenosis Area (mm^2)	15.5 ± 2.6	19.4 ± 8.7	0.02
Remodeling Index	1.17 ± 0.2	1.01 ± 0.03	0.02
T difference	0.22 ± 0.17	0.03 ± 0.03	0.001

Results: (Table) Pts of both groups were similar in age, reference vessel size, and percent diameter stenosis. Positive remodeling was more frequent in pts with ACS (64% vs 23%, $p < 0.01$). In addition there was a good correlation between remodeling index and difference in plaque temperature in pts with ACS ($r = 0.68$, $p < 0.001$).

Conclusion: The results of this study show that coronary remodeling is greater in culprit lesions of pts with ACS. This is associated with increased T probably as a result of cellular and matrix production. These findings provide new insights about the involvement of inflammation in the pathogenesis of ACS.

9:15 a.m.

862-4 Determining the Thermal Heterogeneity of a Model Vessel Wall by Pulsed Laser Irradiation: A Experimental Attempt to Detect Vulnerability of Atherosclerosis

Takemi Matsui, Tsunenori Arai, Shunichi Sato, Minoru Suzuki, Toshiaki Ishizuka, Makoto Kikuchi, Akira Kurita. *National Defense Medical College, Tokorozawa, Saitama, Japan*

Background: Human atherosclerotic plaques have been shown to display thermal heterogeneity with elevated temperature associated with culsters of macrophages, suggesting a possible modality for detecting vulnerable plaques. The temperature of plaques can not be measured by using conventional thermistors because of fibrous caps of the intimal surface.

Methods: We developed a method to determine the thermal heterogeneity of vessel walls using a phantom agar model. Light absorption coefficients of the agar vessel wall were adjusted to simulate the coefficients of the arterial intima, the atheromatous core and the media. The temperature of the middle layer in the agar vessel wall (corresponding to the atheromatous core) was calculated from the measured temperature changes of the model surface (corresponding to the arterial intima) under pulsed neodymium yttrium aluminum garnet (Nd:YAG) laser irradiation at 3W for 0.1 seconds. The middle layer was heated with electric current to simulate temperature elevation derived from inflammation. The thermal heterogeneity of the agar vessel wall can be obtained by solving the heat transform equation using the upper layer thickness, the surface temperature and the boundary temperature at 1 mm above the model surface.

Results: The upper layer thickness, D, can be calculated using the following working formula: $D = 1–0.3\Delta Ts + 0.02\Delta Ts^2$, where ΔTs denotes the surface temperature change. There was a significant highly correlation between the calculated temperature of the middle layer (the atheromatous core) and the measured temperature of the middle layer ($r = 0.98$, $p < 0.0001$).

Conclusion: This new method can provide us to measure plaque heat accurately despite fibrous caps coveting atheromatous plaques.

9:30 a.m.

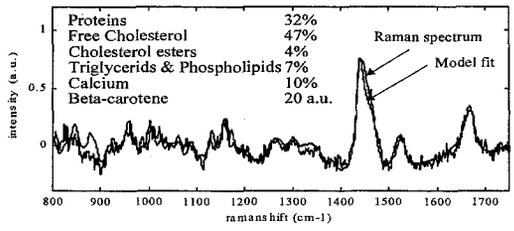
862-5 Raman Spectroscopy Provides Characterization of Human Atherosclerotic Plaque Composition *In Vivo*

Sweder W.E. van de Poll, Hendrik P.J. Buschman, Michel J. Visser, J. Hajo van Bockel, Arnoud van der Laarse, Albert V.G. Bruschke, Gerwin J. Puppels. *Leiden University Medical Center, Leiden; Erasmus University, Rotterdam, The Netherlands*

Background: Raman spectroscopy has shown to provide important diagnostic information on plaque composition *in vitro.* We tested the applicability of Raman spectroscopy *in vivo* during abdominal aortic surgery.

Methods: We used a clinical Raman system that delivers 830 nm laser excitation light through a Raman optical fiber probe. During abdominal aneurysmectomy, performed on a 58 year old man, the tip of the Raman probe was positioned perpendicularly onto the opened, diseased aortic wall. Raman spectra were then collected in 10 seconds, shining 80–100 mW laser light at the aorta. The spectrally examined tissue was then excised for histological examination. Spectra were modeled to extract quantitative chemical information (Circulation 1998; 97: 878–885).

Results: We collected Raman spectra with a good signal to noise ratio to determine the chemical composition of the atherosclerotic aneurysm (fig).



Conclusion: Raman spectroscopy can be applied successfully for remote, *in vivo* characterization of human atherosclerotic plaque. It can accurately quantify the amount of proteins, cholesterol and calcium and may prove an ideal technique to help identify plaques prone to rupture.

9:45 a.m.

862-6 Optical Coherence Tomography of Human Coronary Arteries: A New Imaging Modality to Visualize Different Components of Plaques

Guillermo J. Tearney, Ik-Kyung Jang, Dong-Heon Kang, H. Thomas Aretz, Stuart L. Houser, Thomas J. Brady, Kelly Schlendorf, Milen Shishkov, Brett E. Bouma. *Massachusetts General Hospital, Boston, MA, USA*

Background: Optical coherence tomography (OCT) is a catheter-based, cross-sectional optical imaging technique with high resolution (10 μm). The goal of this investigation was to correlate OCT images of human coronary arteries with histology.

Methods: Cadaveric coronary artery segments (n = 42) were obtained from 11 patients: 17 segments contained intimal hyperplasia only (Group A) and 25 segments contained atherosclerotic plaques (Group B). OCT images were obtained using a 3F or 7F OCT catheter and histologic examination was performed.

Results: In Group A, the internal elastic lamina was clearly visualized in 11/17 (65%), while the external elastic lamina was identified in 10/17 (59%). In Group B, a lipid pool was identified in 15/25 (60%). Fibrous cap thickness was measured by OCT (30–450 μm). The correlation between OCT and histology was high for measured cap thickness (r = 0.98).

Conclusion: OCT imaging identified different components of plaques with a high correlation to histology. This high resolution imaging technique may be used in the future for early detection of vulnerable plaques.

POSTER

1129 Percutaneous Interventions: Miscellaneous I

Tuesday, March 14, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1129-75 Acute Renal Failure Requiring Hemodialysis After Percutaneous Coronary Intervention: In-Hospital and One-Year Outcomes

Luis Gruberg, Roxana Mehran, George Dangas, Gregg W. Stone, Mun K. Hong, Gary S. Mintz, Ron Waksman, Ran Kornowski, Alexandra J. Lansky, Kenneth M. Kent, Augusto D. Pichard, Lowell F. Satler, Martin B. Leon. *Washington Hospital Center, Washington, D.C., USA*

Background: Acute hemodialysis due to acute renal failure (ARF) is a rare but important complication after percutaneous coronary intervention (PCI). From a total of 12,054 patients who underwent PCI at our institution, we have analyzed the clinical characteristics and outcome of 52 consecutive patients (0.4%) who underwent PCI and developed ARF that required emergency hemodialysis.

Results: Mean age was 71 years (range 39–90), 42% were female, 62% diabetics (37% insulin treated), 84% had prior renal insufficiency (serum creatinine $\geq$ 1.5 mg/dL, mean 2.7 $\pm$ 1.5 mg/dL), 60% prior MI and 48% prior CABG. Left ventricular ejection fraction was 35 $\pm$ 13%. Low-osmolar contrast material was used in 94%. Angiographic success rate was 100% and procedural success 82%. Patients remained in the hospital after the procedure for 15.5 $\pm$ 10.3 days, with 7.3 $\pm$ 7.0 days in the intensive care unit. During hospitalization mortality rate was 25.5%. At one-year follow up, mortality rate was 54.6%, Q-wave MI 16.7% and major adverse cardiac events (MACE) (death, MI and target lesion revascularization), 61.4% (hierarchial). At discharge 31% of the patients were on dialysis and at one-year follow-up 23% remained on dialysis.

We conclude: Although the likelihood of ARF that requires emergency hemodialysis after PCI is low (0.4%), it is associated with: 1) a prohibitive in-hospital and one-year mortality 2) a dramatic increase in hospital resource utilization and 3) 23% require permanent hemodialysis therapy.

1129-76 Catheter Closure of Patent Foramen Ovale: Single Center Experience With the Cardioseal and the New Cardioseal-Starflex Occluder

Horst Sievert, Ulrike Krumsdorf, Kathrin Horvath, Patrick Keppeler, Rainer Schäder, Andreas Fach, Hartmut Merle, Hans Spies, Detlef Scherer, Roland Ensslen, Harald Zeplin. *Cardiovascular Center Bethanien CCB, Frankfurt, Germany*

Background: Catheter closure of patent foramen ovale (PFO) has been proposed to prevent recurrent paradoxical embolism. We used the Cardioseal and the Cardioseal-Starflex ASD occluder in this indication.

Methods: Transcatheter PFO closure was attempted with a Cardioseal (n = 22) or a Cardioseal Starflex (n = 3) occluder in 25 patients. The age ranged from 26 to 75 years (mean 49 $\pm$ 14). 41 embolic events occurred in these 25 patients prior to PFO closure. The diameter of the PFO, measured with a balloon, ranged from 6 to 17 mm.

Results: The implantation of the device was successful in all patients. The device diameter was 17 mm in 7, 23 mm in 15 and 28 mm in 31 patients. The procedure could be performed without general anesthesia in 18/25 patients. Mean X-ray time was 7.5 $\pm$ 2.4 min. including balloon sizing of the defect. Transoesophageal echocardiogram (TOE) showed a small residual shunt in 7 Cardioseal patients which persisted in one patient. No complications occurred during the procedure. The advantage of the Starflex occluder was a better apposition of the arms to the septum. In one Cardioseal patient an asymptomatic left sided thrombus was detected on the device by a routine TOE. During follow-up of 1 to 21 months (mean 15.7 $\pm$ 6.4) no further embolic events and no complications occurred.

Conclusion: PFO closure with the Cardioseal and the Cardioseal-Starflex ASD occluder is a safe procedure and prevents further i embolic events.

1129-77 Cost Effectiveness of Digital vs. Analogue Archiving of Diagnostic Cardiac Catheterization

Matthew E. Oetgen, Gishel New, Stephen Balter, Emily J. Lawrence, Issam Moussa, Sriram S. Iyer, Michael B. Collins, Jeffrey W. Moses. *Lenox Hill Heart and Vascular Institute, New York, NY, USA*

Background: The utility of digital technology in the cardiac catheterization laboratory can range from hospital wide picture archiving systems to merely recording individual cases on compact disc (CD). Whether the conversion from analogue to digital technology is cost effective is unknown. Therefore, the aim of our study was to determine the difference in direct costs of digital versus analogue media, for the storage of diagnostic coronary angiograms.

Methods: The procedural cost of producing a diagnostic angiogram in a digital lab (CD) was compared with the procedural costs in a conventional lab (cineangiogram), at our institution. We calculated direct costs for all diagnostic coronary angiograms performed by three physicians, between May 1998 to February 1999, in these two labs (n = 109). The direct procedural costs for each case was determined from five economic variables: the length of procedure, contrast media used, angiographic equipment, cost of recording media, and x-ray imaging equipment. We also calculated the direct procedural costs of these cases excluding the recording media costs.

Results: The costs are shown in the table below.

Media Cost	Mean Cost in Cine Room ($)	Mean Cost in CD Room ($)	P-Value
Included	1102	1087	**<0.001**
Excluded	1079	1080	0.931

Conclusion: This study shows there is a significant procedural cost saving in a catheterization laboratory that uses digital CD's versus cineangiogram. The cost saving is due to the reduced cost associated with the use of CD's as the recording media for diagnostic coronary angiograms. Transition from conventional to digital archiving of catheterizations may offer significant cost savings in even low volume, cardiac catheterization laboratories.

1129-78 Telecommunications System to Support Percutaneous Coronary Intervention at a Hospital Without Cardiac Surgical Services

Henry H. Ting, Kirk N. Garratt, Jack T. Cusma, Katherine L. Boutchee, Joseph A. Dearani, Douglas L. Wood, David R. Holmes Jr.. *Mayo Clinic, Rochester, MN, USA*

Background: Percutaneous coronary intervention (PCI) is usually performed in hospitals with cardiac surgery services (CSS). With careful patient and lesion type selection, urgent cardiac surgery is needed in <1.0% patients in the current era. We sought to examine the safety and success of PCI at a hospital without on-site CSS.

Methods: Immanuel St. Joseph's Hospital (ISJ), Mankato, MN has a fully equipped cardiac catheterization laboratory, but does not possess on-site CSS. ISJ is located 85 miles from the nearest tertiary medical center with CSS, St. Mary's Hospital (SMH), Rochester, MN. To facilitate PCI locally, ISJ was connected to SMH via a dedicated T3 fiberoptic line having a maximal data transfer rate of 45 megabits per second. Digital angiographic images, hemodynamic data, intravascular ultrasound images, and video images of the ISJ laboratory were transmitted real-time during PCI procedures to SMH via the T3 line.

Results: Elective patients classified as low clinical risk and possessing type A and B1 lesion characteristics were eligible for PCI at ISJ. In the first 5 months, 30 patients underwent PCI at ISJ with consultative support from SMH. All 30 patients underwent successful PCI procedures. There were no in-hospital complications including death, myocardial infarction, or urgent revascularization. One patient developed an expanding hematoma treated conservatively and did not require vascular surgical repair. Glycoprotein 2b/3a inhibitors were used in 26 (87%), intravascular ultrasound in 6 (20%), and fractional flow reserve in 4 (13%) of the cases. At 30 days follow-up, 1 patient underwent surgical revascularization and 1 patient underwent PCI for an unrelated vessel.

Conclusion: Elective PCI can be performed safely and successfully at a hospital without on-site CSS utilizing a dedicated, high-resolution telecommunications system to provide consultative support. Further study is needed to define the potential of this system to expand PCI to hospitals without on-site CSS.

1129-79 A Randomized Controlled Trial of Groin Shielding During Catheter Ablation and Cardiac Catheterization

Alan Kadish, Annie Palmer, Zachary Yablon, Andi Schaechter, Jeffrey Goldberger, George Horvath, Rod Passman, Charles Davidson. *Northwestern University, Chicago, Illinois, USA*

Groin shielding typically used in selected patients during cardiac catheterization to decrease gonadal radiation exposure. However, data supporting decreased radiation exposure are lacking and concerns regarding peri-shield scatter exist. In 47 patients undergoing catheter ablation (n = 15) or cardiac catheterization and/or angioplasty (n = 29), patients were randomized to groin shielding (n = 24) or no groin shielding (n = 23) during the procedure. The mean total fluoroscopy time for the procedure was 20.02 ± 18.4 minutes. Mean patient age was 54 ± 14 years. There were 32 men. Radiation exposure was corrected for fluoroscopy time and values below are shown millirems per minute (mRem/min) of flourosopy time. There was no significant difference in back radiation exposure between patients with and without the shield (1127 ± 2585 mRem/min) with shield vs. 916 ± 1608) mRem/min in unshielded patients. Gonadal radiation exposure was low with or without shield (1.9 ± 3.3 mRem/min), (2.3 ± 3.7 mRem/min). Radiation exposure on the leg just below the groin shield was also low both with and without the shield (6.1 ± 1.6 in patients who were unshielded and 3.0 ± 10.1 mRem/min patients with shielding). Radiation exposure just cranial to the shield was similar in patients with (1.1 ± 2.5 mRem/min) and without (0.6 ± 2.1 mRem/min) groin shielding.

In summary, although groin shielding does not increase radiation exposure due to radiation scatter, there is no systematic decrease in gonadal radiation exposure with the use of shielding. Radiation exposure to the gonadal region during cardiac catheterization is without shielding. Thus, groin shielding while not deleterious, does not confer any clinical benefit.

1129-80 Patient Radiation Exposure Related To Complexity of Coronary Interventional Procedures

Jacob Federman, Jack T. Cusma, David R. Holmes. *Mayo Clinic, Rochester, Minnesota, USA*

Background: Increased complexity of coronary interventional procedures (CI) may lead to increased patient (Pt) X-ray exposure, particularly if multiple procedures are required. Our aim was to assess the current Pt radiation exposure related to procedural complexity.

Methods: The radiation exposure of 245 Pts having 253 CI over an 8 week period commencing Dec 98 was monitored using a Pt Exposure Monitoring Network (PEMNET) System. Procedures were assessed for complexity related to lesion factors (site, severity, number, calcification, thrombus) and procedural factors (coronary angioplasty (PTCA), 1º or 2º stent, rotablator or complications). Procedures were given an overall grade of 1–3 related to their complexity.

Results:

	CI No	Fluoro (min)	Cine (min)	Total Dose Rad (R)	P Value
All CI	253	21.6 ± 14.5	1.2 ± 0.6	343.3 ± 216.3	
PTCA alone	28	19.7 ± 14.0	1.0 ± 0.4	361.2 ± 204.2	
Coronary Stents	214	21.3 ± 14.4	1.3 ± 0.6	339.7 ± 221.1	
1 stent	116	17.4 ± 12.6	1.2 ± 0.6	274.2 ± 216.6	
2 stents	72	24.2 ± 13.8	1.3 ± 0.6	392.6 ± 187.7*	0.0001
≥3 stents	26	31.0 ± 17.0	1.7 ± 0.6	485.5 ± 225.2*	0.06
1º stenting only	68	13.7 ± 8.3	1.0 ± 0.5	233.7 ± 141.5*	<0.0001
2º stenting only	117	24.6 ± 16.1	1.3 ± 0.6	376.6 ± 246.2	
Rotablator	26	31.5 ± 16.5	1.1 ± 0.6	386.9 ± 191.7	
Grade 1	70	11.7 ± 6.5	0.9 ± 0.4	204.4 ± 115.8	
Grade 2	127	20.5 ± 10.8	1.3 ± 0.5	337.3 ± 52.1*	<0.0001
Grade 3	56	36.6 ± 17.1	1.5 ± 0.7	530.4 ± 290.9*	<0.0001

Exposure was particularly high for bifurcation lesions (n = 11) and total occlusions (n = 39) with radiation dosage being 613.8 ± 258.5 (p = 0.001) and 469.0 ± 308.39 (p = 0.018) respectively. Lesion calcification (n = 19) or presence of thrombus (n = 65) did not significantly increase radiation exposure.

Conclusion: Pt radiation exposure is significantly increased in long complex interventional procedures; close monitoring of fluoroscopy (Fluoro) and cine time is critical to prevent potential radiation complications.

1129-81 Scanning-Beam Digital X-Ray System Significantly Reduces X-Ray Exposure for Cardiac Angiography

Michael S. Van Lysel, Matthew R. Wolff, Timothy E. Tanke, Michael A. Speidel, Timothy D. Betts, Joseph A. Heanue, Brian P. Wilfley, Jerry Pretti. *University of Wisconsin, Madison, WI; Cardiac Mariners, Inc., Los Gatos, CA, USA*

Background: As fluoroscopically-guided interventional procedures become more prevalent and more complex, the high x-ray exposure delivered to both the patient and the medical staff is of increasing concern.

Methods: A prototype scanning-beam digital x-ray (SBDX) system has been constructed and is being tested. SBDX uses an electronically scanned x-ray source, producing a narrow x-ray beam which scans the patient at up to 30 frames/sec. Transmitted x-rays are detected by a 5.4-cm × 5.4-cm solid-state, direct-conversion, photon-counting device. The goal of SBDX is to provide equivalent image quality as conventional image intensifier based cardiac angiographic systems at substantially lower x-ray exposure. Ten patients were imaged with SBDX after the conclusion of their diagnostic examinations on a conventional image intensifier based system.

Results: Patient entrance exposure with SBDX averaged 7.5 times lower than with the conventional system. Models attribute 4x of this reduction to the exposure-saving design of the SBDX system. The remainder is attributed to limited x-ray output of the prototype x-ray source. Efforts are underway to boost both source output and detector efficiency. Increased detector efficiency will result in further exposure-savings.

Conclusion: SBDX technology promises to significantly reduce the x-ray exposure required for fluoroscopically-guided interventional procedures.

1129-82 Revascularization of the Internal Mammary Artery Graft: In-Hospital and One-Year Outcomes

Luis Gruberg, Roxana Mehran, George Dangas, Mun K. Hong, Alexandra J. Lansky, Gary S. Mintz, Ron Waksman, Ran Kornowski, Kenneth M. Kent, Augusto D. Pichard, Lowell F. Satler, Gregg W. Stone, Martin B. Leon. *Washington Hospital Center, Washington, D.C., USA*

Background: Due to the increased use of the internal mammary artery (IMA) as the conduit of choice for coronary artery bypass surgery (CABG), there is a growing need for percutaneous revascularization of this artery.

Methods: We analyzed the clinical and angiographic characteristics, as well as the in-hospital and one-year outcomes of 207 consecutive patients who underwent percutaneous revascularization of the IMA.

Results: Mean age was 64 ± 10 years (range 36–91), 69% male, 33% diabetics, 60% with prior MI, and 27% with peripheral vascular disease. Left ventricle ejection fraction was 42 ± 13%. 63% of the lesions were located at the anastomosis site, 30% at the shaft and 7% at the IMA ostium. Procedural success was 97% (unable to cross or deliver the device in 3%); By quantitative coronary angiography, the reference vessel diameter was 2.1 ± 0.6 mm, the pre-intervention minimal lumen diameter (MLD) was 0.68 ± 0.52 mm, and the final MLD was 1.66 ± 0.62 mm (p < 0.001 vs. pre-intervention).

Clinical outcomes:	In-Hospital	One-Year
Death	1.0%	4.3%
Q-wave myocardial infarction (MI)	0	0.5%
Non Q-wave MI	11.1%	1.4%
Emergent or urgent CABG	1.0%	0
Target lesion revascularization (TLR)	5.3%	10.1%
Death/MI/TLR	1.9%	14.5%

Conclusions: Revascularization of the IMA graft can be performed with high procedural success and a low rate of major in-hospital complications. At one-year follow-up, clinical event rates are low despite a small vessel size of the IMA.

1129-83 Lack of Correlation Between Angiographic Collateral Grading and Myocardial Perfusion and Function: Implications for the Assessment of Angiogenic Response

Shmuel Fuchs, Matie Shou, Richard Baffour, Anthony Pierre, Martin B. Leon, Stephen E. Epstein, Ran Kornowski. *The Cardiovascular Research Foundation, Washington Hospital Center, Washington, D.C., USA*

Background: Angiographically apparent collaterals (AAC) have been proposed to reflect angiogenic response that may enhance myocardial perfusion and function in ischemic myocardium. The relationship between AAC with quantified myocardial blood flow and regional contractility in chronic ischemic myocardium has not been well established. We studied those relationships in a pig model of chronic myocardial ischemia.

Methods: Angiographic collateral assessment (visually graded as 0 to 3) was performed @4 weeks following ameroid placement around the left circumflex artery in pigs (n = 27). Fluorescent microspheres (4×10^6) injected into the left atrium were used to quantify regional endocardial, epicardial, and transmural myocardial blood flow (MBF) and echocardiography was used to assess % regional myocardial thickening (%MT) at rest and stress (pacing @180 beats/min) in the collateral dependent (LCx artery) region.

Results: No significant correlation was found between endocardial, epicardial or transmural MBF and AAC grading (Table). MBF but not AAC significantly correlated with % MT @rest according to the formula:

$\%\ MT = 0.06 + 0.42 \times MBF_{transmural}$ ($r = 0.39$, $p = 0.047$).

Collateral Grade (# animals)	0–1 (12)	2 (8)	3 (14)	P
MBF @rest (ml/gm/min)				
Endocardial	0.48 ± 0.13	0.49 ± 0.12	0.53 ± 0.15	0.74
Epicardial	0.52 ± 0.10	0.50 ± 0.09	0.53 ± 0.10	0.78
Transmural	0.50 ± 0.11	0.49 ± 0.10	0.53 ± 0.12	0.83
MT (%)				
Rest	24.7 ± 5.2	28.6 ± 15.4	27.6 ± 13.2	0.77
Paced	20.0 ± 11.0	12.4 ± 16.0	12.6 ± 11.4	0.35

Conclusions: Visual angiographic assessment of collateral vessels may not correlate with myocardial perfusion and function. Thus, AAC assessment should not be considered as a primary endpoint in clinical studies designed to enhance myocardial perfusion in ischemic regions.

POSTER

1130 Coronary Stenting: Outcomes

Tuesday, March 14, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1130-84 Evolving Patterns of Coronary Stenting: Report from a Large National Database

Sameer Mehta, Richard R. Heuser, Salvatore L. Battaglia, April W. Simon, Steven D. Culler, Edmund R. Becker. *Columbia HCA, Nashville, TN; Emory University, Atlanta, Georgia, USA*

Background: In recent years, there has been significant evolvement in the practice of coronary stenting. Our purpose is to highlight key changes and improvements in stent practice in 70 catheterization laboratories over an eighteen-month period using the Operational Effectiveness Program (OEP™) reporting system.

Methods: 21,166 consecutive stent patients were analyzed for the period July 1997 thru December 1998. Twelve indices of stent activities were examined (although all indices are not reported because of space limitations).

Results: As shown in the table, procedures times and total times have dropped 14 and 16 minutes over the study period ($p < 0.05$). Devices per patient have dropped by half a device per patient ($p < 0.05$). The proportion of patients experiencing an abrupt closure or an emergency CABG has been cut in half ($p < 0.01$). Stent success rates, stents per vessel, stents per patient, total direct variable costs, and mortality rates have all remained stable over the study period.

	Q3-97	Q4-97	Q1-98	Q2-98	Q3-98	Q4-98
Proc Time	82	80	72	70	70	67
Total Time	124	123	114	110	109	107
Device/Pat	6.4	6.5	6.1	6.1	6.0	5.9
Total Cost	$3637	$3940	$3764	$3799	$3690	$3724
Abrt Closure	1.0%	1.2%	1.0%	0.8%	0.5%	0.4%
Emrg CABG	0.7%	0.7%	0.6%	0.5%	0.5%	0.4%
Mortality	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%

Conclusion: Stent use patterns demonstrate significant reductions for procedure times and major complications. Monitoring process measures is a critical aspect of maintaining and improving cath lab quality.

1130-85 Randomized Comparison of 4 Different Stent Designs in 966 Stenoses

Peter B. Sick, Gunar Zindler, Rainer J. Zotz, Hans Krankenberg, Klaus W. Diederich, Bernward Lauer, Rainer Hambrecht, Oana Brosteanu[1], Gerhard Schuler. *University of Leipzig, Heart Center; [1]Institute for Medical Informatics, Statistics and Epidemiology, Leipzig, Germany*

Background: Primary success rate, incidence of early complications (stem loss, myocardial infarctions (MI), CABG, death, stent thrombosis) and long term results may be influenced by stent design.

Methods: In a prospective randomized trial four different stent designs (Micro II, AVE: Sito, Sitomed; Pura vario (PuVa), Devon Medical; Inflow. Inflow Dynamics) were compared in 966 treated stenoses of 926 patients with respect to primary success rate, incidence of complications and angiographical long term results after 6 months. A total of 1302 stents were implanted. The Micro stent arm had to be closed earlier, as stent production was stopped. Increase of %-stenosis and restenosis rate was analyzed by quantitative coronary angiography (QCA) after stent implantation and at follow up.

Results:

	Micro	Sito	PuVa	Inflow	p
treated stenoses	177	259	263	267	
primary success rate	98.9	98.1	96.2	95.5	0.12
stent loss rate	0	0.8	0	1.9	0.04
stent thrombosis	0	1.5	1.9	1.1	0.30
MI, CABG	0	0.8	1.1	1.8	0.32
Death	1.2	0.4	2.6	2.6	0.13
Δ% stenosis[median]	32.6	28.8	29.9	26.9	0.42
restenosis rate	27.1	30.5	33.8	29.4	0.55

Conclusion: Stent design seems to have no relevant influence on development of in stent restenosis, primary success rate and periinterventional complications like stent thrombosis, MI and emergency CABG. Stent loss rate. however, was significantly lower with the premounted stent system (Micro Stent) as compared with hand crimped slotted tube stents.

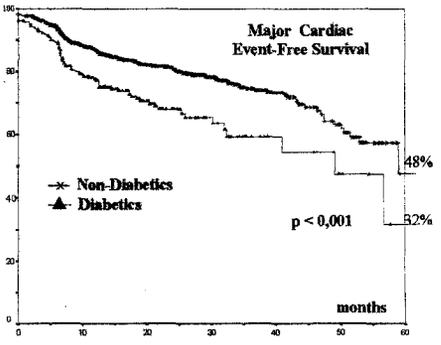
1130-86 A Less Favorable Long-Term Clinical Outcome in Diabetics Persists Despite Treatment With Intracoronary Stents

Aurea Chaves, Luiz Mattos, Ibraim Pinto, Alexandre Abizaid, Andrea Abizaid, Fausto Feres, Marinella Centemero, Luiz Tanajura, Angela Paes, Amanda Sousa, J. Eduardo Sousa. *Instituto Dante Pazzanese de Cardiologia, São Paulo, Brazil*

Background: There is controversy regarding the results of intracoronary stenting in diabetic pts.

Methods: We analyzed the event-flee survival (freedom from death, MI or any repeat revascularization) following coronary stenting of 1756 consecutive pts, comparing diabetics (n = 321) with non-diabetics (n = 1435). Clinical FU was obtained in 86% of the pts at 21 ± 13 months. Interventions for acute MI (<7 days) were the only exclusion criteria.

Results: Diabetics were older (61 ± 10 vs. 58 ± 11 years, $p < 0.001$), more often female (32 vs. 23%, $p = 0.002$) and hypertensive (64 vs. 54%, $p = 0.002$). History of smoking was less frequent in diabetic pts (52 vs. 66%, $p < 0.001$). The incidence of unstable angina showed no difference between groups (51 vs. 46%). Multivessel disease occurred more often in diabetics (31 vs. 22%, $p = 0.003$), but the frequency of LVEF < 50% was similar (39 vs. 39%). There was no difference on the incidence of ACC/AHA B2/C lesions (63 vs. 58%). Quantitative angiography showed a smaller vessel size (3.10 ± 0.4 vs. 3.17 ± 0.4 nun, $p = 0.03$), final MLD (3.08 ± 0.6 vs. 3.17 ± 0.4 mm, $p = 0.003$) and final % DS (4 ± 6 vs. 5 ± 12%, $p = 0.03$) in diabetics. Procedural success (95 vs. 97%, $p = 0.10$) and in-hospital MACE (4.0 vs. 2.3%, $p = 0.11$) were similar in both groups. At the long-term FU target lesion revascularization was significantly higher among diabetics (19.0 vs. 13.2%, $p = 0.015$). The event-flee survival is presented in the graph.



Conclusion: Coronary stenting in diabetics resulted in equivalent in-hospital outcome when compared to non-diabetics; however the long-term FU was characterized by a higher incidence of death, myocardial infarction and repeat revascularization procedures.

1130-87 Stent Implantation in Proximal Left Anterior Descending Coronary Disease is Associated With Improved 30-day, 1 and 3-Year Outcomes

James L. Velianou, Charanjit S. Rihal, Diane E. Grill, David R. Holmes Jr.. *Mayo Clinic, Rochester, MN, USA*

Background: Patients with proximal LAD coronary disease have an increased morbidity and mortality. The long-term role of stents in this group remains poorly defined.

Methods: We performed an analysis of the Mayo Clinic PTCA registry for all patients (n = 948) who underwent PTCA with stent or PTCA alone for treatment of proximal LAD disease, from 1979–98 and compared outcomes at 30-days, 1 and 3-years. Patients with AMI were excluded.

Results: Patients were well matched. The stent group had a higher procedural success rate (96.4% vs. 82.6%, p < 0.001). Stent use was associated with a significant decrease in adjusted relative risk for MACE of 0.68 (95% CI 0.53–0.88). See table for results.

Endpoint	Stent (n = 280)	PTCA alone (n = 668)	p
30-day			
Repeat Procedure %	2.8	5.1	0.27
CABG %	1.9	9.2	<0.001
Death %	1.6	1.8	0.89
Freedom from MACE %	91.2	82.5	0.004
1-year			
Repeat Procedure %	15.3	20.3	0.27
CABG %	8.2	18.4	<0.001
Death %	4.6	5.7	0.89
Freedom from MACE %	71.8	59.9	0.004
3-year			
Repeat Procedure %	26.2	24.3	0.27
CABG %	10.8	22.4	<0.001
Death %	9.6	8.7	0.89
Freedom from MACE %	57.9	52.7	0.004

Conclusion: Treatment of unselected, prognostically important proximal LAD coronary artery disease with stent versus PTCA alone is associated with lower rates of MACE, in particular CABG, at 30-days, and 3-years.

1130-88 Divergent Effects of "Discretional" vs "Mandated" Stenting on Acute Myocardial Infarction Survival in Women

Lorelei L. Grines, David A. Cox, Eulogio Garcia, James D. Johnston, Mark A. Turco, Thomas P. Wharton Jr., John J. Griffin, Joseph McGarvey Jr., Dawn Shaddinger, Mariann Graham, Judith A. Boura, William W. O'Neill, Gregg Stone, Cindy L. Grines. *William Beaumont Hospital, Royal Oak, MI, USA*

Background: In trials comparing stents to PTCA, "mandated stenting" due to the randomization process did not improve 6 month clinical outcomes for women. It is unknown whether these results are seen when operators place stents at their discretion.

Methods: To address this issue, we examined 146 females enrolled in PAMI No SOS (stents were used at the operator discretion) and 227 Stent PAMI women who were randomized to stent vs PTCA (mandated).

Results: No differences in recurrent MI or stroke was observed between the groups. When mandated stenting was applied to women, there was no reduction in ischemia driven TVR at 6 months (11.4 vs 16.8, p = 0.24) and mortality was non significantly higher. Conversely, mortality was significantly reduced after discretional stenting (table).

	Mandated (Stent PAMI)		Discretional (No SOS)	
	PTCA n = 113	Stent n = 114	PTCA n = 75	Stent n = 71
In-hospital Death	4.4%	7.0%	6.7%	1.4%
6 Month Death	5.3%	9.7%	10.7%	1.4%*

*p = 0.02

Conclusions: Although "mandated stenting" in women did not improve outcomes compared to PTCA, stents placed at the operator discretion resulted in lower mortality. These data suggest that when the operator is able to use his/her judgement, they are able to select women who are unlikely to have adverse events from stents.

1130-89 Small Vessel Stenting – Comparison of Modular vs Slotted Tube Design. Six Month Results From the EXTRA Trial

Ronald P. Caputo, Alessandro Giambartolomei, Alan Simons, Paolo Esente, Dean Keriakes, Kalon Ho, Joseph P. Carrozza. *St. Joseph's Hospital, Syracuse N.Y.; Beth Israel Hospital, Boston, USA*

Background: A slotted tube stent design has been shown to provide superior outcomes compared to a coil design, especially in smaller vessels. In order to determine the effect of modular stent design, we compared the results of stenting vessels < 3.0 mm diameter in patients randomized to either Palmaz-Schatz (PS) or the modular XT stent in the EXTRA trial.

Results: Baseline clinical and angiographic variables were similar between groups. Mean reference vessel diameter (2.66 ± 0.27 mm vs. 2.66 ± 0.24 mm; p = NS), device success, acute angiographic results and in-hospital outcomes were similar. Combined 180 day outcomes are shown.

	XT (n = 178)	PS (n = 160)	p
MACE	32 (18%)	19 (11.9%)	NS
Death	5 (2.8%)	2 (11.9%)	NS
Total MI	14 (7.9%)	5 (3.1%)	0.09
Q MI	9 (5.1%)	0	0.004
TLR	21 (11.8%)	13 (8.1%)	NS
LossIndexRatio	0.65 ± 0.45	0.65 ± 0.38	NS
Binary Restenosis	41.3%	32.3%	NS

Conclusions: Angiographic results at 180 days were comparable for modular and slotted tube stent designs for vessels < 3.0 mm diameter, however, a significantly increased incidence of Q wave MI was noted within the modular stent group. The effect of stent design on clinical outcomes following small vessel revascularization warrents further investigation.

1130-90 Comparison of Intravascular Ultrasound Guided 'Stent Like' Optimal Balloon Angioplasty and Stenting: Immediate and One Year Clinical Outcomes

Javed M. Ahmed, Sarah Pollard, Paul N. Silverton, Alex V. Zezulka, M. Wazir Baig, John Bowles, David C. Cumberland. *Northern General Hospital Sheffield, UK*

Background: Previous reports have shown that optimal stent deployment using intravascular ultrasound (IVUS) guidance results in favorable long-term outcomes. We tested the hypothesis whether in the era of stenting IVUS guided 'stent like' optimal balloon angioplasty (OBA) would have comparable clinical outcomes.

Methods: We prospectively studied 75 patients: 35 treated with OBA and 40 received stents. IVUS was performed at baseline, post intervention and @one year follow-up. Balloon size selection under IVUS guidance was based on the average of the vessel diameter of the proximal and distal reference segments in both groups. OBA result was considered when the final lesion lumen cross-sectional area (CSA) by IVUS was more than 80% of the reference vessel CSA, residual angiographic stenosis < 30% and non-flow limiting dissections.

Results: Both groups had similar baseline clinical and lesion characteristics including QCA reference vessel diameter (3.2 ± 0.7 mm vs 3.3 ± 0.9 mm, p = 0.3) and lesion length (9.9 ± 4.7 mm vs 10.1 ± 4.7 mm, p = 0.8). Final IVUS lumen CSA in OBA group was 6.2 ± 1.3 mm^2 and in the stent group was 7.7 ± 1.2 mm^2 (p = 0.02). OBA criteria was achieved in 65.7% of the patients.

	'Stent Like' OBA	Stent	p
In-hospital complications (%)	0.2	0.4	NS
TLR at one year (%)	15.0	14.2	NS
MACE at one year (%)	1.0	1.2	NS

MACE = death, Q-wave MI, CABG;TLR = target lesion revascularization

Conclusion: IVUS guided 'stent like' optimal BA compared with IVUS guided stenting in larger vessels (>3 mm) with shorter lesions (<15 mm) has similar rates of TLR and MACE at one year follow-up.

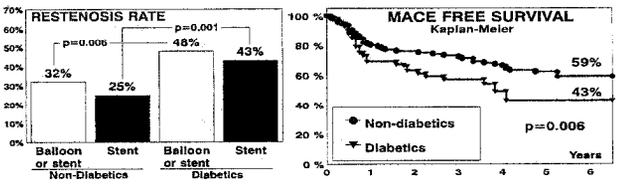
1130-91 Influence of Diabetes Mellitus on Initial and Long-Term Outcome of Stented Patients With Multivessel Coronary Disease

Joaquín J. Alonso, Juan M. Durán, Federico Gimeno, Benigno Ramos, Juan C. Muñoz, José Bermejo, Emilio García-Morán, Olga Sanz, Javier Paniagua, Francisco Fernández-Avilés. *Hospital Universitario, Valladolid, Spain*

Background: The objective of this study was to assess the influence of diabetes mellitus (DM) on restenosis and long-term prognosis after coronary stenting (CS) of pts with multivessel disease.

Methods: We compared the clinical and angiographic evolution of 94 multivessel pts with DM versus 489 non-diabetic pts. Diabetics were older (64 ± 8 vs 62 ± 10 yr, $p < 0.01$) and had more number of diseased vessel (2.5 ± 0.5 vs 2.3 ± 0.5, $p < 0.05$) and a higher rate of female gender (23 vs 13%, $p < 0.001$), hypertension (51 vs 40%, $p = 0.01$) and previous heart failure (14 vs 6%, $p < 0.01$). No other clinical or angiographic differences were found. Clinical follow-up (FU) was completed for 94% of pts at 33 ± 18 months.

Results: Coronary stenting was the only revascularization method in 70% of pts, whereas additional ballooning was required in 30% of pts, without differences between diabetic and non-diabetics. Initial clinical success (absence of death, AMI, new revascularization or hospital admission due to angina at 30 days) was similar in both groups (87 vs 87%, p = NS). Likewise, diabetics and non-diabetics had similar long-term survival (84.5 vs 86.4%, p = NS). Nevertheless, diabetics had a higher rate of restenosis and events during FU (figures).



Conclusions: Thus CS provides similar procedural result and initial outcome in diabetic and non-diabetic pts with multivessel disease. In terms of mortality, late prognosis is also similar. However, events during FU are more frequent among diabetics.

1130-92 Autologous Venous and Arterial Graft-Covered Stents in Porcine Coronary Arteries: Is Hyperplasia a Common Process?

Konstantinos Toutouzas, Christodoulos Stefanadis, Eleftherios Tsiamis, Dorothea Tsekoura, Lubna Khaldi, Antonios Doufas, Konstantinos Tentolouris, Pavlos Toutouzas. *Hippokration Hospital, University of Athens, Greece*

Background: Intimal cell proliferation after stent implantation plays a role in the formation of the neointima. However, limited information exists regarding cell type and cellular proliferation within the arterial wall following stem implantation. The aim of this study was to characterize the proliferation and cell types using immunohistochemical and histological methods after conventional stent implantation or covered stents by autologous vascular grafts.

Methods: Fifteen swines were studied (20–25 kg). A 3–4 cm graft was harvested from the porcine femoral artery or cephalic vein. These grafts were used for coverage of conventional stents. Ten arterial- (AC) and 10 venous-covered (VC) stents were implanted. Also, 10 conventional stents were placed, serving as a control group. After 1 month, all stented arterial segments were removed, and stained using antibodies against PCNA and a-actin. Additional sections were stained with Hematoxylin-Eosin and Elastica van Giesson staining.

Results: Covered stents had a trend to reduce maximal intimal thickness (AC:112.2 ± 43.6; VC:119.5 ± 35.5; control:158.3 ± 48.3 μm, $p < 0.07$). Abundance of PCNA was expressed in the media and intima of the control segments coinciding with a-actin. In AC stents atrophy of the media was detected, and PCNA positive cells were detected in the autologous arterial graft and in the intimal layer but not in the arterial media. These cells were also stained with a-actin. In VC stents, PCNA positive cells were found in the venous graft and in the intimal layer but not in the media.

VC/AC/Control	SMA (%)	PCNA (%)
Media	30*/90/90	20*/70/80
Graft	40/10*	40/10*
Intima	90/90/90	90/90/90

However, these positive PCNA cells in the venous graft were not stained by a-actin.

Conclusion: The origin of the proliferating cells seems to differentiate between conventional uncovered, AC and VC stents indicating different pathophysiologic mechanisms of intimal hyperplasia.

POSTER

1131 Restenosis: Basic

Tuesday, March 14, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1131-115 Six Months Follow-Up of Circulating Basic Fibroblast Growth Factor in Patients With Coronary Artery Disease Undergoing Percutaneous Transluminal Coronary Angioplasty

Anastasia A. Katinioti, Emanuel V. Economou, Christodoulos I. Stefanadis, Christos P. Pitsavos, Athanasios G. Trikas, Marina G. Toutouza, Konstantinos I. Kapetanios, Pavlos K. Toutouzas. *Dept. Cardiology, Univ. Athens, Hippokration Hospital, Athens, Greece*

Background: Basic fibroblast growth factor (bFGF) has recently become of major importance because it can induce coronary artery neovascularization. Aim of this study was to evaluate the significance of circulating bFGF in patients (pts) with coronary artery disease (CAD) undergoing percutaneous transluminal coronary angioplasty (PTCA) in a six months follow-up.

Methods: Twenty nine consecutive pts with CAD referred for an initial elective PTCA and obtained primary success (<10% residual diameter stenosis). Twenty CAD pts who underwent elective coronary angiography without PTCA (CA) and 20 healthy subjects (HS) served as controls. Peripheral blood was sampled on the morning of PTCA or CA and at 24 hours (h) after PTCA or CA, as well as 3 months (m) and 6 m after PTCA and was evaluated for plasma levels of bFGF (measured by ELISA). In CAD pts undergoing PTCA, before the procedure, bFGF plasma levels (2.6 ± 0.8 pg/mL) were similar to those of CA pts before the respective procedure (2.4 ± 0.5 pg/mL) but significanty higher compared to those of HS (0.7 ± 0.2 pg/mL, $p < 0.002$). Significant positive relation (F-ratio = 0.478, $p < 0.003$) was noticed between those levels and the extent of CAD, defined as the number of vessels with a >50% diameter stenosis. In PTCA pts, bFGF plasma levels gradually decreased to 1.6 ± 0.4 pg/mL ($p < 0.01$) after 24 h and to 0.9 ± 0.2 pg/mL ($p < 0.01$), after 3 m, in comparison to those before PTCA. However, in CA pts, bFGF plasma levels remained, after 24 h, similar to those before the procedure (2.5 ± 0.5 pg/mL). In PTCA pts, bFGF plasma levels rose, although non significantly, to 1.2 + 0.2 pg/mL after 6 m, in comparison to those after 3 m. This slight increase was mainly attributed to 10 PTCA pts who presented excercise-induced electrocardiographic abnormalities (EIEA), when tested after 6 m, without any other clinical symptom. These pts presented, after 6 m, bFGF plasma levels higher, although non significantly, than those without EIEA (1.3 ± 0.3 vs 1 ± 0.2 pg/mL, p = NS).

Conclusions: bFGF plasma levels are elevated in CAD pts and this may reflect an adaptive effort to compensate, probably by inducing coronary artery neovascularization, for the reduced coronary circulation. After a primary successful PTCA, bFGF plasma levels gradually decreased to values slightly higher than those of HS, since there is no more need for neovascularization due to PTCA-mediated coronary revascularization. A slight rebound of bFGF plasma levels 6 m after PTCA may be indicative of need for neovascularization due to progression of CAD. Since elevation of circulating bFGF is considered an adaptive mechanism when needs for neovascularization are increased, its monitoring may be a useful biochemical indicator for reduction of coronary circulation.

1131-116 Induction of Extracellular Matrix Expression in the Arterial Wall After the Application of Cryotherapy in a Porcine PTCA Model

Jean-François Dorval, Pascale Geoffroy, Martin G. Sirois, Jean-François Tanguay. *Montreal Heart Institute, Montreal, Canada*

Background: The extracellular matrix (ECM) of which collagen is a major component, seems to have a role in vascular remodeling and restenosis after balloon angioplasty (PTCA). We have shown in previous studies that cryoapplication post-PTCA, enhances the luminal area and positive remodeling in arteries. Therefore, we hypothesized that this technique could modify the collagen expression in the arterial wall.

Methods: In a porcine model, the femoral arteries underwent a single oversized PTCA ± cryoapplication. The animals (n = 31) were euthanized at various timeframes and the tissues were fixed and red Sirius stained. Each segment was illuminated through polarized light. The presence of collagen type I (C1) and III (C3) was quantified using a 0–4 scoring grade (0 = absence of collagen).

Results:

	1 week		1 month		3 months		6 months	
	C1	C3	C1	C3	C1	C3	C1	C3
PTCA	0.77 ± 0.17	1.38 ± 0.18	1.07 ± 0.13	1.29 ± 0.13	1.40 ± 0.16	1.60 ± 0.16	0.64 ± 0.10	1.64 ± 0.10
PTCA+ Cryo	1.17 ± 0.11	2.17 ± 0.11	1.92 ± 0.14	2.08 ± 0.14	2.10 ± 0.18	2.10 ± 0.10	1.35 ± 0.13	1.90 ± 0.12
p	0.06	0.0001	0.0001	0.0001	0.009	0.02	0.0001	0.1

Average value with no treatment was 0.67 ± 0.19 (C1) and 1.00 ± 0.12 (C3)

Conclusion: Cryoapplication increases collagen I and III expression in the vessel wall at different timeframes compared to single PTCA alone. Therefore, the benefit of cryoapplication in impeding negative vascular remodeling appears to be related to ECM modulation post-PTCA injury.

1131-117 Vascular Remodeling Following Intracoronary Radiation in the Porcine Model

Yves Cottin, Balram Bhargava, Yoram Vodovotz, Marc Kollum, Han-Soo Kim, Rosanna C. Chan, Ron Waksman. *Washington Hospital Center, Washington, DC, USA*

Background: Intracoronary Radiation (IR) with doses between 10–25 Gy following overstretch balloon injury (BI) has been demonstrated inhibition of neointimal proliferation (NP) and arterial constriction in porcine coronaries.

Methods: To determine the degree of arterial remodeling (AR) following IR we evaluated forty-seven juvenile swine (93 coronary arteries) who were subjected to BI followed by IR with doses of 0–25 Gy of either β or γ radiation. Two weeks following treatment, the animals were euthanized and their arteries subjected to histomorphometric analysis.

Results: Lower dose of 2.5 Gy was associated with increase in IA. Doses between at 7.5–25 Gy were associated with reduction of NF. However, vessel area with 25 Gy was smaller than control despite decreased in NP. Medial area was unaffected by IR at all doses.

	Luminal Area (mm^2)	Intimal Area (IA; mm^2)	Vessel Area (VA; mm^2)	Adventitial Area (AA; mm^2)	Medial Area (MA; mm^2)
Control (n = 12)	4.8 ± 0.8	1.1 ± 0.3	7.2 ± 0.9	2.3 ± 0.4	1.4 ± 0.2
2.5 Gy (n = 3)	3.5 ± 1.6	1.4 ± 1.0	6.5 ± 1.5	3.3 ± 1.9	1.3 ± 0.7
5 Gy (n = 13)	4.5 ± 1.1	0.9 ± 0.9	6.7 ± 1.6	2.2 ± 1.4	1.2 ± 0.5
7.5 Gy (n = 8)	4.2 ± 1.9	0.4 ± 0.5*	6.5 ± 1.6	3.5 ± 1.5	1.3 ± 0.4
15 Gy (n = 30)	6.0 ± 0.8*	0.2 ± 0.1*	7.3 ± 0.9	2.1 ± 0.5*	1.0 ± 0.2
18 Gy (n = 17)	6.3 ± 1.1*	0.1 ± 0.1*	7.9 ± 1.1	2.0 ± 0.4*	0.9 ± 0.3
25 Gy (n = 10)	4.3 ± 1.5	0.2 ± 0.4*	5.9 ± 1.7*	3.2 ± 1.3	1.0 ± 0.3

*P < 0.05 vs control

Conclusions: Therapeutic doses of IR reduce IA and AA but do not reduce MA. The maximal efficacy of the IR with favorable remodeling and maximal decrease of IA is range of 15–18 Gy in this model.

1131-118 Coronary Artery Endothelial Protection Following Local Delivery of 17-Beta Estradiol During Balloon Angioplasty: A Potential New Pharmacological Approach to Improve Long-term Outcome of Angioplasty

Baskaran Chandrasekar, Stanley Nattel, Jean-Francois Tanguay. *Montreal Heart Institute, Montreal, Quebec, Canada*

Background: Endothelial damage occurs following percutaneous transluminal coronary angioplasty (PTCA). As the endothelium plays a critical role in the regulation of structural and functional integrity of coronary arteries, restoration of its function is crucial. We studied the effect of locally delivered 17-beta estradiol (BE) following PTCA on endothelial function.

Methods and Results: Juvenile farm pigs (8 castrated males, 1 female) underwent PTCA of all 3 coronary arteries, following which one artery each was randomly assigned to treatment with either 600 μg of BE delivered locally (via the InfusaSleeve catheter), vehicle alone, or PTCA only. Cardiac catheterization was repeated after 4 weeks. After selective cannulation of a coronary artery, acetylcholine (Ach) was infused in increasing concentrations of 10^{-7} M, 10^{-6} M, 10^{-5} M, and 10^{-4} M, and angiography was repeated after each dose. At 10^{-5} M and 10^{-4} M, arteries treated with PTCA alone or vehicle alone demonstrated significant vasoconstriction ($p < 0.02$, and $p < 0.0001$ respectively), compared to the basal diameter before Ach infusion. No vasoconstrictive response to Ach was observed in arteries treated with BE. Administration of the endothelium-independent vasodilator nitroglycerin dilated the constricted arteries (after 10^{-4} M Ach, in the PTCA only and vehicle groups) to their basal diameter. At 4 weeks, immunohistochemistry with the lectin *Dolichos biflorus* agglutinin revealed enhanced reendothelialization ($p < 0.0005$) and immunohistochemistry for endothelial nitric oxide synthase (eNOS) demonstrated markedly higher eNOS expression ($p < 0.0005$) in BE treated arteries compared to the other 2 treatment groups.

Conclusion: Local delivery of BE following PTCA significantly enhances reendothelialization and endothelial function, possibly by improving the expression of eNOS. Since endothelial dysfunction can promote both restenosis and coronary spasm, local BE delivery is a promising new approach to improving the results after PTCA.

1131-119 Stent-Based Delivery of Sirolimus for the Prevention of Restenosis

Bruce D. Klugherz, Gerard Llanos[1], Warren Lieuallen[1], Greg Kopia[1], George Papandreou[1], Pallassana Narayan[1], Tara Levengood, Brett Sasseen, Steve Adelman[2], Robert Falotico[1], Robert L. Wilensky. *University of Pennsylvania Health System, Philadelphia, PA; [2]Wyeth-Ayerst Labs, Radnor, PA; [1]Cordis Corporation, Warren, NJ, USA*

Background: Drug-eluting stents represent a promising strategy for local vascular therapy. We studied the effects of sirolimus (rapamycin), a cell-cycle inhibitor eluted from a polymer-coated stent, on intimal hyperplasia in rabbit iliac arteries.

Methods: Coronary stents were coated with a non-erodable polymer incorporating sirolimus and hand-crimped on 3.0 mm angioplasty balloons. Via right carotid access, bilateral iliac artery stent implantation was performed in New Zealand white rabbits. Animals were randomized to 1 of 4 groups: (1) uncoated stent (n = 8); (2) polymer-coated stent (n = 10); (3) low dose sirolimus (n = 9); (4) high dose sirolimus (n = 10). Animals were euthanized at 28 days. Stented segments were embedded in plastic and analyzed morphometrically (IA = intimal area, mm^2, IT = intimal thickness, microns, % AS = % area stenosis, I:M = intimal area/medial area).

Results:

	Uncoated	Coated	Lo Sirolimus	Hi Sirolimus
IA	1.20 ± 0.07	1.26 ± 0.16	0.92 ± 0.14	0.66 ± 0.12*^
IT	129.50 ± 8.34	132.34 ± 16.51	95.58 ± 14.09	69.14 ± 12.98*^
%AS	16.09 ± 1.12	15.92 ± 1.80	11.67 ± 1.69	8.62 ± 1.59*^
I:M	1.35 ± 0.13	1.19 ± 0.18	1.01 ± 0.24	0.54 ± 0.10*^

*p < 0.01 vs. uncoated, ^p < 0.01 vs. coated.

Conclusion: There was a dose-dependent reduction in intimal hyperplasia following deployment of the sirolimus-eluting stent in rabbit iliac arteries. The polymer coating did not provoke exaggerated intimal formation or local inflammation. This study suggests that local vascular therapy for preventing restenosis may be accomplished using a polymer-coated stent eluting a cell-cycle inhibitor.

POSTER

1132 IVUS Insights Into Arterial Remodeling

Tuesday, March 14, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1132-109 Increased Presence of Matrix-Metalloproteinase 3 in Human Coronary Lesions With Positive Arterial Remodeling

Paul Schoenhagen, D. Geoffrey Vince, Khaled Ziada, Tim Crowe, Samir Kapadia, Michael Lauer, Steven E. Nissen, E. Murat Tuzcu. *The Cleveland Clinic Foundation, Cleveland, Ohio, USA*

Background: Arterial remodeling describes changes in external elastic membrane (EEM) area in atherosclerosis. Histologic studies have linked matrix-metalloproteinases (MMP) to remodeling. We investigated MMP in human coronary lesions with positive or negative remodeling.

Methods: Pre-interventional intravascular ultrasound, images and directional atherectomy samples of 25 patients were analyzed. A remodeling ratio was calculated as lesional EEM area divided by the *proximal reference* area. Positive and negative remodeling were defined as ratios of >1.05 and <0.95, respectively. Using immunostaining, two independent operators classified intracellular MMP's 1, 2, 3, 9 as absent to mild vs. moderate to heavy.

Results: Positive and negative remodeling was present in 13 and 12 lesions, respectively. Absent to minimal staining for MMP 1 and MMP 3 was evident in 16 and 15 samples, respectively. Moderate to heavy staining for MMP 1 and MMP 3 was found in 9 samples each. MMP 2 and 9 were negative in all samples. Moderate to heavy staining for MMP 3 was more common in lesions with positive than negative remodeling (58% vs. 17%; p = 0.035) with no difference in the frequency of moderate to heavy staining for MMP 1 (30% vs. 41%; p = 0.57).

Conclusion: In this combined intravascular ultrasound and histologic study, increased intracellular MMP 3 was associated with positive arterial remodeling. This association suggests a pathophysiologic role of MMP 3 in the remodeling process of human coronary atherosclerotic lesions.

1132-110 Negative Remodeling is an Important Determinant of Lumen Compromise in the Aortoostial Location: Intravascular Ultrasound Analysis of Coronary and Renal Artery Atherosclerosis

George Dangas, Neil J. Weissman, Adrienne Tinana, Nina Goyal, Gary S. Mintz, Roxana Mehran, Javed M. Ahmed, Alexandra J. Lansky, John R. Laird, Jr., Michael R. Jaff, Ann Greenberg, Augusto D. Pichard, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

We hypothesized that proximity to the aorta would limit the typical positive remodeling response of atherosclerotic lesions in both coronary and non-coronary arteries. To test this, we studied 44 right coronary artery (RCA) and 114 renal artery lesions that met the following strict criteria: no significant calcium, minimum lumen area within 5 mm of the true aortoostial junction, and modest distal reference disease (plaque burden ≤40%).

		Lesion	Distal Ref	p
RCA	Arterial area (mm^2)	14.5 ± 3.8	16.3 ± 5.4	0.0248
	Lumen area (mm^2)	3.5 ± 1.8	11.3 ± 4.2	<0.0001
	Plaque area (mm^2)	11.0 ± 3.7	4.7 ± 2.1	<0.0001
	Plaque burden (%)	75 ± 12	28 ± 7	<0.0001
Renal	Arterial area (mm^2)	12.8 ± 11.5	33.2 ± 13.0	<0.0001
	Lumen area (mm^2)	4.3 ± 3.1	26.1 ± 9.0	<0.0001
	Plaque area (mm^2)	19.6 ± 4.0	6.8 ± 10.2	<0.0001
	Plaque burden (%)	81 ± 11	22 ± 11	<0.0001

Importantly, 61% of RCA and 96% of renal lesions fit the definition of negative remodeling (lesion arterial area <distal reference). This is distinctly different from reported series of nonostial coronary lesions in which only 20–30% exhibit negative remodeling characteristics.

We conclude: Proximity to the aorta appears to limit positive arterial remodeling response of atherosclerotic lesions in both coronary and renal arteries. Negative remodeling contributes importantly to lumen compromise in this lesion location and may also account for the observed higher restenosis frequency.

1132-111 Influence of a Change in Gender on Coronary Arterial Size. A Longitudinal Intravascular Ultrasound Study in Transplant Recipients

Niall A. Herity, Sidney T. Lo, Michael R. Ward, David P. Lee, Steven D. Filardo, Sharon A. Hunt, Paul G. Yock, Peter J. Fitzgerald, Alan C. Yeung. *Stanford University, Stanford, CA, USA*

Background: Gender differences in coronary artery size, which are independent of body surface area, may explain the unfavorable clinical outcomes after coronary surgery and angioplasty in women compared with men. This study aimed to examine the relationship between gender and vessel size, by measuring temporal changes in coronary arterial vessel area (VA) in hearts transplanted across-gender and in hearts transplanted within-gender.

Methods: In 46 heart transplant recipients, serial intravascular ultrasound (IVUS) measurements of the proximal left anterior descending artery (LAD) were made immediately post-transplant and at the first annual evaluation to assess change over the first post-transplant year. In a separate group of 49, measurements were made at the first and second annual evaluations to assess change over the second post-transplant year. Only disease-free segments were considered.

Results: Baseline LAD VA was similar in men and women. Over the first post-transplant year, LAD VA did not change significantly in any group (table). However over the second post-transplant year LAD VA increased significantly in female hearts transplanted into male recipients and in no other group.

Conclusion: The observed relationship between gender and coronary arterial size is likely to be explained by the hormonal and metabolic influences of the host environment.

	VA over the first year (n = 46)			VA over the second year (n = 49)		
	Baseline	1 year	P	1 year	2 years	P
F to F	15.41 (3.77)	16.25 (3.11)	0.42	17.29 (3.17)	16.28 (3.73)	0.08
F to M	16.73 (3.57)	17.80 (4.36)	0.15	14.79 (2.04)	16.56 (3.42)	0.009
M to M	17.15 (2.91)	17.68 (2.90)	0.50	17.41 (2.18)	17.29 (2.82)	0.79
M to F	16.73 (3.70)	16.58 (3.28)	0.70	16.74 (2.01)	17.48 (2.63)	0.74

Mean (SD). VA = vessel area in mm^2. F = female. M = male.

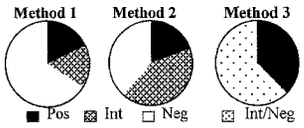
1132-112 Impact of Different Definitions on the Interpretation of Coronary Remodeling by Intravascular Ultrasound

Kiyoshi Hibi, Peter J. Fitzgerald, Allen Jeremias, Takeshi Suzuki, Yasuhiro Honda, Michael R. Ward, Hiroyuki Okura, Akiko Maehara, Alan C. Yeung, Paul G. Yock. *Stanford University Medical Center, Stanford, California, USA*

Background: Multiple IVUS studies have demonstrated the importance of coronary remodeling, but the actual definitions of remodeling used in these studies have differed. The purpose of this investigation was to compare the remodeling pattern and predictors of arterial remodeling among the 3 remodeling definitions most commonly used.

Methods: 514 lesions in 512 patients with stable or unstable angina undergoing pre-interventional IVUS in native coronary arteries were studied. Vessel area (VA), lumen area (LA), and plaque area (PA) at the lesion site (L) and at the proximal (PR) and distal reference site (DR) were measured. In method I, positive (pos), intermediate (int), and negative (neg) remodeling were defined as L-VA/PR-VA of >1.05, ≥0.95 and ≤1.05, and <0.95, respectively. In method 2, pos, int, and neg remodeling were considered present when L-VA was larger than PR-VA, intermediate between PRVA and DR-VA, and smaller than DR-VA, respectively. In method 3, pos and int/neg remodeling were defined as L-VA/(average of PR-VA and DR-VA) of >1 and ≤1, respectively.

Results: The remodeling distributions were significantly different among 3 methods (Figure, all P < 0.0001). By multivariate logistic analysis, the clinical and IVUS predictors of positive remodeling varied significantly among the 3 methods (Table).



	Age	Non-calc	DR-LA	DR-PA	L-LA	L-PA
Method 1	NS	NS	<0.0001	<0.0001	NS	<0.0001
Method 2	NS	NS	<0.0001	<0.0001	0.0008	<0.0001
Method 3	0.032	0.023	<0.0001	NS	NS	<0.0001

Numbers were P values, NS = not significant.

Conclusions: This study demonstrates that the definition of remodeling chosen has a major impact on the apparent incidence and predictors of the remodeling phenomenon. These definition-associated effects should be taken into account in evaluating the remodeling pattern by IVUS.

1132-113 Lipoprotein (a): A Predictor of Coronary Artery Remodeling. An Intravascular Ultrasound Study

Shigeru Fukuzawa, Shun Ozawa, Juji Sugioka, Kazuhiro Shimada, Masayuki Inagaki, Kaoru Tateno, Marehiko Ueda. *Funabashi Municipal Medical Center, Chiba, Japan*

Background: De novo atherosclerotic remodeling of coronary artery segments ranges from compensatory enlargements (CR) to inadequate shrinkage (IR). We investigated the hypothesis that serum lipoprotein (a) level may influence remodeling patterns.

Methods: We measured the remodeling by the ratio of total vessel area (TVA) at the lesion (L) site to the proximal (P) reference TVA in 88 de novo, non-branching, non-ostial lesions on the pre-intervention, 30 MHz intravascular ultrasound (IVUS). We also studied serum Lp(a) level and coronary risk factors.

Results: The L-TVA/P-TVA ratio showed a normal distribution (mean ± SD = 0.92 ± 0.18). Lesion with an L-TVA/P-TVA ratio of >1 SD below and above the mean were defined as IR (n = 18), and as compensatory remodeling (CR) (n = 21), respectively. The IR and CR groups were similar

regarding age, sex, diabetes, hypertension, unstable presentation, IVUS plaque morphology and calcification. In the CR group, the serum level of Lp(a) was higher compared to the IR group, 42.8 ± 12.4 mg/dl versus 18.1 ± 14.2 mg/dl ($p < 0.05$), respectively, while no significant differences in remodeling patterns were seen with respect to the serum level of total cholesterol or low density lipoprotein.

Conclusion: The serum level of Lp (a) may influence remodeling patterns and may be a good predictor in compensatory vessel enlargement.

1132-114 The Impact of Remodeling on the Acute Results of Saphenous Vein Graft Stent Implantation

Gary S. Mintz, Myeong-Ki Hong, Mun K. Hong, Chrysoula Pappas, Kenneth M. Kent, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

We hypothesized that the pattern of SVG lesion remodeling would impact on the acute results of stent implantation. Therefore, we categorized remodeling in SVG lesions as positive (lesion/mean reference SVG area >1.1, n = 77), intermediate (lesion/mean reference SVG area 0.9–1.1, n = 51), and negative (lesion/mean reference SVG area <0.9, n = 52) based on pre-intervention intravascular ultrasound (IVUS) analysis and compared pre-intervention and final IVUS dimensions:

	Positive	Intermediate	Negative	P
SVG age <12 mos (%)	0	4	12	0.0071
Stent size (mm)	3.9 ± 0.3	4.0 ± 0.5	3.9 ± 0.6	0.64
Inflation pressure (atm)	12.3 ± 4.0	13.0 ± 3.6	13.7 ± 2.8	0.38
Mean reference				
SVG area, mm^2	17.3 ± 5.5	17.6 ± 5.0	18.9 ± 7.0	0.16
Lumen area, mm^2	10.5 ± 3.9	10.5 ± 2.5	10.8 ± 3.9	0.91
Plaque area, mm^2	6.8 ± 2.9	7.1 ± 3.1	8.1 ± 4.5	0.12
Lesion				
Pre SVG area, mm^2	23.5 ± 9.0	17.6 ± 4.9	13.5 ± 5.2	<0.0001
Pre lumen area, mm^2	2.9 ± 1.4	2.8 ± 1.5	2.2 ± 1.2	0.0163
Pre plaque area, mm^2	20.6 ± 8.8	14.7 ± 5.0	11.2 ± 5.2	<0.0001
Arc of calcium (°)	6 ± 18	8 ± 24	37 ± 88	0.0131
Final lumen area, mm^2	*9.6 ± 2.8*	*8.6. ± 1.8*	*7.9 ± 2.9*	*0.0078*

Negative remodeling lesions were more often proximal in location (p = 0.0182).

We conclude: Remodeling (positive and negative) in SVG lesions is commonly observed and impacts procedural results. Despite similar reference dimensions and stenting techniques, final lumen areas depended significantly on pre-intervention remodeling characteristics and were *smallest* in lesions with negative remodeling.

ORAL

870 New Delivery Approaches

Tuesday, March 14, 2000, 10:30 a.m.–Noon
Anaheim Convention Center, Lecture Hall A2

10:30 a.m.

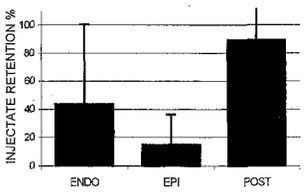
870-1 Retention of myocardial Injectate After Direct Surgical or Catheter-Based Needle Administration

P. Michael Grossman, Maria Palasis[1], James J. Barry[1], Sanjay Rajagopalan, Robert J. Lederman. *University of Michigan Health Systems, Ann Arbor, MI; [1]Boston Scientific Corporation, Natick, MA, USA*

Background: Direct intramyocardial injection is an attractive strategy for local delivery of protein and gene therapy agents for myocardial and coronary artery disease. Little is known about the acute retention of compounds administered via percutaneous endomyocardial catheters or via direct epicardial injection.

Methods: Fifteen 40–50 kg pigs underwent overlapping myocardial injections using a percutaneous endomyocardial catheter (ENDO), an epicardial needle via an open. chest (EPI), and epicardial needle post-mortem (POST). Multiple distinct 15 μ neutron-activated microsphere species were used as tracers. Two or three myocardial walls were injected in each animal using 3 mm 27G needles at varying injectate volumes. Animals were sacrificed immediately. Myocardial walls were divided and microspheres quantified.

Results: Endomyocardial injection was associated with 43 ± 15% bead retention, compared with 15 ± 21% ($p < 0.01$) retention of open-chest epicardial injection and 89 ± 60% ($p < 0.01$) for postmortem injection. Preliminary data in three animals suggest reducing catheter injectate volume from 100 μL to 20 μL may improve bead retention (20 ± 32% vs 50 ± 58%, p = 0.14).



Conclusion: (1) Despite direct intramyocardial administration, a significant fraction of injectate is not retained locally. (2) Catheter-based needle endomyocardial injection is associated with equivalent or superior injectate retention compared with open-chest epicardial injection. (3) Proportionately more injectate may be retained at lower volumes. Loss may involve a combination of channel leakage, venous, and lymphatic return.

10:45 a.m.

870-2 Transendocardial Delivery of Autologous Bone Marrow Enhances Collateral Perfusion and Regional Function in Pigs With Chronic Experimental Myocardial Ischemia

Shmuel Fuchs, Richard Baffour, Marie Shou, Anthony Pierre, Y.F. Zhou, Neil J. Weissman, Martin B. Leon, Stephen E. Epstein, Ran Kornowski. *The Cardiovascular Research Foundation, Washington, DC, USA*

Background: The bone marrow (BM) is a natural source of a broad spectrum of cytokines and cells that are involved in the control of angiogenic and inflammatory processes. Angiogenesis involves complex time-critical interactions among numerous molecules. We therefore postulated that the intramyocardial injection of autologous (A) BM, by taking advantage of the natural ability of these cells to secrete many angiogenic factors in a time-appropriate manner, would provide an optimal intervention for achieving therapeutic angiogenesis in ischemic myocardium.

Methods: Chronic heart ischemia model was created in 14 SPF Yorkshire pigs by the placement of ameroid constrictors around the proximal left circumflex (LCx) coronary artery. Four weeks after implantation, 7 animals underwent transendocardial injections of freshly aspirated, heparinized (20 IU/ml) and filtered ABM (2.4 ml per animal, 0.2 ml per injection site × 12 sites) into the ischemic zone using the Biosense™ transendocardial injection catheter. 7 control animals were injected with heparinized saline. At baseline and 4 weeks after treatment, all animals underwent 1) rest and pacing (@180 b/min) echo to assess regional function, and 2) rest and adenosine stress microsphere infusion to assess collateral perfusion.

Results: Collateral flow, expressed as a ratio of ischemic/normal zone perfusion improved in ABM-treated pigs but not in controls @4 weeks vs baseline (*ABM:* 0.98 ± 0.17 vs 0.83 ± 0.12 @rest; p = 0.001; 0.89 ± 0.18 vs 0.78 ± 0.12 during adenosine, p = 0.025, *Controls:* 0.92 ± 0.10 vs 0.89 ± 0.09 @rest; p = 0.49; 0.78 ± 0.11 vs 0.77 ± 0.05 during adenosine, p = 0.75). Also, regional contractility assessed by echo as % myocardial thickening and expressed as % of ischemic/normal zone, increased in ABM-treated pigs but not in controls (*ABM:* 83 ± 21 vs 60 ± 32 @rest, p = 0.04; 91 ± 44 vs 35 ± 43 during pacing, p = 0.056, *Controls:* 69 ± 48 vs 64 ± 45 @rest, p = 0.74; 65 ± 56 vs 37 ± 56 during pacing, p = 0.23).

Conclusions: The results indicate that transendocardial injection of ABM can augment collateral perfusion and function in ischemic myocardium, findings suggesting that this approach may constitute a novel strategy for achieving optimal therapeutic angiogenesis.

11:00 a.m.

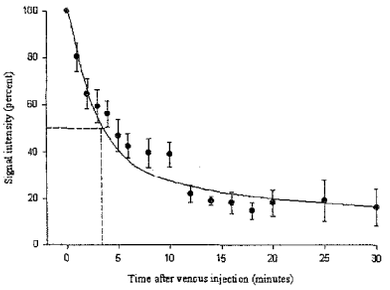
870-3 Feasibility of the Percutaneous Coronary Venous Approach for Local Drug Delivery to the Myocardium

Niall A. Herity, Sidney T. Lo, Frederick Oei, David P. Lee, Michael R. Ward, Steven D. Filardo, Ali Hassan, Takeshi Suzuki, Paul G. Yock, Alan C. Yeung, Peter J. Fitzgerald. *Stanford University, Stanford, CA, USA*

Background: Therapeutic angiogenesis is a promising option for patients with refractory angina unsuitable for revascularization, but current delivery methods either require open-chest surgery or provide only short-lived, transient exposure to growth factors. This study assessed the feasibility of percutaneous coronary venous cannulation and selective regional injection as a novel approach to local myocardial drug delivery.

Methods and Results: In 13 anesthetized pigs the coronary sinus was cannulated percutaneously and a balloon-tipped catheter was advanced to the anterior interventricular vein (AIV) or middle cardiac vein (MCV). During balloon occlusion, selective venous injection of radiographic contrast (diatrizoate) caused localized myocardial staining. Videodensitometric analysis showed that diatrizoate persisted for at least 30 minutes, with 50% clearance over approximately the first 4 minutes (figure). Venous injection of Evans

Blue dye showed that localized, regional infiltration was reproducibly accomplished in targeted myocardial regions: the left ventricular apex, anterior interventricular septum and anterior wall via the AIV and the inferoposterior wall via the MCV.



Conclusions: The percutaneous coronary venous route is a favorable delivery approach for therapeutic angiogenic substances, being reproducibly accessible and facilitating selective regional myocardial delivery and persistence of delivered substances.

11:15 a.m.

870-4 Percutaneous Myocardial Revascularization Using a Myocardial Channeling Device: First Human Experience Using the AngioTrax System

Fayaz A. Shawl[1], Upendra Kaul, Vahid Saadat. *Batra Hospital and Medical Research Centre, New Delhi, India; [1] Washington Adventist Hospital, Takoma Park, Maryland, USA*

Background: Percutaneous myocardial revascularization using laser energy alleviates angina in inoperable pts with coronary ischemia. However, lasers are complex and expensive. We describe the first human experience with a mechanical myocardial channeling device.

Methods and Results: In 7 consecutive inoperable (due to diffuse disease) pts (6 men and 1 women, mean age 61 ± 7 years) with Class III (n = 5) or IV (n = 2) refractory angina, we performed percutaneous myocardial revascularization using a 9F percutaneous device that forms channels by combined mechanical coring and vacuum tissue extraction (AngioTrax System). History of prior MI was present in 4 pts, CABG in 2, 3 vessel CAD in 6, 2 vessel in 1 and LV ejection fraction of ≥25% (mean 47 ± 7). An average of 9 ± 3 channels (range 5–15) were created in ischemic regions (all had thallium perfusion defects in these regions) – inferior wall: 5; anterior: 1; inferolateral: 1 and posterolateral wall: 1 Endomyocardial tissue was extracted as each channel was created. Total procedure time was 31 ± 8 min and total fluoro time was 12.7 ± 5.5 min. Left ventriculography performed before and after the procedure demonstrated unchanged or improved wall motion in the target region. Histology of core biopsies in all 7 pts demonstrated myocytes with focal hypertrophy, myocytolysis, with interstitial scarring in 3, who had wall motion abnormalities on left ventriculography. No complications occurred (specifically, no CPK-MB elevations) and all pts were discharged within 48 hours. Follow up exercise thallium perfusion studies will be performed at 1, 3, and 6 months. Six month follow-up clinical and thallium perfusion data will be presented.

Conclusion: Mechanical percutaneous myocardial revascularization with AngioTrax system is safe and feasible and may prove to be an inexpensive substitute for laser revascularization. Moreover, left ventricular tissue obtained may provide diagnostic and therapeutic insights.

11:30 a.m.

870-5 Percutaneous In-Situ Coronary Venous Arterialization (PICVA) Improves Survival in Response to Acute Ischemia in the Porcine Model

Stephen N. Oesterle, Alan C. Yeung, Sidney Lo, Renu Virmani, Richard Van Bibber, J. Christopher Flaherty, Theodore C. Lamson, Stephen W. Kim, John T. Garibotto, Margaret W. Tumas, Josh Makower. *Massachusetts General Hospital, Boston, MA; Stanford University Medical Center, Stanford CA; Armed Forces Institute of Pathology, Washington, D.C.; SNBL USA, Inc., Redmond, Washington; TransVascular, Inc., Menlo Park, CA, USA*

Background: We have previously reported on PICVA, a percutaneous technique of arterializing a segment of the coronary venous system to retroperfuse an ischemic region of the heart. This is the first study to investigate the efficacy of PICVA in an animal model.

Methods: To model ischemia, a prototype occlusion device was placed into the mid Left Anterior Descending Artery (LAD) region in twelve (12) 50–60 kg Domestic Crossbred Swine. Six (n = 6) of these pigs were simultaneously treated with an LAD-AIV PICVA procedure and six (n = 6) were left untreated as a control. The PICVA procedure connecting the proximal LAD i to the isolated Anterior Interventricular Vein (AIV) was performed using prototype devices developed by TransVascular, Inc. (Menlo Park, CA). Survival rate, the site of LAD occlusion, circulating myocardial enzyme levels, left ventriculography, EKG, IVUS and angiography were recorded. Measurements were made at baseline, post-procedure and at 1 week follow-up. All surviving animals were sacrificed at one week and the heart and coronary vessels were extracted and examined.

Results: 17% (n = 1/6) of the control animals survived to 7 days (five died within two hours after LAD occlusion); whereas, 83% (n = 5/6) of the PICVA treated animals survived to follow-up at one week. This survival difference was statistically significant (p = 0.04) when analyzed using the Fischer Exact Test. At follow-up, all surviving PICVA animals (n = 5/5) had occluded LAD vessels, patent LAD-AIV channels and patent AIV grafts with TIMI II (n = 2/5) or TIMI III (n = 3/5) flow. Serum levels of Troponin I measured at follow-up were 4.7 ± 1.3 ng/ml (n = 5) for the PICVA treatment group and 29.7 ng/ml (n = 1) for the single surviving control. One animal (n = 1/6) in the treatment group died of tamponade, secondary to a perforation of the Great Cardiac Vein (GCV), caused by a defect in one of the prototype devices. Further angiographic and IVUS data will be presented.

Conclusions: PICVA improves survival in the porcine model challenged with acute occlusion of the LAD. These data support the potential of the PICVA procedure to relieve ischemia in humans.

11:45 a.m.

870-6 Intrapericardial Ethanol Delivery Inhibits Neointimal Proliferation After Porcine Coronary Overstretch

Dongming Hou, Alexander E. Marsh, Pamela I. Rogers, Keith L. March. *Indiana Univ, IN, USA*

Background: Catheter-based approaches to intrapericardial (IPC) delivery of therapeutic agents have recently demonstrated to be feasible and well tolerated. Previous work has shown that ethanol can dampen cell growth signals and inhibit smooth muscle proliferation in restenosis models. This study tested the effect of IPC instillation of 30% ethanol on the injury response of overstretched porcine coronary arteries.

Methods: Overstretch injury of porcine coronary arteries (LAD and LCx) was performed followed immediately by IPC administration of 30% ethanol (E, 10 ml, n = 6) or 0.9% saline as a control (C, 10 ml, n = 6). Animals were sacrificed and coronary arteries were perfusion fixed 28 days after balloon dilation. Serial sections were evaluated by morphometric analysis.

Results: Arterial injury indices were no different in the two groups. The neointimal and adventitial area were significantly reduced in the ethanol group (E, 0.36 ± 0.05 mm^2; 1.68 ± 0.09 mm^2) as compared to the control group (C, 0.61 ± 0.05 mm^2; 2.61 ± 0.14 mm^2; $p < 0.001$). The maximal intimal and adventitial thickness of the ethanol treated vessels were also significantly smaller than saline treated vessels (E, 0.44 ± 0.02 and 0.38 ± 0.08 mm vs C, 0.57 ± 0.03 and 0.54 ± 0.03 mm; $p < 0.005$). The calculated luminal stenosis decreased in the treated group, 16.1%, versus the control group, 25.3%.

Conclusion: IPC delivery of a single-dose of 30% ethanol solution significantly reduces neointimal proliferation in the porcine balloon-overstretch model. IPC ethanol delivery may represent a clinically feasible approach to reduce restenosis after interventional procedures.

MODERATED POSTER SESSION

1008 Coronary Stenting: Challenging Subsets

Tuesday, March 14, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A

Noon

1008-167 Stenting for Unprotected Left Main Coronary Stenosis: Acute and Long-Term Results of the First 100 Cases

Seung-Jung Park, Seong-Wook Park, Cheol Whan Lee, Myeong-Ki Hong, Jae-Joong Kim. *Department of Medicine, University of Ulsan, Asan Medical Center, Seoul, Korea*

Objectives: The aim of this study was to evaluate the acute and long-term results of elective coronary stenting for unprotected left main coronary artery (LMCA) stenosis in selected patients with normal left ventricular function.

Methods and Results: Elective stenting with (n = 66) or without debulking atherectomy (n = 34) was performed in 100 consecutive patients with significant LMCA stenosis (men 62, women 37; age 55.3 ± 10.2 years) at

our institution. Coronary artery lesions were located at the ostium (47%), body (15%) and bifurcation sites (38%) of LMCA. Coronary angiography was performed at 6-months and clinical evaluation at regular interval. Procedural success rate was 99%. Subacute stent thrombosis occurred in 1 patients on day 3 after the procedure and treated with repeated intervention. Mean follow-up duration was 20.1 ± 13.4 months. Four patients died during the follow-up (1 in cardiac origin, 3 in non-cardiac origin). Angiographic restenosis rate (>50% diameter stenosis) was 15.8% (12/76) (11.1% in debulking group vs 18.0% in non-debulking group, p = NS), and target lesion revascularization rate was 11%. Event-free survival rate (death, myocardial infarction, repeat revascularization) was 81.5 ± 4.7% at the end of the follow-up period.

Conclusions: Stenting may be a safe and feasible technique for treatment of untprotected LMCA stenosis in selected patients, and be associated with a favorable long-term clinical outcome.

12:12 p.m.

1008-168 Intervention of Unprotected Left Main Stenosis in High Risk Patients: Acute and Long Term Results

Samin K. Sharma, Annapoorna Kini, David Reich, Tudor Bertea, Javed Suleman, Jonathan D. Marmur. *Mount Sinai Hospital, New York, NY, USA*

Elective stenting of the left main coronary artery (LMCA) with normal left ventricular function has been reported to have excellent short and long term results, comparable to coronary artery bypass surgery (CABG). Outcome of LMCA intervention in patients considered at high risk for CABG due to low ejection fraction, comorbid conditions and advanced age, has not been published. We report our experience of 72 consecutive patients who underwent LMCA intervention, deemed unsuitable for CABG.

Methods and Results: Mean age was 84 years (range 62–98), 40% female and indication for procedure being unstable angina and post MI in 60%, CHF in 25% and both in 15%. Mean LVEF was 32 ± 14% (range 11–63%) with 42% of patients had LVEF < 25%. Stenosis location was at the ostium in 25%, in body/distal in 60% and at bifurcation in 15%. All patients underwent stenting; 89% after debulking with rotational atherectomy (RA) and 11% had stent implantation without debulking. GP IIb/IIIa inhibitors were used in 78% of cases and elective IABP assistance in 35.5% of cases. Procedural success was achieved in all patients without any in-hospital major complications of Q-wave MI, CABG or death. Major vascular complications (large hematoma, pseudoaneurysm, drop in hemoglobin > 5 gm/L and vascular surgery) occurred in 3.2%. Mean reference vessel diameter was 3.81 ± 0.81 mm with MLD pre-procedure 1.12 ± 0.36 mm, post-debulking 2.11 ± 0.26 mm and post-procedure 3.67 ± 0.52 mm with residual of 8%. Slow flow and minor dissection (NHLBI grade < C) occurred in 8% and 13% respectively. Any CK-MB elevation occurred in 20.8%, with >5× normal in 2.8%. All patients were discharged alive at a mean duration of 6 ± 5 days with 30 day MACE occurring in 2 patients (3.2%) from non-cardiac cause. At a mean follow-up of 9 ± 3 months there have been 4 additional deaths (2 cardiac, 2 non-cardiac) and 5 (8%) clinical restenosis. Freedom from Q-wave MI, repeat intervention and death in first 40 patients who have completed at least one year follow-up is 82%. Majority (80%) of patients have <III CCS class angina.

Conclusion: Unprotected LMCA stenting with RA in high risk subset of patients can be performed with very high procedural success, low in-hospital complications and favorable mid term prognosis. The long term follow-up of this strategy for left main coronary interventions needs to be determined.

12:24 p.m.

1008-169 The Use of IVUS-Guided PTCA and Spot Stenting for the Treatment of Long Lesions: A Comparison to Traditional Stenting

Joseph De Gregorio, Issam Moussa, Milena Adamian, Yoshio Kobayashi, Carlo Di Mario, Jeffrey Moses, Antonio Colombo. *Centro Cuore Columbus, Milan, Italy; Lenox Hill Hospital, New York, USA*

The treatment of long lesions has traditionally yielded unsatisfactory long-term results. A prospective registry of consecutive patients were treated utilizing the approach of spot stenting (SS) where IVUS guided PTCA was performed and short stents were placed only in the segments of a lesion where IVUS criteria are not met (CSA of ≥5.5 mm^2 or ≥50% of reference vessel CSA at the lesion site). These patients were compared to a matched group treated during the same time period with the traditional stenting (TS) approach where a lesion is covered from proximal normal segment to distal normal segment. The SS group (101 patients, 130 lesions) and the TS group (143 patients, 168 lesions) had similar baseline clinical and lesion characteristics including lesion complexity and reference vessel diameter (2.95 ± 0.5 vs 3.01 ± 0.5, p = ns). However, the SS group contained significantly longer lesions (27 ± 10 vs 24 ± 9, p = 0.01) and shorter stent lengths (20 ± 12 vs 25 ± 13, p = <0.01).

Characteristic	SS	TS	p
Mean age	60 ± 10	58 ± 10	ns
LVEF%	60 ± 11	64 ± 13	<0.05
Multivessel disease, n (%)	72 (72)	94 (67)	ns
Balloon/artery ratio	1.23 ± 0.2	1.21 ± 0.2	ns
Min lumen diameter pre (mm)	0.75 ± 0.4	0.89 ± 0.4	<0.05
Final min lumen diameter (mm)	2.7 ± 0.7	3.0 ± 0.5	<0.05
Acute gain (mm)	1.94 ± 0.8	2.10 ± 0.6	<0.05
Acute stent thrombosis, n (%)	2 (1)	0 (0)	ns
Procedural MACE, n (%)	3 (3.0)	5 (3.5)	ns
Restenosis, n (%)	27 (26)	63 (38)	<0.05
Target lesion revasc., n (%)	25 (20)	54 (32)	<0.05
6 Month MACE, n (%)	22 (22)	51 (36)	<0.05

(Angiographic follow-up in 81% of SS group and 100% of TS group).

Conclusions: Despite the use of shorter stent lengths to treat longer lesions, the SS group had similar short-term event rates and significantly better long-term outcome with lower restenosis rates, TLR and 6 month MACE.

12:36 p.m.

1008-170 Stenting of Long Coronary Lesions: A Prospective 6-Month Quantitative Angiographic Study (STELLA Trial)

John A. Ormiston, Peter N. Ruygrok, Mark W.I. Webster, Ian T. Meredith, Sue Price, Justin P. Ardill, Christopher E. Buller, Donald R. Ricci, Charles Chan, Gerard P. Devlin, James T. Stewart, Ian M. Penn. *For the STELLA Trial Investigators, Green Lane Hospital, Auckland, New Zealand*

Background: Long lesions are often treated by long stent deployment, but there is little prospective 6-month angiographic data.

Methods: This multicenter, prospective, quantitative angiographic (QCA) trial of elective long stent deployment enrolled 120 patients with *de novo* native vessel lesions (length > 20 mm, diameter ≥ 3 mm) to be treated with 1 or more MultiLink stents (25 and 35 mm). QCA with the CMS-Medis system pre- and post-procedure and at 6 months was performed in 93% of patients. Clinical follow-up was to 12 months.

Results: The procedural angiographic success was 100%, with successful delivery of MultiLink stents in 98%. The interpolated QCA vessel reference diameter was 3.12 ± 0.56 mm before stenting. The mean lesion length was 33.4 (18–99) mm, and the mean length of stent used was 35.8 (25–95) mm. Hierarchical major adverse events by 12 months were: death (0%), Q-wave myocardial infarction (1%), non-Q-wave myocardial infarction (2%), and target vessel revascularization (14%). Restenosis of ≥50% diameter loss occurred in 32%, but there was ≥70% diameter loss in only 8%. No patient had clinical subacute stent occlusion, but 3 (3%) had suffered a silent stent occlusion at 6-month angiography.

Conclusion: Long MultiLink stenting for long coronary lesions can be performed with a high procedural success rate and a low adverse event rate. Although restenosis occurred in 32%, severe restenosis was uncommon (8%), and the rate of target vessel revascularization by 12 months was low (14%).

12:48 p.m.

1008-171 Which is the Best Strategy for Chronic Coronary Total Occlusions; Stenting or Debulking or the Other?

Etsuo Tsuchikane, Osamu Katoh[1], Nobuhisa Awata, Tohru Kobayashi. *Osaka Medical Center for Cancer and Cardiovascular Diseases, Osaka; [1]Kyoto Katsura Hospital, Kyoto, Japan*

PTCA of chronic coronary total occlusions (CTO) is associated with an acceptable success rate and a favorable long-term angiographic patency by primary stenting nowadays. However, massive plaque burden in CTO sometimes interferes with optimal lesion dilatation, which results in restenosis. To determine the best strategy for CTO, we analyzed angiographic outcomes of 398 recanalized CTO (TIMI = 0, occlusive duration ≥ 3 months) by balloon angioplasty alone (POBA) or stenting or debulking strategy (DCA or rotational atherectomy (RA)) retrospectively. Unsuitable CTO lesions for stenting or debulking were excluded. POBA was performed in 224 lesions, primary stenting in 96 lesions, debulking alone in 31 lesions (DCA: 16, RA: 15), and debulk-stenting (D-stenting) in 47 lesions (DCA: 1, RA:46). Initial restenosis and reocclusion (within 6 months) rates and long-term patency rate at follow-up angiography 617 ± 486 days after the initial PTCA are shown in the table.

	POBA	Stenting	Debulking	D-stenting	P value
Number	224	96	31	47	
RD ≥ 2.5 mm	52.2%	57.3%	61.3%	55.3%	NS
OL ≥ 20 mm	29.0%	24.0%	22.6%	19.1%	NS
Post MLD ≥ 2.0 mm	27.2%	66.7%	51.6%	93.6%*	<0.0001
Initial restenosis	49.6%	43.8%	51.6%	25.5%*	0.02
Initial reocclusion	12.1%	4.2%	12.9%	2.1%	0.03
Long-term patency	93.3%	100%	93.5%	100%	0.02

* P < 0.05 vs. Stenting (RD: reference diameter, OL: occlusive length, MLD: minimal lumen diameter)

Conclusion: Stenting provides a favorable long-term patency compared to POBA or debulking alone. However, stenting alone is not sufficient to prevent initial restenosis. Stenting combined with plaque debulking is the best strategy for desirable mid- and long-term angiographic outcomes of recanalized CTO.

1:00 p.m.

1008-172 Bifurcation Lesions: Two Stents vs. One Stent Immediate and Follow-Up Results

Takehiro Yamashita, Takahiro Nishida, Milena G. Adamian, Carlo Briguori, Marco Vaghetti, Nicola Corvaja, Remo Albiero, Leo Finci, Carlo Di Mario, Antonio Colombo, Jonathan M. Tobis. *EMO Centro Cuore Columbus, Milan, Italy; University of California, Los Angeles, Los Angeles, California, USA*

Background: In the treatment of bifurcation lesions, limited information is available if stent placement into the side branch provides any advantage over a simpler strategy of stenting the parent vessel and balloon angioplasty of the side branch.

Methods: A total of 92 patients with true bifurcation lesions (defined as a 50% stenosis in both the parent vessel and the contiguous side branch) were treated with two strategies: stenting both vessels (bilateral group B, n = 53) or stenting the parent vessel and balloon angioplasty of the side branch (single group S, n = 39). Paired angiograms were analyzed by quantitative angiography, and clinical follow-up was obtained.

Results:

	Bilateral	Single	p-value
Post procedure %DS			
parent vessel	6.7 ± 9.9%	7.6 ± 12.1%	NS
side branch	7.4 ± 10.9%	23.4 ± 18.7%	<0.0001
Procedural success	91%	95%	NS
In-hospital MACE	9.4%	0%	<0.05
Angiographic restenosis of			
any branch	56%	52%	NS
both vessels	22%	24%	
the parent vessel	11%	14%	
the side branch	22%	14%	
6 M total MACE	43%	33%	NS

%DS, percent diameter stenosis; MACE, major adverse cardiac events = death, myocardial infarction, coronary artery bypass grafting or repeat percutaneous procedure.

Conclusion: For the treatment of true bifurcation lesions, a complex strategy of stenting both vessels provided no advantage in terms of procedural success or late outcome.

1:12 p.m.

1008-173 Angiographic Follow-Up of Bifurcated Coronary Stent Implantation: Results From a Single Center Feasibility Study

Bernard Chevalier, Bernard Glatt, Philippe Guyon, Thierry Royer. *Centre Cardiologique du Nord, Saint-Denis, France*

Many options have been proposed to cover complete bifurcation lesion with coronary stents, using step by step techniques. Bifurcated stent (BS) is a theoritical one-step alternative. In the setting of a preliminary feasibility study, 20 pts were treated, from 06/98 to 07/99, with a XT Carina Bard* on 15 LAD/diagonal, 4 Circumflex/obtuse marginal branch and 1 distal RCA bifurcations. Baseline lesion were D type in 19 and C type in 1. Procedure was conducted through an 8 F (6) or a 9 F (14) access using a 23 mm long Carina. One failure was related to proximal calcification and another one to the lack of legs rotation in a calcified bifurcation. These 2 cases were treated with stenting in main branch and balloon in side branch. There were 2 nonQ MI (1 related to stent thrombosis at day 9). On-line QCA results (mm):

	RD	preMLD	postMLD
Proximal main branch	3.1 ± 0.41	0.61 ± 0.35	2.93 ± 047
Distal main branch	2.81 ± 0.45	0.63 ± 0.32	2.58 ± 0.46
Side branch	2.7 ± 0.7	0.8 ± 0.3	2.5 ± 0.81

RD: reference diameter, MLD: minimal lumen diameter

Twelve pts had a 7 m. angiographic control with, using off-line QCA, residual stenosis from 3 to 44% in proximal main branch, from 17 to 73% in distal main branch and from 22 to 93% in side branch. Restenosis (>50%) was noted in 1/12 in main vessel and in 3/12 in side vessel among which 2 were not associated with ischemia. So, TLR was only present in one pt. Follow-up on the whole cohort is pending.

Thus, these results showed a 90% feasibility in large bifurcation lesions with encouraging preliminary midterm results.

1:24 p.m.

1008-174 Treatment of Small Coronary Vessels With Complex Lesions

Carlo Briguori, Takahiro Nishida, Milena Adamian, Carlo Di Mario, Antonio Colombo. *Centro Cuore Columbus, Milan, Italy*

Background: The impact of elective stent implantation in small vessels (<3.0 mm) with complex lesions (B2-C) is still controversed. Restenosis rate in this population is high (42% to 53%).

Methods: We compared the early and late outcome of patients with complex coronary lesions in small vessel treated with successful traditional coronary angioplasty (Angioplasty Group; n = 80) and with elective stent implantation (Stent Group; n = 100). Angioplasty Group and Stent Group were comparable for all clinical and angiographic characteristics. All patients in the 2 groups had clinical and angiographic follow-up. Major adverse cardiac events (MACE) and restenosis rate were evaluated.

Results: No patients in the 2 groups experienced in-hospital death or bypass surgery. Myocardial infarction occurred in 4 patients in the Angioplasty Group, and in 7 patients in the Stent Group (p = 0.28). No patients in either the Angioplasty and Stent Group had acute stent thrombosis, whereas subacute stent thrombosis occurred in only one patients of the Stent Group (1.5%). Long-term MACEs (20 ± 4 month) were not different in the 2 groups (Angioplasty Group 39% vs. Stent Group 44%, p = 0.49). Target lesion revasculatization rate was 35% in the Angioplasty Group and 36% in the Stent Group (p = 0.51). Restenosis rate was not statistically different in the 2 groups (Stent Group 41% vs. Angioplasty Group 35%, p = 0.41).

Conclusion: Elective stent implantation in small coronary vessels with complex lesions does not seem to improve both early and late outcome.

1:36 p.m.

1008-175 Immediate and One-Year Outcome of Coronary Stent Implantation in Small Coronary Vessels Using 2.5 mm Stents

Jassim Al Suwaidi, Kirk N. Garratt, Charanjit S. Rihal, Peter B. Berger, Malcolm R. Bell, Diane E. Grill, David R. Holmes Jr.. *Mayo Clinic, Rochester, MN, USA*

Background: The role of coronary stents in the treatment of patients with small vessels is not well defined.

Objectives: To evaluate the immediate and one-year outcome of coronary stents for the treatment of lesions in small coronary arteries.

Methods: Between Jan 1995 and Aug 1999,108 patients with small coronary arteries were treated with 2.5 mm stents and 4047 patients with large coronary arteries were treated with ≥3.0 mm stents. Patients who simultaneously underwent 2.5 mm and ≥3.0 mm stents placement were excluded. Procedural success, complications, in-hospital and one-year outcomes were examined.

Results: Clinical characteristics, indications for revascularization and the number of significantly diseased vessels (<70% diameter stenosis) were comparable between the groups.

Outcomes	2.5 mm stent	≥3.0 mm stent	p
Procedural success (%)	97.2	96.7	0.77
In-hospital events (%)			
Death	0.9	1.5	0.65
QMI	0	1.0	0.30
CABG	0.9	0.7	0.75
One year events (%)			
Death	3.8	3.8	0.62
QMI	0.0	0.2	0.80
CABG	8.4	5.9	0.73
TLR	23.3	13.0	0.02
Severe angina	33.4	20.2	0.03
MACE	35.4	20.5	0.01*

TLR = target lesion revascularization, MACE = Death, MI&TLR; (* After adjustment for other covaraites in a Cox model, RR = 1.75, P = 0.02)

Conclusion: Stenting in small coronary arteries with 2.5-mm stents can be achieved with a high success rate and acceptable complication rates,

but may be associated with worse long-term outcome when compared with stenting large coronary arteries.

1:48 p.m.

1008-176 Current Indications and Results of Stent Retrieval Techniques

Bernard Chevalier, Bernard Glatt, Philippe Guyon, Thierry Royer, Reza Mohammadzadeh, Menif Wajih. *Centre Cardiologique du Nord, Saint-Denis, France*

In order to evaluate indications and results of stent retrieval technique (SRT), we retrospectively studied a consecutive series of 2959 pts treated with PTCA from 01/98 to 08/99, by four operators, using 3279 coronary stents, with a stenting rate (by pt) of 83.6%. During this time period 178 stents (5.5%) could not be placed on the lesion among which 141 (4.3%) have been removed in the guiding catheter without dislodgement, 4 (0.1%) were immediatly lost after dislodgement without any possible SRT use, 3 (0.1%) were proximaly deployed in the coronary artery and 34 (1%) needed a SRT. Stents were manually crimped in 38%. Dislodgement occurred during stent removal in the guiding catheter in 13, lesion crossing in 10, intracoronary advance in 7, and within the guiding in 4. Dislodgement mechanism was calcifications in 12, tortuosities in 7, strut damage in 6, handling mistake in 3, stent entrapment in another stent in 2 and unsatisfactory dilation in 2. SRT was performed with a biopsy forceps in 2, a small balloon in 1 and a microsnare in 31 cases. Stent status before SRT was: in place on the wire 29, still on the balloon 2, free 3. SRT site was iliac artery 10, aorta 9, left main 10, RCA 3, graft 2. SRT procedure was successful in all pts using a 6F sheath in 28 pts, an 8F sheath in 4 pts and a larger sheath in 2 pts. There was no SRT-related complication during the inhospital outcome.

Thus, stent dislodgement became unfrequent (1.2%) with new generation products. When it occurs, a SRT can be attempted in 83% of cases with a very high success rate in experienced hands.

POSTER

1152 Prognostic Indices

Tuesday, March 14, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1152-75 Comparison of Serial Intravascular Ultrasound Findings of Multi-Link and GFX Stents

Shiro Ishikawa, Yasushi Asakura, Takahiro Kato, Teruo Okabe, Keiko Asakura, Toshiyuki Takahashi, Akio Kawamura, Akiko Yamane, Hideo Mitamura, Satoshi Ogawa. *Keio University, Tokyo, Japan*

Methods: Intravascular ultrasound (IVUS) findings of Multi-Link stent (ML: n = 24) and GFX stent (n = 18) were analyzed, and the late results were compared. Vessel area (VA), stent area (SA), and lumen area (LA) were measured at the cross section of the smallest LA before (pre) stenting. IVUS measurement was performed at the same cross section after (post), and at 6 months after stenting (FU). Late recoil of implanted stent (Recoil SA = post_LA-FU_SA), neointimal area (NIA = FU_SA-FU_LA), and ratio of NIA to FU_SA (%NIA = NIA × 100/FU_SA) were calculated.

Results: There were 4 (17%) angiographic restenosis in ML, and 7 (39%) in GFX (p = 0.11). Target lesion revascularization was necessary in 2 (8%) of ML and 5 (28%) of GFX implanted lesions (p = 0.09). Quantitative coronary angiography showed that reference vessel diameter, % diameter stenosis (%DS) before and after stenting, and balloon/reference vessel diameter ratio were not different between ML and GFX. Late loss (ML: 0.93 ± 0.71, GFX: 1.6 ± 0.9 mm, $p < 0.05$) was larger and %DS at follow-up (ML: 25.6 ± 20.9, 46.6 ± 30.4%, $p < 0.05$) was smaller in GFX. There were no significant differences in pre_VA (ML 16.2 ± 3.7, GFX 14.0 ± 3.8 mm^2), post_LA (ML 15.2 ± 3.9, GFX 16.5 ± 4.2 mm^2), pre_LA (ML 1.7 ± 0.9, GFX 2.1 ± 0.9 mm^2), post_LA (ML 7.0 ± 1.9, GFX 7.2 ± 1.4 mm^2), FU_VA (ML 15.0 ± 3.4, GFX 16.0 ± 3.7 mm^2), and FU_SA (ML 6.6 ± 2.4, GFX 6.9 ± 1.3 mm^2) between ML and GFX.

	Recoil SA (mm^2)	FU_LA (mm^2)	NIA (mm^2)	%NIA
ML	0.14 ± 0.89	4.8 ± 1.9	1.7 ± 2.4	29.8 ± 17.8*
GFX	0.38 ± 0.83	4.2 ± 2.3	2.8 ± 2.4	46.7 ± 28.1

* $p < 0.05$ vs. GFX

Conclusions: Angiographically, ML tended to show lower restenosis rate. IVUS findings indicated that stent recoil was minimum with both ML and GFX, however, there was significantly less intra-stent neointimal thickening with ML.

1152-76 Recruitable and Non-Recruitable Collateral Circulation After Successful Recanalization of Chronic Total Coronary Occlusions

Gerald S. Werner, Barbara M. Richartz, Oliver Gastmann, Markus Ferrari, Klaus Lang, Hans R. Figulla. *Friedrich-Schiller-University, Jena, Germany*

Background: Collateral coronary flow (CCF) in total chronic coronary occlusions (TCO) preserve myocardial viability distal to the occlusion. After successful PTCA the remaining collateral function determines late cardiac events. This study should evaluate the time course of changes in CCF during and after successful PTCA of TCO.

Patients: 22 patients with a chronic TCO (i.e. at least 4 weeks) were studied with an intracoronary Doppler wire. It was advanced through the occlusion via an over-the-wire catheter before dilation to record the baseline CCF. After stenting of the occlusion, the recruitable CCF was assessed during a repeated balloon occlusion of 3 min. This was repeated during a control angiogram on the following day. Average peak velocity (APV, absolute value), peak velocity integral (PVI), and a collateral flow index (CFI = PVI during occlusion/PVI unobstructed) were measured. A CFI >0.30 is considered to indicate a sufficient recruitable CCF to prevent ischemia.

Results: The table shows the data of CCF at baseline, after recanalization indicating the recruitable CCFr, and after 24 hours (* $p < 0.05$).

	APV (cm/s)	PVI (cm)	CFI
CCF baseline	12.1 ± 6.4	9.7 ± 5.3	0.43 ± 0.18
CCFr	4.4 ± 2.3*)	3.6 ± 2.0	0.20 ± 0.14
CCFr next day	4.9 ± 4.8*)	4.3 ± 4.1	0.15 ± 0.16

In 36% CCF was completely abolished at the end of PTCA and 24 hours later. The non-recruitable CCF was 64% of baseline CCF. A CFI >0.30 was observed in only 18% of TCO 24 hours after PTCA.

Conclusion: CCF is instantaneously influenced by the reopening of a TCO. The remaining recruitable CCF is considerably lower than baseline CCF. The CFI decreases in the majority of patients and may not be sufficient to prevent future ischemic events.

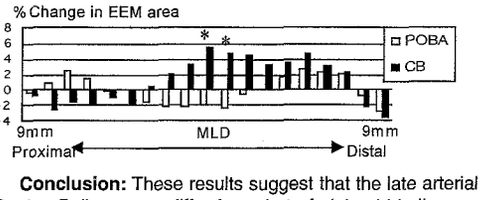
1152-77 Does Late Arterial Response After Cutting Balloon Angioplasty Differ From That of Conventional Balloon Angioplasty? A Volumetric Intravascular Ultrasound Analysis

Takeshi Suzuki, Hiroaki Hosokawa, Koichi Yokoya, Takahiko Suzuki. *Stanford University, Stanford, California, USA; National Toyohashi Higashi Hospital, Toyohashi, Japan*

Background: The Cutting Balloon (CB) is a novel dilation device that longitudinally incises the coronary plaque during balloon dilation. This incision limits the degree of arterial trauma associated with balloon dilation, potentially reducing the late injury response compared with plain old balloon angioplasty (POBA).

Methods: To evaluate whether the late arterial response of CB differs from that of POBA, a total of 67 lesions, 33 CB and 34 POBA, was imaged at pre-, post-procedure and follow-up. The each area and volume of external elastic membrane (EEM), lumen and plaque was measured using Simpson's method. ΔVolume and Δarea ((Follow-up-Post)/Post*100) were calculated.

Results: The loss of EEM and lumen volume at follow-up in the CB group tended to be less than that in the POBA group (ΔEEM volume; 0.8 ± 10.0% vs −3.3 ± 18.2%: p = 0.26, Δlumen volume; −0.5 ± 20.1% vs −6.5 ± 22.5%: p = 0.26). There was no significant difference in ΔPlaque volume in both groups (3.4 ± 17.6% vs 0.5 ± 21.8%: p = 0.55). As the figure indicates, in mid-lesion, the loss of EEM area at follow-up in the CB group was significantly less than that in the POBA group.



Conclusion: These results suggest that the late arterial response of the Cutting Balloon may differ from that of plain old balloon angioplasty In the CB group, mid-lesion vessel geometry remodeling is favorable.

1152-78 Prognostic Value of Diabetes for Long-Term Event After Percutaneous Coronary Intervention is Augmented in Proximal Left Anterior Descending Artery Lesion

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Background: Diabetes has been known as a major risk factor for long term prognosis after percutaneous coronary intervention (PCI). We tested the hypothesis that impact of diabetes may be different according to the location of target lesion.

Methods: All patients who were followed up for more than 1 year after successful PCI in single lesion of native coronary artery in Samsung Medical Center between January 1995 and July 1998 were included. Patients with cardiogenic shock and/or left main disease were excluded. Major cardiac adverse event (MACE) was defined as death, myocardial infarction, repeated PCI, or coronary artery bypass surgery.

Results: 832 patients out of 875 patients were followed up for 1 year (follow-up loss 4.9%). 1) 1 year MACE rate was higher in diabetes patients (DM) compared with non-diabetes patients (non-DM) (p = 0.024). It was also higher in the patients who underwent PCI in proximal left anterior descending segment (pLAD) compared with non-pLAD group (p = 0.024). 2) Among pLAD group, DM was associated with significantly higher 1-year MACE rate (p = 0.003). On the contrary, there was no signifiaant difference in 1-year MACE rate between DM and non-DM group among patients whose target lesions were not pLAD (p = 0.41). 3) Among MACE in pLAD group, only the risk of repeated PCI lesion was significantly higher in DM group (non-DM 15.6%, DM 37.8%, p = 0.001). In multivariate analysis, only diabetes was an independent risk factor for 1 year MACE rate in pLAD group. 4) Odds ratio between DM and non-DM group was 4.0 (95% CI: 1.4–11.4, p = 0.007) for non-stent group and 2.1 (95% CI: 0.8–5.8, p = 0.13) for stent group in pLAD group.

	non-pLAD	pLAD	All	p-value
non-DM	17.4% (493)	20.4% (147)	18.1% (640)	0.41
DM	20.4% (147)	42.2% (45)	25.5% (192)	0.003
All	18.1% (640)	25.5% (192)	19.8% (832)	0.024
p-value	0.41	0.003	0.024	

* *Data presented as 1-year MACE rate (patients number in the group)*

Conclusion: Prognostic value of diabetes for long-term event after PCI is augmented in proximal left anterior descending artery lesion. Bypass surgery using left internal mammary artery can be the better option in this group.

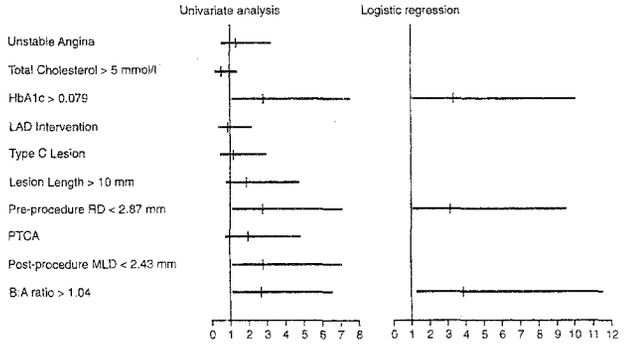
1152-79 Predictors of Angiographic Restenosis After Coronary Intervention in Patients With Diabetes Mellitus

Peter K. Mazeika, Neeraj Prasad, Sanh Bui, Peter Seidelin. *Division of Cardiology, The Toronto Hospital, Toronto, Ontario, Canada*

Background: The identification of risk factors for restenosis in diabetics could guide patient selection and allow insight into underlying mechanisms.

Methods: To pinpoint predictors of restenosis, 75 diabetics (age 60 (10) yrs) with 86 treated lesions were studied using a concurrent case-control design. All patients had a first, successful, PTCA or stent placement and underwent follow-up angiography with analysis using QCA.

Results: There were 45 patients (53 lesions) with restenosis and 30 patients (33 lesions) without restenosis. Univariate predictors of angiographic restenosis as a binary (graph) or continuous variable were: periprocedural HbA1c level; vessel reference diameter (RD); PTCA; postprocedure MLD; and larger final balloon size to reference artery diameter (B:A) ratio. Logistic regression identified HbA1c level, vessel RD and B:A ratio as independent risk factors (graph). On multiple linear regression, HbA1c level (regression coefficient 3.16 (0.05 to 6.27)), PTCA (15.14 (2.33 to 27.9)) and vessel RD (−11.74 (−22.92 to −0.56)) were independently predictive of diameter stenosis at follow-up angiography. However, the goodness of fit of the final model was poor (adjusted R^2 19%).



Conclusion: Vessel reference diameter, HbA1c level, PTCA and B:A ratio were independent predictors of restenosis in diabetics. Improved periprocedural glycemic control and the avoidance of oversized balloons, in addition to stenting, may reduce the restenosis rate in these patients.

1152-80 The Plasminogen Activator Inhibitor 1 Promotor Polymorphism Predicts Late Loss After Coronary Stenting

J.R. Ortlepp, P.W. Radke, A. Killian, S. Merkelbach-Buse, J. vom Dahl, P. Hanrath. *Medical Clinic I, University Hospital, Aachen, Germany*

Background: The use of intracoronary stents has improved acute and long-term outcome after percutaneous coronary interventions. However instent restenosis remains a significant clinical problem. Identification of "high-risk" patients would allow selection of individualized appropriate therapeutic approaches. Genetic polymorphisms have been previously suggested to be associated with instent restenosis. In this study we investigated the influence of two recently studied polymorphisms of the DCP1 (ACE) gene and the ITGA2B (GIIb/IIIa) gene and of the promotor polymorphism of the plasminogen activator inhibitor type 1 (PAI-1) gene.

Methods: 100 consecutive unselected patients with elective coronary stent placement and 6-month angiographic follow up were recruited. Quantitative coronary angiography and genotyping with PCR and restriction fragment length polymorphism analysis for the three polymorphisms were performed in all patients.

Results: Patients with the PAI-1 4G/4G genotype (n = 24) showed a significant (univariate p = 0.03; multivariate p = 0.007) greater late loss (0.71 mm ± 0.13 SE) vs patients with PAI-1 genotype 4G/5G or 5G/5G (n = 76) (0.38 mm ± 0.05). The PAI-1 genotype was the only independent predictor for late loss in univariate and multivariate analysis.

Conclusion: The promotor polymorphism of the PAI-1 gene may be of high relevance in the pathophysiological pathway of neointima hyperplasia. The 4G/4G genotype may predispose gene carriers to a higher expression of plasminogen activator inhibitor 1 after stenting with consecutive more proliferation of endothelial and smooth muscel cells and a higher degree of neointima hyperplasia.

1152-81 Reversible Perfusion Defects on Thallium-201 SPECT Scintigraphy Early After Coronary Stenting Occur Frequently and Do Not Predict Late Target Lesion Revascularization

Ronen Jaffe, Simona Ben-Haim, Avi Front, Giora Weisz, Basheer Karkabi, Nader Khader, Amnon Merdler, Moshe Y. Flugelman, David A. Halon, Basil S. Lewis. *Lady Davis Carmel Medical Center and Bruce Rappaport School of Medicine, Technion-IIT, Haifa, Israel*

Background: In the pre-stent era, thallium-201 reversible perfusion defects (RevPd) early after successful coronary balloon angioplasty (PTCA) predicted late coronary restenosis. We investigated the frequency and significance of such findings in the current stent era.

Methods: Single photon emission computed tomography (SPECT) Tl-201 myocardial scintigraphy (rest and dipyridamole) was used to detect RevPd early (12–24 hr) after angiographically successful coronary stenting in 42 pts. Late follow-up at 9 (range 3–40) mths sought clinically indicated target lesion revascularization (TLR). Findings were compared to 33 pts who underwent angiographically successful PTCA without stenting (POBA) during the same period.

Results: Demographic, clinical and pre-procedural angiographic findings were similar in both groups. Coronary stenting achieved a larger minimal lumen diameter (MLD) than POBA (2.7 ± 0.4 vs 2.1 ± 0.4 mm, p < 0.001) and smaller residual stenosis (4.7 ± 11.5 vs 19.8 ± 11.0 per cent, p < 0.001). The 12–24 hr scan revealed RevPd in 13/42 (31%) of stented lesions and 11/33 (33%) of POBA lesions (NS). Early RevPd did not correlate with lesion length, MLD or residual stenosis. During follow-up, late TLR was performed in 1/12 (8%) of stented lesions with early RevPd and in 4/26 (15%) of lesions without (NS). In the POBA group, TLR was performed in 2/11 (18%) of lesions with early RevPd and 3/21 (14%) of lesions without (NS).

Conclusions: This prospective study showed that in era of provisional stenting: 1. Early RevPd on 12–24 hr SPECT Tl-201 scintigraphy occurred in a third of pts both after stenting and POBA, despite the larger MLD and lesser residual stenosis achieved by stenting. 2. Incidence of late TLR was low in both groups. 3. Late TLR was not predicted by presence or absence of early RevPd in either group.

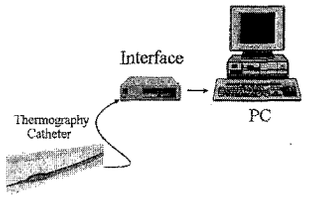
1152-82 Atherosclerotic Plaque Temperature Before and After Angioplasty

Christodoulos Stefanadis, Leonidas Diamantopoulos, Charalambos Vlachopoulos, Eleftherios Tsiamis, John Demellis, Emmanuel Vavuranakis, Costas Stratos, Pavlos Toutouzas. *Hippokration Hospital, Athens Medical School, Athens, Greece*

Background: We have shown that plaque temperature (T) is increased in acute ischemic syndromes (*Circulation 1999; 99: 1965–71*) presumably due to the intense presence of activated macrophages in the unstable plaques. In the present study, we investigated the effect of coronary intervention on plaque T.

Methods: Plaque T was measured with a catheter-based technique that was designed and developed in our laboratory (figure) in 35 patients with stable angina (SA, 18 pts) and unstable angina (UA, 17 pts) before and after angioplasty. The 3 F thermography catheter incorporates a thermistor at its distal end (accuracy: 0.05 ºC, time constant: 300 msec; spatial resolution 0.5 mm).

Results: Plaque temperature (difference of maximum plaque T from healthy wall T) was greater in the UA pts compared to the SA pts both before and after angioplasty ($P < 0.001$ for bot comparisons). However, there wa no difference in the plaque T befor and after angioplasty (SA: befor 0.153 ± 0.123 vs. after 0.147 ± 0.106 UA: before 0.788 ± 0.337 vs. afte 0.771 ± 0.324, P = NS for both).



Conclusions: Coronary angioplasty does not alter plaque T. This implies that the underlying mechanism causing increased plaque T in unstable plaques is not affected by changes in plaque structure or blood flow. Thus, the hypothesis that activated macrophages are the source of heat production is reinforced.

1152-83 Coronary Flow Reserve as Compared to Pressure-Derived Fractional Flow Reserve After Successful Recanalization of Chronic Total Coronary Occlusions

Gerald S. Werner, Barbara M. Richartz, Markus Ferrari, Oliver Gastmann, Klaus Lang, Hans R. Figulla. *Friedrich-Schiller-University, Jena, Germany*

Background: Doppler-derived coronary flow reserve (CFR) and pressure-derived fractional flow reserve (FFR) are used to assess the result of PTCA. A CFR >2.0 and a FFR >0.75 indicate a sufficient PTCA result in nonocclusive lesions. The present study evaluated the relevance of these parameters in total chronic coronary occlusions (TCO) with a collateral dependent myocardial area.

Methods: Fourteen patients with successful recanalization of a TCO were studied by intracoronary Doppler and intracoronary pressure wire simultaneously. Mean duration of TCO was 17 months (4–72). All TCO were treated by stenting. CFR and FFR were measured after stent implantation when the angiographic result was considered optimal. A bolus of adenosin was injected (12 μ for fight or 18 μ for left coronary) and CFR and FFR recorded at least three times. In 10 patients a control angiogram was done after 24 hours and the measurement of CFR and FFR was repeated.

Results: CFR after recanalization of the TCO and stenting of the lesion ranged from 1.2 to 3.0 (mean 1.9 ± 0.5). It was below 2.0 in 50% of patients. The FFR ranged from 0.66 to 0.97 (mean 0.83 ± 0.10); it was below 0.75 in only one patient. After 24 hours, CFR remained unchanged (mean 1.9 ± 0.4) as was FFR (mean 0.84 ± 0.08). Repeat PTCA in patients with CFR < 2.0 did not improve the CFR. The value of the CFR was not depedent on the extent of global or regional ventricular dysfunction, or on the duration of occlusion.

Conclusion: CFR is dependent on the microvascular function of the myocard. The variable myocardial resistance in TCO may impair CFR in a large proportion of patients and make it a less valuable tool to assess the angioplasty in TCO as compared with FFR.

POSTER

1153 Antiplatetet Therapy With Coronary Stenting

Tuesday, March 14, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1153-116 Short Term Mortality Lower With Clopidogrel Than Ticlodpidine Following Coronary Artery Stenting

Philippe L. L'Allier, Herbert D. Aronow, Fernando A. Cura, Deepak L. Bhatt, Abdulhay Albirini, Jakob P. Schneider, Eric J. Topol, Stephen G. Ellis. *Cleveland Clinic, Cleveland, OH, USA*

Background: Due to its more favorable safety profile, clopidogrel is used with increasing frequency in place of ticlopidine after coronary artery stent implantation. Randomized trial data (n = 1020) have not shown a difference in major adverse clinical events.

Methods: Between June 1996 and December 1998, 2369 patients who underwent coronary stent implantation received peri-procedural anti-platelet regimens containing clopidogrel (300 mg × 1; and 75 mg PO daily × 30)/ASA (325 mg daily) or ticlopidine (500 mg × 1, 250 mg PO BID)/ASA (325 mg daily). We compared in-hospital and 30-day outcomes among patients not in clinical shock at the time of the procedure.

Results: Follow-up was 97% complete. There were few important differences in baseline characteristics. More than 50% of patients received abcximab. The in-hospital bleeding complications were not different. The 30-day outcomes are summarized below. After multivariate analysis the association between clopidogrel and reduced 30-day death persisted (OR 0.231, 95% CI 0.05–0.99).

30-day Outcomes	Clopidogrel n = 652	Ticlopidine n = 1717	p
Death	2 (0.3%)	25 (1.5%)	0.024
MI	26 (4.0%)	110 (6.5%)	0.023
Revasc.	9 (1.4%)	27 (1.6%)	ns
Composite	38 (6.2%)	153 (9.1%)	0.03

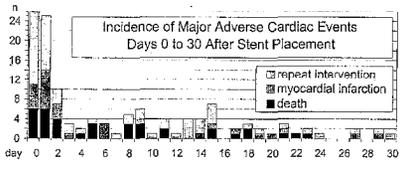
Conclusion: In this registry study, clopidogrel after coronary stenting appears to yield more favorable clinical outcomes at 30 days than ticlopidine. Whether this difference is due to more potent or rapid platelet inhibiton with clopidogrel remains to be elucidated.

1153-117 Thrombotic Stent Occlusion and Associated Major Adverse Cardiac Events Beyond the First 2 Weeks After Coronary Stent Placement. Analysis of 3676 Patients With a 4-Week Ticlopidine Regimen

Helmut Schühlen, Jürgen Pache, Jörg Hausleiter, Juli Mehilli, Josef Dirschinger, Adnan Kastrati, Albert Schömig. *I. Medizinische Klinik rechts der Isar & Deutsches Herzzentrum Technische Universität, Munich, Germany*

Background: The ISAR and STARS trials have demonstrated the benefit of a ticlopidine regimen after coronary stent placement. As the risk for ticlopidine-induced severe neutropenia may be >1% after 2 weeks, there is interest to discontinue ticlopidine after 2 weeks. In ISAR and STARS with a 4-week regimen, no adverse cardiac events occurred beyond the first 2 weeks, and nonrandomized trials suggest that the risk for cardiac events is low if ticlopidine is discontinued after 2 weeks. However, the size of these studies may be too small to specify a risk between 0 and 1%.

Methods & Results: We analyzed 3676 patients, all with 4 weeks of ticlopidine. The overall adverse event rate was 3.4% after 4 weeks; the temporal distribution of the events is shown in the graph. The rate for days 14 to 30 was 0.8%, 17 of these events (0.5%) were stent thromboses or cardiac deaths.



Conclusions: With a 4-week ticlopidine regimen, the risk for major adverse cardiac events beyond the first 2 weeks is low but not zero. Randomized trials are necessary to weigh a presumably higher risk for adverse cardiac

events with a 2-week ticlopidine regimen against a lower risk of neutropenia. Furthermore, a 4-week regimen might be preferable for clopidogrel with its lower risk for neutropenia.

1153-118 The Impact of Oral Antiplatelet Therapy on CK Release After Coronary Stent Implantation: A Comparison Between Ticlopidine and Clopidogrel

Issam Moussa, Eli Traube, Gary Roubin, Antonio Colombo, Sriram Iyer, Gishel New, Nadim AL-Mubarak, Michael Collins, Edward Kreps, Jeffrey Moses. *Lenox Hill Cardiac and Vascular Institute of New York, NY, USA*

Background: Data suggest that ticlopidine administration 3 days prior to stenting may reduce post-procedural CK elevation. The purpose of this study was to investigate the differential impact of pre-procedure administration (within 24 hrs) of ticlopidine versus Clopidogrel on CK elevation after stenting.

Methods: All consecutive pts undergoing stent implantation between 1/1997 and 12/1998 were the subject of this analysis. These pts were divided into 2 groups: group I – 1405 pts who were pretreated with ticlopidine (250 mg PO BID); and group II – 1069 pts who were pretreated with a 300 mg loading dose of Clopidogrel. Total CK was systematically determined in all pts and MB fraction was determined if total CK was higher than normal (225 unit). CK elevation was defined as any increase in total CK above normal limits with >4% MB.

Results: Pts treated with clopidogrel were older (64 ± 11 yrs vs 62 ± 11 yrs, p = 0.03) and had smaller vessels (2.74 ± 0.60 mm vs 2.84 ± 0.70, p < 0.0001), but there were no differences in lesion severity, length or complexity. The frequency and magnitude of CK release is shown in the table below:

	Ticlopidine n = 1405	Clopidogrel n = 1069	P
Any CK Release	113 (8%)	64 (6%)	0.059
Mean CK release (U)	684 + 663	465 + 364	0.016

Conclusions: Clopidogrel loading prior to stenting may be an effective strategy to achieve rapid and effective platelet inhibition which may attenuate the degree of myocardial necrosis following coronary stenting.

1153-119 A Comparison of Clopidogrel to Ticlopidine Therapy for the Prevention of Major Adverse Cardiac Events at Thirty Days and Six Months Following Coronary Stent Implantation

D.A. Plucinski, Karen Scheltema, Jan Krusmark, Nancy Panchyshyn. *Cardiovascular Consultants, Ltd., North Memorial Health Center (CVC.NMH), Minneapolis, Minnesota, USA*

Objective: To compare the efficacy of clopidogrel (CL) to ticlopidine (TI) for the prevention of major adverse cardiac events (MACE), including total mortality (Total Mort), cardiovascular mortality (CV Mort), myocardial infarction (MI), and clinically driven repeat target vessel revascularization (TVR), either percutaneous (PCI) or surgical (CABG); and to ascertain event free survival (EFS).

Methods: All patients, including patients undergoing PCI for MI, were prospectively enrolled into the CVC.NMH Angioplasty registry from September 1996 to December 1998. MACE and EFS were determined at thiry days and six months after PCI. For patients who underwent stent implantation, outcomes for post stent CL were compared to TI.

Results: The baseline demographic and clinical status of the patients in the CL and TI cohorts were comparable with no significant differences. Thirty day and six month outcomes are displayed in the following table:

	30 Day Outcomes		6 Months Outcomes	
	TI n = 1138	CL n = 240	TI n = 1138	CL n = 240
Total Mort	1.3%	0.0% p = 0.088	3.7%	1.7% p = 0.113
CV Mort	0.3%	0.0% p = 1.0	1.5%	0.8% p = 0.555
MI	0.6%	0.8% p = 0.660	2.8%	4.6% p = 0.151
Repeat PCI	1.3%	0.4% p = 0.333	9.6%	10.8% p = 0.552
CABG	0.3%	0.8% p = 0.211	4.6%	6.3% p = 0.271
Total TVR	1.6%	1.3% p = 1.0	14.1%	17.1% p = 0.228
Event Free	97.8%	99.2% p = 0.206	82.2%	79.2% p = 0.276

Conclusions: MAE and EFS at thirty days and six months following stent implantation are similar in patients treated with TI and CL with no significant differences.

POSTER

1154 Carotid, Renal, and Femoral Stenting

Tuesday, March 14, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1154-84 Relationship Between the Structure of the Plaque and the Importance of Embolization During Carotid Angioplasty

Serge Kownator, François Luizy, Michel Henry, Max Amor, Bernard Foliguet, Zucaï Chati. *Polyclinique, Essey-les-Nancy, France*

Background: Carotid angioplasty (CA) is associated with a higher rate of embolization than carotid endarterectomy. A previous ex vivo study found a relationship between hypoechoic plaques, high degree of stenosis and embolization during CA. The purpose of this study is to investigate in vivo the importance and the nature of embolization during CA and to establish a correlation with the structure of the plaque and the importance of the stenosis.

Method: 20 patients were selected for CA. Ultrasound examination were performed in the first place on an ATL HDI 5000 device. All the frames were recorded on HDI lab and SVHS videotape. The images were computerized and standardized following Nicolaïdes' method, in order to define the median density value (MDV) of the plaque. Low MDV is correlated with hypoechoic lesions, high MDV with hyperechoic. Degree of stenosis is evaluated by measuring the peak systolic velocity on duplex scan. CA and stenting has been performed under cerebral protection completed through a protection balloon (PercuSurge system). Debris were collected by aspiration and flushing before deflation of the protection balloon. After filtration and fixation they were analyzed by microscopy and electron microscopy.

Results: Size of the debris take place between 50 μ and 2.5 mm. They are made of recent thrombi, ancient thrombi, lipoid masses or acellular material such as fibrous particles, calcified particles. Low MDVs (i.e. hypoechoic plaques) are related with a greater number of panicles but a smaller size. High MDVs (i.e. hyperechoic plaques) are associated with a bigger size of particles, but a lower number of debris. We do not find any relationship between the degree of stenosis and the number or particles.

Conclusion: Whatever the structure of the plaque, CA brings exposure to the risk of embolism Hypoechoic lesions provide a great number of small debris, hyperechoic lesions, a smalier number of larger particles. To avoid cerebral embolization, protection seams to be an effective technique.

1154-85 Probucol and Brachytherapy as a Combined Strategy to Prevent Restenosis After Angioplasty of the Lower Limb Arteries (PTA): A Valid Model to Prevent Restenosis After PTCA?

Augusto Gallino, Felix Mahler, Kurt Jäger, Ernst Schneider. *Divisions of Vascular Medicine Bellinzona, Bern; Basel; Zurich, Switzerland*

In the femoro-popliteal arteries restenosis occurs with an incidence of ~40%. Among the large number of strategies tested for the prevention of restenosis only a few seem to maintain their potential value: the antioxidant drug Probucol (P) and intravascular brachytherapy (B). Aim of our prospective randomized multicenter trial involving the major Swiss angiology centres, is to determine the impact of *P* and *B* or *both* in reducing restenosis after femoro-popliteal PTA when compared to a standard regimen with Aspirin alone (*A*). The study consists of the following four treatment arms of 80 randomized patients each:

A alone (100 mg/d)	*A* + *B*
A + *P* (1 g/d, d −30 → 180 d)	*A* + *B* + *P*

The prescribed gamma-radiation dose is 16 Gy to a 2 mm radial distance from a non-centred 6Fr closed endlumen catheter.

Follow-up examinations immediately post, 3 and 6 mts after PTA include assessment of the key lesion by duplex-US defining restenosis as >50% reduction of luminal diameter (major endpoint). A total of 166 pts (81 pts receiving B) have been randomized with a drop out rate of 11%. Thusfare no major side effects have occurred. The long multicenter experience of the participating centres and the expected number of eligible pts should allow to determine the efficacy of two of the most promising treatments for prevention of restenosis and may serve as a model for studies in pts undergoing PTCA.

1154-86 Radial Approach for Selective Carotid Angiography

Young-sup Yoon, Won Heum Shim, Kyung-Jin Park, Seung-Yun Cho. *Yonsei Cardiovascular Center, Yonsei University College of Medicine, Seoul, Korea*

Background: Carotid and coronary artery occlusive diseases frequently coexist. Currently, diagnostic and interventional coronary procedures are increasingly performed by the radial approach. In this regard, the radial approach can be beneficial for the evaluation of carotid system during coronary angiography. This approach can also be useful for follow-up angiography after carotid stenting. We assessed the feasibility and safety of selective carotid angiography by transradial route at cardiac cath lab.

Methods: Selective carotid angiography was performed in 90 consecutive patients through the right radial artery at cardiac oath lab. Data for patients were collected prospectively as "intention to use" the radial artery after confirming positive Allen's test. There were 68 males and 22 females. Mean age was 62 ± 8. The indications were follow-up angiography after carotid stenting in 22 cases and detailed assessment of carotid artery stenosis in 68 cases at the same setting of coronary angiography. We used 4F/5F Simmons catheter for the initial 19 cases and 4F multipurpose (125 cm-long) catheter for the latter 71 cases. Hydrophilic guidewire (0.035 inch, 260 cm-long) was used to facilitate the manipulation of the catheter or to engage carotid arteries. Procedure time (after sheath insertion to catheter removal), fluoroscopy time and amount of dye used were measured. Patients were discharged on the same day unless follow-on intervention was performed.

Results: Radial artery cannulation was successful in all cases. Selective angiography was successfully performed for 179 carotid arteries of 90 patients (success rate 99%). All the angiograms were of diagnostic quality. In one patient we failed in engaging the left carotid artery due to spasm of the radial artery and severe tortuosity of the fight subclavian artery. In the latter 70 cases, procedure time and fluoroscopy time was 8.3 ± 4.1 minute and 3.2 ± 1.5 min, respectively. Average amount of dye used was 23.8 ± 7.6 ml. There were no neurologic complications or clinically significant access site complications such as radial artery perforation, aneurym, fistula or hand ischemia.

Conclusion: Transradial angiography of both carotid arteries can be performed safely and effectively with high procedural success rate and no significant complications at cardiac oath lab. Considering short procedure time and small amount of dye used, this procedure will find wider applications such as the assessment of carotid system during transradial coronary angiography or follow-up angiography after carotid artery stenting.

1154-87 A New Protection Filter Device to Prevent Distal Embolization in Peripheral Interventions – First Results in Renal and Carotid Arteries

Ulrich Gerckens, Ralf Mueller, Sabine Soblik, Thomas Wollweber, Eberhard Grube. *Department of Cardiology/Angiology Heart-Center Siegburg, Siegburg, Germany*

Background: Percutaneous interventions of renal and carotid arteries are now frequently performed. However, they carry a high risk of distal embolization. The AngioGuard™ Emboli Capture system provides a method of containing and retrieving loose plaque material without distal vessel occlusion. We evaluated the effectiveness and safety of the system in renal and carotid artery interventions.

Device description: The AngioGuard™ Capture Guidewire system consists of a 0.014 PTCA wire with an expandable filter basket at the distal end. After crossing the target lesion the basket is expanded and the intervention can be performed in a standard manner. Plaque debris is captured within the distal basket and can be extracted using the AngioGuard™ Guidewire. The filter membrane allows a normal blood-flow during the procedure.

Method: To evaluate the efficacy and safety of this new protection device we used the AngioGuard™ system in 8 patients with 11 lesions (renal stenosis n = 6, carotid stenosis n = 5). In all lesions angioplasty with additional stent implantation was performed.

Results: In all patients the system could be safely placed, expanded and extracted. We observed no in-hospital major events related to the AngioGuard™ device. In renal arteries the success rate was 100%. Macroscopic debris could be retrieved in every case. In one case, a large plaque particle contained in the filter caused side branch occlusion. Normal flow was reestablished after the plaque was extracted using the basket filter.

The AngioGuard™ Capture Guidewire was able to cross all carotid lesions, also highgrade and ulcerative lesions, and could be passed even through tortourous vessels. Common practice with wall stent implantation could be performed. Debris was extracted in 4/5 carotid interventions. In one case visible obstruction caused by loosened material within the filter deminished distal flow. A large atheromatous plaque could be safely retrieved and normal flow was reestablished thereafter.

Conclusion: The AngioGuard™ Emboli Capture system can be easily and safely used in renal and carotid arteries. It is effective in retrieving debris material which potentially could cause clinically important distal vessel occlusion.

1154-88 Factors Influencing and Predicting Post-Intervention Renal Function Outcome on Ischmic Nephropathy

Robin Yue, Mark Wholey, Zhanbin Feng, Tyrone J. Collins, J. Stephen Jenkins, Stephen R. Ramee, Christopher J. White. *Ochsner Medical Foundation, New Orleans, Louisiana; Pittsburgh Vascular Institute, Pittsburgh, Pennsylvania, USA*

Background: Progressive renal artery stenosis can cause ischemic nephropathy. Percutaneous revascularization has high success rate and low complication rate. Clinical predictors for improvment or stabilization of renal function (ISRF) are uncertain.

Methods: Successful renal artery intervention was obtained in 131 patients between 1994 and 1998. Renal function was determined at baseline, ≤72 hours post-procedure and at ≥6 months of follow-up. Univariate and multivariate analysis of variables were used to analyze clinical outcomes at ≥6 months post-intervention. Renal function improvement or deterioration was defined as greater than 0.2 mg/dl change in serum creatinine (Cr).

Results: Univariate and multivariate analysis revealed that baseline Cr (BCr) ≤ 2.0 mg/dl ($p < 0.04$) and ISRF at ≤72 hours post procedure ($p < 0.0001$) correlated with stable renal function at ≥6 mos follow-up. In contrast, BCr ≥ 2.0 mg/dl and post-procedure ≤ 72 hours serum creatinine deterioration were with worsening outcome 6 mos later. In 14 out of 31 (45%) patients with BCr ≥ 2.0 mg/dl had a worsening outcome.

		≥6 mos		
	Pt #	Better/same	Worse	p-value
BCr ≥ 2.0 mg/dl	31	17 (55%)	14 (45%)	0.0116
BCr ≤ 2.0 mg/dl	100	78 (78%)	22 (22%)	0.0116
Worse ≤ 72 hrs Cr	21	8 (38%)	13 (62%)	0.0001
ISRF ≤ 72 hrs Cr	110	87 (79%)	23 (21%)	0.0001

Conclusion: Baseline and <72 hours post-procedure renal function are independent predictors of more than 6 mos renal function.

1154-89 Late Clinical Outcomes After Renal Artery Stenting in Patients With Renal Insufficiency and Uncontrolled Hypertension

George Dangas, John R. Laird, Roxana Mehran, Luis Gruberg, Javed M. Ahmed, Ajith Purush, Chryssoula K. Pappas, Petros Okubagzi, Michael Astatkie, Ahn Bui, Bryan Curry, Nancy McCarthy, Martin B. Leon. *Cardiovascular Research Foundation, Washington, DC, USA*

Background: Renal artery stenosis can led to uncontrolled hypertension (HTN) and chronic renal insufficiency (CRI). Endovascular stent implantation is a commonly employed method of renal artery revascularization for atherosclerotic ostial renal artery narrowing.

Methods: We studied the outcome of renal stenting for uncontrolled HTN in patients with CRI (baseline creatinine > 2 mg/dl, n = 63) versus *No CRI* (n = 56). One-year follow-up was obtained by a dedicated Data Coordinating Center. Overall, 43% of patients had diabetes, 52% prior myocardial infarction, 50% prior coronary bypass surgery, and 48% prior coronary angioplasty. Patients with CRI were older: 72 ± 8 versus 69 ± 8 years, p = 0.04; other baseline demographics were similar.

Results: Procedural success was 100%. Post procedure, 9% of patients with CRI required temporary hemodialysis, but none required permanent dialysis. Long-term functional and clinical results are shown:

	CRI	No CRI	P
Temporary Dialysis	9%	0	0.03
Acute renal failure	11%	5%	0.12
Δcreatinine, mg/dl	−0.1 ± 0.8	0.1 ± 0.4	NS
ΔSyst;Diast. BP	−21 ± 14*; 8 ± 9*	−24 ± 20; 7 ± 10*	NS; NS
1-year Death; Q-MI	16%; 1.6%	7%; 0	NS; NS

*Significant decrease from baseline ($p < 0.05$, paired t-test). MI = myocardial infarction. Syst;Diast. BP = systolic/diastolic blood pressure (mmHg).

No patient required repeat renal artery intervention.

Conclusion: Renal artery stenting is safe and improves BP control without worsening renal dysfunction in patients with CRI. Despite these results, late mortality is high due to the presence of advanced atherosclerosis and significant cardiac comorbidity.

1154-90 Renal Artery Stenosis Interventions Guided by Intravascular Ultrasound and Pressure Gradient Measurements

Michael Haude, Dirk Welge, Dietrich Baumgart, Clemens von Birgelen, Holger Eggebrecht, Andreas Kribben, Thomas Philipp, Raimund Erbel. *Cardiology Department and Department for Nephrology and Hypertension, University-GHS Essen, Germany*

Background: Percutaneous transluminal angioplasty (PTA) and stenting are accepted techniques for the treatment of renal artery stenosis to preserve renal function and to control hypertension. In order to maintain an optimal interventional result we measured luminal enlargement by quantitative angiography (QA), intravascular ultrasound (IVUS) and translesion pressure gradients (Δp mean).

Methods: In 35 patients (pts) with 45 renal artery stenoses QA (CMS, Medis), IVUS (3.0 F Vision Five-64 F/X, Endosonics) and Δp mean measurements (0.014 inch Wave Wire, Endosonics) were performed before PTA, after PTA, after stent implantation and at six month.

Results: The maximum balloon diameter for PTA was 6.2 ± 0.8 mm compared to 6.4 ± 0.7 mm for stent implantation.

	Before PTA	After PTA	After Stent	At 6 months
QA MLD [mm]	2.2 ± 0.9	5.7 ± 1.8#	6.7 ± 0.7#+	6.0 ± 1.6*
QA MCA [mm²]	3.8 ± 1.9	25.5 ± 8.7#	33.9 ± 5.8#+	29.3 ± 7.7*
IVUS MLD [mm]	1.8 ± 1.1	4.7 ± 1.9#	6.4 ± 0.9#+	5.8 ± 1.4*
IVUS MCA [mm²]	2.8 ± 1.7	17.9 ± 6.6#	32.8 ± 4.8#+	26.9 ± 6.1*
Δp mean [mm Hg] 55 ± 19	23 ± 20#	5 ± 3#+	5 ± 2§	

MLD = Minimal luminal diameter, MCA = minimal cross-sectional area, #: $p < 0.001$ versus pre PTA, +: $p < 0.05$ versus after PTA, §: n. s. versus after stent, *: $p < 0.05$ versus after stent. There was no restenosis at 6 month. Serum creatinine was 1.4 ± 0.5 mg/dL before intervention and 1.3 ± 0.4 mg/dl at six month. Mean blood pressure decreased from 178/97 to 156/88 mm Hg ($p < 0.01$).

Conclusion: Guidance of renal artery stenosis intervention by QA, IVUS and Δp mean provides the best interventional short- and long-term results. IVUS better reflects luminal enlargement compared to QA.

1154-91 Long-Term Outcome Following Carotid Artery Stenting

Fayaz A. Shawl, Fernando Lapetina, Waleed Y. Kadro, Stephanie Cornell, Kathryn G. Dougherty. *Washington Adventist Hosptial, Takoma Park, Maryland, USA*

Background: Although recent studies have suggested that carotid stenting (CS) can be performed with a low periprocedural complication rate, the long-term benefit from CS has not been evaluated.

Methods: We prospectively followed 91 patients (with 97 vessels) undergoing carotid stenting from 8/95 to 8/98.

Results: The mean age of the patients 72 ± 9 yrs (73% were male). Thirty nine percent had no history of a neurological event or symptoms and 68% were NASCET eligible. Bilateral disease was present in 36% with contralateral occlusion in 8%. There were ipsilateral prior CEA in 9%. Periprocedural death, major stroke and minor stroke was 3.3%, 0% and 3.3%, respectively for the first year of the study and 3.3%, 0%, 0% for the last year.

3 Year Event-Free Survival

Event	Inclusive of periprocedural events	Exclusion of periprocedural events
All neuro deaths & stroke	90.7 ± 3%	93.6 ± 3.5%
All neuro deaths & ipsilateral stroke	90.7 ± 3%	92.6 ± 3.2%

Conclusion: Periprocedural outcomes improved over the time course of the study. The risk of long-term neurological events following carotid artery stenting is small. These data suggest that carotid stenting is durable and effective in reducing the risk of Stroke or neurological death.

1154-92 Is Combined Intervention a Safe Alternative to Staged Intervention in Patients With Coronary Artery Disease and Renal Artery Stenosis?

Krishnamoorthy Vivekananthan, Aditya Samal, Vijay Chillakumari, J. Stephen Jenkins, Tyrone J. Collins, Christopher J. White, Stephen R. Ramee. *Ochsner Clinic, New Orleans, Louisiana, USA*

Background: Significant renal artery stenosis is present in as high as 30% of patients with CAD. The safety and cost effectiveness of combined intervention in a single procedure versus staged intervention has not been adequately evaluated. We performed this study to evaluate the above hypothesis.

Methods: Our study population consisted of a total of 79 patients (40 males, 39 females). Group I consisted of 45 consecutive patients who underwent combined coronary (single or multivessel) and renal artery (unilateral or bilateral) interventions as a single procedure. We assessed the baseline patient characteristics, duration of hospitalization (LoS), procedural succes (PS) (residual diameter stenosis <50%, with TIMI III flow) and in-hospital outcomes in these patients. A parallel group of 34 patients (Group II) who underwent renal and coronary intervention as staged procedure were similarly assessed and the composite outcomes of both the procedures were compared.

Results:

	Combined	Staged	P-value
Age (yrs)	71 ± 9	69 ± 8	NS
Hypertension, %	92	94	NS
Diabetes, %	36	32	NS
Dyslipidemia, %	57	63	NS
Smoking, %	42	43	NS
Indication (for either coronary/renal intervention)			
Stable angina, %	34	50	NS
Unstable angina, %	36	34	NS
Myocardial Infarction, %	9	9	NS
Heart Failure, %	21	16	NS
Hypertension, %	93	93	NS

	Combined (n = 45)	Staged (n = 34)	P-value
Mean LoS, days	2 ± 1	5 ± 3	NS
PS, %	98	97	NS
SBP – Baseline (mm/Hg)	167 ± 29	177 ± 30	NS
SBP – 1 month (mm/Hg)	148 ± 17	144 ± 28	NS
DBP – Baseline (mm/Hg)	84 ± 14	90 ± 14	NS
DBP – 1 month (mml/Hg)	71 ± 10	79 ± 10	<0.03
Target Vessel Revasc, %	0	3	NS

There were no myocardial infarctions, need for surgical revascularization, or dialysis among both the groups. One patient died in the combined group due to sustained ventricular fibrillation during hospital stay, and in the staged group one patient died of advanced heart failure.

Conclusions: 1) Combined coronary and renal intervention is a safe alternative to staged intervention, and can be performed with a high success rate and few complications. 2) In addition, the shorter hospitalization period makes combined intervention more cost-effective than staged intervention.

POSTER

1155 Restenosis: Basic Research IV

Tuesday, March 14, 2000, Noon–2:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: Noon–1:00 p.m.

1155-109 Red Light Therapy Does Not Prevent Restenosis: Angiographic Results of the Pilot Phase of CLASS Trial

Bernard Chevalier, Upendra Kaul, Balbir Singh, Stephen W. Lee, Bernard Glatt, Philippe Guyon, Linda Lam, Thierry Royer. *On behalf of CLASS investigators; Centre Cardiologique du Nord, Saint-Denis, France; Batra Hospital, New Delhi, India*

Evidence of intimal hyperplasia prevention by cold red laser illumination (CRL), after balloon and stent, in animals was already published. On this basis, a pilot randomized study was organized in 4 centers to validate a statistical hypothesis before the launching of a large mullticenter trial. Pts

	CRL	Control	p
N pts	30	17	
pre RD (mm)	3.11 ± 0.7	3.05 ± 0.62	NS
pre MLD (mm)	0.88 ± 0.39	0.77 ± 0.39	NS
post MLD (mm)	2.65 ± 0.68	2.81 ± 0.65	NS
Fup MLD (mm)	1.89 ± 0.82	1.87 ± 0.98	NS
Net gain (mm)	1 ± 0.8	1.19 ± 0.86	NS
Loss index	0.42 ± 0.47	0.36 ± 0.41	NS

RD: reference diameter, MLD: minimal lumen diameter

were randomized on a 2:1 basis between cold laser (red: 650 nm wavelength) illumination (2 times 60 sec./10 mWatt power) using dedicated rapid exchange balloon catheter after achievement of angioplasty or conventional angioplasty technique. Baseline and procedural data were similar in both groups, particularly restenotic lesion and stenting rates. There was no CRL-related clinical event in this group. Corelab angiographic analysis was done (acute and at systematic (100%) follow-up angiography) (see table).

Thus, at this level of power, CRL does not prevent angiographic restenosis in human beings. A new pilot phase study is in progress using higher power.

1155-110 Sulindac Reduces Intimal Hyperplasia After Femoral Artery Endothelial Denudation in Apolipoprotein E Knockout Mice

Merce Roque, Ernane D. Reis, Juan J. Badimon, Hayes Dansky, John T. Fallon, Steven Shiff, Edward A. Fisher. *Mount Sinai School of Medicine, and Rockefeller University, New York, New York, USA*

Background: Endothelial dysfunction and inflammation are central to the development and progression of atherosclerosis. The nonsteroidal antiinflammatory Sulindac can inhibit cyclooxygenase-2 (COX-2), which is induced predominantly at inflammatory sites. Sulindac also has been associated with inhibition of cell proliferation and induction of apoptosis. We studied the effect of Sulindac on intimal hyperplasia after femoral artery endothelial denudation in apoE-knockout (apoE KO) mice, a model that mimics the response to injury of human atherosclerotic vessels.

Methods: Thirty apoE KO mice underwent femoral artery denudation by three passages of a 0.25-mm angioplasty guidewire. Mice were fed a Western diet (WD) from 1 week before injury to 4 weeks after, either alone, or supplemented with Sulindac (300 mg/kg of food/day) or aspirin (300 mg/kg of food/day). Arterial specimens were harvested 28 days after injury and histologic and morphometric analyses performed.

Results: Total cholesterol levels were comparable in the three treatment groups, averaging 1,704 ± 310 mg/dL. Twenty-eight days after endothelial denudation, exuberant lesions, composed of smooth muscle cells, cholesterol crystals, and macrophages, were found in specimens from apoE KO mice fed a WD, with an intimal-to-medial (I/M) ratio of 1.6 ± 0.2, and luminal narrowing of 49 ± 6%. Sulindac reduced the I/M ratio significantly, 0.8 ± 0.1 ($p < 0.01$), as well as the percentage of luminal narrowing, 28 ± 6% ($p < 0.05$). Aspirin did not change the intimal response significantly when compared to WD alone. Macrophage infiltration tended to be reduced in the intimal lesions of Sulindac-treated mice (2.6 ± 1.3%) versus WD alone (6.8 ± 3.1%).

Conclusions: Sulindac decreased the proliferative response to arterial injury in the apoE KO murine model of atherosclerosis. The results suggest Sulindac could have a potential application in preventing progression and complications of human atherosclerotic disease, such as restenosis following coronary angioplasty.

1155-111 Evaluation of the Effect of Oversizing on Vascular Injury, Thrombogenicity and Neointimal Hyperplasia Using the Magic Wallstent™ in a Porcine Coronary Model

Ivan De Scheerder, Monika Szilard, Yanming Huang, Qiang Bei Ping, Xiaoshun Liu, Erik Verbeken, Frans Van de Werf. *University Hospitals, Leuven, Belgium*

Background: Oversizing of self-expandable coronary stents results in a continuous pressure on the stented vessel wall and has been considered as a continuous stimulator for neointimal growth.

Methods: Magic Wallstents (Schneider, Bulach) with a length of 24 mm were randomly implanted with either an oversizing of ±50% (n = 28), or an oversizing of ±100% (n = 28) in two coronaries of 28 crossbred pigs (weight 20–25 kg). The pigs underwent a control angiogram and were subsequently sacrificed at day 3 (n = 4), day 7 (n = 4), day 14 (n = 6), day 42 (n = 10) and day 84 (n = 4). Quantitative coronary analysis before, immediately after stent implantation and before sacrifice was performed using the semi-automated Polytron 1000® system. Morphometry was performed using a computerized morphometric program.

Results: Histopathology showed significantly more perivasculitis in the high oversizing group (1.08 ± 0.17 vs. 0.92 ± 0.16, $p < 0.02$). Morphometry showed a similar lumen area at day 3 and 7. At day 14 the lumen area in the high oversizing group was significantly smaller compared to the low oversizing group (4.70 ± 0.56 vs. 5.70 ± 0.64 mm^2, $p = 0.016$). At day 42 and 84, however, this difference became insignificant.

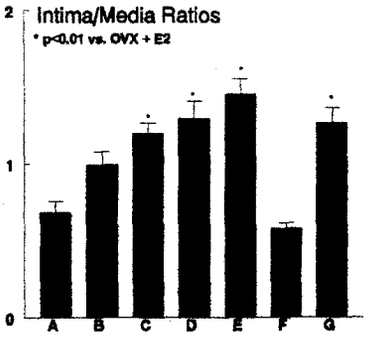
Neointimal hyperplasia was also significantly more pronounced at day 14 in the high oversizing group (1.94 ± 0.64 vs. 1.04 ± 0.66, $p < 0.037$). At later follow-up neointimal hyperplasia remained increased at a non-significant level in the high oversizing group.

Conclusion: This study suggests that high oversizing results in an early neointimal overresponse, most probably induced by the higher vessel stretch, resulting in more perivasculitis and subsequently more neointimal hyperplasia. At longer follow-up, however, this continuous vessel overstretching did not result in a significantly more pronounced neointimal hyperplasia.

1155-112 Estrogen-Induced Vasprotection is Estrogen Receptor Dependent: Evidence From the Balloon Injured Rat Carotid Artery Model

Tatsuhiko Mori, Stephen Bakir, Yiu Fai Chen, Suzanne Oparil. *University of Alabama at Birmingham, USA*

Previous studies carried out in mice with deletion of either α or β isoform of the estrogen receptor (ER_α, $ER\beta$) have demonstrated vasprotective responses to exogenous estrogen indential to those seen in wild type mice. These findings indicate that the vascular injury response in this model, which is produced by repetitive passage of angioplasty wire or plastic filaments in the mouse carotid artery, is not dependent on either isoform of the ER alone. Possible explanations include: (1) redundancy of function, such that both ER isoforms must be blocked in order to inhibit the estrogen effect; (2) participation of a novel ER isoform; (3) a nongenomic effect of estrogen. This study tested the hypothesis that the vasoprotective effect of estrogen in the rat carotid artery is mediated by ER. Balloon injured intact female Sprague-Dawley rats (Int) were randomly divided into four groups and were treated with either the non selective ER antagonist ICI182,780 (ICI;0.5, 1.5 or 5 mg/kg/day, S.C.) or vehicle (V) beginning before and continued for 14 days after balloon injury of the right common carotid artery. Ovariectomized rats (OVS) were treated with either 17β-estradiol (E2) (20 μg/kg/day, S.C.) or V according to a similar protocol. Two weeks after balloon injury, rats were killed and carotid arteries were evaluated for neointima formation using morphometric analysis. Results (mean ± SE) in graph: A) Int B) Int + 0.5 C) ICI1.5 D) Int + 5.0 E) OVX F) OVX + E2 G) OVX + ICI5.0 + E2. ICI 182,780 increased neointima formation in balloon injured carotid arteries of Int. and inhibited the effects of exogenous E2 in OVS in a dose-dependent fashion.



These data provide strong evidence that estrogen-mediated vasoprotection in this model is an ER-dependent phenomenon, perhaps depending on inhibition of multiple ER isoforms.

1155-113 T-Lymphocytes in Initial Coronary Lesions are Associated With the Development of Clinical Restenosis in Patients With Unstable Angina

Martijn Meuwissen, Steven A.J. Chamuleau, Jan J. Piek, Karel T. Koch, Allard C. van der Wal, Anton E. Becker. *Academic Medical Center, University of Amsterdam, Amsterdam, the Netherlands*

Background: Literature suggests a positive association between macrophage infiltration in atherosclerotic plaques and the incidence of angiographic restenosis after coronary atherectomy for unstable angina.

Methods: A total of 64 patients with unstable angina, according to Braunwald's classification, underwent directional coronary atherectomy (DCA) for culprit lesions. Cryostat sections of atherosclerotic plaques were immunohistochemically stained with the monoclonal antibodies, α-actin (smooth muscle cells; SMC), CD-68 (macrophages; MAC) and CD-3 (T-lymphocytes; T-cells). The extent of atherosclerotic inflammation of the initial lesion was determined by MAC and T-cells, planimetrically quantified as the percentage immunopositive tissue area of the total tissue area (MAC) or counted per mm^2 (T-cells). Patients were followed for one year for development of clinical restenosis, defined as recurrence of stable or unstable angina related to renarrowing (diameter stenosis > 50%) of the initial treated lesion.

Results: Clinical restenosis developed in 18 patients (28%). Immunopositive MAC and SMC areas were not different in patients with or without restenosis. However, numbers of T-lymphocytes were significantly increased in patients who developed clinical restenosis. The table shows initial plaque inflammation in patients with clinical restenosis.

	% MAC	T-cells/mm^2	% SMC
No Restenosis (n = 46)	21.8 ± 15.0	14.6 ± 11.8	24.0 ± 14.8
Restenosis (n = 18)	21.1 ± 14.8	25.0 ± 12.7*	25.3 ± 15.3

*p = 0.003 compared to group without Restenosis.

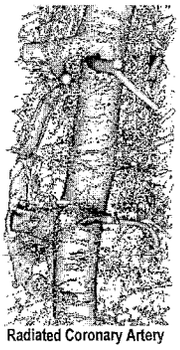
Conclusion: Rather than macrophages, large amounts of T-lymphocytes in initial plaques are associated with the development of clinical restenosis after directional coronary atherectomy. This suggests a regulatory role for T-lymphocytes in the process of restenosis.

1155-114 How Does Brachytherapy Affect Coronary Artery Vasa Vasorum and Vessel Wall Neovascularization After Angioplasty? Three-Dimensional Analysis by Microsopic Computed Tomography

Birgit Kantor, Ron Waksman[1], Yves Cottin[1], Marc Kollum[1], Yoram Vodovotz[1], Erik L. Riman, David R. Holmes Jr., Robert S. Schwartz. *Mayo Clinic and Foundation, Rochester, MN 55905; [1]Washington Hospital Center, Washington DC, 20010, USA*

Background: A fine network of vasa vasorum (vv) provides oxygen and nutrients to the outer layers of the arterial wall. These adventitial capillaries proliferate in both atherosclerotic arteries and in neointimal proliferation after angioplasty. Intracoronary radiation reduces neointima formation through poorly understood mechanisms. The impact of brachytherapy on neovascularization is unknown. This study assessed the spatial density and distribution of vv in normal, injured and radiated porcine coronary arteries 28 days after balloon-angioplasty.

Methods: Following balloon-injury, ten coronary artery segments were randomized to receive intracoronary radiation therapy (15 Gy; n = 5) or to be injured, but unradiated controls (n = 5). Micro-CT, a novel high resolution imaging technique was used to obtain microscopic 3-D images of coronary vasa vasorum (voxel size 40 μm).



Radiated Coronary Artery

Results: Normal coronary arteries showed a typical well-organized pattern of 1st and 2nd order vasa vasorum. In balloon-injured control segments, adventitial capillary density was increased and disorganized compared to normal segments (3.2 ± 0.2/mm^2 vs 1.9 ± 0.1/mm^2, p < 0.001). Radiated segments showed significantly decreased vasa vasorum density (2.2 ± 0.4/mm^2, p < 0.01) 28 days after balloon injury compared to injured untreated controls.

Conclusions: 1. Normal coronary arteries contain a well-organized three-dimensional network of vasa vasorum, which proliferates in an disorganized manner after angioplasty. 2. Intracoronary radiation causes significant decrease in spatial vasa vasorum distribution 28 days after balloon injury. 3. Brachytherapy may have an antiangiogenic effect on arterial adventitia, which may relate to its apparent efficacy in reducing neointimal thickening.

1155-115 $\alpha_v\beta_3$ Integrin Receptor Blockade Reduces Restenosis and Macrophage Infiltration With a Reduction in Cellular Adhesion Molecule Expression Following Balloon Angioplasty in the Atherosclerotic Rabbit

Gregory G. Bishop, John A. McPherson, John Sanders, Sean Hesselbacher, Michael J. Feldman, Lawrence W. Gimple, Eric R. Powers, Shaker A. Mousa, As Ian J. Sarembock. *University of Virginia, Charlottesville, VA; DuPont Pharmaceutical Company, Wilmington, DE, USA*

$\alpha_v\beta_3$ integrin receptors are up-regulated in atherosclerotic arteries and play a key role in smooth muscle cell (SMC) and possibly inflammatory cell migration. We hypothesized that following balloon angioplasty (BA) of atherosclerotic arteries, inhibition of the $\alpha_v\beta_3$ receptor by XT199, a non-peptide selective $\alpha_v\beta_3$ integrin inhibitor would reduce restenosis.

Methods: Following induction of focal atherosclerosis, NZW rabbits underwent femoral BA and received XT199 (2.5 mg/kg IV bolus plus 2.5 mg/kg/d IV) (n = 19) or vehicle (n = 20) for 14 days.

Results: At 28 days after BA, by histomorphometric analysis the XT199 treated group had a significantly larger lumen (0.75 ± 0.26 vs. 0.57 ± 0.20 mm^2, p = 0.03) and smaller intimal area (0.49 ± 0.18 vs. 0.68 ± 0.25 mm^2, p = 0.01). Vessel size and adaptive remodeling at 28 days were not different in the two treatment groups. Immunohistochemical analysis of arteries harvested at 28 days after BA showed no effect on intima-media SMC content but a 50% reduction in macrophage cell density in the XT199 versus vehicle treatment group (716 ± 452 vs. 1458 ± 989 cells/mm^2, p < 0.006). Peripheral monocyte count was not altered by XT199. At the site of angioplasty, femoral arteries from the XT199 group had reduced intima-media ICAM-1 expression at 3 days post BA followed by a reduction in VCAM-1 and macrophage infiltration at 7 days, with no affect on MCP-1 expression. Quantitative angiography confirmed a 30 to 40% reduction in restenosis after $\alpha_v\beta_3$ receptor blockade as measured by a decrease in minimal luminal diameter (MLD), $\Delta MLD_{(post\ BA\ to\ 28\ d)}$ and late lumen loss index.

Conclusion: Following BA, in the focally atherosclerotic rabbit, specific $\alpha_v\beta_3$ receptor blockade for 14 days significantly reduced restenosis, limited intramural macrophage infiltration, and was associated with a reduction cellular adhesion molecule expression.

ORAL

878 Risk Factors for Adverse Outcomes of Percutaneous Coronary Intervention

Tuesday, March 14, 2000, 2:00 p.m.–3:30 p.m.
Anaheim Convention Center, Lecture Hall A1

2:00 p.m.

878-1 Angioplasty in Women: A Re-Look Into Their Clinical Success and Complications

Patrick C.H. Ang, Richard W. Harper, Ian T. Meredith. *Center for Heart & Chest Research, Monash Medical Center, Monash University, Melbourne, Australia*

Background: Past studies have shown that women undergoing percutaneous coronary revascularization (PCR) have a lower success rate and higher incidence of procedure-related complications than men. It is possible that recent improvements in PCR such as the widespread use of stenting and more aggressive antiplatelet regimes may have abolished or lessened these differences. The purpose of this study was to analyze the baseline characteristics and compare the procedural results and the incidence of complications in women undergoing PCR in the modern era with men.

Methods: Of 2584 patients who underwent PTCA from February 1994 to March 1999, 723 were females 1861 were males. Their short-term procedural success and complication rates were compared.

Results: Women were older with a mean age of 64.5 ± 11.1 *vs* 58.9 ± 11.3 years, p < 0.001). At presentation, females had a higher incidence of hypertension (60% *vs* 43%), diabetes (18% *vs* 14%) and obesity (41% *vs* 33%) but a lower incidence of smoking (30% *vs* 59%) and left ventricular dysfunction (36% *vs* 46%, p values < 0.05). Acute coronary syndromes were more common in women (54% *vs* 48%, p < 0.01). Females had more single vessel disease (62% *vs* 50%, p < 0.01) and ostial lesions (9.2% *vs* 6.7%, p = 0.01). The vessel length, size and type were similar in both groups. The stent rates per person (60% *vs* 58%) and the combination therapy of aspirin and ticlopidine after angioplasty (88% *vs* 87%) were similar. The angiographic and clinical success rates were comparable (93% *vs* 94% and 90% *vs* 90% respectively). The incidence of death, stroke, Q and non-Q myocardial infarction were similar in both groups (1.0% vs 1.2%, 0.1% vs

0.3%, 0.7% vs 0.4% and 4.1% vs 3.0% respectively) but women had a higher incidence of repeat angioplasty (2.5% *vs* 1.2%, p = 0.02) and emergency bypass surgery (2.9% *vs* 1.4%, p = 0.01) during the same admission and a higher incidence of local vascular complications (3.9% *vs* 1.7%, p < 0.01). These differences remained after correcting for baseline characteristics.

Conclusion: In the modern era, PCR in women now has a similar angiographic and clinical success rates as in men but the need for repeat revascularization during the index admission is higher and there is a higher incidence of local vascular complication. These differences could not be accounted for by differences in baseline characteristics.

2:15 p.m.

878-2 Influence of Gender on In-Hospital Outcomes of Patients Undergoing Primary Percutaneous Transluminal Coronary Angioplasty for Acute Myocardial Infarction: New York State Experience

Babak A. Vakili, David L. Brown. *Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, New York, USA*

Background: Female gender has been found to be an independent risk factor for mortality from acute myocardial infarction (MI), possibly due to undertreatment of women with reperfusion therapies. We sought to determine if gender influenced outcome in a cohort of acute MI patients, all of whom underwent primary percutaneous transluminal coronary angioplasty (PTCA).

Methods: Using the 1995 New York State Angioplasty Database, we compared the in-hospital mortality of men and women undergoing primary PTCA for a first MI within 24 hours of symptom onset.

Results: A total of 1044 patients undergoing primary PTCA for acute MI were identified, of whom 727 (70%) were males and 317 (30%) were female. The mean age was 59 years in men and 65 years in women (p < 0.005). Significantly more women were ≥70 years of age (42% vs. 23%, p < 0.005). Diabetes was present in 14% of men and 19% of women (p = 0.04). Hypertension was diagnosed in 44% of men and 59% of women (p < 0.005). Shock was present at the time of PTCA in 3% of men compared to 7% of women (p < 0.005). Intra-aortic balloon counterpulsation was required in 7% of men and 12% of women (p = 0.02). Triple vessel coronary disease was present in 15% of men compared to 12% of women (p = NS). Left main disease was demonstrated in 0.7% of men and 1.6% of women (p = NS). In-hospital mortality was 2.3% in men and 7.9% in women (p < 0.005). After multivariate analysis to correct for differences in baseline characteristics, female gender remained associated with significantly increased in-hospital mortality (OR 2.2, 95% CI 1.1–4.5, p = 0.025).

Conclusion: Women undergoing primary PTCA for acute MI present with higher risk characteristics than men. However, after correction for differences in baseline characteristics, women have significantly higher in-hospital mortality.

2:30 p.m.

878-3 Diabetes Mellitus is Associated With an Increased Risk of In-Hospital Death Following Elective Percutaneous Coronary Intervention: An Analysis of 18,309 Patients

Steven P. Marso, Lee V. Giorgi, Warren L. Johnson, Steven B. Laster, Kenneth C. Huber, James O'Keefe, Barry D. Rutherford. *Mid America Heart Institute, Saint Luke's Hospital, Kansas City, Missouri, USA*

Background: Patients (Pts) with diabetes mellitus have been shown to have increased rates of restenosis, myocardial infarction and late mortality following percutaneous coronary intervention (PCI). It is unclear whether diabetics also have an increased short-term death following PCI.

Methods: We evaluated in-hospital mortality in consecutive pts who underwent elective PCI from June 1980 through December 1998. A multi-variable logistic regression model was developed for the diabetic cohort for in-hospital mortality.

Results: 18,309 pts underwent PCI during study period: 14827 non-diabetics and 3482 diabetics. In-hospital mortality was 1.0% and 2.0% for the non-diabetic and diabetic cohorts respectively, p < 0.001. Independent multivariable predictors of in-hospital mortality for the diabetic cohort included the following: Age (Relative Risk (RR) 1.02; p < 0.001), ejection fraction (RR 1.02; p < 0.001), serum creatinine (RR 1.17; p = 0.002) and hypertension (RR 1.31; p < 0.041).

Conclusion: When compared with non-diabetics, pts with diabetes have a two-fold increase in short-term mortality following elective PCI.

2:45 p.m.

878-4 One Year Follow-up After Primary Coronary Interventions for Acute Myocardial Infarction in Diabetic Patients: STENT PAMI Trial Results

Luiz Mattos, Cindy Grines, J. Eduardo Sousa, Gregg Stone, Marie C. Morice, Judith Boura, David Cox, Eulogio Garcia, William O'Neill, Mariann Graham, Brian Firth. *Institute Dante Pazzanese of Cardiology, Sao Paulo, Brazil; William Beaumont Hospital, Royal Oak, Michigan, USA*

Background: The multinational STENT PAMI trial randomized 900 pts with <12 hours of AMI at 62 centers, either to coronary stenting or primary PTCA. The 6 months ischemia driven TVR rote was reduced when a routine stenting strategy was applied (7.7 vs. 17%, p = 0.0001). However, the extension of this benefits to diabetic pts treated in AMI is not clear.

Methods: We compared the combined occurrence of major clinical events at 1 year, between diabetic and non-diabetic pts randomized to heparin coated stent or balloon PTCA during AMI.

Results: One year cumulative follow-up was obtained in 893 patients.

	Non-Diabetics (N = 758)			Diabetics (N = 135)		
	Stent	PTCA	P	Stent	PTCA	P
Baseline (%)						
N =	377	381		72	63	
Anterior MI	40	*44*	0.26	42	41	0.96
TIMI 3 post	89	93	0.10	91	90.5	1.0
Stenosis post	20 ± 9	29 ± 10	*0.0001*	19 ± 7	28 ± 9	*0.0001*
6 months (%)						
Ischemic TVR	7	17	*0.001*	8	16	0.18
Restenosis	20	36	*0.001*	40	40	0.94
Stenosis f-up	39 ± 19	47 ± 22	*0.001*	46 ± 21	54 ± 23	0.09
1 year (%)						
Reinfarction	3.2	2.4	0.49	1.4	3	0.60
Death	6	3	*0.05*	4	5	1.0
Stroke	0.5	0.3	0.62	0	1.6	0.50
Ischemic TVR	10	21	*0.001*	15	21	0.42
Combined	17	25	*0.005*	20	30	0.21

Conclusions: At 1 year follow-up, non-diabetic stent pts had higher rate of death although the ischemia driven TVR and overall rate of combined events were lower for coronary stenting vs. balloon PTCA. For diabetics, routine stenting did not reduce the major complications of AMI and neither the need for further revascularization procedures driven by the presence of ischemic evidences.

3:00 p.m.

878-5 The Impact of Diabetes Mellitus on In-Hospital Clinical Outcomes Post Angioplasty

S. Chiu Wong, Stylianos Papadakos, Carl Rosenberg, Gregory Gustafson. *The New York Hospital Medical Center of Queens, Flushing, New York, USA*

Background: Diabetes mellitus (DM) is associated with worse long-term clinical outcomes post PTCA. Whether pts with DM also experience worse in-hospital clinical outcomes post PTCA less clear.

Methods: Using the 1995 NYS Angioplasty Database, we compared acute clinical events in pts with DM (treated with insulin or oral hypoglycemics) to non-DM pts.

Results:

	Non-DM (N = 18,366)	DM (N = 4372)	P value
Pt Characteristics			
Age (yrs)/%Male	61/72	63/58	Both < 0.0001
%Smoke/Hypertension	27/57	19/72	Both < 0.0001
%Hx* MI/CHF	50/3.9	51/9.9	NS/<0.0001
%Multi -vessel disease	42	54	<0.0001
%Hx stroke/CABG	2/12	4/18	Both < 0.0001
%Creatinine > 2.5 mg/dl	0.9	3.4	<0.0001
%Dialysis/Shock	0.5/0.7	1.7/0.7	<0.0001/NS
In-Hospital Events			
%Death/CABG/Q-MI	0.77/1.5/0.32	1.42/1.3/0.25	0.0002/NS/NS
%Dialysis/LOS#(days)	0.05/5.5	0.55/6.4	Both < 0.0001

* = History of, # = length of stay

Multi-variant regression analysis revealed age, female, history of DM (OR = 1.58, 95% CI = 1.1–2.3, P = 0.01), MI, prior CABG, dialysis and multi-vessel disease as well as pts with MI, CHF, or shock on admission were independent predictors for in-hospital mortality.

We conclude: 1) Compared with non-DM pts, DM pts had more adverse co-morbid conditions and were more likely to require dialysis with a longer length of stay post PTCA. 2) Pts with DM not only have a worse long-term

prognosis, but DM itself is an independent predictor for in-hospital mortality post PTCA.

3:15 p.m.

878-6 The Detrimental Impact of Chronic Renal Insufficiency and Diabetes Mellitus on Late Prognosis After Percutaneous Coronary Interventions

Roxana Mehran, George Dangas, Luis Gruberg, Alexanda J. Lansky, Petros Okubagzi, Michael Astatkie, Ajith Purush, Kartick Desai, Frank Küpper, Hassan Faraj, Kenneth M. Kent, Gregg W. Stone, Martin B. Leon. *Cardiovascular Research Foundation Washington, DC, USA*

Background: The interaction of diabetes mellitus (D) and chronic renal insufficiency (RI, defined as serum creatinine >2.0 mg/dl or dialysis) on prognosis after percutaneous coronary intervention (PCI) is unknown.

Methods: We studied the effects of D and RI on late mortality, non-fatal myocardial infarction (MI) and target lesion revascularization (TLR) in 7,640 consecutive patients who underwent PCI. Patient grouping: (i) –D, –RI n = 5278; (ii) +D, –RI n = 1681; (iii) –D, +RI n = 371; (iv) +D, +RI n = 300. Events were source documented and adjudicated by a dedicated Data Coordinating Center.

Results: A significant additive effect of these two co-morbid conditions was noted with respect to short and long-term clinical outcomes:

Outcomes	–D, –RI	+D, –RI	–D, +RI	+D, +RI	P
Procedural success	94.6%	97.5%	96.6%	98.3%	NS
30-day Death or MI	1.6%	2.4%	3.6%	6.3%	0.0001
1-year Death or MI	4.2%	7.8%	14.9%	25.9%	0.0001
1-year TLR	16.8%	22.1%	16.4%	17.9%%	NS

Post-procedure CKMB enzyme elevation >3x normal occurred in 20%, 18%, 21% and 25% of patients respectively (p = 0.006).

Conclusions: The combination of D and RI confer additive and disastrous post-procedural prognosis in patients undergoing PCI, despite non-significant impact of long-term TLR. Thus, in patients with both co-morbid conditions, the options of medical therapy or bypass surgery should be considered strongly. If PCI is performed in patients with both D and RI, meticulous post-procedural scrutiny and medical management is warranted.

ORAL

879 Gene Therapy: New Approaches to Restenosis and Angiogenesis

Tuesday, March 14, 2000, 2:00 p.m.–3:30 p.m.
Anaheim Convention Center, Lecture Hall A2

2:00 p.m.

879-1 Results of a Phase I Open Label Dose Escalation Study of Intracoronary and Intravenous Basic Fibroblast Growth Factor (rFGF-2) in Patients (Pts) With Severe Ischemic Heart Disease: 6 Months Follow-Up

R.J. Laham[1], N.A. Chronos[2], M. Leimbach[3], J.D. Pearlman[1], R. Pettigrew[2], V. Dilsizian[4], J. Udelson[5], M.J. Whitehouse[6], M. Pike[6], C. Yoshizawa[6], M. Simons[1]. *[1]Beth-Israel Deaconess Medical Center, Boston, MA; [2]Atlanta Cardiovasc. Res. Inst., Atlanta, GA; [3]Emory University, Atlanta, GA: [4]NIH, Bethesda, MD; [5]New England Medical Center, Boston, MA; [6]Chiron Corp., Emeryville, CA, USA*

Background: rFGF-2 is a heparin-binding growth factor capable of inducing functionally significant angiogenesis in animal models of chronic ischemia.

Methods: This Phase I open label dose escalation study was designed to evaluate the safety, tolerability, PK and preliminary efficacy of intracoronary (IC) and intravenous (IV) rFGF-2 administered as a single 20 minute infusion in pts with ischemic heart disease not amenable to treatment with CABG or PTCA. Doses (μg/kg) studied IC ranged from 0.33–48, and IV from 18–36. Efficacy was assessed using treadmill exercise testing (ETT), stress nuclear perfusion, magnetic resonance imaging (MRI) and Seattle Angina Questionnaire (SAQ) at baseline, 1 (except SAQ), 2 and 6 months.

Results: 66 pts were enrolled in the study. The mean age was 60.6 ± 9.6 years with 95% males. 83% of pts had previous CABG, 48% had prior PTCA. Four pts died during the study (cardiac death in 3), 4 pts had myocardial infarction, and one patient had a malignancy. There were no clinically significant hemodynamic effects and no significant renal toxicity.

Values for the following parameters (mean ± S.D.) pooled for all dose groups on all patients with measurements for the specified time points are:

	Baseline	1 month	2 months	6 months	P value
ETT (sec)	518 ± 161	569 ± 150	650 ± 148	658 ± 137	<0.001
RPP (×1000)	18.6 ± 6.7	17.7 ± 5.6	18.5 ± 6.0	21.6 ± 6.5	<0.04
SAQ/EC	49.2 ± 18.9		64.4 ± 21.8	71.2 ± 24.1	<0.001
SAQ/AF	42.1 ± 27.4		68.7 ± 27.5	63.7 ± 29.7	<0.001
MR/TWM%	21.3 ± 8.9	24.3 ± 9.5	26.2 ± 9.7	28.6 ± 8.6	<0.001
MR/Ischemia %	14.9 ± 5.5	9.0 ± 4.3	5.9 ± 4.8	5.4 ± 4.9	<0.001
Nuclear/Ischemia	8.3 ± 7.0	7.3 ± 6.2	8.3 ± 7.0	7.9 ± 6.1	0.12

P value: 6 months compared to baseline, RPP: rate pressure product, EC: exercise capacity, AF: angina frequency, MR/TWM: target wall motion, MR/ischemia: ischemic area by MRI: Nuclear/Ischemia: stress minus rest perfusion reversibility score

Conclusion: A single IC or IV dose of rFGF-2 was well tolerated over a wide range of doses. Preliminary efficacy results in this open label, uncontrolled study showed increased exercise tolerance, improved quality of life by SAQ, improved target wall motion, a reduction of rest ischemic area by MRI, and a similar degree of stress ischemia at a higher stress workload by nuclear imaging. A Phase II double blind placebo controlled study of intracoronary rFGF-2 is ongoing.

2:15 p.m.

879-2 Catheter-Based Transendocardial Injection of Adenoviral $VEGF_{121}$ Offers Equivalent Gene Delivery and Protein Expression Compared to a Surgical-Based Transepicardial Injection Approach

Ran Kornowski, Shmuel Fuchs, Yoram Vodovotz, Michael A. Flynn[1], David A. Gordon[1], Anthony Pierre, Matie Shou, Imre Kovesdi[2], Joan A. Keiser[1], Martin B. Leon, Stephen E. Epstein. *The Cardiovascular Research Foundation, Washington Hospital Center, Washington DC; [1]The Department of Cardiovascular Therapeutics, Parke-Davis Pharmacological Research, Ann Arbor, MI; [2]GenVec, Inc., Rockville, MD, USA*

Background: Angiogenesis has been induced by direct injection of growth factors into ischemic myocardium during open-heart surgery. Catheter-based transendocardial injection of genes encoding angiogenic factors may provide equivalent benefit without the need of open chest thoracotomy.

Methods: We have used a new guidance system (Biosense-Webster™) for transendocardial injection by utilizing electromagnetic fields and catheter-tip sensors to locate the catheter position in space and reconstruct 3 dimensional left ventricular (LV) maps. The guidance system has been coupled to a retractable 27G needle for LV transendocardial injection. Ten (10) animals underwent transendocardial catheter-based injection and 6 animals were injected transepicardially via open chest thoracotomy (n = 6) with the gene encoding vascular endothelial growth factor-121 (Ad. VEGF121.10; 1×10^{10} viral particles per site × 6 sites/animal) and sacrificed @24 hours. Injection sites were identified with UV light by co-injection of fluorescent beads.

Results: 59/60 (98.3%) transendocardial injection sites were identified vs 36/36 (100%) of transepicardial surgical injections. The transfection sites were discrete and manifested significant $VEGF_{121}$ production in 57/59 sites (96.6%) using the catheter approach and in 36/36 sites (100%) using the surgical approach. Ad. VEGF121.10 injected sites showed high levels of $VEGF_{121}$ production which was of similar magnitude whether injected transendocardially (880.4 ± 412.2 pg $VEGF_{121}$/mg protein) or transepicardially (838.3 ± 270.0 pg $VEGF_{121}$/mg protein), (P = 0.62).

Conclusion: The catheter-based transendocardial injection system offers an equivalent gene delivery efficiency and protein expression compared to the surgical-based transepicardial angiogenic gene delivery. Thus, this less invasive catheter-based system may have clear advantages compared to surgical-based transepicardial injection approach.

2:30 p.m.

879-3 Unique Kinetics and Hemodynamics of Vascular Endothelial Growth Factor (rhVEGF) Following Intracoronary and Intravenous Infusion in Humans

Stephen M. Eppler[1], Edward R. McCluskey[1], Timothy D. Henry, Michael Simons, Frank J. Giordano, Thomas F. Zioncheck[1]. *[1]Genentech, S. San Francisco, CA, USA*

Background: Recombinant human vascular endothelial growth factor (rhVEGF) is a angiogenic factor that has been shown to improve myocardial blood flow and function in animal models of myocardial ischemia. VEGF binds to both high affinity signaling receptors and low affinity, high capacity heparan sulfate proteoglycans. Binding to these receptors, which have previously been shown to be upregulated under ischemic conditions, may influence VEGF disposition in vivo. Phase I clinical trials in patients with coronary artery disease investigated the safety, tolerability and pharmacokinetics

(PK) of rhVEGF following two 10-minute intracoronary (IC) infusions (Ia) or multiple intravenous (IV) infusions (Ib). Here we report the first description of rhVEGF PK in humans and the resulting changes in blood pressure.

Results: The PK and hypotensive effects were dependent on rhVEGF infusion rate over the dose range studied (5 to 100 ng/kg/min). Systemic exposure following IC administration of 50 ng/kg/min was low (plasma Cmax = 660 pg/mL) and returned to baseline levels by 30 minutes. Following IV infusion for 1, 2, or 4 hours at 50 ng/kg/min, the Cmax was 1230, 1540, and 2640 pg/mL, respectively. VEGF levels decreased in a biphasic manner with an initial half-life ranging from 2–8 minutes and a terminal half-life ranging from 29 to 77 minutes. The plasma half-life increased with increasing dose, suggesting a saturable tissue uptake mechanism. The volume of distribution ranged from 2 to 15-fold greater than plasma volume, suggesting sequestration of VEGF on endothelial receptors. Transient decreases in mean arterial pressure (MAP) were infusion rate dependent and ranged from 3 to 21 mmHg below baseline following rhVEGF IC infusion. The maximally tolerated infusion rate was 50 ng/kg/min for IC and IV routes. The maximal decrease in MAP occurred within 10 minutes followed by a return to baseline by 90 minutes. Evidence for a tachyphylactic response was noted following the second IC infusion and by the return of MAP to near baseline levels during prolonged IV infusion (1–4 hours).

Conclusion: VEGF is rapidly cleared from the systemic circulation via a specific and saturable tissue uptake process. A 20-minute IC infusion and a 4-hour IV infusion at 50 ng/kg/min was hemodynamically tolerable and resulted in average VEGF plasma levels that were approximately 20 and 80-fold greater than baseline levels, respectively. The characterization of VEGF PK and hemodynamics will be critical in optimizing the dose, route, and regimen for future clinical investigation.

2:45 p.m.

879-4 Reduction in Stress Myocardial Ischemia by Basic Fibroblast Growth Factor (rFGF-2) in Severe Ischemic Heart Disease

J.E. Udelson[1], V. Dilsizian[2], R.J. Laham[3], N.A. Chronos[4], J. Vansant[5], M.J. Whitehouse[6], M. Pike[6], C. Yoshizawa[6], M. Simons[3]. *[1]Tufts-New England Med Ctr, Boston MA; [2]NHLBI/NIH, Bethesda MD; [3]Beth Israel-Deaconess Med Ctr, Boston MA; [4]Atlanta Cardiol. Res. Inst., Atlanta, GA.; [5]Emory University, Atlanta GA; [6]Chiron Corp, Emeryville CA, USA*

Background: While significant angiogenesis has been observed with rFGF-2 in animal models, the effect on myocardial perfusion in humans is unknown.

Methods: In a Phase I open label, uncontrolled, dose escalation study of an intracoronary or intravenous infusion of rFGF-2 in pts with severe ischemic heart disease, serial SPECT imaging was performed at baseline and at 1, 2, and 6 months using stress Tc-99m sestamibi and rest thallium-201. Images were evaluated by 2 observers blinded to patient and test sequence (displayed randomly) using semiquantitative scoring of stress and rest perfusion in a 20 segment model (0 = normal, 4 = severe defect).

Results: Of 66 pts enrolled, 51 pts had SPECT evidence of stress-induced ischemia at baseline. Changes in summed reversibility score (SRS, ischemia) and summed stress score (SSS, total abnormality at stress) in the ischemic segments compared to baseline in these 51 pts, for pooled dose groups are:

	1 Month	2 Months	6 Months
SRS	−3.0 ± 3.2*	−2.9 ± 4.2*	−3.8 ± 4.0*
SSS	−2.9 ± 3.6*	−2.8 ± 3.8*	−3.1 ± 4.2*

*$P < 0.001$

In 37 pts with evidence of rest hypoperfusion without severe infarction (mild/moderate rest thallium-201 defect), there was an apparent improvement in rest perfusion:

	1 Month	2 Months	6 Months
Rest score	−1.4 ± 2.1*	−1.2 ± 2.3*	−0.7 ± 2.1

*$P < 0.005$

Conclusion: These preliminary efficacy data suggest that a single infusion of rFGF-2 reduces the magnitude of stress-induced myocardial ischemia for up to 6 months as assessed by nuclear imaging.

3:00 p.m.

879-5 Regional Intramyocardial Vascular Endothelial Growth Factor (VEGF) Gene Transfer and Expression Using a Fluoroscopically Guided Catheter-Based Technique

Timothy A. Sanborn, Neil R. Hackett, Leonard Y. Lee, Irene Blanco, Norman Tarazona, Ezra Deutsch, Todd K. Rosengart, Ronald G. Crystal. *Weill Medical College of Cornell University, New York, NY, USA*

Background: Preliminary reports indicate the feasibility of catheter-based plasmid and adenoviral mediated marker gene (β galactosidase) transfer and expression in porcine myocardium using both fluoroscopic and electromechanical mapping techniques.

Objective: The present study was designed to test the feasibility of regional intramyocardial expression of the gene for the angiogenic growth factor (Ad_{GV}VEGF121.10) using a percutaneous fluoroscopically guided left ventricular catheter system.

Methods: Using a coaxial 9F aligning and 6F endocardial delivery catheter system, 10 injections (1×10^{11} pu/100 μl of Ad_{GV}VEGF121.10) were administered to either the anterolateral or posterolateral regions of porcine myocardium under biplane fluoroscopy. At 24–48 hours, animals were sacrificed for measurement of VEGF activity in 16 regions of the heart (apex to base; anterior, lateral, posterior and septal walls).

Results: In the first series of animals (N = 3) in which injections were dispersed over the left ventricular free wall, VEGF activity ranged from 50–200 pg/mg protein in the targeted regions. In the second group of animals (n = 3) in which VEGF administration was localized to the posterolateral area from mid ventricle to apex, VEGF activity was 1,272 ± 365 pg/mg protein in the targeted areas as compared to 272 ± 92 pg/mg protein in non targeted regions ($p < 0.001$). No arrhythmias, perforations or hemodynamic compromise occurred.

Conclusion: The feasibility of fluoroscopically guided, endocardial, catheter-based gene transfer and expression of an angiogenic agent (Ad_{GV} VEGF121.10) has been demonstrated. Localized administration of this agent with a percutaneous approach can achieve VEGF levels of similar magnitude to the direct surgical epicardial application. This technique may provide clinical benefit for patients who are not candidates for conventional bypass surgery or angioplasty.

3:15 p.m.

879-6 Low Event Rates in Patients With Viable Underperfused Myocardium Who are Not Eligible (VUNE) for Revascularization: A VIVA Substudy

William L. Greene, Edward R. McCluskey. *The VIVA Investigators; Genentech, Inc., South San Francisco, CA, USA*

Background: Patients who have viable underperfused myocardium but are not considered eligible for PTCA or CABG are thought to have high rates of morbidity and mortality and to be "end stage". They have recently been targets of novel revascularization strategies such as transmyocardial revascularization (TMR). Claims of success with these therapies are difficult to evaluate because intervention studies in this population are often uncontrolled. TMR trials report up to 10% 30-day mortality (up to 18% at one year) in these patients. The VIVA trial assessed rates of adverse events in a prospectively defined, placebo controlled cohort of VUNE patients.

Methods: Patients were eligible if they were willing: to participate in a clinical trial, had stable angina and a significant reversible defect by nuclear perfusion studies, but were not optimal candidates for PTCA or CABG. rhVEGF protein (Genentech, Inc.) was administered by two 10-minute IC infusions followed by three 4 hour IV infusions and compared with placebo. The primary efficacy endpoint of improved treadmill exercise time compared to placebo was not reached, so results for the entire cohort are combined for outcomes analysis at 120 clays.

Results: Baseline demographics: mean age was 60; 59% had a prior MI, 86% prior CABG, 58% prior PTCA; 63% had Class III–IV angina, and 31% had CHF. At follow-up, 52% had Class III–IV angina and 29% had CHF.

120 day outcomes	Placebo (n = 63)	VEGF (n = 115)	All Patients (n = 178)
Death	2	0	2 (1%)
MI	0	0	0 (0%)
Any Hospitalization	5	9	14 (8%)
New or worsened CHF sxs.	3	8	11 (6%)
Worsened angina (≥1 class)	4	3	7 (4%)
Mean change in angina class	−0.62	−0.89	−0.79

Conclusions: Contrary to common perception, "end stage" VUNE patients in clinical trials do not have extremely high short to medium term mortality and morbidity. In this study, there were few deaths and little devel-

opment or worsening of CHF. Patients' angina symptoms improved significantly (perhaps due to being enrolled in a clinical trial). Intervention studies in VUNE patients should employ a control group to avoid erroneous claims of clinical success and possible patient harms from exposure to unwarranted therapeutic maneuvers.

POSTER

1175 Percutaneous Interventions-Coronary: Miscellaneous

Tuesday, March 14, 2000, 3:00 p.m.–5:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 3:00 p.m.–4:00 p.m.

1175-75 Minor Myocardial Damage is Not Associated With an Increase of Cardiovascular Events During Follow-Up After Angioplasty With High Rates of Stenting and GPIIbIIIa-Antagonist Application

B. Mark, R. Zahn, K. Dönges, B. Fraiture, B. Frilling, F. Fischer, D. Nagel[1], D. Seiler[1], J. Senges. *Herzzentrum Ludwigshafen; [1]Institut für Klinische Chemie, Klinikum Ludwigshafen, Germany*

Background: After percutaneous transluminal coronary angioplasty (PTCA) 5–30% of the patients (pts.) show a minor myocardial damage ("infarctlet") diagnosed by an elevation of cardiac markerenzymes without a new ST-elevation or new Q-waves. Little is known about the prognostic value of these infarctlets particulary in the era of stenting and GPIIbIIIa-antagonists.

Methods: Since October 1997, 619 pts. who underwent PTCA for stable or unstable angina were included in a prospective registry. Pts. with an acute myocardial infarction in the past 48 hours or a perinterventional infarction were excluded. Total-CK, CK-MB and troponin T were measured before intervention, 1 to 2 hours and 8 to 24 hours after intervention. Clinical and procedural data were documented. Follow-up data were obtained after 6 months.

Results: 48% of pts. underwent the procedure for a stable and 52% for an unstable angina. A stent was implanted in 48%. 21% were treated with a GPIIbIIIa-antagonist. An elevation of total-CK over the upper limit of normal was found in 10%, whereas CK-MB was elevated in 36% and troponin T in 16%. After 6 months pts. showed the following rates of MACE [= major adverse cardiovascular events: unstable angina (UA), myocardial infarction (MI), Revascularisation by PTCA/CABG, death]:

n = 619 pts.	all MACE	UA	MI	Revascular.	Death
Infarctlet	12%	3%	1%	6%	2%
no infarctlet	12%	2%	1%	8%	1%

Pts. with and without infarctlet had no significant difference in the rates of MACE during this follow-up periode.

Conclusion: In pts. treated with PTCA combined with high rates of stent implantation and application of GPIIbIIIa-antagonist, the occurrence of an infarctlet was not associated with an increase in the rate of MACE during a follow-up period of 6 months. In these pts. MACE were found almost half as often (12%) than reported in previous studies (20%).

1175-76 The Deleterious Prognostic Impact of Cardiac Tropnin I Re-Elevation Following Percutaneous Coronary Intervention in Patients With Acute Coronary Syndromes

Shmuel Fuchs, Ran Kornowski, Roxana Mehran, Lowell F. Satler, Mun K. Hong, Steve Slack, Gregg W. Stone, Martin B. Leon. *The Cardiovascular Research Foundation, Washington Hospital Center, Washington, DC, USA*

Background: In patients undergoing percutaneous coronary intervention (PCI) with normal baseline cardiac enzymes, Troponin I (TnI) elevation may be associated with adverse clinical outcomes. However, the prognostic importance of cardiac Tn-I re-elevation in high-risk patients with acute coronary syndrome (ACS) as reflected by elevated admission Tn-I levels has not been determined.

Methods: We studied 133 consecutive patients (68% males) with non-ST elevation ACS (62% non-Q wave MI) and elevated admission TnI (>0.15 ng/ml) levels who underwent PCI ≥ 48 hrs from admission. TnI levels were routinely measured @6 and 18–24 hrs after the PCI and patients were distinguished according to the presence or absence of TnI re-elevation (>x1 or <x1 admission levels). In-hospital and cumulative 6-month clinical outcomes were compared between the 2 groups.

Results: Patients with TnI re-elevation (n = 52) were slightly older (68 ± 12 vs 64 ± 13 years) but otherwise had similar baseline characteristics, clinical presentation and angiographic success (overall 97%). TnI re-elevation group had significantly higher in-hospital and 6 months death rate MI and target lesion revascularization (TLR) were similar between groups (Table). By multivariate analysis, TnI re-elevation (OR 8.9, 95% CI 1.9–41.7, p = 0.005) and diabetes mellitus (OR 8.6, 95% CI 1.6–45.9, p = 0.01) were the strongest independent predictors for increased 6-months cumulative mortality.

TnI Re-Elevation (# pts)	No (81)	Yes (52)	P Value
In-Hospital			
Death/Q-MI (%)	0/0	11.1/0	0.003/1.0
6 months follow-up			
Death/MI/TLR (%)	4.2/4.3/17.4	23.9/13.5/16.7	0.001/0.12/0.92
Event Free Survival (%)	84.7	65.2	0.014

Conclusion: TnI re-elevation following PCI is associated with substantial increased mortality and overall cardiac events at follow-up. Thus, adjunctive pharmacotherapy aimed to reduce subsequent cardiac enzymes elevation may become mandatory among high-risk ACS patients who undergo early PCI.

1175-77 Prognostic Value of Recurrent Episodes of CK-MB Elevation Following Repeated Catheter-Based Coronary Interventions

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Background: Creatine kinase-MB (CK-MB) elevation after percutaneous coronary intervention (PCI) has been associated with an adverse prognostic risk. The impact of recurrent episodes of CK-MB rise following repeated PCIs has not been shown.

Methods: We studied 767 consecutive pts (age 64 ± 11 yrs, 69% male) who underwent 2 consecutive PCIs on 2 separate hospitalizations (mean interval 121 ± 210 days). Patients were stratified to 4 groups according to number of episodes of any (>4 ng/ml) post PCI CK-MB rise (none, once [current or previous procedure] or twice, N = 403, 107, 153 and 104 pts, respectively). In hospital clinical outcomes (death, Q-MI, and repeat revascularization) and @up to one-year follow up were obtained.

Results: Recurrent episodes of CK-MB elevation were associated with (1) increased in-hospital mortality, (2) increased cumulative mortality and Q wave MI rates and lower overall cumulative cardiac event-free survival at one year (Table).

CK-MB Elevation (#Patients)	None (403)	Prior (153)	Current (107)	Twice (104)	P
In-hospital					
Death/Q-MI (%)	0/0.2	0/0	1.9/1.9	3.8/1.9	0.0003/0.05
One-year cardiac events					
Death/Q-wave MI (%)	4.3/0.8	4.3/1.0	5.9/4.9	18.9/8.0	0.0003/0.005
Event-free survival (%)	88.8	88.8	80.5	66.8	<0.0001

By multivariate analysis, recurrent episodes of CK-MB elevation was the strongest independent predictor for cumulative mortality (OR 3.4, 95% CI 1.6–7.1, P = 0.001) or any adverse cardiac events (OR 2.6, 95% CI 1.6–4.3, P = 0.0002) at one year.

Conclusions: Repeated episodes of peri-procedural CK-MB elevation are associated with incremental cumulative adverse prognostic risk including mortality and Q wave MI. Thus, prior records of peri-procedural CK-MB rise should be obtained and procedural measures aimed at reducing subsequent CK-MB 'leak' may become warranted among patients with a prior history of PCI related CK-MB elevation.

1175-78 AngioJet® Rheolytic™ Thrombectomy: An Important Tool for Percutaneous Coronary Interventions in High Risk Patients; VeGAS II Trial

S. Dohad, T.M. Parris, C. Setum, M. Cohen, D.J. McCormick. *Hahnemann University Hospital, Philadelphia, PA, USA*

Background: Intracoronary thrombus during percutaneous coronary intervention is associated with poor outcome. We evaluated procedural success (PS) and outcome in patients with large thrombus burden using AngioJet rheolytic thrombectomy (ART).

Methods: Patients from randomized trial (VEGAS II) assigned to ART (A), urokinase (U), and patients in the thrombolysis exclusion registry of

VEGAS II (R), from 21 centers were evaluated for outcome. QCA and TIMI (T) flow measurements were performed by angiographic core lab. Endpoints were analyzed on an intent-to-treat basis and adjudicated by an independent clinical endpoints committee. Major adverse cardiac events (MACE) included death, Q-wave MI, non-Q wave MI (CKMB > 3 time normal), CABG, target lesion revascularization, CVA, stent thrombosis at 30 days, and failure to achieve: post-procedure diameter stenosis (DS) < 50%, T III flow, or >20% change in DS.

Results: 454 patients (105 R, 180 A, 169 U), mean age 63 ± 12 years, 78% male, were evaluated, with similar baseline demographics and lesion characteristics (except trombus burden) between groups. Pre-procedure mean LVEF was 47%, minimum luminal diameter was 0.83 mm, lesion length was 15.67 mm. Interventions were performed on 48% native coronary lesions and 52% saphenous vein grafts. 75% were B2/C lesions, 99% with thrombus. In the A and R groups, T III flow was achieved in 75% post-ART alone (MLD 1.6 mm), and in 88% at the end of the procedure (MLD 2.6 mm, 21.6% with residual thrombus, 73% stents).

	PS‡	No reflow	LOS ‡	TBR‡ %	MACE in hospital	MACE 30 days	MACE 1 year
R = 105	76%*	14.4%*	4.1*	83.4%	20.0%*	24.0%*	31%*
A = 180	88.3%*	7.8%*	2.5*	91.0%	13.9%*	15.1%*	28%*
U = 169	72.2%	11.1%	3.5*	83.6%	30.8%*	32.5%*	44%*

Key: * P < 0.01; ‡ LOS = length of stay, PS = procedure success (DS < 50%, T III flow, no death, urgent CABG, Q wave MI prior to discharge); TBR = thrombus burden reduction.

Conclusion: ART is a superior strategy for patients undergoing high risk percutaneous coronary interventions with large thrombus burdens.

1175-79 The strategy for side branch during intervention of target lesion

Teruo Okabe, Yasushi Asakura, Shiro Ishikawa, Keiko Asakura, Toshiyuki Takahashi, Akio Kawamura, Hideo Mitamura, Satoshi Ogawa. *Keio University, Tokyo, Japan*

We evaluated whether the intervention for side branche lesions (SB) at the target lesions (TL) was effective on initial and late results during the same procedure for the latters, by way of the quantitative coronary angioplasty (QCA).

Methods: The study population consists of 432 patients whose TL had SB more than 1.0 mm of the refference diameter (RD), and were followed up by the angiography. The groups that had already SB before the procedure were sub-devided into group I which were treated by PTCA and group II which were not. The groups that had new lesions at the ostium of side brances during the procedure for TL were sub-devided into group III which treated by PTCA and group IV which were not. The group V had no SB before and through procedures, as control group. As QCA measurements, RD of both TL and SB, and %DS were measured at initial and follow-up time.

Result: The RD of both TL and SB before the procedure did not affect the results of SB. The favourable %DS immediately after the procedure in group I became worse at follow-up. There were no different of %DS in group II and III between after the procedure and at follow-up. However, in group IV, %DS after the procedure improved significantly at follow-up. The %DS of SB at follow-up were affetcted by whether or not TL would become restenotic (restenosis (+); 39.2 ± 2.5%, restenosis (–); 32.9 ± 1.7%) (p < 0.05).

	side branch lesions (+)		new lesions		control
group	I (n = 45)	II (n = 57)	III (n = 31)	IV (n = 59)	V (n = 240)
%DS after procedures	34.7 ± 3.8	51.9 ± 1.4	33.5 ± 4.4	76.3 ± 2.6*	18.9 ± 1.2
%DS at follow-up	46.9 ± 2.9#	49.4 ± 3.5	46.6 ± 5.0	47.2 ± 3.9	22.1 ± 1.6

#p < 0.05 vs. after procedures *p < 0.05 vs. at follow-up

Conclusion: This study indicated that initial results of intervention for side branch lesions did not reflect the late results of side branches. Moreover, it was suggested that the late results of side branches might be affected by the late results of target lesions.

1175-80 Cutting Balloon for Treatment of In-Stent Restenosis: Is it More Effective Than Conventional PTCA?

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Background: In the era of stenting the optimal treatment of an instent restenosis has become a growing problem. Conventional PTCA alone does not yield satisfactory long-term results. Therefore we examined whether cutting balloon (CB) treatment leads to better results compared to PTCA (P). Angioplasty with a CB is thought to produce lesser tissue trauma and therefore may lead to less intima proliferation.

Methods: In a controlled matched paired follow-up study we compared the primary and long-term-results of 60 patients (pat) with in-stent restenosis who were treated either with cutting balloon or PTCA. Thirty pairs of patients were matched according to target lesion, degree and length of stenosis. Coronary angiograms were analyzed bei quantitative coronary angiography (QCA) after primary treatment and after six months.

Results: The degree of stenosis (DS) before treatment showed no significant difference (70.6 ± 14.0% (CB) vs 70.8 ± 13.3% (P)). Primary outcome after the procedure was similar in both groups (27.4 ± 9.6% (CB) vs 26.9 ± 8.9% (P)). After six months (30 pat) the DS was not different (44.2 ± 23.1% (CB) vs 47.5 ± 21.9% (P)) between the two groups (p = 0.57). Net gain was similar for both procedures (26.4 ± 21.9% (CB) vs 23.2 ± 19.7% (P), p = 0.73). Out of 30 controls target lesion revascularisation was necessary after CB in 6 patients and after PTCA in 5 patients.

Conclusion: The treatment of in-stent-restenosis with a cutting balloon does not seem to yield better long-term results compared to conventional PTCA.

1175-81 Prospectively Randomized Evaluation of Regular Physical Exercise Versus PTCA/Stent in Stable Coronary Artery Disease

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Background: Aim of this study is to evaluate the effects of regular physical exercise training in comparison to an interventional approach (PTCA and stent implantation) as primary therapy in patients with symptomatic but stable coronary artery disease (CAD).

Methods: 42 male patients (pts) with coronary artery stenosis (amenable for PTCA/stent implantation) with evidence of local ischemia as assessed by radionuclide scintigraphy were prospectively randomized to either a training group (T) (n = 22) or an intervention group (INT) (n = 20). Pts of the T group exercised daily for 20 minutes at 70% of their peak oxygen uptake (VO2max) on a bicycle ergometer whereas pts in INT underwent PTCA with stent implantation. At the beginning and after 6 months patients underwent a symptom-limited bicycle ergospirometry.

Results: After 6 months pts in T and INT demonstrated a significant improvement in clinical status (CCS-class) (from 1.4 ± 0.6 to 0.7 ± 0.6 and from 1.3 ± 0.6 to 0.8 ± 0.7, respectively). Compared to INT, pts in T showed a significant increase in functional work capacity and peak oxygen uptake by 25% (from 134 ± 20 to 167 ± 24 [watts], p < 0.05 vs. INT) and by 18% (from 23.1 ± 3.2 to 27.2 ± 4.2 [mL/kg/min], p < 0.05 vs. INT), respectively.

Conclusion: Daily physical exercise training seems to be a feasible alternative to PTCA/Stent. Both therapies are equally effective regarding the mid-term clinical status of patients with symptomatic CAD. The significantly higher improvement in functional work capacity after training may result in a better quality of life for the patients.

1175-82 Gradual Computerized Inflation During Coronary Angioplasty Reduces by Half the Need for Stenting and Revascularization

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We developed CAPSID (computerized automatic pressure sensor and inflator device) for gradual inflation of the balloon to reduce traumatic dilatation of coronary stenosis, the major cause for early and late complications of coronary angioplasty. CAPSID was applied by intermittent, slow (over 20 inches) incremental pressure rise inflations, followed by rapid deflations and reperfusion (183 lesions) or by a continuous, single slow gradual inflation over 120 sec (91 lesions). This study summarizes our experience in these 274 lesions, dilated gradually by this device – and compared the results to those obtained in a similar consecutive patient group (278 lesions) who underwent standard angioplasty, at the same time period, on days when the device was unavailable. Baseline characteristics were similar. The need for provisional stenting was significantly less in the CAPSID group – 12% vs 25% and the need for 1-year target lesion revascularization (TLR) was halved 16 vs 36% in the standard group (p < 0.05). TLR was significantly reduced by CAPSID in subsets of patients with higher risk for restenosis: diabetes, 11% vs 27% and in proximal LAD lesion: 12% vs 23% (p < 0.05).

Conclusions: Gradual computerized inflation by CAPSID halved the need for provisional stenting and the need for TLR, by minimizing the trauma applied on the vessel wall.

1175-83 Does the Pattern of Arterial Remodeling Impact Vessel Behavior Following Balloon Angioplasty? A Serial Intravascular Ultrasound Study

Hiroyuki Okura, Shinichi Shimodozono, Motoya Hayase, Paul G. Yock, Peter J. Fitzgerald. *Stanford University Medical Center, Stanford, CA, USA*

To characterize the impact of pre-intervention arterial remodeling on subsequent vessel behavior following balloon angioplasty (BA), serial IVUS analysis was performed in 93 coronary lesions. IVUS imaging was performed before and after BA in all lesions, and repeated at 6 M follow-up in 37 lesions. External elastic membrane (EEM) and lumen area were measured. Plaque + media (P + M) area was calculated as the difference between EEM and lumen area. The pattern of remodeling was classified as follows: (1) positive remodeling (PR) as EEM area-lesion > EEM area-proximal reference, (2) intermediate remodeling (IR) as EEM area-proximal reference > EEM CSA-lesion > EEM CSA-distal reference, (3) negative remodeling (NR) as EEM area-lesion < EEM area-distal reference. Serial changes in EEM, P + M, and lumen were compared.

Results: PR, IR, and NR were present in 29 (31%), 35 (38%), and 29 (31%) of 93 lesions, respectively. Although acute lumen gain was similar, lesions with PR showed a smaller ΔEEM and larger ΔP + M area than those with NR (both, $p < 0.05$). During 6 M follow-up, lesions with PR showed a smaller ΔEEM area compared to those with NR ($p < 0.05$). However, ΔP + M area was similar among the three groups. As a result, late loss was significantly larger in those with PR ($p < 0.05$).

	PR	IR	NR
ΔEEM area (post-6 M)	−0.2*	1.5	1.8
ΔP + M area (post-6 M)	1.4	2.4	1.4
Δlumen area (post-6 M)	−1.5*	−0.9	0.4

* $p < 0.05$ vs NR

Conclusions: The pattern of arterial remodeling affects both mechanism of acute gain and late loss following BA. Lesions with PR appear to have less capacity to compensate further to plaque growth following BA and thus show proportionally larger late loss despite the similar acute gain. This may in part explain the less favorable outcomes of the positively remodeled lesions following coronary interventions.

POSTER

1176 Coronary Stenting II

Tuesday, March 14, 2000, 3:00 p.m.–5:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 3:00 p.m.–4:00 p.m.

1176-84 The Incidence of Late Stent Thrombosis Without the Use of Brachytherapy

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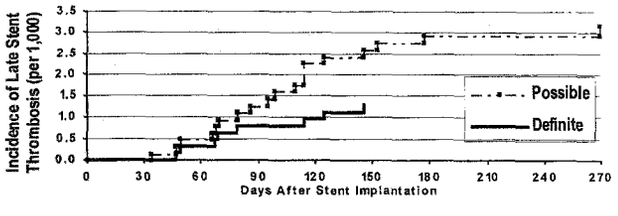
Background: Acute thrombosis within the 1st 30 days after stent implantation is well-described. Recent angioscopic studies and anecdotal reports suggest that endothelialization of stents may be incomplete at 30 days, leading to subsequent late stent thrombosis (LST) with acute myocardial infarction (MI), especially after use of intracoronary brachytherapy.

Methods: The incidence of LST (at >30 days post-stenting) was examined in 6535 patients who underwent elective stenting of a native coronary artery (without the use of brachytherapy) in 7 FDA-sanctioned clinical trials and who were free of stent thrombosis at 30 days. The median duration of follow-up was 284 days. Definite LST was defined as an acute MI attributable to the stented vessel with angiographic evidence of thrombus or total occlusion at the original stent. Possible LST was defined as an acute MI attributable to the stented vessel in the absence of an identifiable "culprit" lesion elsewhere.



MI occurring after revascularization of the target vessel was not considered LST.

Results: Definite LST occurred in 8 patients (47–145 days post-stenting), with possible LST in an additional 11 (34–269 days post-stenting). The cumulative incidence of LST is shown below. The 95% CI for the rate of LST at 180 days was 0.4–2.2/1000 for definite and 1.6–4.3/1000 for possible LST.

Conclusion: MI with stent thromboses beyond 30 days after elective stenting of native coronary arteries (without the use of brachytherapy) occurs rarely (1–3/1000 at 180 days).

1176-85 Aggressive Stent Dilatation Results in Lower Restenosis Despite Greater Late Loss

Yoshio Kobayashi, Joseph De Gregorio, Nobuyuki Kobayashi[1], Carlo Di Mario[1], Antonio Colombo[1]. *Lenox Hill Hospital, New York, NY, USA; [1]Centro Cuore Columbus, Milan, Italy*

Background: There is a concern if aggressive stent dilatation (negative residual stenosis) causes excessive late loss and results in restenosis.

Methods: Between April 1993 and July 1997, 1,306 lesions with ≥3 mm reference vessel diameter underwent successful stenting. Lesions were divided according to the final % diameter stenosis achieved after stenting; 1) Group with a positive residual stenosis (n = 835) defined according to the presence of a final % stenosis ≥ 0 and <30%, 2) Group with a negative residual stenosis (n = 471, final % stenosis < 0%).

Results:

	Positive	Negative	P
Multiple stents (%)	30	29	NS
Stent thrombosis (%)	1.1	0.6	NS
Reference (mm)	3.47 ± 0.40	3.37 ± 0.33	<0.01
Lesion length (mm)	12.0 ± 7.4	10.6 ± 6.1	<0.01
Pre-MLD (mm)	0.94 ± 0.58	0.92 ± 0.53	NS
Final MLD (mm)	3.21 ± 0.47	3.60 ± 0.44	<0.01
Final % stenosis	8.7 ± 6.3	−6.9 ± 5.0	<0.01
F/U MLD (mm)	2.21 ± 1.06	2.39 ± 0.92	0.01
Restenosis (%)	23.5	16.2	<0.01
Acute gain (mm)	2.27 ± 0.66	2.69 ± 0.61	<0.01
Late loss (mm)	1.01 ± 0.98	1.25 ± 0.88	<0.01
Loss index	0.47 ± 0.51	0.48 ± 0.34	NS

MLD: minimum lumen diameter, F/U: follow-up

Follow-up angiography was performed in 925 of the 1,288 lesions (72%) eligible for follow-up.

Conclusion: Aggressive stent dilatation results in lower restenosis despite greater late loss because of similar loss index.

1176-86 Influence of the Presence and Type of Diabetes Mellitus on the Initial and Long-Term Outcome After Coronary Stenting

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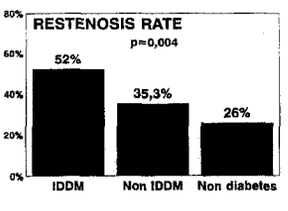
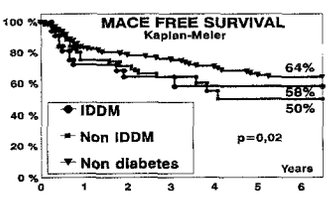
Background: Data regarding the evolution after coronary stenting (CS) of insulin-dependent diabetes mellitus (IDDM) and non-IDDM patients are scant and controversial.

Methods: To assess the initial and long-term efficacy of CS in diabetics we compared the evolution of 35 IDDM patients (pts) with the outcome of 92 non-IDDM pts and a control group of 856 nondiabetic stented pts of a series of 983 consecutive pts treated with CS. Patients with IDDM were more often female (40%), and had a higher rate of previous heart failure (14%) and lower reference diameter ($p < 0.05$, compared with non-IDDM and non-diabetic pts). Hypertension was more frequent in non-IDDM pts than in the other two groups (52% vs 46% vs 37%, $p < 0.05$). Clinical follow-up was completed for 94% of pts (3.1 ± 1.4 years, range: 1.8–6.5).

Results: Clinical success at one month (angiographic success without major events) was similar among the three groups (IDDM: 93%, non-IDDM: 94%, non-diabetic: 94%). Angiographic restenosis rate was significantly higher in IDDM pts. Major adverse cardiac events (death, re-PTCA, CABG or admission for myocardial infarction or unstable angina) (MACE) during





follow-up were significantly higher among diabetics, without differences between IDDM and non IDDM-pts (figures)

Conclusions: Thus: 1) initial outcome of diabetics is similar to that of nondiabetic pts but angiographic restenosis occurs more often in IDDM pts; 2) diabetics have a worse clinical long-term evolution without differences related to the type of diabetes.

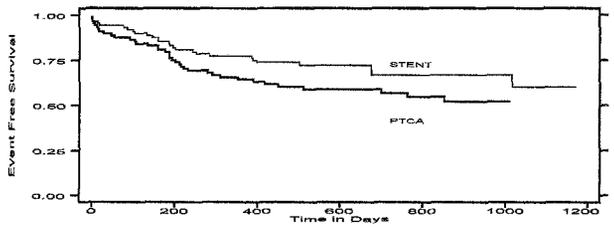
1176-87 Balloon Angioplasty Versus Stenting in Diabetic Patients With Coronary Atherosclerosis

Peter K. Mazeika, Neeraj Prasad, Sanh Bui, Peter Seidelin. *Division of Cardiology, The Toronto Hospital, Toronto, Ontario, Canada*

Background: Although coronary stenting reduces angiographic restenosis in diabetic patients, its impact on clinical outcome remains undefined.

Methods: The Angioplasty *v* Stenting in Diabetics with Angina (ASDA) study compared the clinical effectiveness of these treatments using a observational historically prospective cohort design. Over 30 months, 176 of 433 diabetics who underwent an intervention, met the inclusion criteria and were enrolled. The 88 patients in each group had similar baseline characteristics and were followed up 22 (8) months later. Assuming an alpha error of 0.05 and a treatment difference of 1.75, a sample size of 176 gave a power of 80%.

Results: Post-procedure MLD was greater with stent placement (2.97 (0.44) *v* 2.24 (0.53) mm; $p < 0.001$). Event-free survival for the composite primary endpoint (death, MI, repeat revascularization, clinical restenosis) favoured stenting (hazard ratio 1.57; 95%CI, 0.95–2.58; p = 0.08; graph). A similar trend was seen for the composite secondary endpoint of TVR and clinical restenosis (hazard ratio 1.72; 95%CI, 0.99–2.99; p = 0.05). After adjusting for covariates using Cox regression analysis, the results for both primary (hazard ratio 1.62; 95%CI, 0.97–2.69; p = 0.06) and secondary (hazard ratio 1.64; 95%CI, 0.94–2.86; p = 0.08) endpoints changed only slightly. There was no significant interaction between mode of intervention and severity of CAD.



Conclusion: A strong and consistent trend favoured stenting for both endpoints, and persisted after adjusting for covariates. Diabetics requiring coronary revascularization who are not surgical candidates should be considered for stent placement rather than PTCA.

1176-88 Acute and Long-Term Outcomes for a New Generation Stent: Experience in 441 Patients With the Medtronic AVE GFX Stent

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Background: The acute and long-term outcome for patients (pts) receiving the Medtronic AVE GFX (GFX) stent have not previously been documented for a large, complex group of pts.

Methods: Using a computerized database and chart review, we identified 441 consecutive pts undergoing elective GFX stenting and evaluated in-hospital and long-term clinical outcomes. Mean follow-up was of 9.5 – 4.5 months.

Results: Mean age was 64.8 ± 12.0 yrs, 174 pts (39.4%) were >70 yrs, 116 pts were female (26.3%), mean LVEF was 47.7 ± 12.6%, 163 pts (37.0%) had multi-vessel disease, 134 pts (30.4%) had unstable angina, 32 pts had diabetes (7.3%), 14 pts had serum creatinine > 2.0 mg/dL (3.2%), 198 pts (44.9%) had previous PTCA, 86 pts (19.5%) had previous CABG, and 32 pts (7.3%) had an acute MI < 24 hours. Procedural success was achieved in 424 pts (96.1%), 4 in-hospital deaths occurred (0.9%), 2 pts had an acute MI (0.5%), 11 pts (2.5%) required repeat PTCA, in-hospital MACE (death, acute MI, em-CABG, and re-PTCA) was 17 (3.9%), and acute stent thrombosis rate was 6 (1.4%).

Target lesion revascularization (TLR) rate at follow-up was 57/426 (13.4%). For stent diameter 3.0, 3.5, and 4.0 mm, TLR was 16.7, 8.3, and 4.9% respectively (resp). For stent lengths 0–12, 13–24, 25–36, and ≥37 mm, TLR was 7.5, 12.5, 13.6, and 13.2% resp. TLR rate for LAD, RCA, LCX, and SVG were 8.7, 7.2, 9.7, and 13.0% resp. TLR rate for single-vessel/single-stent procedures 11.4%, for single vessel/multiple stenting 13.0%, and for multiple-vessel stenting 24.3%.

At late follow-up, 11 pts died (2.5%), 46 pts had repeat PTCA (10.5%), and 11 pts underwent CABG (2.5%).

Conclusion: These data indicate that the GFX stent can be deployed successfully in a set of patients with complex clinical and anatomic features with low in-hospital event rates and excellent long-term TLR rates, particularly in patients receiving single stents < 30 mm.

1176-89 Minor Myocardial Injury With Primary Coronary Stenting

Joerg Herrmann, Clemens von Birgelen, Michael Haude, Dirk Welge, Axel Schmermund, Dietrich Baumgart, Stefan Sack, Raimund Erbel. *University of Essen, Essen, Germany*

Background: Especially new device percutaneous coronary intervention can be associated with a post-procedural serum marker elevation, considered to indicate an underlying myocardial injury. However, the incidence of these myocardial "infarctlets" after primary stenting in comparison to balloon angioplasty is not well known.

Methods: 596 consecutive patients (pts) undergoing balloon angioplasty (BA, n = 136), primary stenting (Stent, n = 89), or coronary stenting because of a dissection (40.7%) or a suboptimal result (59.3%) after BA (BA + Stent, n = 371) had blood samples taken before as well as 6, 12, and 24 hours after the coronary intervention. Serum marker analysis was done by enzyme activity assay for creatine kinase (CK, normal range 10–80 IU/l) and by a rapid bedside test for cardiac troponin T (cTnT, threshold 0.1 ng/ml). Normal range values at baseline were obligatory for study inclusion.

Results: With primary stenting serum marker elevation tended to be less frequent than with conventional strategy but was still more frequent than with balloon angioplasty.

	BA (n = 136)	Stent (n = 89)	BA + Stent (n = 371)
Positive cTnT test	7.4% */**	20.2%*	24.5%**
CK 1.5–3x nml	4.4%	7.9%	8.9%
CK >3x nml	0.7%	2.2%	3.5%
Peak CK [IU/l]	51 ± 54°/$^{\circ\circ}$	67 ± 88°	76 ± 145$^{\circ\circ}$

*$p < 0.001$; **$p < 0.001$; $^{\circ}p = 0.02$; $^{\circ\circ}p < 0.001$

Conclusion: Stenting with or without predilatation is associated with a higher incidence of serum marker elevation than PTCA. More extensive squeezing of coronary lesions with consecutive distal microembolization could explain the higher rate of myocardial injury seen with coronary stenting.

1176-90 Comparison of Self-Expanding Wallstents and Balloon-Expandable Palmaz-Schatz Stents During Long-Term Follow-Up: Serial Volumetric Analyses With Intracoronary Ultrasound Regarding Relative Changes of Coronary Morphology

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Background: The self-expanding Wallstent (WS) and the balloon-expandable Palmaz-Schatz Stent (PSS) represent different mechanical and dynamical stent designs. In recent studies we observed a significant late stent expansion after WS implantation and neither expansion nor compression of PSS during long-term follow-up. We performed serial measurements with intracoronary ultrasound (ICUS) to investigate the impact of the different stent designs on the coronary wall morphology during long-term.

Methods: ICUS was performed in stent segments and reference segments of 50 pts. (25 WS/25 PSS) with a standardized, motorized pullback

	WS (n = 25)	PSS (n = 25)	p
Stent segments			
ΔStA %	27.7 ± 23.7	0.2 ± 10.9	*
ΔLA %	−13.6 ± 22.5	−20.1 ± 24.3	NS
ΔVA %	11.8 ± 15.4	2.0 ± 15.8	*
ΔPA %	3.2 ± 21.2	5.2 ± 27.9	NS
NA mm^2	4.23 ± 2.07	2.22 ± 2.22	*
Reference segments			
ΔLA %	−3.3 ± 21.8	−3.8 ± 16.5	NS
ΔVA %	2.8 ± 15.1	−0.7 ± 18.0	NS
ΔPA %	11.6 ± 29.4	13.0 ± 48.3	NS

mean value ± SD; *p = <0.0001

system (0.5 mm/sec, 2.9 F; 30 MHz transducer). Vessel area (VA), stent area (StA), lumen area (LA), neointimal area (NA = StA-LA) and plaque area (PA = VA-StA) were measured in steps of 1.0 mm. Relative changes for each parameter in both stents designs were calculated and tested for significancy (Mann-Whitney, CI < 0.05).

Results: (see table)

Conclusion: We observed a significant difference of ΔVA in WS probably due to late stent expansion while lumen loss was not significantly different between both stent designs. Neointimal ingrowth was significantly higher in WS. ΔPA and ΔLA were not significantly different in stent and reference segments. The late stent expansion of WS did not lead to unfavourable reference response compared to PSS.

1176-91 Autologous Vascular Graft-Covered Stents: Effect on Endothelialization, Intimal Hyperplasia and Vascular Injury in Porcine Coronary Arteries

Konstantinos Toutouzas, Christodoulos Stefanadis, Eleftherios Tsiamis, Lubna Khaldi, Konstantinos Tentolouris, Antonios Doufas, Andreas Michaelides, Pavlos Toutouzas. *Hippokration Hospital, University of Athens, Greece*

Covered stents have been proposed to eliminate current problems of stenting. The aim of this experimental study was to compare stents covered by autologous arterial or venous grafts with conventional uncovered stents.

Methods: The study was performed in 19 swines (20–26 kg). The arterial graft was harvested from the femoral artery and the venous graft from the cephalic vein. Both grafts were stabilized on the external surface of Multilink™ stents by the application of 3 sutures (Prolene 7-0) at each end. Fourteen arterial-covered stems (AC), 14 venous-covered stents (VC) and 10 uncovered Multilink™ stents, serving as control group, were implanted. The animals were sacrificed between a period of 7 days–2 months. The luminal area covered by endothelial cells (EC) was quantified by computer-assisted digital planimetry. The vascular injury score was assigned: IO: intact internal elastic lamina (IEL); I1: fragmentation of IEL; I2: stent penetration into the media; I3: fragmentation of external elastic lamina.

Results: The injury score was less in AC and VC (the majority: I1) compared to the control group (the majority: I3, $p < 0.001$). The maximal intimal thickness (MIT) and the EC were similar between AC and VC. The uncovered stems had less EC.

Group	VA	LA	MIT	EC (%)
AC	40.4 ± 4.2	24.8 ± 1.4	116.7 ± 47.8	81 ± 12
VC	41.2 ± 2.3	23.9 ± 1.6	119.5 ± 34.7	84 ± 14
Control	40.9 ± 3.1	21.5 ± 1.5	150.2 ± 46.8	55 ± 14
p value	NS	NS	0.07	<0.05

VA: Vessel area (μm^2), LA: Luminal area (μm^2), MIT: Maximal intimal thickness (μm).

Conclusions: Our results demonstrate that implantation of covered stents autologous vascular grafts graft results in accelerated endothelialization less vascular injury and has a trend to reduce the neointimal hyperplasia.

1176-92 Long-Term Clinical Outcome After Endoluminal Reconstruction of Diffusely Degenerated Saphenous Vein Grafts With Less-Shortening Wallstents

Rémi P. Choussat, Alexander J. Black, Irene Bossi, Thierry Joseph, Jean Fajadet, Jean Marco. *Clinique Pasteur, Toulouse, France*

Background: The optimal treatment strategy for patients (pts) with diffusely degenerated saphenous vein gratis (SVG) is controversial. "Endoluminal reconstruction" by stent implantation is one proposed strategy however there is little data regarding long-term clinical outcome. We report the follow-up results in patients undergoing endoluminal reconstruction using self-expanding Wallstents in diffusely degenerated SVG.

Methods: Between May 1995 and September 1998, 6534 consecutive pts underwent angioplasty in our institution: 126 (115 males, median age 69 ± 6 years (y)) with old SVG (mean age: 12 ± 2 y) diffusely degenerated stenosed or occluded (mean lesion length: 27 ± 12 mm, range 8–80) were treated electively with implantation of one or multiple (total 197) less-shortening Wallstents. Mean length of the Wallstent per graft was 44.5 ± 16.7 mm.

Results: Before discharge, 13 pts (10.3%) sustained at least one major cardio-vascular event: 4 deaths (3.2%), 11 myocardial infarctions (MI) (8.7%), 3 repeat revascularizations (target vessel = 1, non-target vessel = 2, 2.4%). Surviving patients were followed for 22 ± 11 months: 13 pts (11.1%) died, 11 (9.4%) sustained a MI, 37 underwent angioplasty (31.6%), and 4 (3.4%) underwent bypass surgery. The estimated 3-year event-free survival rates (freedom from death, and freedom from death/MI/target vessel revascularization) were (mean ± SEE) 81.1 ± 7.8% and 40.7 ± 18.5% respectively.

Conclusions: The long-term clinical outcome of pts undergoing the treatment strategy of "endoluminal reconstruction" in diffusely degenerated SVG is relatively poor, mainly because of a high incidence of death, MI and the very strong need for repeat angioplasty. It is unlikely that percutaneous intervention alone will provide a satisfactory or definite answer for these pts.

POSTER

1177 Percutaneous Interventions: Local Delivery

Tuesday, March 14, 2000, 3:00 p.m.–5:00 p.m.
Anaheim Convention Center, Hall A
Presentation Hour: 3:00 p.m.–4:00 p.m.

1177-111 Preclinical Safety of Transatrial Access to the Normal Pericardial Space for Local Cardiac Drug Delivery During Aspirin Use and Pulmonary Hypertension

Todd C. Pulerwitz, Sergio Waxman, Katharine A. Rowe, William C. Quist, Izabella Lipinska, Richard L. Verrier. *Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA*

Background: We have previously demonstrated the feasibility of transatrial intrapericardial access in large animals as an approach for local cardiac drug delivery. Since aspirin use and pulmonary hypertension are prevalent in cardiac patients who could potentially benefit from this procedure, we tested in additional animals whether it can be safely performed in these settings.

Methods: Transatrial access was performed in 10 anesthetized pigs. An 8 Fr multipurpose catheter was fluoroscopically placed via a femoral vein against the right atrial appendage, and a 0.038 inch infusion wire was advanced over a 0.014 inch guidewire transatrially into the pericardial space. Pericardial fluid was aspirated and the catheters removed after 5 min. Six of the animals received oral aspirin (162 mg) on the day before and the morning of the procedure. Arachidonic acid testing confirmed 100% blockage of platelet aggregation by aspirin. Following transatrial access, the pigs recovered and were sacrificed at 24 hrs. In the 4 remaining pigs, pulmonary hypertension was induced by injecting repeated 5 ml (250 mg) doses of 106 μm glass beads directly into the pulmonary artery. Mean pulmonary artery pressure was elevated from 12.7 ± 1.8 to 25.7 ± 0.3 mm Hg and sustained for >45 min, after which transatrial access was performed. Pulmonary hypertension was sustained for an additional 30 min and the animals were sacrificed.

Results: Pericardial access was successfully accomplished in all animals within 3 min following guide positioning and no hemodynamic or ECG changes were observed. In the aspirin group, initial pericardial fluid hematocrit was 0.1 ± 0.1% and 1.9 ± 1.1% at 24 hrs (NS) (Values = Means ± SEM). In the pulmonary hypertension group, initial pericardial fluid hematocrit was 1.0 ± 0.5% and 4.3 ± 0.8% at 30 min (NS). There were no complications such as tamponade in either group. Histopathologic analysis in both groups revealed a small thrombus and localized inflammation at the site of puncture.

Conclusions: Neither aspirin use nor pulmonary hypertension are associated with significant bleeding into the pericardial space following transatrial pericardial access and do not preclude the use of this technique for local cardiac delivery, of angiogenic and antiarrhythmic agents or gene therapy.

1177-112 Catheter-Based Ultrasound With Urokinase Enhances Thrombolysis and Improves TIMI Flow: In Vivo Studies

Joseph Mitchel, Dadong Li, Tod Alberghini, Francis J. Kiernan, Satyendra Giri. *Hartford Hospital, Hartford, CT; Covance, Berkeley, CA, USA*

Background: Catheter-based ultrasound (US) energy has been shown to enhance the effect of urokinase (UK) on TIMI flow in a porcine model. This study was performed in two parts: first, to further examine the effects of UK + US on TIMI flow, thrombolysis and distal embolization in a porcine model. Second, in order to evaluate a new multielement US catheter (EKOS, Bothell, WA) in a thrombus model which responds to lyric agents in a manner similar to humans (canine), time to recanalization and residual thrombus were measured against conventional lytic infusion using a standard sidehole infusion catheter.

Methods: Bilateral iliac arteries underwent endothelial injury (5 cm), followed by ligation. Thrombin was added and autologous blood was incubated to allow clot formation and vessel adherence. In the porcine model, I^{123} was

added for nuclear detection of distal embolization and quantitation of thrombolysis. The treatment time in the porcine studies occurred over a 30 minute interval. In both studies the UK dose used was 250,000 units except for the high dose UK (750,000 units).

Results:

Porcine studies:

Treatment	n	% lysis	# TIMI 3 segments	# distal emboli
US + UK	6	25 ± 7.15	6	1
UK	6	10 ± 7.63*	1*	1
UK (high dose)	5	14 ± 5.03	2	1
US	8	10 ± 6.08#	1	1
Control	3	6.6 ± 3.8*	0*	1

Canine studies: # of Segments at TIMI 2 or 3

Treatment	20 min	40 min	60 min	Residual clot %
US + UK	4/5*	5/5*	5/5*	27.8 ± 25.4*
UK	0/5	2/5	4/5	72.6 ± 41

*P < 0.05; #P = 0.058

Conclusion: In a porcine model, a significant difference in TIMI flow and thrombolysis was seen in segments treated with US + UK vs controls and the same dose of UK. In a canine model, US + UK resulted in faster recanalization time with more complete thrombus removal than conventional side hole infusion alone.

1177-113 Endoluminal Ultrasound Enhances Local Drug Delivery Efficiency

Dongming Hou[1], Michael A. Reidy[2], Keith L. March[1]. *[1]Indiana Univ., Indianapolis, IN; [2]Univ., of Washington, Seattle, WA, USA*

Background: Local drug delivery (LD) to modulate restenosis has attracted much interest. However, the general utility of this approach has been limited by low efficiency in essentially all LD catheters. Since acoustic energy is known to alter cell membrane permeability, we hypothesized that ultrasound exposure might enhance local delivery of compounds into vessel wall cells *in vivo.* This study was designed to determine whether catheter-based application of endoluminal ultrasound enhanced the distribution of compounds into the artery wall.

Methods: Rabbit carotid arteries (n = 38) were bilaterally denuded of endothelium with a balloon catheter. An ultrasound field generating catheter (EKOS Corp., Bothell, WA) was positioned in each vessel and vessels were ligated distally. Goat IgG (25 mg/ml) was infused into each vessel through the ultrasound catheter. One vessel in each animal was exposed to a field of 1.2 MPa peak acoustic pressure at 1.3 MHz for 10 minutes, while the contralateral (control) vessel received no ultrasound exposure. Vessels were perfusion-fixed immediately after treatment. Serial sections (5–6/vessel) were evaluated by immunohistochemical staining and circumferential staining was quantitated for each layer (intima, superficial and deep media, and adventitia) by a grading system of 0–4 quartiles of stained vascular circumference.

Results: The control and ultrasound groups consisted of 104 and 115 vessel segments respectively. Ultrasound treated vessels (U, n = 20) were found to exhibit a significant increase in the average absolute grade of IgG distribution by 26.5% in the intima, 64.1% in the superficial media, 74.6% in the deep media and 86.4% in the adventitia in comparison with the control vessels (C, n = 18). Exposure to endovascular ultrasound also resulted in a higher frequency of segments with greater than 50% circumferential staining (grade ≥ 3) in each of the vessel layers than found in control. Specifically, this frequency was 82.6% (U) vs. 55.8% (C) in the intima; 32.2% (U) vs. 10.6% (C) in the superficial media; 19.1% (U) vs. 6.7% (C) in the deep media; and 31.3% (U) vs. 13.5% (C) in the adventitia.

Conclusion: These results demonstrate that ultrasound exposure significantly enhances the IgG distribution into all layers of the rabbit artery wall by increasing penetration into the deeper artery wall in a manner that results in a more circumferential delivery. This suggests that the addition of ultrasound might provide a feasible therapeutic adjunct to promote local drug delivery consistency and consequent efficacy.

1177-114 Ultrasound Accelerated Thrombolysis in a Canine Carotid Model of Thrombo-Embolic Stroke

Stanley L. Barnwell, Dusan Pavcnik, Russell L. Tucker, Joseph Eskridge, Wolfgang Janas. *Oregon Health Sciences University, Portland, OR; Washington State University, Pullman, WA; University of Washington; EKOS Corporation, Bothell, WA, USA*

Purpose: To evaluate a new 2.5 Fr ultrasound drug delivery catheter as a potential accelerated thrombolysis device for treating thrombo-embolic stroke.

Methods: Measured segments of externally created thrombus were injected bilaterally in canine common carotid arteries and trapped against an occlusive coil positioned at the os of the internal carotid arteries (n = 11 animals). Prototype ultrasound drug infusion catheters (EKOS, Bothell, WA) were advanced bilaterally to the proximal margins of each thrombus. Urokinase (125,000 IU in 10 ml) was infused simultaneously through each catheter for 30 minutes. Ultrasound (Freq = 2.1 MHz, Power = 0.45 W) was activated on one side (test) vs. drug only (control). Blood flow was monitored in each vessel.

Results: The percentage of blood reflow (post-therapy flow/pre-occlusion flow) after 30 minutes of treatment was greater in the ultrasound treated vessels, 36.0% ± 28.9, vs. urokinase only treated vessels, 14.4% ± 16.5 ($p < 0.035$).

US + Drug			Drug		
Pre Occl	Post Tx	%Reflow	Pre Occl	Post Tx	%Reflow
98.7 ± 53.0 ml/min	28.7 ± 25.2 ml/min	36.0 ± 28.9	112.3 ± 26.4 ml/min	17.9 ± 22.6 ml/min	14.4 ± 16.5

Conclusion: Ultrasound enhancement of low dose urokinase is effective in re-establishing flow in occluded canine carotid arteries as compared to urokinase alone. These results reflect earlier fermoral artery studies, indicating that the enhancement can be applied using a small ultrasound transducer designed for cerebral vascular access.

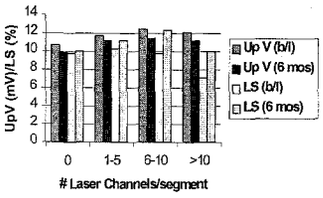
1177-115 Electromechanical Characterization of Treatment Response to Laser Myocardial Revascularization Guided by Left Ventricular Mapping

Ran Kornowski, Shmuel Fuchs, Anthony Pierre, Mun K. Hong, Martin B. Leon. *The Cardiovascular Research Foundation, Washington, DC, USA*

Background: The Biosense™ system has been used for 3D electromechanical (EM) mapping of the left ventricle (LV) and identification of ischemic target zones for direct myocardial revascularization (DMR). Since recent experiences have shown considerable alterations in voltage potentials and mechanical activity in ischemic endocardial regions, we sought to characterize the EM response to DMR in patients undergoing repeat LVEM mapping @6 mos following laser DMR.

Methods: EM mapping was performed immediately before and @6 mos after laser DMR in 54 patients (42 men, age 62 ± 11 yrs) treated with 26 ± 9 laser channels. LV maps were projected into 16 segments model and unipolar voltage amplitudes (UpV) and local endocardial shortening (LS) data were submitted to a central core laboratory for a standardized processing, interpretation and matched analysis. Segments (n = 864) were distinguished by the number of annotated laser channels per mapped segment (none, 1–5, 6–10, >10 channels per segment, n = 477, 267, 87, and 33 segments respectively).

Results: On average, the % of endocardial surface area treated was 25 ± 12% with a mean channel density of 1.0 ± 0.4 channels/cm^2. The UpV showed slight but significant ($p < 0.05$) reduction (by ~1 mV) in voltage amplitudes @6 months compared to baseline without an apparent effect of DMR or the number of laser channels placed on this finding (Figure). By contrast, improved LS was noted from baseline to 6 mos in DMR treated segments but not in segments not treated by DMR (8.7%, 25.5%, and 40.8% relative increase in LS @6 mos in 1–5, 6–10, and >10 channels/segment group, $p < 0.01$ vs 2% change in non-treated segments, p = 0.42, Figure).



Conclusion: At 6 mos following LV guided laser DMR, repeat LVEM mapping document 1) a small (~1 mV) but significant global decrease in voltage amplitudes, and 2) significant improvements in LS in laser treated areas which seem to correlate well with the number of laser channels per treated segment.

ORAL

888 Nonfluoroscopic Electromechanical Mapping to Assess Myocardial Viability

Tuesday, March 14, 2000, 4:00 p.m.–5:00 p.m.
Anaheim Convention Center, Lecture Hall A2

4:00 p.m.

888-1 Hibernating Myocardium Diagnosed With Nonfluoroscopic Electromechanical (NOGA™) Mapping: A Comparison With Dobutamine Stress Echocardiography

Glenn Van Langenhove, Peter C. Smits, Jaap N. Hamburger, Pedro Serrano, Patrick W. Serruys. *Thoraxcentre Rotterdam, The Netherlands*

Introduction: Nonfluoroscopic electromechanical mapping with the NOGA™ system has been introduced as a new technique for the assessment of hibernating but viable myocardium in patients with coronary artery disease. We compared the mapping results with low and high dose dobutamine stress echocardiography (DSE).

Methods: DSE was performed prior to the mapping procedure. 12 different segments were analyzed by an operator blinded for the mapping results. Segments were evaluated at rest (dyskinetic = −1, akinetic = 0, severe hypokinetic = 1, mild hypo = 2, normal = 4), during low dose (unchanged = 0, improvement = 1) and high dose dobutamine (same as at rest). These results were than compared to the average local linear shortening (LLS, %) and the unipolar voltages (UP, mV) of the same 12 segments obtained during the NOGA™ procedure.

Results: In 15 patients, 156 (of 180, 87%) segments were compared. The results are shown in the table.

Comparison	Pearson Correlation	p-value
UP-DSE at rest	0.33	<0.0005
UP-Low dose DSE	0.31	<0.0005
UP-High dose DSE	0.21	0.01
LLS-DSE at rest	0.25	0.002
LLS-Low dose DSE	0.35	<0.0005
LLS-High dose DSE	0.28	0.001

Average UP for patients with or without improvement during low dose DSE was 10.2 mV ± 5.7 and 6.9 mV ± 3.1 respectively ($p = 0.004$); average LLS was 7.3% ± 7.5 (improvement) versus 1.4 ± 9.2% (no improvement) ($p = 0.005$). ROC curves showed cut-off values for viability of UPV = 9.0 mV (sens 56%, spec 81%, $p < 0.0001$) and LLS = 6.8% (sens 56%, spec 92%, $p < 0.0001$).

Conclusion: Nonfluoroscopic electromechanical mapping data (LLS and UP) are significantly correlated with low and high dose DSE, suggesting their value in the detection of viable and ischemic myocardial tissue. UPV of 9.0 mV and LLS of 6.8% are highly significant cut-off values for viable myocardium.

4:15 p.m.

888-2 Correspondence of BIOSENSE-Guided Endocardial Catheter Maps With MRI: Influence of Number of Locations Sampled

Justin D. Pearlman, Yun Wu, Mike Simons, Donald S. Baim, Roger J. Laham. *BIDMC/Harvard Medical School, Boston, Massachusetts, USA*

Background: Biosense NOGA electromechanical triangulation guidance system allows accurate localization for left ventricular mapping and targeted therapy. Eletromagnetic triangulation allows generation of endocardial surface maps from acquired points. We developed methods relating BIOSENSE NOGA points to 4D MRI (beating volume images). We analyzed the overall agreement and influence of the number of sample points.

Methods: 10 patients had MRI sequential breath-hold turboFLASH cine imaging at continguous 5 mm sections from apex to base, using 1.5 T Siemens Vision MRI. The same patients had NOGA maps with >100 points distributed over the endocardium. Volumes were assessed by NOGA algorithm (NA), convex hull fit (CH), Simpson's rule integration, trapezoid rule, and spline, for all points and for random subselections. Distributed random subsampling from MRI was obtained for n = 5–20, 25, 50, 100, 200, 400.

Results: NA and CH correlate well ($r = 0.99$) but with systematic offset: $CH = 0.68NA + 8.8\ cm^3$ ($p < 0.001$). CH vs. MRI volumes by trapezoid rule correlate fairly well ($r = 0.81$) but with a larger systematic offset: $MRI = 0.67\ CH + 71\ cm^3$ ($p < 0.01$). Subsampling MRI as low as 10 distributed points correlates with full MRI $r > 0.83$.

Conclusion: NOGA volumes have a systematic error compared to MRI, but still correlate well. Volumes decrease with subsampling, but good correlation ($r > 0.83$) is preserved down to n = 10 points. The basis for the offsets merits further investigation.

4:30 p.m.

888-3 NOGA® Mapping of the Endocardial Surface Subtended by Chronic Total Occlusions With and Without Collateral Circulation

Mark Reisman, Jeffrey Westcott, John Petersen, Verna Harms, Chiu Wong. *Swedish Medical Center, Seattle WA; Queens Hospital, Flushing, NY, USA*

Background: To date no study has determined the endocardial voltage of myocardium subtended by vessels with chronic total occlusions which have either the presence or absence of collateral flow. This study assesses myocardial voltage in myocardium subtended by chronic total occlusions.

Methods: NOGA three dimensional mapping was performed on 15 patients with either left anterior descending or circumflex total occlusions identified during angiography. Collateral circulation and wall motion were assessed during angiography.

Results: 7/15 patients had normal wall motion in the affected area as judged by LVgram, 7/15 had moderate to severe hypokinesis and 1/15 was akinetic in the affected wall. Collateral circulation was present in 5/7 with normal wall motion, 3/7 with hypokinetic wall motion and 1/1 with akinetic wall motion. As shown in the table below both poor wall motion and lack of collaterals were associated with lower endocardial voltage.

	Voltage ± SD		Voltage ± SD
No Collaterals	10.1 ± 4.3 mv	Poor Wall Motion	9.3 ± 3.2 mv
Collaterals	13.6 ± 4.2 mv	Normal Wall Motio	15.5 ± 3.3 mv
p value	<0.01	p value	<0.001

Conclusions: This study demonstrates the impact of collaterals to zones subtended by chronic total occlusions and demonstrates significant differences in the magnitude of endocardial voltages in zones with and without collaterals and with poor or normal wall motion. Whether these voltages can be used to predict functional recovery in the hypokinetic zones will be important when considering therapeutic strategies.

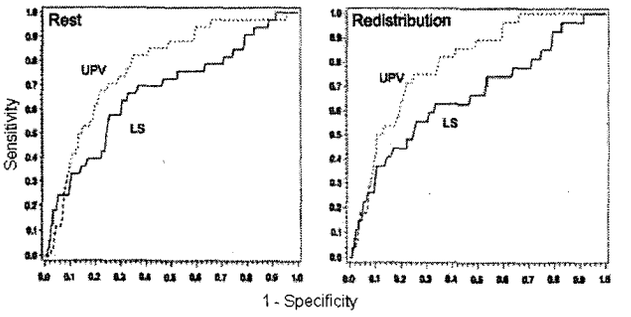
4:45 p.m.

888-4 Endocardial Electromechanical Mapping to Assess Myocardial Viability: A Comparative ROC Analysis With Radionuclide Perfusion Imaging

Ran Kornowski, Shmuel Fuchs, Robert C. Hendel, Matthew Pietrusewics, Robert O. Bonow, Martin B. Leon. *Washington Hospital Center, Washington, DC; Northwestern University Medical Center, Chicago, IL, USA*

Background: Recent experiences using a non-fluoroscopic 3 dimensional (D) left ventricular (LV) mapping system (Biosense™) showed considerable alterations in voltage potentials and mechanical activity detected in endocardial zones with severe myocardial ischemia or infarction. This study examined the sensitivity and specificity cutoffs for detecting myocardial viability using SPECT nuclear perfusion imaging as a 'gold standard' modality for comparison.

Methods: A 12 segment comparative analysis model was used in 61 patients (732 segments) having reversible and/or fixed myocardial perfusion abnormalities on SPECT imaging. Rest unipolar voltage potentials (UpV) and local endocardial shortening (LS) values were compared to rest and rest-4 hrs redistribution ^{201}Tl perfusion defect score (0 = nl, 1 = mild, 2 = mod, 3 = severe, 4 = no uptake). To calculate the sensitivity and specificity of mapping measurements for predicting viable tissue, receiver-operating characteristic (ROC) curves were plotted.



Results: ROC curves showed higher sensitivity and specificity for UpV compared to LS value to detect myocardial viability (Figures). UpV cutoff of ≥7.4 mV had sensitivity and specificity of 71% and 78% for detecting viable tissue (i.e. perfusion score ≤2 @rest) with odds and likelihood ratios of 8.7 and 3.2, respectively. LS cutoff of ≥4.8% had sensitivity and specificity of 63% and 65% for detecting viable tissue. The upper and lower UpV cutoffs to predict myocardial viability with 90% sensitivity and 90% specificity were 12.0 and 5.4 mV, respectively.

Conclusions: 1) LV electromechanical mapping can identify viable myocardium using pre-specified cutoff values, 2) UpV amplitude is a better marker for viable myocardium compared to LS value at rest.

ORAL

896 Coronary Brachytherapy II

Wednesday, March 15, 2000, 8:30 a.m.–10:00 a.m.
Anaheim Convention Center, Lecture Hall A1

8:30 a.m.

896-1 Compassionate Use of Intracoronary Gamma Radiation Therapy for Patients With Refractory In-Stent Restenosis

Ron Waksman, Balram Bhargava, Nancy McCarthy, R. Larry White, Lowell F. Satler, Roxana Mehran, Kenneth M. Kent, Augusto D. Pichard, Martin B. Leon. *Washington Hospital Center, Washington DC, USA*

Background: Clinical trials utilizing intracoronary gamma radiation in-patients with In Stent Restenosis (ISR) demonstrated reduction in the recurrence rate of restenosis. However, large population of patients with ISR does not meet the inclusion exclusion criteria of these clinical protocols. **C**ompassionate **U**se **R**adiation **E**ndovascular (**CURE**) is a FDA approved open label registry in 100 patients with ISR who had at least 2 episodes of restenosis at the target lesion and are not considered good candidates for CABG or medical therapy.

Methods: Patients were eligible to participate in CURE if approved by all members of a committee that includes cardiac surgeon, radiation oncologist, general and interventional cardiologist. Patients with ISR in up to 2 lesions in native coronaries and vein grafts with lesion length <80 mm are included. The angioplasty procedure utilizes balloon, laser, rotational atherectomy, or additional stents. After the intervention a ribbon with different trains of 192Ir seeds is inserted to a closed lumen catheter and covers the treated segment. The radiation doses are 14 or 15 Gy at to 2 mm. Clinical and angiographic follow-up are performed at 6 and 24 months.

Results: To date 68 patients were enrolled into CURE. Baseline demographics detected 74% of patients had prior CABG, 65% had prior MI and 40% had diabetes. The first 23 patients who completed 6 months follow-up had target lesion and vessel revascularization of 3 (13%) and 5/23 (22.7%) respectively. One patient had cardiac death and one had late thrombosis with myocardial infarction.

Conclusion: Intracoronary gamma radiation proves to be an attractive therapeutic modality (78% free from major cardiac events) for complex compassionate patients who did not respond to conventional standard of care therapy.

8:45 a.m.

896-2 Gamma Radiation vs. Placebo in Focal vs. Diffuse In-Stent Restenosis: The Length Makes the Difference!

Roxana Mehran, Alexandra J. Lansky, Ron Waksman. *Washington Hospital Center, Washington, DC, USA*

Angiographic pattern (diffuse vs. focal) of in-stent restenosis (ISR) is a well recognized risk factor for recurrence after treatment of ISR. Gamma radiation reduces angiographic and clinical restenosis in patients with ISR, however the impact of gamma radiation on diffuse vs. focal ISR is not well established. We compared clinical and angiographic outcomes of patients with *diffuse* ISR (lesion length [LL] > 15 mm) vs. *focal* ISR (LL ≤ 15 mm) enrolled in the Washington Radiation for In-stent Restenosis Trial (WRIST). OF the 124 patients with available QCA and 6 month follow-up enrolled in WRIST, 44 had focal ISR, and 80 diffuse ISR. Clinical and angiographic results at *6 mos* are shown (table).

	Diffuse	Focal	P
Placebo	n = 38	n = 23	
Binary RS (*in-lesion*)(%)	73.5	38.9	0.015
Binary RS (*in-stent*) (%)	67.6	38.9	0.046
Target vessel revascularization (%)	78.9	56.5	0.063
Target lesion revascularization (%)	76.3	47.8	0.023
^{192}Ir	n = 42	n = 21	
Binary RS (*in-lesion*)(%)	30.8	5.3	0.043
Binary RS (*in-stent*) (%)	28.2	0.0	0.011
Target vessel revascularization (%)	26.2	28.6	NS
Target lesion revascularization (%))	14.3	14.3	NS

Conclusions: Angiographic and clinical outcomes of patients with ISR treated with placebo after percutaneous intervention remains high even in *focal* lesions. Brachytherapy with ^{192}Ir results in significant reduction of angiographic RS (@6 mos) in diffuse *and* focal lesions. However lesion length remains an important risk factor for recurrence despite radiation therapy. Further optimization of dosimetry is warranted for these challenging lesion subsets.

9:00 a.m.

896-3 Six-Month Angiographic Results of Single ^{32}P Radioactive β-Emitting Stents With an Initial Activity Level Up to 21 μCi Implanted in Patients With CAD

Remo Albiero, Milena Adamian, Takahiro Nishida, Antonio Amato, Nicola Corvaja, Marco Vaghetti, Carlo Di Mario, Antonio Colombo. *Centro Cuore Columbus, Milan, Italy*

Background: We have previously reported a high restenosis rate in the reference segments at the edges of ^{32}P radioactive β-emitting stents with an initial activity level up to 12 μCi in patients (pts) with CAD, possibly due to a low activity level of radiation at the stent edges combined with an aggressive approach to stenting. The aim of this study was to evaluate whether a higher stent activity level of 12–21 μCi combined with a non-aggressive implantation strategy could solve the problem of edge restenosis.

Methods: From Oct '97 till Feb '99 a single ^{32}P radioactive β-emitting slotted tubular stent (15 mm long) was implanted in 98 lesions (les) in 83 pts. Seventy-three pts (86 les, 88%) underwent a 6-month FU angiogram, and were included in this study. The 86 les were divided in 4 groups: Gr1 = 0.75–3 μCi, Gr2 = 3–6 μCi, Gr3 = 6–12 μCi, and Gr4 = 12–21 μCi. The Palmaz-Schatz stent was implanted in Gr1 and the BX Isostent in Gr2–Gr4. In most of the les in Gr3 and Gr4 a non-aggressive stent implantation approach was used.

Results are shown in the table.

Lesions	0.7–3 μCi Gr1, n = 15	3–6 μCi Gr2, n = 23	6–12 μCi Gr3, n = 16	12–21 μCi Gr4, n = 32	P
Ref. Diam, mm	3.07 ± 0.63	3.11 ± 0.33	3.15 ± 0.35	3.17 ± 0.47	NS
Balloon-to-Artery ratio	1.24 ± 0.19	1.19 ± 0.11	1.11 ± 0.10	1.14 ± 0.14	NS
MLD pre, mm	1.00 ± 0.39	0.84 ± 0.32	0.79 ± 0.52	0.90 ± 0.50	NS
MLD post stent, mm	3.20 ± 0.52	3.16 ± 0.39	3.00 ± 0.41	3.04 ± 0.50	NS
MLD FU, mm	1.85 ± 1.0	2.02 ± 0.91	1.84 ± 1.1	2.28 ± 0.87	NS
Intralesion Restenosis, % DS ≥ 50, n (%)	6 (40)	8 (35)	7 (44)	8 (25)	NS
- Only Intra-Stent, n (%)	2 (13)	0	0	0	NS
- Total Occlusion, n (%)	0	0	2 (13)	0	NS
- Edge Restenosis, n (%)	4 (27)	8 (35)	5 (31)	8 (25)	NS

Conclusions: In patients with CAD, ^{32}P radioactive β-emitting stents with a high initial stent activity level of 12–21 μCi, mostly implanted using a non-aggressive approach, did not solve the problem of edge restenosis.

9:15 a.m.

896-4 Economic Assessment of Gamma-Brachytherapy for Treatment of In-Stent Restenosis: Results From the Randomized GAMMA-1 Trial

David J. Cohen, Martin B. Leon, Paul Teirstein, Roberta Cosgrove, Mary A. Jones, Ronna H. Berezin, Kalon K.L. Ho, Donald E. Cutlip, Richard E. Kuntz. *Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA*

Background: Recent studies have demonstrated that intracoronary brachytherapy can reduce angiographic and clinical restenosis in patients undergoing percutaneous coronary intervention for treatment of in-stent restenosis. However, brachytherapy involves considerable expense due to the additional equipment, procedural time, and physician services required, and the overall cost-effectiveness (C/E) is unknown.

Methods: We prospectively measured medical resource utilization and cost for patients with in-stent restenosis randomized to radiation therapy (RT, n = 131) or conventional therapy (CT, n = 121) as part of the GAMMA-1 trial. Catheterization laboratory costs were based on measured resource utilization and 1999 unit costs, while all other costs were estimated from

hospital charges and cost-center specific cost-to-charge ratios. We estimated that the coronary brachytherapy system would cost $2500 per patient.

Results: Compared with CT, RT increased procedure duration by an average of 33 minutes and increased overall initial hospital costs by $3900 per patient ($13,534 vs. $9,933, $p < 0.001$). Over the one-year follow-up period, RT reduced the need for repeat target-vessel revascularization by 42% (24.4 vs. 42.1%, $p = 0.003$) and reduced follow-up medical care costs by more than $2000 per patient ($11,219 vs. $13,244, $p = 0.12$). As a result, overall one year medical care costs were only $1900 higher in the RT group ($32,447 vs. $30,554, $p = 0.02$). Exclusion of events related to late stent thrombosis (n = 8) increased the follow-up cost savings with RT to more than $3100 per patient ($10,124 vs. $13,244, $p = 0.04$). Under these conditions, the net one-year cost difference fell to $750 ($31,404 vs. $30,643, p = NS) and the incremental cost-effectiveness ratio for RT remained <$10,000 per repeat revascularization avoided in 96% of bootstrap simulations.

Conclusions: Coronary brachytherapy for treatment of in-stent restenosis improves late clinical outcomes and reduces follow-up treatment costs by $2000–$2800 per patient. The C/E of this technology thus appears reasonable compared with other accepted interventional techniques (e.g., stenting, ReoPro, etc.).

9:30 a.m.

896-5 The Effect of β-Radiation Therapy on Stented Coronary Segments and Adjacent Stent Edges: A 3-Dimensional IVUS Interpretation

Marco A. Costa, Ken Kozuma, Manel Sabaté, Willem J. van der Giessen, Pedro Serrano, Veronique L.M.A. Coen, I. Patrick Kay, Jurgen M.R. Lighhart, Alexander J. Wardeh, Peter C. Levendag, Patrick W. Serruys. *Thoraxcenter and Daniel den Hoed Cancer Center, University Hospital Rotterdam, The Netherlands*

Background: The "edge effect" has been reported after both conventional and radioactive stents. Catheter-based β-radiotherapy has shown to have a beneficial effect on both vessel remodeling and plaque growth after balloon angioplasty. The aims of this study were: 1) to determine the influence of β-radiotherapy in patients (pts) treated with conventional stenting on vessel remodeling and plaque growth (inside [NIH] and outside the stent), 2) to evaluate the effect of catheter-based brachytherapy on remodeling process and plaque growth at the edges of the stented segment by means of 3-dimensional IVUS volumetric assessment.

Methods: The study population consists of 41 patients successfully treated with single stent (length ≤18 mm) implantation associated (n = 18, RAD group) or not (n = 23, control) with intracoronary β-radiation using either $^{90}Sr/^{90}Y$ or ^{32}P sources. IVUS images were acquired by means of ECG-triggered pullback immediately after the procedure and at 6–8 follow-up (FU) in all patients. Three-dimensional reconstruction and volumetric quantification of total vessel (TVV), overall plaque (PV), NIH and plaque volume outside (PVout) the stent were performed by means of a semi-automated edge detection system. Coronary segments covered with stent as well as the edges (5-mm distal and proximal to the stent) were analyzed.

Results: The lengths of the analyzed segments were similar between both groups. In the RAD group, TVV (292 vs. 316 mm^3, $p = 0.002$), overall PV and outside the stent PV (151 vs. 180 mm^3 and 151 vs. 172 mm^3, respectively, $p \leq 0.001$) increased at FU as compared to post-procedure.

	Stented Segment				Edges		
mm^3	ΔTVV	ΔPV	ΔPVout	NIH	ΔTVV	ΔPV	ΔLV
RAD	23.4	28.7	172.3	7.1	1.3	4.1	−3.8
Control	1.1	23.5	131.2	23.1	−7.4	1.8	−8.5
p value	0.002	NS	0.03	<0.001	0.004	NS	0.05

Delta (Δ) = FU- post- procedure IVUS measurements

Conclusion: Compared to control, irradiation pts had less lumen loss in the stent edges, mainly due to the beneficial effect of β-radiation on vessel remodeling. Plaque growth was not decreased by radiation in both analyzed segments, although the RAD group had less NIH formation compared to control. Our results further suggest that radiation may stimulate vessel enlargement after stenting. The clinical implication of this effect remains to be clarified, since tubular stents are not able to further expand after deployment and stent malapposition may occur at FU.

9:45 a.m.

896-6 A Novel Gamma Emitting Radioactive Stent Constructed by Targeted Radioimmunotherapy

Morris Mosseri, Yoram Vodovotz, Zvi Symon, Rosanna Chan, Rui Lu, Ron Waksman. *Washington Hospital Center, Washington, DC, USA*

Background: Intracoronary radiation (IR) reduces neointima formation following injury. Radioactive stents (RS) as a platform are easy and practical to use compared with other IR modalities. Beta-emitting RS have shown some efficacy at reducing restenosis in the stent but are reported to have excessive restenosis at the edges, possibly due to low radiation doses at these segments. Herein, we present a novel concept for producing a gamma-emitting RS in an attempt to overcome these problems.

Methods and Results: 1. Three stainless steel bovine serum albumin (BSA)-coated and three control steel coupons were treated with anti-BSA. The coupons were then either incubated with biotinylated secondary antibody coupled to alkaline phosphatase and subjected to colorimetric analysis, or incubated with biotinylated antibody horseradish peroxidase and subjected to enhanced chemiluminescence analysis. Both methods showed specific binding of the anti-BSA to BSA-coated coupons. 2. Five BAS-coated and five control-coated Multilink stents (Guidant, Santa Clara, CA) were incubated with 125-I-anti-BSA. The BSA-coated stents exhibited an 13-fold greater radioactivity as compared to controls, with activities in the range of 0.16–0.31 μCi (Table).

Stent type	Activity μci	
Control-coated (n = 5)	0.017 ± 0.009	
BSA-coated (n = 5)	0.23 ± 0.06	P < 0.001

Conclusions: Labeled compounds may be targeted to coated stents to render them radioactive *in vitro*. This concept should allow for numerous variations in dose as well as isotope, and may be extended to *in vivo* targeted immuno-radiotherapy by injecting labeled compounds intravenously.

ORAL

897 In-Stent Restenosis

Wednesday, March 15, 2000, 8:30 a.m.–10:00 a.m.
Anaheim Convention Center, Lecture Hall A2

8:30 a.m.

897-1 Predictors of Recurrent In-Stent Restenosis Following Mechanical Treatment by Angioplasty or Rotational Atherectomy: Results From an Angiographically Controlled Prospective Trial (ARTIST Study)

Juergen vom Dahl, Philipp K. Haager, Thorsten Reineke, Ulrich Dietz, Sigmund Silber, E. Niccoli, H.J. Buettner, Francois Schiele, Martin Thomas, F. Commeau, T. Ramsdale, Ernesto Garcia, Heinrich G. Klues. *On Behalf Of The ARTIST Investigators; University Hospital, RWTH Aachen, Germany*

Background: Diffuse in-stent restenosis (ISR) with high recurrence rates remains a challenging problem for which the best mechanical treatment is not clear. We sought to evaluate clinical and angiographic predictors of recurrent restenosis from an angiographically controlled prospective study (ARTIST study).

Methods and Results: Angiographic follow-up with quantitative coronary angiographic analysis is available in 259/269 eligible patients randomized to either balloon angioplasty (PTCA) or rotational atherectomy (ROTA) for diffuse ISR (10–50 mm length). A logistic regression analysis was performed for restenosis (>50% diameter stenosis (DS) at follow-up) as the dependent variable using univariate and multivariate models with 15 clinical and angiographic variables.

Variable	Univariate model		Multivariate model	
	Odds ratio	p	Odds ratio	p
Diabetes (O = no)	1.67	0.09	1.44	0.30
T (0 = PTCA, 1 = ROTA)	1.75	0.03	1.64	0.10
Lesion length (mm)	1.09	0.0003	1.08	0.001
% DS pre T	1.05	0.0001	1.06	0.0008
MLD post T	0.41	0.02	0.8	0.65

MLD = minimal luminal diameter; T = treatment of ISR

Conclusions: In this angiographically controlled prospective study baseline lesion length defined as length of first in-stent restenosis (>50% DS) and baseline diameter were the most powerful predictors of recurrent restenosis after mechanical treatment. This indicates that the in-stent tissue volumen at first ISR seems to be the most important predictor of angiographic long-term outcome.

8:45 a.m.

897-2 In-Stent Restenosis: An Inflammatory Response

Harish R. Chandra, John A. Fry, Carol O'Neill, Nivedita Choudhary, William W. O'Neill. *William Beaumont Hospital, Royal Oak, Michigan, USA*

Background: In-stent restenosis has been associated with lesion morphology as well as procedural and clinical variables. Potential mechanisms include, elastic recoil, intimal thickening, arterial thickening and remodeling. Recent studies have proposed inflammation as a contributing factor.

Methods: We conducted a case-control study to evaluate the association between in-stent restenosis and serum levels of C-reactive protein (CRP), fibrinogen and *Chlamydia pneumoniae* titres (CPIgG). Blood tests and clinical information were obtained on 67 patients (number of lesions = 70) who underwent repeat coronary angiography due to chest pain within 35 to 442 days (mean = 136 days) of intra-coronary stent placement. Coronary angiograms were reviewed to obtain procedural details. Cases (n = 30, ≥50% diameter stenosis) were compared with controls (n = 40, <50% diameter stenosis).

Results: Mean age of the study population was 62 ± 12 yrs and 63% were males. Cases were not different from the controls in terms of age, gender, diabetes, hypertension, hyperlipidemia, current smoking, congestive heart failure, prior myocardial infarction, and bypass surgery (p = NS). Procedural variables were similar in both groups in terms of indication for stenting, target vessel, denovo lesion, lesion length, pre and post MLD, balloon to artery ratio, maximum balloon pressure, number of stents, total length of stents, and residual stenosis (p = NS). The cases had siginificantly higher levels of CRP (1.65 mg/dl vs. 0.5 mg/dl, p = 0.05) and fibrinogen (346 mg/dl vs. 293 mg/dl, p = 0.05). The distribution of CPIgG titres was found to be similar in both groups (p = NS).

Inflammatory Markers	No In-stent Restenosis (n = 40)	In-stent Restenosis (n = 30)	p Value
C-Reactive Protein, mean ± SD	0.5 ± 0.58 mg/dl	1.65 ± 2.95 mg/dl	0.05
Fibrinogen, mean ± SD	293 ± 69 mg/dl	346 ± 137 mg/dl	0.05
CPIgG			
≥1:64, n (%)	32 (82%)	22 (76%)	0.92
≥1:128, n (%)	30 (77%)	22 (76%)	0.35
≥1:512, n (%)	22 (56%)	13 (45%)	0.92
≥1:1024, n (%)	13 (33%)	10 (34%)	0.53

Conclusion: Elevated levels of inflammatory markers were found to be strongly associated with in-stent restenosis while seropositivity to *C pneumoniae* was not. There is a need to further study the role of inflammation in the pathogenesis of in-stent restenosis.

9:00 a.m.

897-3 A Potential New Indication for Thienopyridine ADP-Receptor Antagonists: In-Stent Restenosis

Debabrata Mukherjee, Joel P. Reginelli, Derek P. Chew, Jakob P. Schneider, Russell Raymond, Patrick L. Whitlow, Irving Franco, Eric J. Topol, Stephen G. Ellis. *Cleveland Clinic Foundation, Cleveland, Ohio, USA*

Background: Thienopyridine ADP-receptor antagonists are not routinely used after PCI for in-stent restenosis. We determined the effect of adjunctive use of ADP antagonists (ticlopidine or clopidogrel) after percutaneous intervention (PCI) for treatment of in-stent restenosis.

Methods: 263 patients with in-stent restenosis underwent PCI at the Cleveland Clinic between 02/96 and 12/98. Patients treated with DCA, Laser, additional stents and brachytherapy were excluded. 205 of these patients received ADP antagonist for 2–4 weeks after PCI and 58 were treated without ADP antagonists. The baseline characteristics and mode of treatment for these patients are summarized in the Table. The groups were similar with respect to age, gender, elevated lipids, diabetes, LV function, number of vessels involved. history of prior CABG and unstable symptoms at presentation. There were more hypertensives in the ADP antagonist treated group.

	ADP antagonist (n = 205)	No ADP antagonist (n = 58)
Age	62 ± 11.2	62.7 ± 10.4
Males	76%	75.8%
Unstable symptoms	12.8%	12.1%
Hypertension	63.4%	46.5%*
Diabetes	26.4%	27.5%
LVEF	60%	62%
Current smoker	14.2%	13.8%
Ballon Angioplasty	84%	88%
Rotablation	16%	12%
MI (Q and Non-Q)	1.4%	8.6%§
Revascularization	14.1%	23.2%§
Death (Total)	4.3%	5.1%

* p < 0.001, § p < 0.01

Results: (table) At 1 year there was a significantly lower revascularization and lower incidence of MI in the ADP antagonist treated group.

Conclusions: For management of in-stent restenosis adjunctive use of ADP antagonists (ticlopidine or clopidogrel) significantly improves clinical outcomes at I year with reduction in myocardial infarction and revascularization.

9:15 a.m.

897-4 Association of In-Stent Restenosis With Hypersensitivity Reactions to Nickel and Molybdenum

Ralf Köster, Dieter Vieluf, Margret Kiehn, Martin Sommerauer, Stephan Baldus, Jan Kähler, Thomas Meinertz, Christian W. Hamm. *University Hospital Eppendorf, Hamburg; Kerckhoff Heart Center, Bad Nauheim, Germany*

In-stent restenosis may be triggered by allergic reactions to nickel, chromate, manganese or molybdenum which are components of stainless steel stents. The aim of this study was to investigate the incidence of allergic reactions to stainless steel components in patients with in-stent restenosis.

In 131 patients (63 ± 9 years) with 171 stainless steel stents (33 Palmaz-Schatz, 70 AVE, 68 other types) coronary angiography was performed 6.1 ± 2.7 months after stent implantation. The percentage diameter stenosis within the stent was measured by quantitative coronary angiography. All patients underwent epicutaneous patch tests using Finn chamber technology for nickel-II-sulfate 2.5% and 5%, potassiumdichromate 0.5%, molybdenum-V-chloride 0.5%, manganese 0.5% and 316L stainless steel platelets. Results of the patch tests were evaluated by independent investigators after 48 h, 72 h and if necessary after 96 h of contact with the potential allergen.

Quantitative coronary angiography revealed in-stent restenoses (≥50% diameter stenosis) in 89 pts; 42 pts had no restenosis. In the group *without* restenosis there was *no* patient with an allergic reaction. *All* pts with positive patch tests (n = 9) were in the group *with* restenosis. In this group the overall incidence of positive reactions was significantly higher compared to that in the control group (10% vs 0%, p < 0.05). In 3 pts we observed positive reactions; to molybdenum and in 6 pts (3 male, 3 female) to nickel. However, none of the pts with hypersensitivity reaction to the standardized test solutions had a positive reaction to the 316L stainless steel platelets.

Conclusions: Patients *with* in-stent restenosis had a higher incidence of positive patch test reactions to nickel than those without restenosis. These results from this small group of patients suggest that allergic reactions to nickel may trigger in-stent restenosis.

9:30 a.m.

897-5 Does "Stent-on-Stent" for In-Stent Restenosis Exaggerate Intimal Hyperplasia? A Volumetric Intravascular Ultrasound Analysis

Gary S. Mintz, Balram Barghava, Roxana Mehran, Ron Waksman, Mihaela Folescu, Alexandra J. Lansky, Augusto D. Pichard, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

In-stent restenosis may be treated with additional stent implantation. To assess the efficacy of this approach, we used serial (post-intervention and follow-up) volumetric intravascular ultrasound (IVUS, using motorized pullback) to study 98 pts enrolled in WRIST, a randomized placebo-controlled trial of Ir-192 gamma irradiation to treat in-stent restenosis. 31 pts had additional stents placed prior to radiation. Stent, lumen, and intimal hyperplasia (IH = stent-lumen) areas were measured every 1 mm of in-stent restenosis length. IH area was averaged, minimum lumen area (MLA) was measured, and differences were compared. Post-intervention lumen dimensions were similar in pts with and without additional stents. Pts with subacute or late stent thrombosis were excluded.

Follow-up @6 months	New stent	No new stent	p
Ir-192			
Δ mean IH area (mm^2)	0.3 ± 0.9	0.1 ± 2.0	0.77
Δ MLA (mm^2)	−0.7 ± 0.12	−0.6 ± 1.9	0.92
Placebo			
Δ mean IH area (mm^2)	2.4 ± 1.4	1.5 ± 1.8	0.0963
Δ MLA (mm^2)	−2.7 ± 1.2	−1.6 ± 2.0	0.0584

In-stent restenosis is the result of exaggerated neointimal hypeplasia. The initial stimulus for this exaggerated neointimal hyperplasia (which resulted in the 1st episode of in-stent restenosis) appears to be retriggered by additional stent implantation (causing greater increase in Δmean IH and a greater decrease in MLA). However, this is neutralized by gamma irradiation.

We conclude: Serial volumetric IVUS analysis shows that the "stent-on-stent" technique for treating in-stent restenosis leads to increased subsequent IH formation without adjunctive radiation therapy.

9:45 a.m.

897-6 Treatment of In-Stent Restenosis. Shall We Balloon or Stent the Stent? A Prospective Single Center Randomized Study

Thierry Lefèvre, Abdeljabbar Benslimane, Rajendra Kumar Premchand, Yves Louvard, Pierre Dumas, Christophe Loubeyre, Niels Guillard, Jean-François Piéchaud, Marie-Claude Morice. *Institut Cardiovasculaire Paris Sud, Massy, France*

Background: In-stent restenosis remains the Achilles' heel of coronary stenting In a prospective observational registry, we found that stenting the stent (sandwich stent) was associated with a lower rate of target vessel revascularization (TVR) than balloon PTCA, Laser or Rotablator in coronary arteries ≥3 mm.

Methods: A randomized study was designed to compare balloon PTCA vs sandwich stent in patients with ischemia-driven in-stent restenosis in coronary arteries ≥3 mm in diameter. Patients were assigned to sandwich stent or balloon PTCA with provisional stenting in cases of unsatisfactory angiographic results (stenosis ≥30% by QCA after balloon PTCA). A 7-month follow-up was set-up with treadmill stress test or thallium scan, coronary angiogram in cases of ischemia and subsequent TVR.

Results: 7-month follow-up was completed in the first 57 pts (69 restenotic lesions) included from April 1998 to January 1999. Both groups were comparable (37 lesions in the balloon group and 32 in the stent group). Patients had a mean age of 61 ± 11 years, 73% male. Repeat PTCA was performed 5.4 ± 3.7 months after the first procedure. The restenotic artery was the RCA n 45% of cases, LAD in 33% and the Circ. in 22%. Reference diameter was 3.2 ± 0.3 mm and length of the previous stent 18 ± 6 mm. Restenosis was focal in 46% of cases, diffuse in 32% and proliferative in 22%. Angiographic success was obtained in all cases. Cross-over to stent was performed in 19% of cases in the balloon group. In-hospital major cardiac events (SAT with rePTCA and non-Q-wave MI) occurred in 1 pt in the balloon group: 1.8%). At 7-month follow-up, TVR was performed in 19% of cases in the stent group vs 32% in the balloon group (p = NS). No other event occurred at follow-up.

Conclusion: The preliminary results of this randomized study suggest that rePTCA or restenting for in-stent restenosis is safe. The use of sandwich stent could be a better option than balloon PTCA with provisional stenting. Final data will be presented during the meeting.

ORAL

898 Carotid and Vertebral Stenting

Wednesday, March 15, 2000, 8:30 a.m.–10:00 a.m.
Anaheim Convention Center, Room 207A

8:30 a.m.

898-1 Long-Term Outcomes of Percutaneous Carotid Artery Revascularization (PCA) for Post-Endarterectomy (CEA) Restenosis

Walter A. Tan, Chester R. Jarmolowski, Gustav Eles, Michael H. Wholey, John S. Bechtel, Mark H. Wholey. *Pittsburgh Vascular Institute, UPMC-Shadyside, Pittsburgh, PA, USA*

Background: Up to 20% of patients develop restenosis after CEA. Redo CEA is accompanied by higher complication rates, and PCA is a potentially suitable alternative. However, long-term outcomes in this population have not been documented.

Methods: Seventy consecutive patients who underwent PCA between January 1996 to June 1999 for restenotic post-CEA lesions were extracted from the Pittsburgh Vascular Institute Carotid Interventional Registry. The mean follow-up was 14.3 months, with a 6-month follow-up rate of 94.5%. Angiograms were evaluated based on NASCET criteria (distal internal carotid artery as reference segment) using standardized core laboratory methods. The mean age was 73 years, 51% were male, and 36% had diabetes, and 20% had a prior MI. Sixty-eight percent had asymptomatic presentation, and 19% had prior stroke. The mean stenosis pre-procedure was 89% visually (64% by electronic calipers), and 0% post (8%).

Results: Periprocedural complications included 1 (1.4%) major stroke and no deaths. There were 2 technical failures without complications. Long-term all-cause mortality was 2.9% (2 patients at 14 and 17 months postprocedurally), and no new neurologic events.

Conclusion: In-hospital and long-term complications in patients undergoing PCA for restenotic CEA lesions are low. Percutaneous treatment of these lesions may be a viable alternative to redo CEA.

8:45 a.m.

898-2 Protected Carotid Stenting With the PercuSurge Guardwire: Results From a Multi Speciality Study Group

Patrick L. Whitlow, Pedro Lylyk, Hugo Londero, Juan Parodi, Claudio Schonholz, José Milei. *Cleveland Clinic Foundation, Cleveland, Ohio, USA; Buenos Aires, Argentina*

Background: Although carotid stenting has been used successfully to treat patients with symptomatic or asymptomatic severe extracranial carotid artery stenosis, embolic complications remain a concern. Stroke has been reported in 2–8% of cases. Emboli protection devices might improve the safety of carotid stenting.

Methods: The PercuSurge Guardwire is a temporary occlusion balloon on a wire which can be steered distal to the carotid stenosis and inflated, providing protection prior to and during balloon dilation and stenting. Trapped material is removed by a monorail aspiration device and the PercuSurge balloon is deflated.

Results: A registry of 50 pts undergoing protected carotid stenting is underway by this multi-specialty group including cardiologists, a neuroradiologist, a vascular surgeon and an interventional radiologist. In our study, 40 cases have been completed to date. 45% of lesions were ulcerated and 11% had visible thrombi prior to treatment. 50% of patients had ipsilateral ischemic symptoms within 3 months of stenting. Two pts had contralateral 100% occlusion, 1 pt had contralateral subtotal occlusion, and a 4th pt had 80% stenosis of the contralateral carotid before the target vessel was treated. Mean total occlusion time was 15.2 ± 5.7 min for the entire procedure. No patient had minor or major stroke or death during the procedure or within 30 days. Two cases were associated with transient focal neurologic deficits which resolved immediately with balloon deflation. Particulate matter was visible in all aspiration samples, and Coulter counter analysis documented 380 ± 164 particles/case. Particle size ranged up to 1.6 mm, but the majority of particulate debris was 50–100 microns. Treatment of the remaining 10 pts in this protocol will be finished within the next month, and complete data on the 50 pt cohort will be presented.

Conclusions: 1). Protected carotid stenting with the PercuSurge Emboli Containment and Aspiration System is feasible and safe. 2). The system is effective in the hands of multiple physicians involved in invasive procedures from all related subspecialities. 3). Emboli appear universal with carotid stenting, and emboli protection systems will be required to minimize ischemic complications.

9:00 a.m.

898-3 Outcome of Carotid Stenting in Symptomatic Octogenarians and Non-Octogenarians

Fayaz A. Shawl, Waleed Y. Kadro, Fernando Lapetina, Robert Tobar, Stephanie Cornell, Kathryn G. Dougherty. *Washington Adventist Hospital, Takoma Park, Maryland, USA*

Background and Methods: With the increase in life span, more octogenarians are presenting with carotid stenosis. Most carotid endarterectomy (CEA) trials (NASCET and ACAS) have excluded these pts. Pts undergoing carotid stenting (CS) at our institution were stratified to ≥80 yrs and <80 yrs in order to assess the impact of age on clinical and in-hospital outcomes.

Results: From 8/95 to 8/99 270 pts (307 procedures) underwent CS (<80 yrs = 194, ≥80 yrs = 76 [including 3 pts >90]). Summarized below are the characteristics of the two groups.

CS in pts stratified by age (yrs)

	Age < 80 (n = 194)	Age ≥ 80 (n = 76)	p value
Age (yrs) Male (%)	66/57	85/59	p < 0.001
Prior CABG/PTCA (%)	73	74	p = 0.528
Contralateral occlusion (%)	7	12	p = 0.1890
Bilateral occlusion >70% (%)	20	13	p = 0.1720
Prior CEA (%)	7	8	p = 0.518
Diabetes (%)	27	72	p < 0.001
Severe COPD (%)	20	25	p = 0.29
Refused for CEA (%)	10	89	p < 0.001
Procedural success (%)	99	100	p = 0.97
Complications at 30 days			
Death (%)	0	0	p = 1.0
Minor CVA (%)	2.5	1.3	p = 0.465
Major CVA (%)	1	0	p = 0.519

Conclusion: Despite a higher incidence of refusal for CEA because of associated comorbidities, octogenarians have similar procedural success and complications as non-octogenarians. Therefore, advanced age should not exclude pts from CS.

9:15 a.m.

898-4 Initial Experience of Glycoprotein IIb/IIIa Inhibition With Abciximab During Carotid Stenting: A Safe Adjunctive Therapy

Samir R. Kapadia, Christopher T. Bajzer, Khaled M. Ziada, Mitchell J. Silver, Fernando A. Cura, Philippe L. L'Allier, Jay S. Yadav. *The Cleveland Clinic Foundation, Cleveland, Ohio, USA*

Background: Abciximab has been shown to decrease periprocedural ischemic complications after coronary intervention. However, the adjunctive use of abciximab in carotid stenting has not been studied. We sought to determine the safety of abciximab in carotid stenting.

Methods: Carotid stenting with adjunctive abciximab was performed m 70 consecutive between April 98 and May 99. Only patients determined to be at high surgical risk by a vascular surgeon were candidates for carotid stenting. All patients received abciximab bolus (0.25 mg/kg) prior to crossing the lesion with guide wire, followed by 0.125 mcg/kg/min infusion. Infusion was discontinued at the end of the procedure. Heparin bolus of 51) units/kg was given and ACT was maintained between 250–300. All patients received aspirin (325 mg/day) and clopidogrel (75 mg/day) for 4 weeks. Independent neurologic assessment was performed pre and post intervention in all patients.

Results: Most of the patients (52, 75%) were men with a mean age of 70 ± 10 years. Forty-nine (70%) patients were symptomatic: 14 (20%) had strokes and 35 (50%) had TIAs. Significant cardiac comorbidities included severe left ventricular dysfunction in 11 (16%), unstable angina in 27 (39%) and aortic stenosis in 10 (14%) patients. Intracranial hemorrhage occurred in 1 patient. This patient was discharged after procedure and presented 6 days after the intervention with subacute intracranial bleeding and had favorable outcome. Minor groin bleeding, not requiring blood transfusion occurred in 2 patients and 2 patients had pseudoaneurysm. There were no periprocedural strokes or stent thromboses.

Conclusion: Adjunctive use of abciximab for carotid stenting is associated with low risk of intracranial hemorrhage Potent glycoprotein IIb/IIIa inhibition may reduce periprocedural adverse events in high-risk patients without increasing bleeding complications.

9:30 a.m.

898-5 Treatment of Atherosclerotic Vertebral Artery Disease by Endoluminal Stenting: Results From a US Multicenter Registry

Suresh P. Jain, Stephen R. Ramee, Christopher J. White, J. Stephen Jenkins, Tyrone J. Collins, Gary S. Roubin, Sriram S. Iyer, Larry S. Dean, Kimberly Kretzer, Jay S. Yadav, Samir Kapadia, John R. Laird, Gary Ansel, Mark H. Wholey. *Ochsner Clinic, New Orleans, LA, USA*

Atherosclerotic vertebral artery occlusive disease has been treated surgically with limited success. Balloon angioplasty of vertebral artery is fraught with suboptimal results due to elastic recoil and intimal dissection. A US multicenter registry was formed to evaluate the safety, acute clinical success and long term outcome of endoluminal stenting (ES) in treating pts with vertebral artery (VA) stenosis. Fifty four pts (mean age 63 yrs, Females = 8) who underwent ES of VA (symptomatic = 43, asymptomatic critical stenosis = 11) between October 1995–July 1999 have been enrolled in the registry. A total of 62 VA (right = 37, left = 25) were treated with balloon expandable stents (n = 69) with the majority receiving medium size Palmaz stents. Post stenting pts received either ticlopidine (250 mg twice a day) or clopidrogel (75 mg once a day) for 2–4 weeks in combination with aspirin (325 mg daily). Quantitative angiography was performed using an automated edge detection technique or electronic calipers.

Results: 53/54 (98%) achieved procedural success defined as <20% diameter stenosis without any major neurological event, emergency surgery or death.

	Baseline	Post stent	P value
MLD (mm)	1.18 ± 0.50	4.57 ± 1.07	<0.0001
Diameter stenosis (%)	74.96 ± 9.32	3.19 ± 1	<0.0001
Acute gain (mm)		3.39 ± 1	

Three pts (5.5%) developed restenosis with recurrent symptoms during follow up (444 ± 353 days) and were successfully treated with balloon angioplasty. Two pts died from cardiac failure.

Conclusions: Endoluminal stenting of vertebral artery is associated with excellent technical and procedural success without any major complications. A low rate of restenosis and symptom recurrence makes it a better choice over traditional surgical revascularization.

9:45 a.m.

898-6 Carotid Stenting in Symptomatic Versus Asymptomatic Patients. Acute and Long-Term Clinical Outcomes

George Dangas, John R. Laird, Roxana Mehran, Neil J. Weissman, Lowell F. Satler, Alexandra J. Lansky, Emily M. Parsons, Lee H. Monsein, Gary S. Mintz, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

Background: Acute surgical complications correlate with the patient's neurological status before carotid endarterectomy (CEA). However, the impact of this factor on the outcome of carotid artery stenting (CAS) has not been established.

Methods: We evaluated the acute and late clinical outcome after CAS in 194 consecutive patients. Independent neurologic evaluation was performed pre- and post-CAS. Patients with neurological symptoms within 4 months of CAS were deemed *symptomatic* (SX, n = 45 patients, 47 CAS), otherwise as *asymptomatic* (ASX, n = 149 patients, 158 CAS).

Results: Baseline clinical characteristics were similar between the two groups. Intravascular ultrasound imaging before stenting identified lower plaque burden in ASX vs SX patients both at the lesion (81 ± 9% vs. 87 ± 6%, p = 0.03) and at the distal reference site (26 ± 12% vs. 32 ± 8%, p = 0.09).

Neurological history and clinical outcomes:	ASX	SX	p
Prior major ipsilateral stroke	10.1%	10.6%	0.94
Prior minor ipsilateral stroke	19.6%	36.2%	0.01
Prior transient ischemic attack (TIA)	25.9%	80.9%	0.001
In-hospital TIA	1.9%	8.5%	0.05
In-hospital minor ipsilateral stroke	4.4%	0	0.35
In-hospital major ipsilateral stroke	1.9%	2.1%	0.84
Any in-hospital ipsilateral stroke	6.3%	2.1%	0.30
One-year follow-up (f/u) TIA	3.2%	0	0.66
One-year f/u minor ipsilateral stroke	0	6.1%	0.06
One-year f/u major ipsilateral stroke	0	0	1

Conclusions: SX patients have marginally fewer acute complications and higher late minor strokes. Careful case selection is required in CAS of ASX patients and improved adjunctive pharmacological therapy may be beneficial after CAS of SX patients.

POSTER

1197 Percutaneous Interventions: Miscellaneous II

Wednesday, March 15, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1197-75 ACC/AHA Guidelines for Coronary Angiography: Analysis of Patients With Non Significant Coronary Artery Disease

Meredith K. Evans, Michael J. Cowley, Evelyne Goudreau, Walter Malloy, On Topaz, George Vetrovec. *Medical College of Virginia Campus of Virginia Commonwealth University, Richmond, Virginia, USA*

To assess the relevance of the clinical decisions to perform coronary angiography (CA) which fails to identify significant coronary artery disease (CAD), the recently published ACC/AHA guidelines were retrospectively applied to 176 patients undergoing CA who had no or non significant (<50% stenosis) CAD (neg-CA). Chart reviews were performed in all patients with neg CA in 1998. Pts with valvular, myopathy and transplant indications were excluded. All 176 pts with CA for suspected CAD were classified according to ACC/AHA guidelines by one primary reviewer. The mean age was 51.8 ± 7 (SEM); 102 were female (58%). Symptoms vs classes are as shown below:

	N	Class				%Positive NuclearScan
		I	IIA	IIB	III	
Stable Angina	68	1	17	49	1	53 (78%)
Unstable Angina	54	35	19	–	–	32 (59%)
Non Spec Chest Pain	24	–	–	16	8	14 (58%)
Post Revasc Ischemia	27	6	9	12	–	9 (33%)
Acute MI	3	–	–	3	–	–
Total	176	42	45	80	9	108 (61%)

In summary, neg CA was performed for Class IIA (established indications) or above indications in 48%, Class IIB (consensus agreement) or above in 90% and in only 5% for Class III (not useful) indications. Nuclear scans were positive in 61% comprising the most frequent underlying factor in CA performance.

1197-76 Regional and Gender Differences in the Access to Early Percutaneous Coronary Intervention for Non-ST-Segment Elevation Acute Coronary Syndromes: Experience From the PURSUIT Trial With Glycoprotein IIb–IIIa Inhibitor Eptifibatide (INTEGRILIN®)

Todd J. Lorenz, Sally Greenberg, Michael M. Kitt. *COR Therapeutics, Inc., South San Francisco, California, USA*

Background: PURSUIT was a randomized, double-blind trial of a GP IIb–IIIa inhibitor eptifibatide (INTEGRILIN®) for the management of patients with non-ST-segment elevation acute coronary syndromes (ACS). A total of 10,948 patients in North America (United States and Canada), Western Europe, Eastern Europe, and Latin America were randomized to receive either eptifibatide or placebo. The use and timing of diagnostic catheterization and PCI was left to the discretion of individual investigators.

Purpose: To investigate the use of percutaneous coronary interventions (PCI) within the first 72 hours (median duration of study drug infusion) in different geographic regions or the overall population, as well as for men and women.

Methods: Data on the use of early PCI were collected from the case report forms.

Results: Early PCI was used most often in North America, with consistency between men and women. This was not the case in the rest of the world, where far fewer patients underwent PCI and men were more likely to undergo the intervention than women.

	North America	Western Europe	Eastern Europe	Latin America
Overall population	24.5%	7.2%	2.0%	4.0%
Men	25.6%	7.6%	2.6%	5.2%
Women	22.4%	6.5%	1.4%	2.0%

Conclusion: For North American patients with non-ST-segment elevation ACS, PCI is a commonly employed procedure in both men and women. In contrast, these procedures are not readily accessible to Western European, Eastern European, and Latin American patients, particularly women. Differences in availability of early PCI may have contributed to the regional/gender variability in outcomes observed in the main study.

1197-77 Transcranial Doppler Detection of Microemboli During Left Heart Catheterization

Florence Leclercq, Saad Kassnasrallah, Jean-Baptiste Cesari, Jean-Marc Davy, Robert Grolleau R.. *Cardiology and Neurology Departments, University of Montpellier, France*

Background: The occurrence of microemboli during invasive procedures such as cardiac angiography is well documented but relationship with patients (pts) characteristics and catheterization procedure remains unclear.

Methods: Fifty-one consecutive pts (38 men, 15 women) who referred for diagnostic coronary angiography were included in the study. Clinical data regarding age, cardiovascular risk factors, history of cardiac or cerebral disease were collected. Left heart catheterization was performed via the transfemoral retrograde route in all pts. Angioplasty was performed during the same procedure in 16 pts. Transcranial Doppler (TCD) examination of the right and/or the left middle cerebral artery was performed from 20 minutes before the start of the catheterization procedure until 10 minutes after its end. Microembolic signals (MES) were counted manually during and after (off-line analysis) of the procedure.

Results: No neurologic event occurred with a mean follow-up of 10 months. MES were never observed before or after the procedure. MES were detected in all but 2 pts (mean 17 ± 12 per patient) during the procedure. They were observed mainly during left ventriculography (38%) and contrast injection in coronary arteries (55%), suggesting its gaseous origin. There was not statistically significant association between the number of MES and patient age or risk factors ($p = 0.3$), left ventricular ejection fraction ($p = 0.5$), aspirin therapy ($p = 0.32$), duration of catheterization or angioplasty procedure ($p = 0.6$). There was a trend between absence of ischemic cardiopathy and number of MES (36 pts; $p = 0.06$)

Conclusion: Despite frequent detection of microemboli with TCD during left heart catheterization, there was no association between MES and patient/procedure characteristics and majority of MES seems to have gaseous origin. Because air embolism may be harmful, attempt to reduce its occurrence may be useful.

1197-78 Post-Interventional Chest Pain – Coronary Stretching or Myocardial Injury?

Joerg Herrmann, Allen Jeremias, Michael Haude, Axel Schmermund, Raimund Erbel. *University of Essen, Essen, Germany*

Background: Chest pain (CP) after successful percutaneous coronary intervention mainly regarded as a stretching effect of coronary arteries, but has not been related to new markers of ischemia. Therefore, we investigated the relationship between post-interventional CP and the incidence of serum marker elevation.

Methods: In 180 consecutive patients (pts) undergoing balloon angioplasty (BA, n = 44), coronary stenting (Stent, n = 120), or rotational atherectomy/excime laser coronary angioplasty (RA/ELCA, n = 16) a validated questionnaire was used to evaluate the occurrence of CP within 24 hours after the coronary procedure. Serum marker analysis was done before, as well as 6, 12, and 24 hours after coronary intervention using a rapid bedside troponin T test (threshold 0.1 ng/ml) for the detection of a cardiac troponin T (cTnT) release and a standard enzymatic assay (normal range 10–80 IU/l) for the quantification of creatine kinase (CK). Only patients with normal range values at baseline were included in this study.

Results: The overall incidence of post-interventional CP was 42%, being significantly higher after RA/ELCA (75%) and Stent (4%, $p < 0.01$ vs. RA/ELCA) than after BA (25%, $p < 0.05$ vs. Stent, $p < 0.001$ vs. RA/ELCA). A significant correlation was found for CP and both cTnT ($r = 0.338$, $p < 0.001$) and CK ($r = 0.413$, $p < 0.001$).

	CP (n = 76)	no CP (n = 104)	p-value
Positive cTnT test	52.6%	14.4%	$p < 0.001$
CK 1.5–3x nml	10.5%	5.8%	$p = 0.26$
CK > 3x nml	7.9%	1.0%	$p = 0.02$
Peak CK [IU/l]	117 ± 213	46 ± 37	$p < 0.001$

Conclusion: Post-procedural chest pain seems to be related not only to stretching but also to myocardial ischemic injury in a considerable number of patients.

1197-79 Rotational Atherectonmy for Chronic Total Coronary Occlusions: Acute Results and Predictors of Target Vessel Revascularization

Annapoorna Kini, David Reich, Tudor Bertea, Javed Suleman, Cristina Mitre, Jonathan D. Marmur, Samin K. Sharma. *Mount Sinai Hospital, New York, New York, USA*

Balloon angioplasty of chronic total coronary occlusion (CTCO) has lower initial success and high subsequent restenosis. Recent reports have shown a lower target vessel revascularization (TVR) rate after stenting of CTCO compared to balloon angioplasty. However, stenting may not be appropriate in all CTCO due to lesion characteristics like long length, calcification, small vessels, ostial location and angulation. Rotational atherectomy (RA) by decreasing the plaque mass and changing lesion compliance may be appropriate for the interventional treatment of CTCO and may facilitate stent deployment (if needed).

Results: We describe the acute results, in-hosptial outcome and need for TVR after RA of CTCO in 201 consecutive lesions in 200 patients which were initially crossed by the guide wire. Clinical characteristics: mean age 64 ± 10 yrs, mean duration of CTCO 82 ± 48 days, multivessel disease 26%, LAD 50%, reference vessel diameter 2.65 ± 0.74 mm. Procedural characteristics: mean burr-to-artery ratio 0.74 ± 0.12, mean maximal burr size 2.0 ± 0.3 mm, and post dilatation balloon size 3.2 ± 0.8 mm. Stent was deployed in 38% of cases without any delivery failure. Procedural success was achieved in 99.5% of cases with post procedural minimal luminal diameter of 2.32 ± 0.42 mm and residual stenosis of 12 ± 10%. There were two cases of wire/burr perforation but no therapy was required. There were no cases of Q-wave MI, CABG, or death. Vascular complications occurred in 1.1% and CK-MB elevation > 3x control occurred in 5%. Subsequent follow-up at a mean of 11 ± 4 months, revealed TVR of 20%; 24% after RA and 13% after RA + stent ($p = 0.04$). Multivariate predictors of TVR were diabetes mellitus (OR 3.02; 95% CI 1.12–4.08), lesion length (OR 2.00 for each 10 mm), reference vessel (OR 2.65; 95% CI 1.35–3.95) and post-procedure MLD (OR 2.12; 95% CI 1.56–2.56). Also on follow-up, 7 patients required CABG, 3 presented with non-Q-wave MI and 3 patients died.

Conclusion: RA in the treatment of CTCO is safe and effective and has a relatively low TVR rate in comparison to historic controls. RA followed by stent implantation in suitable lesions may further decrease the need for

repeat intervention, perhaps by achieving a large post-procedure MLD. Thus, a randomized trial comparing rotational atherectomy with stenting vs. stenting alone in the treatment of CTCO in large vessels (>2.75 mm) is warranted.

1197-80 Prolonged QT Interval and QT Dispersion Induced by Coronary Rotational Atherectomy

Hamo Tomoda, Naoto Aoki. *Tokai University, and Yamato Seiwa Hospital, Kanagawa, Japan*

Background: Although coronary rotational atherectomy (RA) is widely applied to clinical cases with calcified and/or long lesions, the incidence of slow flow and creatine kinase elevation, including overt myocardial infarction, is higher than in percutaneous transluminal coronary angioplasty (PTCA) or stenting. Thus, the aim of this study was to evaluate myocardial perfusion disturbances induced by RA using conventional electrocardiograms (ECGs).

Methods: Twelve patients who underwent RA (group 1) and 12 other patients who underwent PTCA (group 2) for a single target lesion were studied. There was no significant difference in clinical characteristics between the two groups. Standard 12-lead ECGs were recorded before and throughout the interventions. QT interval was measured from the onset of the QRS complex to the end of the T wave. QT dispersion was defined as the difference between the maximum and minimum values of QT intervals. QT interval and QT dispersion were corrected for heart rate (QTc and QTc dispersion).

Results: Electrocardiographic measurements are summarized in the Table. In group 1, maximum and minimum QTc intervals and QTc dispersion were prolonged in all patients during RA. Maximal ECG changes occurred after the first passage of the RA device through the lesions, and these improved rapidly on a beat-to-beat basis after the cessation of RA. There was a single case with non-sustained ventricular tachycardia at the peak of the prolonged QT. In contrast, group 2 showed insignificant decreases in maximum and minimum QTc and an insignificant increase in QTc dispersion.

	Group 1			Group 2		
	Baseline	RA	p	Baseline	PTCA	p
QTc maximum (ms)	449 ± 28	551 ± 67	<0.0001	429 ± 24	423 ± 21	NS
QTc minimum (ms)	406 ± 25	467 ± 62	<0.005	384 ± 27	371 ± 27	NS
QTc dispersion (ms)	43 ± 14	84 ± 20	<0.0001	45 ± 13	52 ± 13	NS

Conclusion: Markedly prolonged QTc interval and QTc dispersion appear to be sensitive markers for myocardial microcirculatory disturbances induced by RA.

1197-81 Relationship of Number of Septal Branches Injected and Creatinine Kinase Area Under the Curve in Nonsurgical Septal Reduction Therapy for Hypertrophic Obstructive Cardiomyopathy

Oscar M. Aguilar, Denise Meyer, Robert E. Fromm, William H. Spencer III. *Baylor College of Medicine, Houston, Texas, USA*

Background: Non surgical septal reduction therapy (NSSRT) injecting alcohol into septal perforator branches for hypertrophic obstructive cardiomyopathy (HOCM) has been used succesfully. We investigated the relationship between the number of septal branches injected with alcohol and myocardial injury by creatinine kinase (CK) area under the curve (AUC).

Methods: In 104 patients undergoing NSSRT, we measured the CK at baseline and during the first 36 hours after the procedure. The baseline and follow up (6–28 weeks) left ventricular outflow (LVOT) gradient was also measured. Baseline clinical data and the relationship between the number of septal branches injected and CK-AUC were analyzed

Results: The mean age was 49.5 (±16), 59 patients were males (57%), 92 (88%) non smokers, 9 had hypertension (9%), 5 had hypercholesterolemia (5%), 8 were diabetics (8%) and 7 had coronary artery disease (7%). The mean baseline LVOT gradient was 60.2 mmHg (±32). Fifty six percent had I septal branch injected, 39 had 2, 3 had 3 and 2 had 4 septal branches injected respectively. Seventeen patients had pacemaker (PM) prior to the procedure.

At follow up, the mean LVOT gradient was 12.1 mmHg (±19), for a decrease of 48.1 mmHg (±29), which represents a decrease of 80%. PM insertion was required in 17 patients (19.5%), 7 (6.7%) required implantable defibrillator insertion after the procedure and 2 patients died (1.9%). Non parametric test for trend showed a statistically significant relationship between the number of branches injected and the CK area under the curve (AUC), $p < 0.001$.

Conclusions: NSSRT succesfully reduces the LVOT gradient in this patient population with low morbidity and mortality. Myocardial injury as measured by CK-AUC was related to the number of septal branches injected. We correlated the CK-AUC and the change in the LVOT gradient.

1197-82 Should Ethanol Septal Reduction be Performed on Young Patients With Symptomatic HOCM?

Nasser Lakkis, Sherif Nagueh, Donna Killip, William Spencer. *Baylor College of Medicine, Houston, TX, USA*

Ethanol septal reduction is a recently introduced therapeutic option to relieve symptoms in patients with HOCM. This percutaneous technique involves the instillation of ethanol to the septal branches supplying the bulging septal muscle resulting in immediate relief of the obstruction along with symptomatic improvement. This treatment could potentially result in myocardial scarring, complete heart block and electrical instability. Thirty-one patients younger than 40 years have been referred to our center to be treated for refractory symptomatic HOCM. The procedure was performed successfully in all except two patients: one due to anatomical reasons where different kinds of wires could not be advanced, and the second patient had a few small septal branches which reduced the gradient only partially and the patient continued to be symptomatic requiring myomectomy. The average number of vessels ablated was 1.6 ± 0.7. The mean increase in creatine kinase was 1524 ± 398 units. All patients had complete symptomatic improvement except for two. The mean resting gradient was 54 ± 34 mmHg. It decreased to 6 ± 13 mm Hg at 6 months ($p < 0.01$). The dobutamine-provoked gradient decreased from 97 ± 9 mmHg at baseline to 57 ± 43 mmHg at 6 months ($p < 0.01$). The mean septal thickness decreased from 2.4 cm to 1.3 cm at 6 months ($p < 0.01$). Only one patient required a permanent pacemaker placement for complete heart block. The mean exercise time increased from 285 ± 90 seconds to 411 ± 54 seconds ($p = 0.03$). None of the patients had any arrhythmic documented events over the period of follow-up. In conclusion, ethanol septal reduction is an excellent option for young patients with symptomatic HOCM.

1197-83 High Homocysteine Concentration is a Risk Factor for Major Adverse Cardiovascular Events and Angiographic Restenosis After Coronary Intervention

Anjan Gupta, Gary Zander, Donald H. Schmidt. *Sinai Samaritan Medical Center, Milwaukee, Wisconsin, USA*

Background: High homocysteine concentration is an independent risk factor for coronary atherosclerotic disease, but its role in causing major adverse cardiovascular events and angiographic restenosis after coronary interventions is unknown.

Methods: Fasting plasma homocysteine levels were measured in 80 patients (56 men, 24 women, mean age 64.4 ± 12.8 years) using high performance liquid chromatographic technique before percutaneous coronary intervention. We then prospectively followed these patients over a course of 10.2 ± 2.3 months.

Results: Twenty-five of the 80 patients (30%) had a major cardiovascular event (death, acute myocardial infarction, or repeat revascularization), and 30 of the 80 patients (37%) had angiographic restenosis > 50% at the site of previous intervention. Those who experienced major adverse cardiovascular events had mean homocysteine concentrations that were significantly higher than those who did not have an adverse event (15.4 ± 5.6 vs. 10.4 ± 4.8 μmoles/L, $p < 0.01$). Multivariate analysis showed that a high homocysteine concentration was an independent risk factor for angiographic restenosis (OR 3.6, CI1.2–5, $p < 0.01$) and for major adverse cardiovascular events (OR4.5, CI2.3–6.8, $p < 0.01$) after a coronary intervention.

Conclusion: High homocysteine concentrations are an independent risk factor for major adverse cardiovascular events and angiographic restenosis after coronary intervention. Since B-vitamins lower plasma homocysteine levels, further studies should evaluate their benefit in reducing the incidence of restenosis after coronary interventions.

POSTER

1198 Coronary Stenting III

Wednesday, March 15, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1198-115 Stent Therapy Improves the In-Hospital Outcome After Coronary Intervention in Males but not in Females

Ziad A. Abbud, Leonard M. Schwartz. *University of Toronto, Toronto, Ontario, Canada*

Background: Intracoronary stent deployment has been shown to improve

the short and long term outcome after percutaneous transluminal coronary angioplasty (PTCA). The female gender, however, is consistently under-represented in the available data studying the outcome after coronary stent therapy.

Methods: To compare the effect of stent therapy on short-term outcome between males and females, we reviewed 5,379 cases that were performed at the Toronto General Hospital between April 1994 and December 1998.

Results: There were 3,978 males and 1,401 females. Stenting occurred in 56.7% of males and in 55.9% of females. In univariate analysis, the in-hospital outcome after PTCA was significantly improved by stenting in males but not in females.

	Females			Males		
	PTCA	Stent	p	PTCA	Stent	p
Acute Reocclusion	4.7%	3.1%	0.122	2.4%	1.5%	0.043
MI	2.4%	4.0%	0.131	2.5%	2.2%	0.524
CABG	1.3%	1.4%	1.000	1.7%	0.7%	0.006
Death	0.5%	0.8%	0.739	0.9%	0.2%	0.003
MACE	3.9%	5.4%	0.206	4.5%	2.8%	0.005

MI: Myocardial Infarction, CABG: Coronary Artery Bypass Graft Surgery, MACE: Major Adverse Cardiac Events.

Similarly, in multivariate analysis adjusting for age, hypertension, diabetes mellitus, hypercholesterolemia, tobacco use, and number of diseased vessels, stenting in males, significantly reduced the risk for acute reocclusion [OR = 1.65, 95% CI (1.03, 2.65)], coronary artery bypass graft surgery [OR = 2.42, 95% CI (1.29, 4.54)], death [OR = 3.35, 95% CI (1.16, 10.06)], and major adverse cardiac events [OR = 1.49, 95% CI (1.05, 2.12)], while consistently not affecting the outcome in females.

Conclusion: While stenting in this series improved the immediate outcome after PTCA in males, it appears to offer no advantage in females. Randomized clinical trials to study the benefit of stent therapy in females are needed.

1198-116 Predictive Factors of Direct Stenting Failure in a Single Center Experience of 1,500 Patients

Bernard Chevalier, Thierry Royer, Philippe Guyon, Bernard Glatt. *Centre Cardiologique du Nord, Saint-Denis, France*

De novo coronary stenting has been validated in some coronary lesions by several randomized studies. In this setting, we used, from 10/95 to 08/99, direct stent implantation (DSI) without prior dilatation technique in 1500 pts excluding age > 70, onset of (related to the target artery) angina or MI > 3 months, TIMI 0 occlusion. Clinical indication were almost exclusively acute syndromes: unstable angina 52%, recent MI 24%, acute MI 14% and stable angina in 10%. Lesions were simple in 61% and complex in 39%. Additional balloon inflation was used in 21% and additional stenting in 4%. Technical success (defined as a successful deployment of the stent on the target lesion) was 95%. All direct stenting failures were successfully treated with conventional technique. Predictive factors of DSI failure, using univariate analysis were respectively in the order of less importance: pre-PTCA MLD, circumflex location, distal location, use of GFX AVE*stent, calcified vessel and age > 70 y. Multivariate analysis identifies circumflex location as the best predictive factors of failure. Stent loss rate was 0.2%. There were 6 cases of partial failure to deploy the stent with residual stenosis from 31% to 42%. Clinical success was 97.6%, inhospital MACE rate was 2.2% and stent thrombosis was 0.6%.

Thus, DSI is feasible in selected coronary lesions and its success is dependent on anatomic conditions and delivery device quality.

1198-117 Clinical and Angiographic Follow-up of a New Biodegradable Coronary Stent (Igaki-Tamai Stent)

Takafumi Tsuji, Hideo Tamai, Keiji Igaki[1], Eisho Kyo, Kunihiko Kosuga, Akiyoshi Kawashima, Shigeo Matsui, Tatsuhiko Hata, Hidenori Komori, Seiichiro Motohara, Hiromu Uehata. *Shiga Medical Center for Adults, Moriyama; [1]Igaki Medical Planning Co. Ltd., Japan*

Background: High molecular weight poly-*l*-lactic acid (PLLA) stent is reported to be the most biocompatible among biodegradable polymer stents. We analyzed our experience of this stent in human coronary arteries.

Methods: The Igaki-Tamai stent is made of PLLA monopolymer with 0.17 mm thickness, and has a zigzag helical coil design with self-expanding ability. Forty-one lesions in 33 patients electively underwent the stent implantation for coronary artery stenoses. There were 29 males, and the mean age was 60 ± 13 yrs. All target lesions were AHA/ACC type B and C. Coronary angiography was performed before, immediately after, 1 day, 3 months and 6 months after the procedure. Serial changes of MLD and %DS were assessed by quantitative coronary angiography. Restenosis was defined as %DS ≥ 50% at follow-up.

Results: The reference vessel diameter was 2.85 ± 0.34 mm and the lesion length was 13.4 ± 5.9 mm. The %DS decreased from 64% before stenting to 12% after stenting. All PLLA stents were successfully implanted. Subacute thrombosis occurred in one lesion (2.4%) which had been treated with inadequate heparinization because of gastorrhagia. No other MI, CABG or death developed within the follow-up period. The interim follow-up results are shown in the table.

	3 months	6 months
Restenosis rate	13% (4/30)	19% (4/21)
TLR rate	10% (3/30)	19% (4/21)

Conclusions: Our preliminary experience suggests the feasibility, safety, and perhaps the efficacy of the Igaki-Tamai biodegradable stent in humans. Six months final outcome will be presented.

1198-118 Is the Angiographic Guidance Sufficient for Optimal Stent Deployment in Ostial Stenoses? Insight From IVUS

Milena Adamian, Carlo Di Mario, Takahiro Nishida, Carlo Briguori, Bernard Reimers, Marco Vaghetti, Nicola Corvaja, Remo Albiero, Antonio Colombo. *Centro Cuore Columbus, Milan, Italy*

Precise positioning of stents in ostial lesions under fluoroscopic guidance is difficult because of the poor stent visibility and angiographic foreshortening or overlapping. The adequacy of stent deployment in ostial stenoses was evaluated with intravascular ultrasound (IVUS) in 86 consecutive patients (90 native de novo lesions).

Methods: The stent position relative to vessel ostium was defined as: "optimal" (within ±1 mm to ostium; 39 lesions); "too proximal" (>1 mm protrusion from the ostium with range from 1.5 to 7.0 mm; 32 lesions) and "too distal" (>1 mm distal to the ostium, range from 1.5 to 4.5 mm; 19 lesions). Lesions were located in: RCA 18%, LAD 46%, LCX 10%, branch-ostial 19%. All deployed stents were balloon-expandable with PS-154 used in 46 lesions (50%). Angiographic follow-up was obtained in 86% of eligible patients 6.8 ± 2.0 months after stenting.

Results: There were no statistically significant differences in clinical characteristics among the 3 groups.

	Optimal	Too Proximal	Too distal
RVD (pre/final), mm*	3.3 ± 0.5/3.4 ± 0.4	3.1 ± 0.6/3.4 ± 0.4	3.1 ± 0.3/3.3 ± 0.5
MLD (pre/final), mm*	1.1 ± 0.7/3.3 ± 0.6	1.0 ± 0.6/3.3 ± 0.5	0.9 ± 0.5/3.2 ± 0.7
B/V Ratio*	1.11 ± 0.30	1.19 ± 0.21	1.16 ± 0.16
Acute Gain, mm*	2.27 ± 0.73	2.29 ± 0.78	2.19 ± 0.85
Late Loss, mm*	0.94 ± 0.83	1.10 ± 0.95	0.93 ± 0.99
Loss Index*	0.45 ± 0.42	0.67 ± 0.82	0.42 ± 0.33
Fin stent CSA, mm^{2*}	9.83 ± 2.66	9.70 ± 2.39	9.5 ± 3.37
Fin vessel CSA, mm^{2*}	17.43 ± 4.76	17.33 ± 4.40	17.25 ± 5.36
Restenosis/TLR, %*	25/25	22/20.7	19/18.7

* p = NS; RVD = reference vessel diameter; MLD = minimal lumen diameter; TLR = target lesion revascularization; CSA = cross-sectional area

Conclusions: With modern stents and angiographic guidance precise stent positioning can be achieved in most cases with a trend to moderate stent protrusion. Suboptimal (too proximal or too distal) stent position within the small range observed does not predict an increased risk of restenosis.

1198-119 Rotational Atherectomy, Excimerlaser-Angioplasty or Balloon Angioplasty for Therapy of In-Stent-Restenosis?

Bernward Lauer, Eike Schmidt, Heiko Ambrosch, Silke Steinbrink, Klaus W. Diederich, Rainer Hambrecht, Hans Krankenberg, Andreas Kuhn, Peter Sick, Rainer Zotz, Gerhard Schuler. *University of Leipzig-Heart Center, Germany*

Background: Optimal treatment of restenosis after stent implantation remains to be determined. Tissue debulking with rotational atherectomy (PTRA) or excimer-laserangioplasty (ELCA) may be more efficious than conventional balloon angioplasty (PTCA) alone. Therefore, the present study evaluates the acute and long-term results after PTRA, ELCA or PTCA for in-stent restenosis.

Methods: 682 lesions (L) in 576 patients with in-stent restenosis were treated with PTRA (190 L), ELCA (191 L) or PTCA (301 L), respectively. After PTRA or ELCA, additional PTCA was performed to achieve optimal acute procedural results. Coronary angiogramms were analyzed by quantitative angiography (QCA).

Results: QCA data are given in the table.

	Acute intervention				Long-term results	
	n	MLD at baseline	MLD after debulking	MLD after intervention	n	MLD at follow-up (6 months)
PTRA	190	0.84 ± 0.45	1.83 ± 0.47	2.71 ± 0.53†	161	1.62 ± 0.89*
ELCA	191	0.86 ± 0.44	1.83 ± 0.48	2.89 ± 0.75†	159	1.35 ± 0.93
PTCA	301	0.81 ± 0.73	–	2.51 ± 0.64	229	1.53 ± 0.87

MLD: minimal lumen diameter (mm), †: $p < 0.05$ vs PTCA, *: $p < 0.05$ for PTRA vs ELCA

Conclusions: PTRA and ELCA for in-stent restenosis result in significant ablation of restenotic tissue. Acute gain with PTRA and ELCA is better than with PTCA alone. However, in the present study, MLD after 6 months is significantly greater only after PTRA compared to ELCA.

POSTER

1199 Glycoprotein IIb/IIIa Receptor Blockers and Outcomes

Wednesday, March 15, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1199-84 Total Platelet Volume is an Independent Predictor for Mortality Reduction in Patients Treated With Abciximab

Mark G. Treuth, John C. Isaac, Katherine Wolski, Neal S. Kleiman. *Baylor College of Medicine, Houston, TX; Delmarva Heart, Salisbury, MD; Cleveland Clinic Foundation, Cleveland, OH, USA*

Background: We investigated the relationship between total platelet volume and the effect of abciximab on mortality.

Methods: Calculation of total platelet volume was performed using platelet volume prior to percutaneous coronary intervention and multiplying it by estimated blood volume. Estimated blood volume was calculated using the following formulas: [weight (kg) × 41] + 1530 for males, and [weight (kg) × 47.2] + 846 for females. Patients (n = 8555) enrolled in EPIC, EPILOG, EPISTENT, and CAPTURE were analyzed for death at 6 months. Platelet volume was dichotomized into high vs low (upper 20th vs. lower 80th percentile). A Cox Proportional Hazard model was used to control for significant differences in baseline characteristics.

Results: Abciximab treatment resulted in a reduction of the hazard for mortality in patients with high platelet volumes (unadjusted hazard ratio = 0.368; 95% CI = 0.176–0.771). At baseline, there were significant differences with respect to the number of patients with CHF, PVD, hypertension, or age. When controlling for these factors, there was still a significant benefit from treatment with abciximab in patients with high platelet volumes (adjusted hazard ratio = 0.384; 95% CI = 0.180–0.821).

Conclusion: The risk of death was significantly reduced when patients with high platelet volumes were treated with abciximab. Even after controlling for differences in baseline characteristics, platelet volume predicts a subpopulation of patients that have a mortality benefit when treated with abciximab during angioplasty.

1199-85 Abciximab Administration During Angioplasty in Acute Coronary Syndromes

Battistina Castiglioni, Mauro Boscarini, Vruyr Balian, Raffaella Vaninetti, Sergio Repetto. *Invasive Cardiology, Department of Cardiology, Ospedale di Circolo, Varese, Italy*

Background: Abciximab is now a spreading treatment of complicated percutaneous transluminal coronary angioplasty (PTCA) and acute coronary syndromes. To reduce bleeding complication, we are now using the only bolus administration with the aim of evaluate efficacy of abciximab administered with conventional way of treatment (bolus + venous infusion) and with the only bolus administration.

Method: From 1996 to 1999 143 consecutive patients with acute coronary sindrom have been treated with abciximab during PTCA, 56 (39%) with bolus and infusion, 87 (61%) with the only bolus. Clinical and angiographic characteristic, technical data and results are reported in the table.

Conclusion: Abciximab is a good way of treatment in PTCA during acute coronary sindromes. With the only bolus administration we obtain an important antiplatelet aggregation and a reduced bleeding risck.

	Bolus	Bolus + Infusion
Treated vessels		
LAD	44 (51%)	28 (50%)
LCX	16 (18%)	7 (13%)
RCA	21 (24%)	17 (30%)
IA	4 (4%)	0
LM	0	1 (2%)
SVG	3 (3%)	3 (5%)
Stenting	81 (93%)	54 (96%)
Indications for abciximab		
No-reflow	63 (72%)	27 (48%)
Thrombus	20 (23%)	20 (36%)
Dissection	4 (5%)	9 (16%)
TIMI 3	86 (99%)	55 (98%)
30 days follow-up		
Exitus	0	1 (2%)
Subacute occlusion	2 (2%)	1 (2%)
Re-PTCA	1 (1%)	1 (2%)
Bleeding complications	2 (2%)	4 (7%)

1199-86 Influence of Thrombus on the Outcome of Coronary Interventions in the Current Era

Mandeep Singh, Henry H. Ting, Nelson A. Araujo, Guy S. Reeder, John F. Bresnahan, Ryan J. Lennon, David R. Holmes Jr.. *Mayo Clinic, Rochester, MN, USA*

Background: Thrombus is associated with increased risk of complications during percutaneous coronary interventions (PCI). We sought to determine the influence of pre-existing thrombus in the current era on the acute and intermediate-term outcomes of PCI.

Methods: 3914 patients who underwent PCI at Mayo Clinic between 1996 and 99 were identified from the prospective database and divided into those with (n = 1508) and without (n = 2406) angiographic thrombus prior to treatment. Baseline, angiographic data, in-hospital outcomes and post-discharge outcomes of patients with successful procedure (<50% residual stenosis with no in-hospital death, MI, TVR and combined end points) were compared.

Results: The group with thrombus was more likely to present with acute MI (35% vs 3.1%), cardiogenic shock (9% vs 1.4%) and prior MI (74.5% vs 39.9%) before PCI.(each $P < 0.01$).

Event	Odds ratio (95% C.I.)	P
*In-hospital-Death	2.09 (1.11–3.96)	0.02
– Death/MI	1.79 (1.37–2.34)	<0.001
– Composite end points	2.4 (1.93–2.98)	<0.001
*Post-discharge	Risk ratio (95% C.I.)	P
– Death	0.99 (0.72–1.35)	0.94
– Death/MI	1.21 (0.94–1.54)	0.14
– Composite end points	0.92 (0.86–1.19)	0.92

In the multivariate analysis after adjusting for all the significant variables, thrombus Was a predictor of in-hospital death, MI, and composite end points. In post-discharge survival there was no influence of thrombus on adverse events.

Conclusion: Patients with pre-existing thrombus have lower procedural success and higher in-hospital complications. After adjusting for variables in patients with a successful procedure, pre-existing thrombus before PCI was not an independent predictor of adverse outcome following hospital discharge in the present era.

1199-87 An Algorithm Based on Clinical and Angiographic Criteria for Selecting a Glycoprotein IIb/IIIa Inhibitor During Percutaneous Coronary Intervention

Annapoorna Kini, Chacko I. Nebu, Elie Banbahji, David Reich, Tudor Bertea, Samin K. Sharma. *Mount Sinai Hospital, New York, NY, USA*

The GP IIb/IIIa inhibitors (GPI) during percutaneous coronary intervention (PCI) can reduce periprocedural CK-MB release and major adverse cardiac events (MACE) of acute/subacute closure, Q-wave MI and emergent bypass surgery. In the absence of randomized trials directly comparing the available GPI [abciximab (A), tirofiban (T) and eptafibatide (E)], the decision to use a particular agent depends on a case by case analysis of risk/benefit vs. cost. To define the most appropriate GPI use, a practice guideline for selecting a particular agent based on clinical and angiographic variables was formulated: A in high risk subsets (type C, complex, thrombotic or calcified lesions, post MI, diabetes mellitus), T or E in moderate risk subsets (type B, 10–20 mm lesion length, vein graft, prior A use, stable or crescendo angina), and no

GPI in low risk lesions (type A, restenotic, small vessel, thrombocytopenia, bleeding disorders).

Methods: To analyze the impact of these guidelines, we studied 919 consecutive patients undergoing PCI with baseline normal CK-MB. GPI were used in 73.2% (A in 46.1%; T in 16.1% and E in 11%). Crossover to emergent bailout use of abciximab for significant procedural complications was required in 2.0% after no GPI, 4% after T and 2% after E (p = NS).

Results:

	No GPI (n = 246)	A (n = 424)	T (n = 148)	E (n = 101)
30 day MACE (%)	2.0	1.4	3.4	0
Any CK-MB ↑ (%)	13.0	14.6	16.2	14.8
1–3 × normal (%)	12.6	10.4	10.8	12.8
3–5 × normal (%)	0.4	2.8	3.4	1.0
>5 × normal (%)	0	1.4	2.0	1.0
Vascular complications (%)	0.8	1.4	1.4	1.0

p = NS for all categories and groups

Conclusion: A strategy based on clinical guidelines for use of GPI during PCI was associated with similar incidence of CK-MB elevation and 30 day MACE. Thus, in the absence of a head-to-head comparison, the decision to use a particular GP IIb/IIIa inhibitor (A, T or E), based on a clinical and angiographic algorithm, can be expected to result in similar outcome and may be justified from the cost-effective point of view.

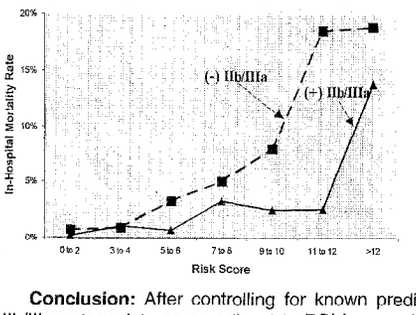
1199-88 Observed Protective Effect of Glycoprotein IIb/IIIa Antagonists Against In-Hospital Death Stratified by Patient Risk

Frederic S. Resnic, Lucila Olmo-Machado, Gavin J. Blake, Andrew Selwyn, Daniel I. Simon, Jeffrey J. Popma. *Brigham and Women's Hospital, Boston, MA, USA*

Background: Randomized trials suggested an early mortality benefit of lycoprotein IIb/IIIa antagonists (IIb/IIIa) used at the time of percutaneous coronary interventions (PCI). However, the benefit observed in clinical practice is known to vary based on underlying risk factors. Accordingly, we sought to clarify the relationship of the benefit of adjunctive IIb/IIIa antagonists with identifiable patient risk factors.

Methods: We prospectively collected data on 37 clinical and procedural variables for 2,804 consecutive cases from 1/97 through 2/99, including patients presenting with acute myocardial infarction, cardiogenic shock, and those who underwent same stay coronary artery bypass surgery. The dataset included 996 patients who received IIb/IIIa at the time of PCI. Risk score models were developed from the beta coefficients of a multiple logistic regression model. Models were constructed from a random subset of 1877 cases and validated on the remaining 927 cases.

Results: There were 19 deaths in the IIb/IIIa treated patients (1.91%) and 43 deaths in the non-IIb/IIIa group (2.38%; Odds Ratio = 0.80 p = 0.42). After controlling for independent predictors of in-hospital death (including: age, gender, occluded vessel, type B2 or C lesion, presenting AMI, congestive heart failure and left main lesion), the use of IIb/IIIa antagonists was associated with a trend toward reduced risk of in-hospital death (Odds Ratio = 0.504, p = 0.074). This mortality benefit was concentrated in those patients presenting with acute myocardial infarction, congestive heart failure, or two or more additional clinical risk factors. Observed mortality versus risk score stratified by use of IIb/IIIa antagonists is shown.



Conclusion: After controlling for known predictors of risk, the use of IIb/IIIa antagonists as an adjunct to PCI is associated with a trend toward a 50% reduction in the odds of in-hospital mortality. This benefit appears concentrated in those patients with identifiable increased pre-procedural risk. Further study is warranted to refine the identification of patients most likely to benefit from these agents.

1199-89 The Impact of Abciximab on Mortality After Multivessel PCI: A Striking Effect in Diabetics

Deepak L. Bhatt, A. Michael Lincoff, James E. Tcheng, Robert M. Califf, Philippe L. L'Allier, Steven P. Marso, Katherine E. Wolski, Dean J. Kereiakes, Eric J. Topol. *Cleveland Clinic, Cleveland, Ohio, USA*

Background: Patients with multivessel disease, especially diabetics, are often referred for coronary artery bypass surgery as an outgrowth of the BARI randomized trial. We sought to determine whether abciximab at the time of multivessel percutaneous coronary intervention (PCI) would favorably alter 1-year death and MI.

Methods: Data from the EPIC, EPILOG, and EPISTENT trials were pooled. The 1-year death and MI rates for patients undergoing multivessel intervention randomized to either placebo or abciximab were compared.

Results: In the overall cohort, the 1-year mortality rate was 3.1% for patients receiving placebo versus 2.0% for patients randomized to abciximab, p = 0.010. In the 612 patients undergoing multivessel PCI, the rate of death or MI at 1 year was decreased by abciximab use from 15.5% to 8.5%, p = 0.006, from 14.2% to 8.5% in the 439 non-diabetic patients undergoing multivessel PCI, p = 0.053, and from 18.7% to 8.3% in the 173 diabetic patients undergoing multivessel PCI, p = 0.044. Similarly, in the patients undergoing multivessel PCI, abciximab decreased the mortality from 5.0% to 2.3%, p = 0.070; specifically, in the non-diabetic patients mortality was reduced from 3.9% to 2.8%, p = 0.548, while in the diabetic patients undergoing multivessel PCI, abciximab decreased the mortality from 7.7% to 0.9%, p = 0.018.

Conclusion: Abciximab substantially reduces the risk of death or MI in patients undergoing multivessel intervention. The mortality reduction at 1 year is particularly striking in diabetic patients.

1199-90 Abciximab and Enoxaparin Administration During Elective High-Risk PTCA in Patients With More Than 3 Days of Ticlopidine Pretreatment

Dariusz Dudek, Stanislaw Bartus, Pawel Zymek, Jacek Legutko, Lukasz Rzeszutko, Marianna Janion, Krzysztof Zmudka, Jacek S. Dubiel. *Cardiology Department, Jagiellonian University, Krakow, Poland*

Background: Low molecular weight heparins have been suggested to reduce acute coronary events during and after PTCA in comparison to unfractionated heparin (UFH), whereas platelet IIb/IIIa blockade with abciximab substantially improves the outcome. On the other hand ticlopidine therapy several days prior to PTCA is also associated with a reduced risk of procedural non-Q-wave myocardial infarction (MI).

Methods: To assess the efficacy and safety of combined abciximab-enoxaparin versus enoxaparin (Enox) administration during PTCA of complex (B2 or C) lesions, we randomized patients (n = 162) to 3 groups: UFH (n = 50) adjusted to ACT > 300 sec, Enox (n = 58) enoxaparin (iv 1 mg/kg) and ReoEnox (n = 54) receiving enoxaparin (iv 0.75 mg/kg) followed by abciximab (iv bolus 0.25 mg/kg and 0.125 μg/kg/min 12 h infusion). Importantly, all patients were pretreated for 3 days with aspirin and ticlopidine (250 mg bid) prior to elective PTCA. Serial CK, CK-MB (0, 8, 16, 24, 48 h) and cardiac troponin TnT and TnI (0, 24, 48 h) were obtained after PTCA.

Results: There were no major cardiac events (death, large MI [CK-MB < 5×], rePTCA, CABG) in any group, but biochemical markers were distinct:

	UFH	Enox	ReoEnox	p
Stenting rate	68%	59%	72%	NS
Non-Q MI, CK-MB > 3 x	16%	6.9%	5.5%	p = 0.07*
TnT positive	18%	11%	11%	NS
TnT positive	60%	50%	44%	p = 0.07*
Bleeding major/minor	0/4%	0/10%	0/11%	NS

** UFH vs ReoEnox*

Conclusions: Despite standard therapies (aspirin + UFH + ticlopidine), there remains a relatively high occurrence of peri-PTCA myocardial damage. The use of enoxaparin reduced the number of ischemic events and the combination of enoxaparin and abciximab appears safe, however there was no additional benefit of abciximab against myocardial damage in pts with ticlopidine pretreatment and application of enoxaparin during PTCA.

1199-91 Abciximab Thrombocytopenia: Clinical Correlates and Outcomes

Dean J. Kereiakes, Scott D. Berkowitz, A. Michael Lincoff, James E. Tcheng, Katherine Wolski, Robert M. Califf, Eric J. Topol. *The Lindner Center, Cincinnati, Ohio, USA*

Thrombocytopenia (TP) is infrequently associated with abciximab (AB) therapy, but was shown in the EPIC trial to contribute to hemorrhagic risk and to be associated with adverse outcomes. To further define clinical predictors of and

outcomes in patients with TP following AB, we pooled and analyzed the data from EPIC, EPILOG and EPISTENT placebo (PL) controlled randomized trials of AB therapy in 7290 pts undergoing percutaneous coronary intervention. While AB bolus + infusion was similar in the 3 trials, in EPIC, heparin administration was not weight-adjusted and higher total doses of heparin were administered. TP (plt count $< 100 \times 10^9$/L) occurred in 178 (2.4%) pts and was more frequent (multivariable analysis) in EPIC ($p < 0.001$) and in older (>65 yrs; $p < 0.001$), lighter weight (<90 kg; $p < 0.027$) pts, those with lower baseline platelet counts ($<150 \times 10^9$/L; $p < 0.001$) and pts who received AB therapy ($p < 0.002$). Clinical outcomes to 30 days in pts with/without TP by AB treatment are shown (*$p < 0.001$; †P = NS TP vs. Non-TP):

	TP (AB)	TP (PL)	TP (Total)	Non-TP
N	139	39	178	7112
Major Non CABG Bleeding Events (%)	13.4	22.2	15.3*	2.7
Minor Non-CABG Bleeding Events (%)	16.4	11.1	15.3*	6.6
Transfusion (%)	43.2	82.1	51.7*	4.7
Death	6.5	15.4	8.4*	0.6
MI	3.6	0	5.6†	2.8
Urgent Revasc	0.7	2.9	3.0†	1.2

Conclusion: Age, weight, baseline platelet count, AB therapy and non-weight adjusted heparin are associated with AB-TP. TP is associated with increased bleeding risk and transfusion requirement. Among TP pts, those who received prophylactic AB have improved survival.

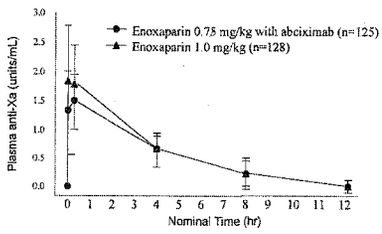
1199-92 Abciximab-Enoxaparin Interaction During Percutaneous Coronary Intervention: Results of the NICE 1 and 4 Trials

Dean J. Kereiakes, Cindy Grines, Edward Fry, Lawrence Barr, William Matthai, Thomas M. Broderick, Rose Lengerich, Marc Cohen, Paolo Esente. *The Lindner Research Center, Cincinnati, Ohio, USA*

Low molecular weight heparin (LMWH) is used both for prevention and therapy of deep venous thrombosis and ischemic complications of acute coronary syndromes. Its adjunctive role during percutaneous coronary intervention (PCI) is unknown.

Methods: As part of two multicenter, open-label trials to evaluate safety of 0.75 mg/kg IV enoxaparin (EN) administered concomitantly with abciximab (AB) (NICE-4) or EN 1.0 mg/kg without concomitant AB (NICE-1) to patients undergoing PCI, indices of coagulation (anti-Xa, anti-IIa activity) were measured.

Results: The interaction of AB and EN as reflected by measured levels (mean ± SD) of anti-Xa vs. time from each trial (figure) is shown. NICE 4 samples were obtained at baseline, post-EN, post-AB, 4, 8, 12 hrs. Anti-IIa concentrations followed a similar pattern.



Conclusion: These data suggest an AB-EN interaction that enhances antithrombotic effect of EN. The mechanisms and safety of this interaction are being evaluated.

POSTER

1200 Coronary Flow Reserve and Fractional Flow Reserve

Wednesday, March 15, 2000, 9:00 a.m.–11:00 a.m.
Anaheim Convention Center, Hall A
Presentation Hour: 9:00 a.m.–10:00 a.m.

1200-109 Theoretical Evaluation of the Influence of Aortic Pressure and Zero-Flow Pressure on Myocardial Fractional Flow Reserve

Maria Siebes, Jos A.E. Spaan, M. Meuwissen, J.J. Piek. *Depts. of Cardiology and Medical Physics, University of Amsterdam, The Netherlands*

Background: Myocardial fractional flow reserve (FFR) is a measure of the functional significance of a stenosis which is assumed to be independent of heart performance at the time of measurement, and has a cut-off value of 0.75 as the decisive threshold for coronary intervention. The theoretical model underlying FFR was evaluated on how variations in the zero-flow pressure (Pzf) and aortic pressure (Pao) propagate into FFR.

Methods: The stenosed coronary circulation was modeled as a flow-dependent stenosis resistance in series with a downstream myocardial resistance that was low and constant over the physiological pressure range, thus modeling maximum vasodilation. Lesion severity was varied from 20 to 80% diameter stenosis (DS) in a 3 mm coronary vessel. Mean Pao was varied from 70–130 mmHg and distal perfusion pressure (Pd) was calculated with and without inclusion of Pzf = 10 mmHg. Parameters of the stenosis resistance were chosen based on their geometry, using well-established fluid dynamic principles.

Results: Overall, FFR decreased hyperbolically with increasing aortic pressure. With inclusion of Pzf, the decline of FFR was larger over the same range of Pao. These effects were larger with increasing stenosis severity. An example for an intermediate lesion is given below:

DS	Pzf mmHg	Pao mmHg	Pd mmHg	Q ml/min	FFR = Pd/Pao
60%	0	70–130	49.8–82.6	124.6–206.4	0.71–0.63
	10	70–130	53.7–83.5	109.3–193.7	0.77–0.68

Conclusions: Only with Pzf = 0 and a flow-independent stenosis resistance is FFR independent of Pao. Inclusion of a realistic nonlinear stenosis resistance and a non-zero Pzf results in FFR being dependent on cardiac conditions unrelated to stenosis severity. In the worst case for the above example, a decrease in Pzf and increase in Pao causes FFR to change by 0.14 (0.77–0.63), which is a considerable fraction of the decision margin between 0.75 and 1.0 and can result in crossing the established threshold value of 0.75. This theoretical analysis suggests that additional controlled experiments are needed to further study these effects.

1200-110 A Novel Method to Simultaneously Measure Fractional Flow Reserve and Coronary Flow Reserve

Luis Gruberg, Gary S. Mintz, Neil J. Weissman, Evgeny Shalman[1], Chen Barak[1], Elhanan Dgani[1], Augusto D. Pichard, Ben Berogan, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA; [1]Florence Medical, Kfar Saba, Israel*

Background: Coronary flow reserve (CFR) and fractional flow reserve of the myocardium (FFR_{myo}) can be useful to assess not only the functional severity of coronary artery stenoses, but also the prognosis after intervention. Unfortunately both methods have inherent limitations and require different guide wires and subsequent hyperemic measurements. Obtaining both measurements simultaneously, with a single guidewire, may provide important information regarding the precise hemodynamic characterization of the epicardial stenosis (FFR_{myo}) and of the distal microcirculation (CFR).

Methods: The SmartFlow™ intravascular processor (SFIP™) is a medical grade personal computer based device which together with unique algorithms provide immediate FFR_{myo} and CFR calculations based on intravascular pressure measurements using the PressureWire™ (Radi Medical Systems, Uppsala, Sweden).

Results: In 11 consecutive patients, pre- and post-stenotic coronary pressure measurements were obtained at rest and during maximal hyperemia induced with an intracoronary bolus injection of 36–48 μg of adenosine. Quantitative coronary analysis (QCA) using automated edge detection was performed after the procedure at the Core Laboratory.

FFR_{myo} Radi	FFR_{myo} SFIP™	CFR-SFIP™	%DS by QCA
0.80 ± 0.14	0.85 ± 0.05	1.81 ± 0.59	50.4 ± 15

%DS = percent diameter stenosis

We conclude: Simultaneous measurements of transstenotic FFR_{myo} and CFR with the SFIP™ may simplify the process of obtaining accurate stenosis hemodynamics, and may have potential clinical advantages. With a single guidewire and pharmacologic vasodilation we can now accurately assess translesion physiology and target vessel microcirculatory phenomena.

1200-111 Time Course of Coronary Flow Reserve Recovery in Infarct-Related and Remote Vascular Areas Following Acute Myocardial Infarction

Matthijs Bax, Robbert J. De Winter, Carl E. Schotborgh, Karel T. Koch, Jan J. Piek. *Acad. Med. Center, Dept. of Cardiol., Amsterdam, The Netherlands*

Background: Several studies have indicated the pivotal role of adequate

flow restoration in acute myocardial infarction (AMI). However, there are limited data on coronary flow dynamics in the infarct (IRA) related and the non-infarct (non-IRA) related arteries following AMI.

Methods: We prospectively studied 57 patients treated with primary PTCA for anterior AMI. Coronary flow velocity reserve (CFR), defined as the ratio of hyperemic and baseline average peak flow velocity (APV), was measured, using a Doppler guide wire, directly after successful PTCA and at 1 week (n = 34) and 6 months (n = 21) follow up.

Results: CFR of IRA improved at 6 months follow up due to a decrease in baseline APV ($p = 0.11$) and in particular an increase in hyperemic APV ($p \leq 0.05$), while the CFR improvement in non-IRA was particularly due to a decrease in baseline APV ($p \leq 0.05$). (See table)

	CFR		baseline APV		hyperaemic APV	
	IRA	non-IRA	IRA	non-IRA	IRA	non-IRA
PTCA	1.7 (±0.4)	2.4 (±0.6)	21 (±8.9)	17 (±5.5)	34 (±14)	40 (±13)
1 week	1.9 (±0.4)*	2.8 (±0.5)*	22 (±7.4)	18 (±6.0)	40 (±13)	48 (±14)†
6 months	2.7 (±0.9)*	3.5 (±0.5)*	16 (±8.3)	13 (±5.9)†	45 (±23)†	45 (±18)

All data as mean (±SD). APV in cm/s. *$p \leq 0.001$ vs PTCA; †$p \leq 0.05$ vs PTCA

Conclusions: Coronary flow reserve recovery shows a similar trend in both the infarct-related and the remote vascular areas, although this may be due to different underlying mechanisms. The alterations in baseline APV indicates disturbed autoregulation in remote normally perfused areas following the acute phase of myocardial infarction.

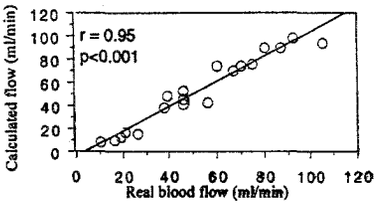
1200-112 Intravascular Estimation of Volumetric Blood Flow From Doppler Powers Using a Doppler Guide Wire

Lazar Mandinov, Andre Linka, Rolf Jenni. *Echocardiography, Division of Cardiology, University Hospital Zurich, Switzerland*

Background: Measurement of coronary blood flow in patients requires traditionally determination of blood flow velocity by Doppler ultrasound and vessel cross-section area by quantitative coronary angiography. Average peak velocity alone is widely used for evaluation of coronary blood flow and flow reserve, however, changes in velocity profile and vessel area are not taken into account. We studied the ability of a new method for calculation of volumetric blood flow by Doppler powers using Doppler flow wire.

Method: An in vitro pulsatile flow model with serially connected silicon tubes of known lumen diameters (2.0, 2.5 and 3.0 mm) and changing blood flow (range 10 to 110 ml/min) was employed. A 0.014 inch Doppler Flow Wire was coupled to a commercially available Doppler system (FloMap, Cardiometrics). The following power-based parameters were calculated on line by the Doppler system: M1 = first Doppler moment, M0 = zeroth Doppler moment; M1/M0 = mean flow velocity. Two different groups of sample volumes (different gate depths) were used to evaluate the effect of scattering and attenuation on Doppler power: 1) sample volumes, lying in the vessel (proximal gates), and 2) those, intersecting the vessel lumen (distal gates). Power-based parameters obtained at the distal gates were corrected for scattering and attenuation by the data obtained at the proximal gates. Corrected power-based parameters were than used for calculation of vessel cross-section area and mean blood flow velocity. Finally, an absolute volumetric flow in each tube and in 7 different flow rates was calculated and compared to time collected flow.

Results: Volumetric flow calculated by the power-based method was compared to the real (time collected) flow through the system. The calculated flow 52.6 ± 28 ml/min did not significantly differ from the real flow 52.7 ± 31 ml/min The mean paired difference between the two flows was 0.05 ml/min, $p = 0.97$.



Conclusion: Volumetric blood flow (ml/min) can be measured from Doppler powers, using Doppler flow wire. This method can improve markedly further application of Doppler guide wire for measurement of coronary volumetric flow and flow reserve for physiologic and clinical purposes.

1200-113 Mechanisms of Systolic Flow Reversal in Internal Mammary Artery Grafts

Iku Toda, Masakazu Teragaki, Kenei Shimada, Yuji Sakanoue, Makoto Hirose, Hiroyuki Yamagishi, Minoru Yoshiyama, Kaname Akioka, Kazuhide Takeuchi, Junichi Yoshikawa, Toshihiko Shibata, Shigefumi Suehiro. *Osaka City University Medical School, Osaka, Japan*

Background: The internal mammary artery (IMA) graft is generally used for coronary artery bypass grafting, since it remains patent for a long period of time. However, the hemodynamics of IMA grafts have not been clearly determined.

Objective: We investigated the hemodynamics of the IMA grafts anastomosed to the left anterior descending coronary artery (LAD) using a Doppler guide wire.

Methods: The subjects were 48 patients who underwent successful LAD bypass using IMA grafts (38 men and 10 women, mean age: 64 ± 7 years). During postoperative coronary angiography, a Doppler guide wire was used to measure the time-averaged peak velocity (APV) in the distal IMA graft and that in the LAD distal to the anastomosis (distal LAD).

Results: Baseline systolic flow reversal (FR) was confirmed in 71% (34/48) of the subjects. The postoperative vessel diameter and APV in the IMA were significantly greater in patients without FR than in those with FR (2.13 ± 0.25 vs 1.81 ± 0.42 mm; $p < 0.05$, 32.0 ± 10.4 vs 23.1 ± 12.9 cm/s; $p < 0.05$, respectively). There were no significant differences in APV and coronary flow reserve of the distal LAD between the patients with and without FR (21.6 ± 7.6 vs 26.0 ± 10.5 cm/s; p = NS, 2.23 ± 0.72 vs 1.80 ± 0.30; p = NS, respectively). The % diameter stenosis of the proximal LAD lesion was significantly more severe in patients without FR than in those with FR (86.0 ± 17.1 vs 67.8 ± 18.5%; $p < 0.005$). We believe that blood flows backwards through the IMA graft when a pressure gradient is created between the LAD and the IMA graft due to a time difference in pulse wave propagation between the coronary artery and the IMA.

Conclusion: Systolic FR is observed in approximately two-thirds of patients with a patent IMA graft. FR is present in IMA grafts when the amount of blood flowing through the grafts is low and the % diameter stenosis of the proximal LAD is mild.

1200-114 Can the Results of Intracoronary Doppler Flow Velocity Measurements and of Quantitative Coronary Angiography Predict Less Major Adverse Cardiac Events After Stenting Compared to PTCA According to the DEBATE Trial?

Michael Haude, Dietrich Baumgart, Dirk Welge, Christoph Altmann, Heinrich Wieneke, Holger Eggebrecht, Olaf Oldenburg, Jörg Herrmann, Claus Neurohr, Raimund Erbel. *Cardiology Department, University GH Essen, Essen, Germany*

Background: The D.E.B.A.T.E trial identified a distal coronary flow velocity reserve (CVRd) of >2.5 and a residual diameter stenosis of <35% after balloon angioplasty (PTCA) to be predictive for good long-term outcome with a low incidence (16%) of major adverse cardiac events (MACE). A similar approach after additional stent implantation has not been described.

Methods: Sequential measurements of minimal luminal diameter (MLD), percent diameter stenosis (%stenosis), baseline and hyperemic (after 18 μg adenosine) coronary flow velocity distal to the target lesion and in a non-stenotic reference artery were performed before and after predilatation, after stenting and after six months in 99 patients (pts) with single vessel coronary artery disease. Additionally, CVRd was calculated as the ratio of hyperemic and baseline velocity, and relative CVR (CVRrel) as the ratio of CVRd and CVR in the reference artery. Cut-off criteria were derived from Receiver-Operator-Curve analysis. Positive (PPV) and negative (NPV) predictive values are reported.

Results: At six months 16 of 99 patients (16%) developed MACE (no death, 4 myocardial infarctions, 12 target vessel revascularisations).

Parameter	Cut-off Value	Sensitivity	Specificity	PPV	NPV
MLD	2.65 mm	72%	79%	43%	93%
% stenosis	11%	83%	61%	32%	94%
CVRd	2.7	83%	75%	43%	95%
CVRrel	0.88	78%	84%	52%	94%

Conclusion: Best long-term outcome after stenting with a MACE rate of only 2% is predicted by a MLD > 2.65 mm and a CVRrel > 0.88, documenting a better outcome as after PTCA in the DEBATE trial.

ORAL

907 IVUS Insights Into Neointimal Proliferation

Wednesday, March 15, 2000, 10:30 a.m.–Noon
Anaheim Convention Center, Room 213A

10:30 a.m.

907-1 Impact of Coronary Debulking Prior to Stenting Versus Conventional Stenting on Early Outcome: Initial IVUS Findings

Kiyoshi Hibi, Tadanori Aizawa, Yasuhiro Honda, Yasushi Asakura, Shozo Tanaka, Takashi Uchiyama, Tetsuo Matsubara, Cynthia E. Handen, Paul G. Yock, Hideo Tamai, Peter J. Fitzgerald. *Stanford University, Stanford, CA, USA; Cardiovascular Institute, Tokyo, Japan*

Background: Previous IVUS studies have shown a strong relationship between neointimal hyperplasia after stent implantation and the amount of pre-existing plaque burden. The purpose of the Debulking and Stenting in Restenosis Elimination (DESIRE) trial was to compare DCA prior to stent implantation (DCA/S) to stent implantation alone (SA).

Methods: To date, 175 patients out of 400 target enrollment have been randomly assigned to DCA/S or to SA. Pre- and post-interventional IVUS studies have been fully analyzed in 37 patients (DCA/S: 16, SA: 21). IVUS images were obtained using a motorized pullback speed of 0.5 mm/sec, and measurements made of vessel area (VA) and lumen area (LA).

Results: There were no significant differences in the pre-interventional IVUS characteristics between the DCA/S group and the SA group with regard to vessel size (VA at the proximal and distal reference site: 17.1 ± 3.1 vs. 18.0 ± 5.0 mm^2, P = 0.57 and 12.8 ± 3.8 vs. 12.1 ± 4.0 mm^2, P = 0.67, respectively) and lesion characteristics (VA: 14.5 ± 3.8 vs. 14.4 ± 3.3 mm^2, P = 0.95 and LA: 1.44 ± 0.55 vs. 1.47 ± 0.44 mm^2, P = 0.83). The maximum inflation pressure for stent deployment was 9.5 ± 2.0 atm for the DCA/S group and 10.5 ± 2.7 atm for the SA group (P = 0.30). However, the acute LA gain was larger in patients who underwent DCA/S compared to those who underwent SA (7.2 ± 2.1 vs. 5.7 ± 1.5 mm^2, P = 0.02), resulting in a larger minimal LA after the procedure (8.6 ± 2.3 vs. 7.2 ± 2.6 mm^2, P = 0.03). VA at the minimal LA tended to be larger for DCA/S group compared to SA group (17.8 ± 4.2 vs. 15.3 ± 3.6 mm^2, P = 0.07).

Conclusions: The present study demonstrates that DCA/stent results in larger acute lumen and vessel dimensions compared with stent alone. Debulking prior to stenting may be an important adjunct to stenting lesions with large plaque burden.

10:45 a.m.

907-2 Normal Intimal Thickness is an Age Dependent Phenomenon: An Intravascular Ultrasound Study in Asymptomatic Individuals

Samir R. Kapadia, Khaled M. Ziada, Oussama M. Wazni, Eralp Tutar, Mandish Rai, Ivan Casserly, Suzanne R. Lutton, Steven E. Nissen, E. Murat Tuzcu. *The Cleveland Clinic Foundation, Cleveland, OH, USA*

Background: Although normal values for intimal thickness by intravascular ultrasound are commonly used, no *in vivo* data have documented whether age adjustment of measurements is necessary.

Methods: We performed intravascular ultrasound within 1.470 coronary segments in 260 recipients 31 ± 28 days after cardiac transplantation (donor age 33 ± 13 years). All sites with atherosclerosis defined as maximal intimal thickness (ITmax) >0.5 mm were excluded. In each CASS segment without atherosclerosis, ITmax, lumen area, EEM area, and percent intimal area were measured. For each patient, the average ITmax was calculated.

Results: The arterial wall was monolayered (ITmax = 0) more frequently in younger individuals (table). The mean and median intimal thickness increased with age (table). In a multivariate model, age was the only determinant of intimal thickness (odds ratio 1.2).

Age	n	ITmax = 0	Avg ITmax	Median (range)
<20	47	18 (38%)	0.07 ± 0.07	0.05 (0.0–0.28)
20–30	66	12 (18%)	0.10 ± 0.08	0.09 (0.0–0.29)
30–40	57	8 (14%)	0.15 ± 0.10	0.14 (0.0–0.39)
40–50	58	5 (8%)	0.18 ± 0.12	0.16 (0.0–0.49)
>50	33	1 (3%)	0.20 ± 0.12	0.21 (0.0–0.47)

Conclusion: The normal value for coronary intimal thickness increases with age. Accordingly, the definition of abnormal intimal thickness in clinical trials must be adjusted for patient age.

11:00 a.m.

907-3 Restenosis Following Minimally Traumatic Rotational Atherectomy is Associated With Higher Residual Plaque Burden-IVUS Results From the R&R Study

Gregory A. Braden, Teresa Young, Wendy Love. *Wake Forest University School of Medicine, Winston-Salem, North Carolina, USA*

Restenosis following balloon angioplasty and directional atherectomy has been associated with higher residual plaque burden (PB), however, the relationship of PB to restenosis following rotational atherectomy (RA) has not been evaluated. Pre, post and follow-up IVUS imaging was compared in the subset of the 100 patients in the R&R Study, a series of patients treated with a careful stepped burr technique followed by 1 atm oversized balloon to minimize vessel wall trauma. Angiographic restenosis occurred in 27% of these lesions. For the group, lumen area increased from RA by plaque removal while late lumen loss occurred secondary to neointimal proliferation (vascular remodeling did not occur). Compared to new restenosis lesions, those which restenosed had both larger lumens and substantially higher plaque areas.

	LA	PA	VA	mm^2
PreRA	1.75 ± 0.85	9.6 ± 0.3	11.3 ± 0.3	
Post RA	4.4 ± 0.1*	7.3 ± 0.2*	11.7 ± 0.3	
FU	4.0 ± 0.1*	8.4 ± 0.4*	12.5 ± 0.4	
POST RA				* p < 0.01
Restenosis	4.5 ± 0.1	7.2 ± 0.3	11.6 ± 0.6	
No Restenosis	5.25 ± 0.8*	8.7 ± 0.8*	14.0 ± 8*	

Conclusion: Minimal traumatic rotational atherectomy increases lumen size by plaque area removal, and late lumen loss is largely a proliferative process. Lesion restenosis is associated with larger lumens initially and larger residual plaque burdens.

11:15 a.m.

907-4 Intravascular Ultrasound Study of Residual Dissection Following Percutaneous Coronary Intervention

Takahiro Nishida, Carlo Briguori, Milena Adamian, Nicola Corvaja, Marco Vaghetti, Vaios Tzifos, Remo Albiero, Carlo Di Mario, Antonio Colombo. *Centro Cuore Columbus, Milan, Italy*

Background: The aim of the present study is to investigate severity of Residual Dissection (RD) on their outcomes following percutaneous interventions with unrestricted stent usage.

Methods: Minimal lumen area (MLA) at RD, area stenosis at RD, depth of vessel wall injury and axial length of RD were studied with intravascular ultrasound (IVUS) on 125 consecutive lesions accompanied by RD in 97 patients. Patients of acute myocardial infarction (MI), lesions treated with radioactive stents and in-stent restenotic lesions were excluded.

Results: The ACC/AHA type B2 and C lesion accounted for 119 lesions (95%). Stents were used in 82 lesions (66%) and angiographic success was achieved in all lesions. None of the lesion required repeat intervention during the hospital stay. No acute or subacute stent thrombosis occurred. In-hospital major adverse cardiac events (death, emergency coronary bypass surgery, Q-wave MI or non-Q-wave MI) occurred in 9 patients (9.3%). Type A dissection was found in 8 lesions (6.4%), type B in 102 (82%), type C in 14 (11%) and type D in 1 (0.8%). In all lesions, MLA at RD was 6.5 ± 3.1 mm, area stenosis at RD was 50 ± 13% and axial length of RD was 9.6 ± 9.0 mm. RD reached media in 92 lesions (74%). Angiographic follow-up was achieved in 94 lesions (75%) and restenosis was found in 27 lesions (29%). None of the above variable significantly correlated with the occurrence of in-hospital major adverse cardiac events. In lesions which developed restenosis, MLA at RD was smaller (5.1 ± 2.1 mm^2 vs 6.5 ± 2.9 mm^2, p = 0.022) and area stenosis at RD was larger (55 ± 14% vs 48 ± 13%, p = 0.045) compared to lesions without restenosis. The depth of RD and axial length of RD were similar between lesions with or without restenosis.

Conclusions: 1) Most of RD was type B and frequently reached media. 2) For short-term outcomes, area stenosis at RD ≤50% and ≤10 mm length of RD would be acceptable. 3) To minimize restenosis rate, area stenosis at RD site is an important variable and should be minimized.

11:30 a.m.

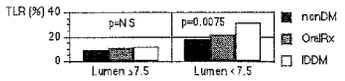
907-5 Increased In-Stent Restenosis in Diabetes is the Combination of Small Vessel Size and Exaggerated Intimal Hyperplasia

Gary S. Mintz, Roxana Mehran, Alexandra J. Lansky, Donald Harrington, Borjanka Leiboff, Kenneth M. Kent, Martin B. Leon. *Washington Hospital Center, Washington, DC, USA*

To understand the reasons for increased in-stent restenosis in diabetic (DM) pts, we analyzed procedural variables, intravascular ultrasound (IVUS) findings, and target lesion revascularization (TLR @1 yr) in 2853 lesions in 2242 pts according to DM status or treatment (Rx): nonDM, oral Rx, or insulin dependence (IDDM):

	nonDM	Oral Rx	IDDM	p
Balloon size (mm)	3.5 ± 0.6	3.5 ± 0.5	3.4 ± 0.6	0.07
Inflation pressure (atm)	15 ± 3	16 ± 3	16 ± 4	0.18
Reference lumen (mm^2)	8.5 ± 2.7	8.3 ± 2.7	7.9 ± 2.6	0.013
Final lumen (mm^2)	7.6 ± 5.7	7.4 ± 2.4	7.0 ± 2.4	0.0064

Despite similar procedural variables (balloon sizes & inflation pressures), final lumen dimensions were smaller in DM pts, *especially IDDM pts.* The overall mean IVUS final lumen area was 7.5 mm^2. Therefore, we assessed TLR according to DM status and IVUS final lumen area larger or smaller than 7.5 mm^2:



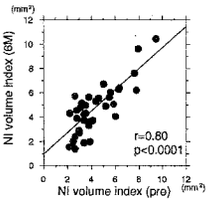
We conclude: Increased in-stent restenosis in diabetic pts is multifactorial. Smaller reference size and noncompliant lesion characteristics result in smaller final lumen areas upon which is superimposed an exaggerated neointimal response (higher TLR than non diabetic pts with the same lumen CSA). As a result lesions with a final lumen area <7.5 mm^2 in IDDM pts, have strikingly high TLR (31%).

11:45 a.m.

907-6 Extent of Neointima Predicts Subsequent Neointimal Proliferation in In-Stent Restenosis: A Volumetric Intravascular Ultrasound Study

Hiroyuki Okura, Thosaphol Limpijankit, Atsushi Takagi, David P. Lee, Yasuhiro Honda, Paul G. Yock, Peter J. Fitzgerald. *Stanford University Medical Center, Stanford, CA, USA*

Background: Pre-intervention plaque burden has been shown to impact the neointimal (NI) proliferation following de novo stent implantation. However, it is unknown whether plaque burden and thus the amount of NI accumulation at the time of in-stent restenosis (ISR) impact subsequent NI proliferation following treatments of ISR.



Methods: To clarify the relationship between the amount of preexisting in-stent neointima as well as plaque burden outside the stent and subsequent NI proliferation, serial (pre, post, and 6M) volumetric intravascular ultrasound analysis was performed in a total of 37 ISR lesions from the Stanford Core Laboratory database. Plaque and NI volume were calculated using Simpson's method.

Results: In-stent NI volume decreased significantly after interventions (rotational atherectomy, laser angioplasty, stent, and/or balloon angioplasty) to treat ISR (112.9 ± 100.0 to 65.9 ± 64.2 mm^3, $p < 0.01$), but increased significantly during 6M follow-up (138.0 ± 109.2 mm^3, $p < 0.01$). NI volume at 6M correlated well with plaque volume outside the stent prior to interventions ($r = 0.76$). In addition, NI volume index normalized by the stent length at 6M correlated well with both *pre*-intervention and *post*-intervention NI volume indexes (6M vs pre: $r = 0.80$, 6M vs post: $r = 0.54$).

Conclusions: Recurrent in-stent neointimal proliferation following catheter interventions to treat ISR is strongly influenced by both the amount of plaque volume outside the stent and initial NI volume prior to intervention despite the amount of neointimal removal by various devices. Adjunctive therapy (pharmacological, gene, or radiation) may be necessary to impact this biological component of ISR.