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Optical Coherence Tomography can be combined with angiography to create highly accurate patient-specific models of human coronary anatomy in a rapid automated manner.

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Background: Optical coherency tomography (OCT) presents high fidelity intra coronary imaging, which may improve the spatial resolution offered by current coronary reconstruction methods. In this study, we applied a new approach to generate patient-specific virtual coronary anatomy models by combining OCT imaging with angiography.

Methods: Invasive angiography and OCT was prospectively acquired in 21 coronary vessels from 19 patients using the routine clinical approach for both. A custom algorithm traced the OCT contours and mapped them in 3D-space upon the angiographically derived centreline to produce a patient specific 3D-model of the coronary vessel.

Results: The reconstructions showcase the high in-plane and longitudinal resolution of OCT, capturing the geometrical irregularities in detail. The final construction had the high resolution of the original OCT (in-plane:10µm longitudinal:0.2mm). Phantom modeling confirms that the technique process produces realistic models. Reconstruction was semi-automated with minimal input and output was produced within 7±0.5 seconds/frame (average 232 frames/vessel).

Conclusions: High fidelity, high resolution, realistic patient-specific models can be constructed using available clinical tools, without additional acquisition time in the catheter lab. By applying OCT-derived contours, the models more accurately reflect patient geometry and overcome the inherent limitations of angiographic reconstruction which assumes elliptical lumen. This may facilitate greater accuracy from computer patient geometry and overcome the inherent limitations of angiographic reconstruction. For accurate assessment of plaque volume and IMT. For accurate assessment of plaque volume and thickness, intravascular ultrasound imaging is more reliable than OCT especially for the assessment of transplant vasculopathy.

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Comparison of Intravascular Ultrasound (IVUS) and Optical Coherence Tomography (OCT) assessment of Coronary Allograft Vasculopathy (CAV) in patients after orthotopic heart transplantation

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Background: Coronary allograft vasculopathy (CAV) is a major cause of graft failure. Intravascular Ultrasound (IVUS) is more sensitive than angiography for detecting early CAV. The newer imaging modality of Optical Coherence Tomography (OCT) has not been assessed for CAV. We compared intravascular imaging of coronary arteries after heart transplantation utilizing IVUS and OCT.

Methods: 17 patients with OHT were enrolled in this study. The left anterior descending coronary artery (LAD) was imaged by IVUS and OCT. 20 sections distributed evenly of the LAD were used to compare the measurements of the diameter and the area of the external elastic membrane (EEM), calculated plaque area, and intima-media thickness (IMT) between IVUS and OCT.

Results: The borders of the EEM were visualized and the vessel area was measured in 37% of OCT cases, compared to 90% of IVUS images (p<0.001). Figure 1 shows the ability to detect the EEM on OCT and IVUS was compared for smaller and larger plaques determined by IVUS measurements.

Conclusions: We identified a significant difference in the ability of IVUS and OCT to detect the EEM in patients following cardiac transplantation. The lack of EEM border detection affects the measurements of plaque volume and IMT. Larger volume of plaque and IMT affect the ability of OCT to assess plaque volume and IMT. For accurate assessment of plaque volume and thickness, intravascular ultrasound imaging is more reliable than OCT especially for the assessment of transplant vasculopathy.

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Association between Glycemic Variability and Coronary Tissue Characteristics in Patients with Acute Coronary Syndromes

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Background: Glycemic variability is receiving considerable attention as a new risk factor for coronary artery disease. This study aimed to assess the effect of glycemic variability on tissue characteristics of coronary atherosclerotic plaques as assessed by integrated backscatter intravascular ultrasound (IB-IVUS).

Methods: In 66 patients with acute coronary syndromes, culprit vessels were evaluated at 1 mm intervals (length analyzed: 62.2±24 mm) by gray-scale and IB-IVUS before balloon dilatation or stent implantation. Thrombus aspiration was performed prior to IVUS as necessary. Standard IVUS parameters were assessed as a volume index (volume/length), and plaque components were evaluated by III-IVUS as % tissue volume. In addition to conventional glycermic parameters, glycemic variability in a stable state was determined by calculating the mean amplitude of glycemic excursions (MAGE) using a continuous glucose monitoring system.

Results: While fasting plasma glucose and HbA1c levels were not related to any IVUS parameters, higher MAGE correlated with larger vessel and plaque volumes, higher % lipid volume, and lower % fibrous volume (Figure). Insulin resistance as assessed by HOMA-IR positively correlated with vessel and plaque volumes, but not with % plaque components. In multiple regression analysis, higher MAGE was independently associated with higher % lipid volume.

Conclusions: Higher glucose variability was associated with increased lipid and decreased fibrous contents with larger plaque burden, suggesting glycemic variability as one of the important factors related to coronary plaque vulnerability.