Correlation between fractional flow reserve and intravascular ultrasound in patients with isolated ambiguous left main stenosis

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Background: Fractional flow reserve (FFR) is a “golden standard” in determining hemodynamic significance of ambiguous lesions and provides guidance on appropriate-ness of revascularization. The cut-off values for intravascular ultrasound (IVUS) parameters corresponding to FFR of 0.75 or 0.80 are still under investigation. The aim of this study was to determine best IVUS criteria for predicting physiological significance of left main coronary artery (LMCA) stenosis with FFR as the standard.

Methods: FFR values during adenosine infusion (at the rate of 1.40 µg/kg/min - femoral venous injection) were calculated in 95 patients aged 58 ± 10 years with an angiographically ambiguous LMCA stenosis. Subsequently, all patients underwent IVUS with automatic pullback at a constant speed of 0.5 mm/sec, from the middle segment of left descending artery (LAD) to the aorto-ostial junction of LMCA. The following IVUS parameters were analyzed: minimum lumen area (MLA, mm²), minimum lumen diameter (MLD, mm), the maximum plaque burden (PB, %), and percent area stenosis (%AS, %).

Results: The averaged FFR was 0.77 ± 0.10 (range 0.51-0.99). FFR ≤ 0.75 was observed in 42 patients (42.4%). Linear regression analysis revealed a strong correlation between the values of FFR and MLA (AUC = 0.86, p <0.001), PB (AUC = 0.64, p <0.001), %AS (AUC = 0.72, p <0.0002) and the MLA and MLD (AUC = 0.75, p <0.0001). Cut off points for the value of FFR ≤ 0.75 were: <5.59 mm² for MLA (sensitivity 0.69 and specificity 0.85), >9.79% for PB (sensitivity 0.77 and specificity 0.48), >36% for %AS (sensitivity 0.94 and specificity 0.44) and ≤2.9 mm for MLD (sensitivity 0.97 and specificity 0.50), respectively.

Conclusions: Strong correlation between FFR and LMCA lesion critical IVUS parameters was found in our patient group. MLA value of ≤5.99 mm² in IVUS seems to be a useful criterion for predicting FFR ≤ 0.75.

Plaque Neovascularization Correlates With Thermal Heterogeneity As Measured By Microwave Radiometry

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Background: Both neangiogenesis and inflammation contribute in atherosclerosis progression. Contrast-enhanced ultrasound (CEUS) provides visualization of plaque neovascularization. Microwave radiometry (MR) allows in vivo non-invasive measuring of temporal change of tissues, reflecting inflammatory activation. We assessed the association of carotid plaque temperature, measured by MR, with plaque neovascularization assessed by CEUS.

Methods: Consecutive patients with coronary artery disease and carotid atherosclerosis underwent carotid ultrasound imaging, CEUS and MR. Plaque texture, plaque surface, and plaque echogenicity were analyzed. Contrast enhancement (CE) by CEUS was defined as the percentage of signal intensity difference, prior and post contrast infusion. Thermal heterogeneity (ΔT) was assigned as maximum temperature along the carotid artery minus minimum.

Results: Eighty-six carotid arteries of 48 patients were included. Fatty plaques had higher CE% compared to mixed and calcified (21.4±2.70 versus 17.1±5.52 versus 8.55±2.42, p<0.01). Heterogeneous plaques had higher CE% compared to homogeneous (21.4±2.7 versus 14.66±6.02%, p<0.01). Plaques with irregular surface had higher CE% compared to plaques with regular (18.29±5.09 versus 13.64±6.06%, p<0.01). Fatty plaques had higher ΔT compared to mixed and calcified (1.3±0.27 versus 0.95±0.34 versus 0.83±0.32°C, p<0.01). Plaques with irregular surface had higher ΔT compared to plaques with regular (1.05±0.32 versus 0.75±0.32°C, p<0.01). Heterogeneous plaques had higher ΔT compared to homogenous (1.13±0.27 versus 0.83±0.37°C, p<0.01). There was a good correlation between ΔT and CE (R=0.60, p<0.001).

Conclusions: Carotid plaque neovascularization on CEUS examination is associated with thermal heterogeneity and ultrasound characteristics of plaque vulnerability.

Rate of Plaque Negative to Plaque Positive Conversion in Patients by Serial 64-Slice Computed Tomography Coronary Angiography (CTCA)

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Background: This retrospective study sought to demonstrate coronary plaque regression as assessed by CTCA occurs much more frequently than expected and may be related to medical therapy that includes statins and Vitamin D.

Methods: Using our CTA database, we studied patients undergoing CTA for any reason between 2004 and 2011. The morphologic characteristics of plaques that evolved into culprit lesions were compared to plaques which remained quiescent.

Results: Between 2004 and 2011, 241 consecutive patients were identified that underwent serial 64-slice CTCA studies over a mean period of 34.6 months. Incidence and Morphologic Characteristics of Plaques that Evolve into Culprit Lesions: A Coronary CT Angiography Natural History Study

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Background: The defining morphologic characteristics of plaques that progress to culprit lesions have not been delineated. This study was undertaken to determine if plaques that evolve late to become culprit lesions have distinct morphologic features by coronary CT angiography (CTCA) compared to plaques which remain quiescent.

Methods: Using our CTA database, we studied patients undergoing CTCA for any reason who were ultimately determined not to have a culprit lesion. From this population, we identified patients who subsequently presented with acute coronary syndrome (ACS) >45 days later, and were found to have a new culprit lesion by invasive angiography. Among these patients, the index CTA was analyzed in a blinded fashion for plaque morphology. The morphologic characteristics of plaques observed by CT to evolve into culprit lesions were compared to those which remained clinically silent.

Results: Among 4,459 patients undergoing CTA, a total of 9,718 plaques were present. There were 24 patients who subsequently developed ACS >45 days (mean 609±324 days) after their index CTA. The index CTA plaque scores showed that plaques which subsequently evolved to culprit lesions (n=24) had a median calcium score (CCS) of 31% (145±25) versus 20% (141±23) for plaques which remained quiescent.

Conclusions: This study indicates that coronary artery disease regression as assessed by CTCA occurs much more frequently than expected and may be related to medical therapy that includes statins and Vitamin D.
However, the morphology of plaques which evolved into culprit lesions was not significantly different from those lesions which remained clinically silent (Table 1).

Table 1

| CTA Morphologic Characteristics of Plaques that Evolved into Culprit Lesions and Those That Did Not |
|---------------------------------------------------------------|-------------------------------|
| Future Culprits                                               | Non-culprits                  |
| N=25 (%)                                                      | N=100 (%)                     |
| Diameter stenosis (%)                                         |                               |
| 49 +/- 17                                                    | 45 +/- 13                     | 0.14 |
| Heavily calcified                                             |                               |
| 9 (36)                                                        | 35 (35)                       | 1    |
| Mixed                                                         |                               |
| 2 (8)                                                         | 28 (26)                       | 0.04 |
| Non-calculated                                                |                               |
| 13 (52)                                                       | 37 (37)                       | 0.18 |
| Disrupted                                                     |                               |
| 3 (12)                                                        | 17 (17)                       | 0.76 |
| Plate volume (mm³)                                            |                               |
| 137 +/- 84                                                    | 133 +/- 81                    | 0.84 |
| Remodeling index                                              |                               |
| 1.3 +/- 0.3                                                  | 1.3 +/- 0.3                   | 0.71 |
| Positively-remodeled                                         |                               |
| 17 (68)                                                       | 75 (75)                       | 0.46 |
| Proportionate volume LAP (%)                                  |                               |
| 15 +/- 11                                                     | 16 +/- 10                     | 0.49 |
| Volume LAP (mm²)                                              |                               |
| 21 +/- 21                                                     | 22 +/- 19                     | 0.92 |

Conclusions: We found no significant differences in the morphology of plaques which evolved into culprit lesions compared to those which remained clinically silent. Interestingly, in this large CTA database, the incidence of plaques evolving into culprit lesions and causing ACS was remarkably low.

Cath Lab Advances

Hall D

Tuesday, October 23, 2012, 8:00 AM–10:00 AM

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TCT-314

A Bridging Solution For Hybrid Operating Suites: Periprocedural New Generation C-arm Imaging During Cardiac Interventional Procedures

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Background: Transcatheter valve interventions, hybrid coronary and aortic disease procedures require angiographic intraoperative imaging supporting a heart team approach. Facing limited financial and logistic possibilities of many medical centers, alternative periprocedural imaging strategies should be investigated.

Methods: Between 2/2001 and 3/2012, 424 pts were evaluated and treated using 4 different types of mobile c-arms: GE OEC 9800 (325), Siemens Arcadis (5), Philips Veradus (17), Ziehm RFD (77). TAVI (n=85) was performed via transfemoral, transapical, transradial or transaxillary access sites. Bail out intraoperative angiography was considered in elective CABG, valve or transplant surgery with occurrence of myocardial ischemia. Coronary bypass grafts were assessed in 318 pts during implementation of new procedures.

Results: We observed a steady increase of intraoperative imaging from 23 to > 50 cases per year during the last decade (p=0.002). 84/85 TAVI procedures were completed without valve malposition or coronary obstruction. In one pt valve embolization occurred with successful bailout open surgery. There were 3 cases of system crashes, one procedure was deviated from TAVI to open surgery. Anastomotic or graft revision after endoscopic grafting was required in 11/375(3%). Emergency intraoperative angiography for signs of myocardial ischemia was needed in 14 pts(4 after CABG, 2 after AVR, 7 after MVR and 1 cardiac transplant recipient), in all but 2 pts at least one additional graft was needed. Bail out aortic stenting was needed in 7 pts and performed using conventional and digital subtraction angiography and roadmapping. Median duration for coronary evaluation was 22 (10-110) min, fluoroscopy time was 413 (89-2282) sec, cumulative radiation (dose area product) was 46.261 (9.381-429.787) mGy/cm². The amount of contrast agent used was 150 (20 to 600) ml.

Conclusions: The use of periprocedural new generation mobile c-arm imaging in the operation room is very useful for transcatheter valve and aortic interventions as well as coronary artery graft evaluation and allows bail-out procedures without time delay. This approach may represent a bridging solution to a fully equipped hybrid operating room.

TCT-315

A hybrid simulator for femoral artery access training

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Background: Femoral artery puncture is the most common method of vascular access for all kinds of endovascular procedures. The possible complications of the femoral artery puncture are diverse and partially critical. Local complications may include hematoma, pseudoaneurysm, formation of arteriovenous fistula and retroperitoneal bleeding.

Methods: Femoral artery puncture should be learned with a hybrid endovascular simulator. We invented and constructed a totally new hybrid simulator to put the idea into action. The simulator allows to palpate the human inguinal region with prominent landmarks like the spina iliaca anterior superior, inguinal ligament and inguinal crease for the correct identification of the puncture site and offers a pulsatile flow and a haemodynamic model. All variables are controlled through a microprocessor and can be controlled from an Apple iPad tablet computer. Standard and non-standard cardiovascular conditions can be simulated as well as different morphological artery-related conditions.

Results: We were able to present a fully functioning new hybrid simulator to train femoral artery puncture and Seldinger technique under standard and non-standard morphological and hemodynamic conditions.

Conclusions: Novices in the Cathlab should learn and train femoral artery access and puncture technique with our simulator before they start their work in a cathlab. The simulator will now be evaluated in a controlled trial and trainees performance will be checked by experts supervision and usage of a technical skills evaluation scale.

TCT-316

Radiation Dose Surveillance Using Automated, Remote-site Dose Monitoring In Cardiac Catheterization Laboratories Across Asia Pacific

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Background: Surveillance of patient radiation dose in cardiac catheterization laboratories is a prerequisite in the benchmarking effort across Asia Pacific. We validated the use of an automated, remote-site dose monitoring technology at our center and analyzed the trends in patient radiation dose across Asia Pacific.

Methods: The onsite dose records for dose area product (DAP), total dose (mGy) and fluoroscopic time (TI) were cross-referenced with remote site monitoring by General Electrics (GE) healthcare. Secondly, data was collected across eight centers, including Singapore (n=154), Japan (n=307), Indonesia (n=342) and Korea (n=139) using this technology. Parameters measured include DAP, TI and equivalent patient thickness (EPT) summarized using 75th percentile. Type and complexity of procedures were not taken into account.

Results: DAP (mean difference (d) = 1.6 Gy.cm², limit of agreement (LOA) = -1.10 to 4.33), total dose (d=0.2 mGy, LOA = -1.75 to 2.29) and TI (d=1.6 min, LOA=-9.7 to 12.9) demonstrated good agreement between dose records from both onsite and remote monitoring. Despite similar EPT (20.5 to 24.9), DAP and TI were as follows: Singapore (60.4 Gy.cm²; 13.1 min), Japan (48 to 135 Gy.cm²; 21.0 to 40.5 min), Indonesia (152 to 163 Gy.cm²; 19.8 to 24.3 min) and Korea (85 Gy.cm²; 7.4 min).

Conclusions: Based on our preliminary analysis, radiation dose varied widely amongst centers. Automated, remote-site dose monitoring has the potential to increase dose awareness and establish benchmarking standards across cardiac catheterization laboratories in Asia Pacific.

TUESDAY, OCTOBER 23, 8:00 AM–10:00 AM