44% (only 4% with optimal quality) and 89% (only 36% with optimal quality) with conventional color Doppler respectively before and after C. PW Doppler results paralleled those of Harmonic CF. After C injection CF length increased from (mean ± SD) 5.2 ± 5 mm to 17.6 ± 10 mm (conventional), and 20 ± 7 mm (Harmonic) ($p < 0.01$ C vs baseline).

Conclusion: Blood flow in the distal LAD can be detected by transthoracic Harmonic color Doppler and PW Doppler along with C with a very high success rate. This high success rate makes this non invasive technique suitable for clinical application like coronary flow reserve assessment.

1050-120 Changes in Myocardial Blood Flow After Ischemia-Reperfusion: Quantitative Evaluation by Fluorescent Microspheres and Myocardial Contrast Echocardiography

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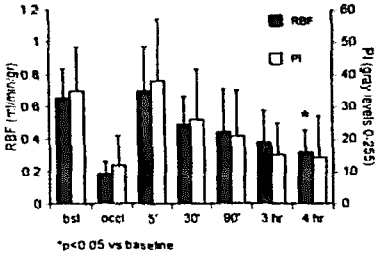
Background: A progressive reduction in myocardial blood flow has been observed following reperfusion of an occluded coronary artery. Myocardial contrast echo (MCE) is capable of detecting the absence of flow at the microvascular level. We hypothesized that MCE was able to assess serial changes of myocardial blood flow during post-occlusion reperfusion.

Methods: Ten dogs underwent 90 min or 3 hr LAD occlusion, followed by 4 hr reperfusion. Regional blood flow (RBF) was assessed by fluorescent microspheres at baseline (bsl), during coronary occlusion (occl) and 5', 30', 90', 3 h, 4 h during reperfusion. At the same time points, MCE was performed with Imagent® US (Alliance Pharm.) infused i.v. (2 ml/min). The heart was imaged in short axis using an epicardial transducer operating in harmonic mode (1.67–3.33 MHz, ATL). Gated end-systolic images were acquired in digital format on-line. Background-subtracted peak intensity (PI) and RBF were calculated for the risk area, identified as the non-perfused area during coronary occlusion both by MCE and blue dye staining.



Results: After initial return to baseline, a progressive reduction in blood flow was observed (graph). MCE correctly detected the time course of changes in flow during coronary occlusion-reperfusion. PI values significantly correlated with RBF data ($r = 0.8$; $p < 0.05$)

Conclusion: These data confirm that a progressive reduction in blood flow occurs within the myocardium reperfused after temporary occlusion. Serial changes in flow were accurately detected by MCE. This approach has potential application in the evaluation and management of post-ischemic reperfusion in humans.

1050-121 Myocardial Contrast Echocardiography Using Harmonic Imaging Can Be Used to Assess Collateral Function During Chronic Ischemia

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Normal resting myocardial perfusion can be maintained in an occluded vascular bed by collateral (coll) vessels. During exercise, however, coll may be inadequate in providing an adequate increase in myocardial blood flow. We tested the hypothesis that myocardial contrast echo (MCE) using harmonic imaging and intravenous (iv) contrast could quantify coll reserve in a chronic canine model of progressive ischemia. Eight dogs were instrumented (Day 0) with an ameroid constrictor placed around the left anterior descending artery (LAD) to cause gradual coronary occlusion (occ) by 3 weeks and coll growth in the LAD bed. On Day 0, end-systolic harmonic imaging using a slow intravenous bolus of MRX-115 was performed during transient LAD occ to delineate risk area. After 6 weeks, MCE was done at rest and with iv adenosine (0.4 mg/kg/min). Blood flow was derived using radioactive microspheres. Peak videointensity was measured in the LAD bed and normalized to the circumflex (LCX) and digital subtraction and color-coding were used to identify MCE perfusion defects (percent of the mid-papillary slice).

LAD risk area on Day 0 was 32% ± 9% and was barely detectable (6% ± 8%, $p < 0.001$) at 6 weeks. The ratio of peak intensity in the LAD bed normalized to the LCX (LAD/LCX) increased from 0.3 ± 0.2 on Day 0 to 1.0 ± 0.4 ($p < 0.001$) at 6 weeks, and paralleled an increase in transmural LAD/LCX flow from 0.1 ± 0.1 to 0.9 ± 0.2 ($p < 0.001$). With adenosine, MCE showed a relative perfusion defect (25% ± 4%) similar to the Day 0 risk area, peak LAD/LCX intensity decreased to 0.6 ± 0.2, and LAD/LCX flow fell to 0.4 ± 0.1 ($p < 0.05$). There was a significant linear relationship between peak LAD/LCX intensity and transmural LAD/LCX flow ($r = 0.64$, $p < 0.001$). We conclude that in this model of chronic ischemia-induced coll development, resting myocardial perfusion is maintained despite coronary occ and MCE confirms nearly homogenous perfusion at 6 weeks. Coll flow reserve in response to stress is impaired, however, and the relative degree of myocardial contrast opacification linearly relates to the magnitude of impairment. MCE using triggered harmonic imaging can be used to spatially charactenze and quantify coronary coll flow reserve.

1050-122 Contrast Echocardiographic Evaluation of Regional Myocardial Perfusion in a Porcine Model of Hibernating Myocardium

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Myocardial contrast perfusion echocardiography (MCE) has been used to assess myocardial viability in patients with ischemic LV dysfunction. To evaluate its ability to assess myocardial blood flow (MBF) in hibernating myocardium (HM), MCE was performed at 13 levels of reduced MBF in 6 pigs with HM (1 to 4 wks).

Methods: The model of HM was created with a left anterior descending coronary stenosis to reduce resting MBF from 0.84 ± 0.13 to 0.55 ± 0.34 ml/min/g and regional wall thickening from 40.7 ± 2.7% to 20.5 ± 15.1% (both $p < 0.01$). MCE was performed using a left atrial injection of 4 ml Albunex while imaging from a midventricular short axis view. Myocardial contrast intensities were determined at end-diastole and time-intensity curves were plotted for each experiment in the anterior and inferior (control) walls. The area under the time-intensity curve (A_{TIC}) and the peak intensity (I_P) were compared to MBF determined by flowmeter.

Results: The reduction of coronary flow by the ratio of A_{TIC} (x) from HM to normal (35% ± 27%) correlated well with the reduction of MBF by flowmetor (y, 38% ± 31%): $y = 1.13x - 0.74$, $r = 0.99$, $p < 0.01$, SEE = 4.46%). A slightly weaker correlation was found between the relative reduction in I_p measured by MCE versus flowmeter ($r = 0.89$, $p < 0.01$, SEE = 12.5%).

Conclusions. Myocardial contrast perfusion echocardiography can accurately measure the degree of myocardial hypoperfusion in hibernating myocardium. This method holds promise for the quantitative evaluation of dynamic changes of myocardial blood flow in ischemic myocardium.

1050-123 Relation of Myocardial Swelling and Regional Perfusion to Infarct Size Early After Reperfusion: Observations From Contrast Echo

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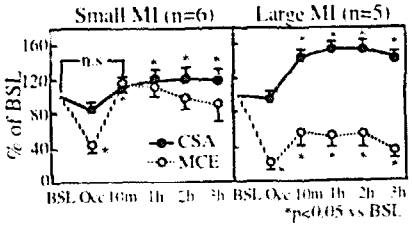
Both impaired perfusion by myocardial contrast echocardiography (MCE) and myocardial swelling (SWL) can be observed following myocardial reperfusion (REP). However, few data exist regarding either the relation of SWL to impaired perfusion or of these two phenomena to the extent of myocardial necrosis following REP. Thus, we performed MCE in short axis using IV 0.15 cc/kg preactivated QW7437 (Sonus) in 11 dogs at baseline (BSL), and during 3-hour LAD occlusion and 3-hour REP. From the risk segment (MCE defect during occlusion), we measured regional cross sectional wall area (CSA) and background-subtracted videointensity 90 sec after IV contrast normalized to nonischemic segments.

Results: (Figure) In 6 dogs infarction was SMALL (TTC unstained area < 50% of risk segment), and CSA increased only slightly while MCE uptake recovered at 10 min REP. Conversely, in 5 dogs with LARGE infarct (> 50% of risk area), CSA increased markedly at 10 min REP and MCE did not recover



from pre REP value. Changes in CSA and MCE at 10 min REP determined infarct size as 0.71 - CSA·0.17 - MCE·32 ($r = 0.91$, $p < 0.001$).

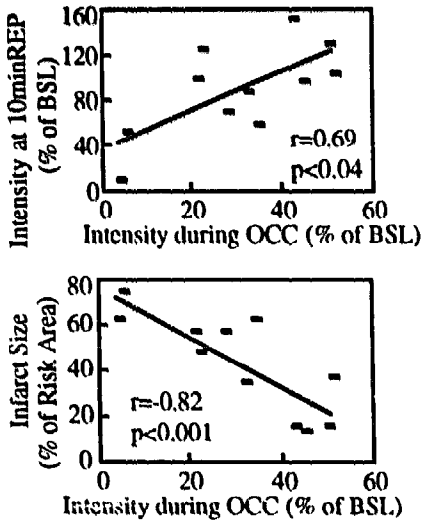
Conclusions: Following REP, variable degrees of wall swelling and MCE perfusion are observed. When wall swelling is mild, MCE returns to baseline and infarct size is reduced. When wall swelling is marked, MCE perfusion remains diminished and infarct size is large. The extent of change in wall thickness and MCE uptake correlate with infarct size, and may be of value in quantifying necrosis early after myocardial reperfusion.

1050-124 Residual Blood Supply to the Risk Area During Coronary Occlusion Limits Infarct Size Following Myocardial Reperfusion: Evidence From Contrast Echo

K. Ohmori, B. Cotter, E. Lelstad, A.N. DeMaria. *University of California at San Diego, San Diego, CA, USA*

The factors which determine the extent of myocardial salvage versus necrosis following reperfusion (REP) remain uncertain. Therefore, we used myocardial contrast echocardiography (MCE) to examine the role of residual perfusion within the risk area of an occluded coronary in determining the extent of infarction. We performed MCE in short axis image using IV 0.15 cc/kg pre-activated QW7437 (Sonus) in 11 dogs who underwent 3-hr LAD occlusion followed by 3-hr REP. At 3-hr occlusion and 10-min REP, mean background subtracted videointensity (VI) was measured from the risk segment (defined as MCE opacification defect at 3-hr occlusion) and was normalized to nonischemic segments. Infarct size was derived by triphenyl tetrazolium chloride as % unstained area to the risk area.

Results: (Figure) MCE-VI during occlusion (OCC) was taken as marker of residual blood supply, and showed a direct correlation with MCE-VI at 10-min REP ($r = 0.69$, $p < 0.04$). MCE-VI during occlusion showed a close inverse correlation with infarct size ($r = -0.82$, $p < 0.001$).



Conclusions: MCE evidence of residual blood flow in the risk area during occlusion correlates with the extent of infarction following reperfusion and the degree of post ischemic reactive hyperemia. These data are consistent with the concept that residual flow during occlusion reduces the extent of infarction either by preserving myocardial microcirculatory integrity or by avoiding reperfusion injury.

1051 New Echocardiographic Methods for Assessment of Left Ventricular Function

Monday, March 30, 1998, Noon–2:00 p.m.
Georgia World Congress Center, West Exhibit Hall Level
Presentation Hour: Noon–1:00 p.m.

1051-137 Immediate Effects of Partial Left Ventriculectomy on Regional Left Ventricular Function: Quantitative Assessment by Color Kinesis Echocardiography

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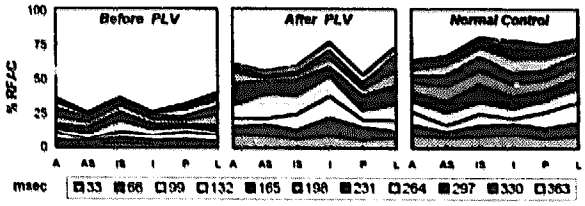
Partial left ventriculectomy (PLV) is a novel surgical therapy for pts with severe heart failure, however, its effects on regional LV function are not known. Accordingly, 8 consecutive heart failure pts, aged 58 ± 5 yrs, (EF 12 ± 3%) had color kinesis (CK) studies before and immediately after PLV. Transesophageal mid-LV short-axis color-coded CK images were digitally acquired at 30 Hz and analyzed by customized software (Mor-Avi et al, Univ. Chicago). Quantitative time-motion data were assessed from 6 segments: anterior (A), A-septal (AS), inferior (I), I-septal (IS), posterior (P) and lateral (L). A control group of 12 subjects, aged 52 ± 12 yrs, had similar CK analysis.



Regional fractional area change (RFAC) improved from 34 ± 11 to 53 ± 13*% after PLV (example shown) in all segments except the posterior PLV site (*$p < 0.05$ vs. before). RFAC remained less than control: 74 ± 10% ($p < 0.05$).

Conclusion: PLV results in an immediate improvement in regional LV function by quantitative CK. Long term results and their relation to pt outcome remain to be defined.

1051-138 Echocardiographic Detection of Regional Diastolic Dysfunction in Patients With Coronary Artery Disease and Normal Wall Motion

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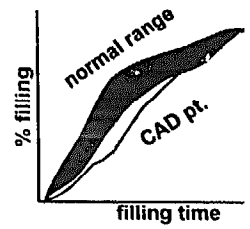
Background: Prolonged regional relaxation and delayed endocardial motion precede systolic dysfunction in myocardial ischemia. Color Kinesis (CK) allows direct quantification of the timing of regional endocardial motion. Our aim was to determine whether Color Kinesis could detect regional diastolic dysfunction at rest in patients with coronary artery disease (CAD) and no echocardiographic evidence of regional wall motion abnormality.

Methods: We studied 29 normal subjects and 14 patients with CAD. Regional diastolic endocardial motion was quantified using custom software applied to diastolic CK images, which resulted in regional LV filling time-curves. For each segment, curves obtained in normal subjects were averaged to generate a normal range for comparisons with individual patients' data. Regional filling curves were correlated with the findings of coronary angiography on a segmental basis. Significant coronary stenosis was defined as ≥70% luminal narrowing.

Results: Delayed early diastolic endocardial motion was detected in 37/168 segments, all supplied by stenotic coronary arteries. In 6 patients, 16/168 segments showed normal regional filling curves despite significant stenosis. Three of these six patients had evidence of collateral circulation



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