Native Coronary Artery Plaque Composition of Intermediate Lesions as Assessed by Virtual Histology Intra-Vascular Ultrasound - Potential Implications for Interventional Strategy

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Background – One of the main morphologic characteristics of vulnerable plaque is a large necrotic core (NC). As most of acute rupture plaque events occur at lesion with mild stenosis we sought to investigate, using IVUS radiofrequency data analysis (virtual histology, VH), the NC distribution in coronary segments containing intermediate lesions

Methods - We have analyzed 42 native coronary segments with denovo lesions obtained from 26 non-ST elevation myocardial infraction patients (81% men, mean age 63±10.6 years, diabetes 50%, and unstable angina 50%). IVUS was performed using automatic pullback and ~2400 slices were analyzed for VH. Maximal necrotic core was defined by absolute NC area.

Results – Investigated segment location included LM 2, LAD/Diagonal 22, LCX/OM 15, Ramus 1 and RCA 2. The mean segment and lesion length were 31±20mm 12±7mm, respectively. Maximal NC area was present at MLD site in 35%, proximal to MLD site in 51% and distal to it in 14% of segments. The mean distance between MLD site and non-MLD Max NC site was 8.5±7 mm. Maximal NC area had less plaque burden, ~50% larger NC area and calcification and significantly less fibrous and fibrofatty tissues, compared to MLD site (Table). Max NC area was inversely related to plaque burden (r= -0.1147, p=0.0001) and to %FF (r= -0.684, p=0.0001), was proportional to %Ca (r=0.68, p=0.001).

IVUS/VH	MLD site	Non-MLD Max NC site
CSA	4.44±1.62	7.76+3.95
Plaque burden (%)	67±11	57.68±9.18
NC area (mm^2)	0.97±0.77	1.46±0.87
NC (%)	16.44±10	22.4±10.14
Calcium (%)	8.14±8.18	13.4±9.56
Fibrous (%)	73.63±43.94	53.28±14.73
Fibrofatty (%)	17.88±13.55	10.88±7.42

* P<0.0001 for all comparisons

Conclusions – In segments containing intermediate lesion, plaque containing maximal NC area is often located in angiographycally segments adjacent to the MLD site. This preliminary observation may carry implications for designing optimal interventional strategies and should be evaluated in larger patient's population.

Computerized Gradual Angioplasty Improves Outcome of Coronary Stenting – Final Results of a Randomized Controlled Trial

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Background: Mechanical trauma caused by PCI is a major reason for restenosis and subsequent target lesion revascularization (TLR). Drug-eluting stents (DES) reduce this problem as compared to bare-metal stents (BMS) with an increased risk of late thrombosis. To minimize this trauma we developed an automated computerized device with slow and gradual inflation (CAPSID). In a previous study in patients undergoing POBA or stenting we demonstrated improved outcomes particularly in the stented patients. The objective of this prospective study was to examine whether use of CAPSID reduced MACE and TLR in patients undergoing stenting.

Methods: Patients undergoing stenting were eligible for the study and randomized to CAPSID or standard manual inflation. Exclusion criteria were acute MI, total occlusions, bifurcation lesions, or vein grafts. Clinical follow-up for MACE was performed up to 12 months, with repeat coronary angiography performed for clinical symptoms or positive stress testing with TLR as needed.

Results: 310 patients have been randomized and have completed 12 month follow-up. Baseline clinical characteristics were similar, including age, sex, risk factors, the number of patients with unstable coronary syndromes, QCA data in both the CAPSID and control groups. 90% of the patients in each group received BMS. There was a significant reduction in MACE (death, MI, TLR) in the CAPSID group - 8% vs. 18% in the control group based on significant reductions in MI (1% vs. 7%) and TLR (5% vs. 12%) in the CAPSID group, $p<0.05$.

Conclusions: Gradual computerized balloon inflation using the CAPSID device results in a reduction in MACE and TLR in patients undergoing stenting. This method may be a valuable adjunct to BMS implantation which may provide results comparable to DES without the risk of late thrombosis.

Coronary Optical Coherence Tomography (OCT) – A Single Center Experience

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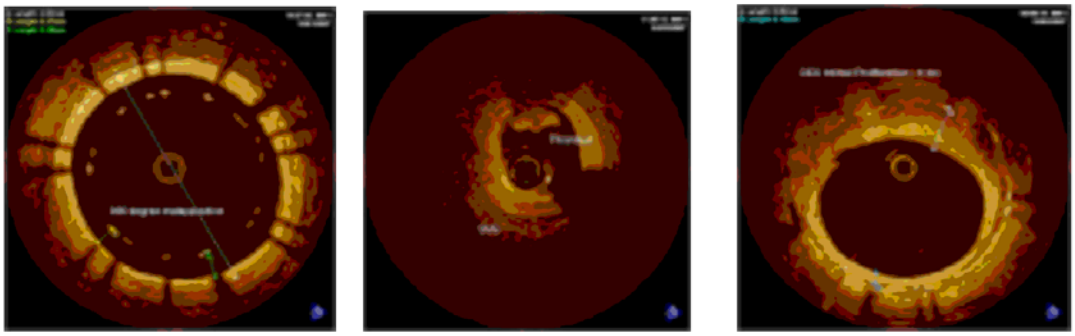
Background: OCT is a new high-resolution light-base infrared imaging modality for visualization of intra-coronary microstructures during the course of PCI.
Objective: To evaluate the use of intra-coronary OCT among patients undergoing coronary angiography and angioplasty for feasibility, safety and imaged findings.
Methods and Results: OCT was employed in 6 patients. Two patients with occlusive balloon technique while in four patients imaging was obtained with non occlusive technique. The mean age was 63±7 yrs, the majority had unstable angina at presentation (67%), four patients had pre and post stent deployment imaging for optimal stent deployment. In every case imaged, an unexpected finding has been revealed. For example (Figure): case #1 (left panel) showed severe DES mal-apposition of 360° that was well corrected with post dilatation; case #2 (middle panel) demonstrated thrombus containing lesion with tissue prolapse following angioplasty of a totally occluded graft; Case #3 (right panel) showed intimal proliferation @4 months after DES implantation. All OCT procedures went uneventfully.



Conclusions- Intra-coronary OCT imaging is feasible and seems to be safe. It provides high resolution imaged insights into intimal tissue, fibrous cap, stent apposition, tissue prolapse and the presence of thrombus in atherosclerotic lesions.

Bifurcation Lesions in the Coronary Arteries: Association between Geometric Changes after Intervention and Clinical Results

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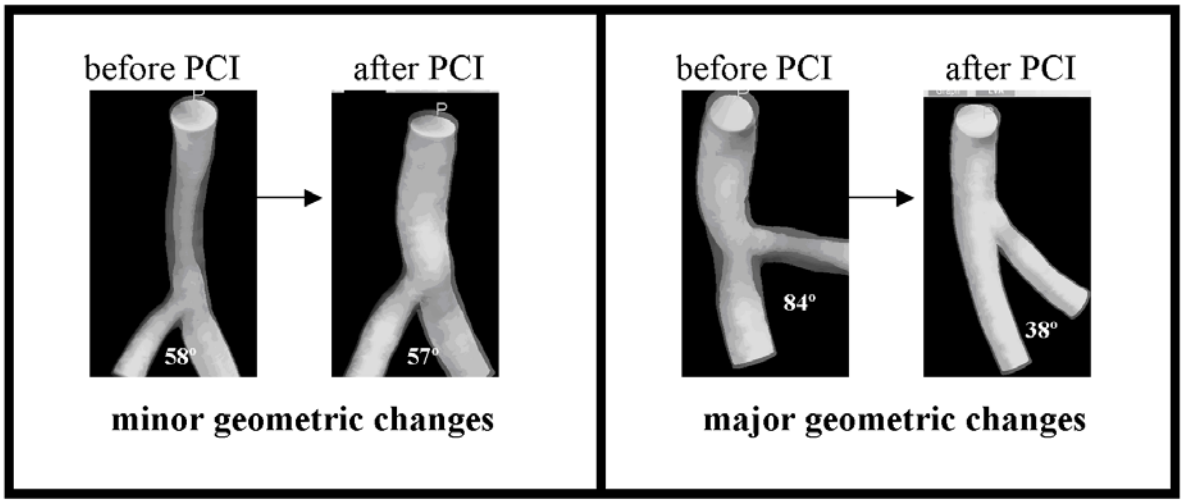
Background: Recent studies show that after bifurcation percutaneous coronary interventions (PCIs) severe morphological changes might occur. These changes appear especially at the angle between the distal main-branch and the side-branch (DMB-SB), with clinical impact that is not known yet.
Objectives: To evaluate clinical outcome of bifurcation PCIs according to the severity of angulation changes between bifurcation branches after the procedure
Methods: We used the CardiOp (Paieon Medical) system for 3-dimensional reconstruction of the coronary vessels. We conducted evaluation of 118 images from 23 patients (78% men, age 60±14 years) with bifurcation lesions in the coronary arteries undergoing angioplasty procedures. We included only interventions performed in both the main vessel and the side-branch (non-provisional) and only cases where no drug-eluting stents were used. Angles between bifurcation branches were measured, before and after stenting. For each patient a follow-up clinical evaluation was performed for up to 1 year with documentation of adverse-events such as death, myocardial infarction or need for repeat revascularization.
Results: Of the 23 patients studied, 10 patients (43%) needed target-vessel revascularization in 1-year follow-up (the TVR group). In the TVR group a non-significant trend towards a decrease in DMB-SB angle appeared (67±20 degrees vs. 54±18, p=0.13) whereas in the non-TVR group there was almost no change in the mean angle after PCI (60±14 vs. 63±18), this difference between the TVR group and the non-TVR group is statistically significant ($p<0.05$). Significant decrease in DMB-SB angle (more than 15 degrees) appeared in 40% of cases in the TVR group whereas in no patients of the non-TVR group ($p<0.05$).
Conclusion: Interventions at coronary bifurcations could result in significant geometrical changes. After intervention, a severe decrease in the angle between the distal-main branch and the side-branch could be associated with increased restenosis.



Atherosclerotic Coronary Plaque Characteristics in Diabetic Compared to Non-Diabetic Patients - Insights from Comprehensive Virtual Histology Analysis

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Background – Diabetic patients known to have more diffuse coronary artery disease. Preliminary IVUS radiofrequency data analysis (virtual histology, VH) also suggest larger necrotic core (NC) in culprit lesions of patient with diabetes. However, the relation between diabetics and NC distribution in non-severe coronary obstruction was not fully elucidated. Accordingly, we sought to investigate plaque characteristics of whole coronary segments containing intermediate lesions in patients with and without diabetes.

Methods - We have analyzed 39 native coronary segments with denovo lesions obtained from 23 non-ST elevation myocardial infraction patients (83% men, mean age 64±11, unstable angina 56%, hypercholesterolemia 82%). IVUS was performed using automatic pullback and ~2100 slices were analyzed for VH. Comparison between groups was performed for most severe obstruction [minimal luminal diameter, (MLD)] and for maximal necrotic core sites.

Results – In diabetic patients, plaque composition at MLD site contained less fibrous tissue but other wise was similar to non-diabetic patients. Maximal NC area sites also differed between groups (Table). Strong correlation was noted between NC% and calcium deposition ($r=0.79$ and 0.61 for diabetics and non diabetics, respectively, $p<0.0001$ for both), whereas inverse correlation was noted between NC% and fibrous tissue in both groups ($r= -0.58$ and -0.68, respectively, $p<0.001$).

	Diabetes		Non-Diabetes	
IVUS/VH	MLD site	Non-MLD Max NC	MLD site	Non-MLD Max NC
CSA	4.5±1.8	6.2±2.1	4.8±1.6	7.1±3.1
Plaque burden (%)	69±12	63±8	66±1	59±11
NC area (mm2)	1.08±0.97	1.68±1	0.88±0.58	1.35±0.81
NC (%)	16.5±11.48	24.5±10.3	16.1±9.2	22.4±9.4
Calcium (%)	9.9±10.6	15.5±10.7*	5.7±5.0	9.8±5.7*
Fibrous (%)	53.0±12.05¶	49.9±14.7**	63.5±9.1¶	58.0±12.0**
Fibrofatty (%)	20.5±15.2	10.1±7.6	14.6±8.4	9.8±5.8

*, **, ¶: p value <0.05 between compared parameters.

Conclusions – Plaque composition of atherosclerotic coronary segments containing intermediate lesions in diabetics and non-diabetics differ in the amount of fibrous and calcified tissues. Similar relations between NC and other plaque components may suggest similar pathophysiological process. Further studies are needed to explore these early observations.

"Normal Coronary Artery" with Slow Flow Improved by Adenosine Injection, Not so Normal for the Myocytes

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Background: Some patients with chest pain and ischemia by objective criteria, undergoing coronary angiography, show no significant coronary narrowing (CN) but slow flow. For these cases we challenge the entity "normal coronary arteries".

Methods: 35 patients with chest pain and evidence of ischemia (dynamic ECG changes, ischemia at exercise test, radioisotope scan or stress echo), underwent coronary angiography. No significant CN (>50% minimal lumen diameter stenosis) was found but there was a slow coronary flow phenomena defined by angiography frames count (FC) for each coronary artery. Intra coronary (IC) adenosine was given (40-80 micrograms) followed by repeat dye injection with FC (at the same projections) and LV pressure recording.

Results:

	LAD FC	LCX FC	RCA FC
Pre Adenosine IC injection	45±12	26±8	26±7
Post Adenosine IC injection	18±3	14±4	15±6
Post/Pre	0.40	0.53	0.57

Mean LV diastolic pressure and trans-myocardial gradient where 11.5±4 and 82±12 mmHg respectively.

Conclusions: Slow coronary flow with no epicardial artery narrowing, indicates failure to deliver sufficient blood to meet the myocytes metabolic demand due to small intramyocardial blood vessel malfunction. The good but short term response to adenosine injection calls for specific oral medication (Dipyridamole? Calcium channel blocker?) to get a similar long term effect in addition to the general recommendation of risk factors modifications.