HIGH SPEED INTRA-CORONARY OPTICAL FREQUENCY DOMAIN IMAGING: IMPLICATIONS FOR THREE-DIMENSIONAL RECONSTRUCTION AND QUANTITATIVE ANALYSIS

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Background: Optical frequency domain imaging (OFDI) developed by Terumo is capable of acquiring 160 frames/s at different pullback speeds (20, 30, 40mm/s). Faster pullbacks reduce the contrast volume needed to create a blood-free environment for image acquisition. The objectives are to assess the reproducibility of quantitative analysis of OFDI acquired at different pullback speeds as well as the impact of cardiac motion artefact on the three-dimensional (3D) reconstructions.

Methods: A total of 36 OFDI pullbacks were obtained pre- and post-stent implantation at the pullback speeds of 20, 30 and 40mm/s in non-diseased swine coronary arteries. The amount of x-ray contrast needed for blood clearance during OFDI imaging was recorded. Three-dimensional images of stented segment were rendered and the number of misalignments due to cardiac motion artefacts on 3D images were assessed. Lumen areas (LA) were measured on each individual frame in pre- and post-stent pullbacks.

Results: The volume of contrast used with a pullback speed of 40mm/s was significantly smaller than with those of 30 and 20mm/s (10.8±1.8, 12.9±1.6, 15.9±2.6ml, p<0.01, respectively). Three-dimensional reconstruction was feasible in all pullbacks. Faster pullback speeds resulted in a smaller number of artefacts. For quantitative measurement, a total of 7426 frames were analyzed. In non-stented vessel, LA derived from corresponding selected frames increased significantly with increasing pullback speeds (6.35±2.14 vs. 6.58±2.10 mm² for 20 vs. 30mm/s [p<0.001], 6.36±2.13 vs. 6.75±2.09mm² for 20 vs. 40mm/s [p<0.001]), whereas in stented vessel there was no significant difference in mean LA between the three different pullback speeds (6.75±1.30 vs. 6.78±1.36mm² for 20 vs. 30mm/s [N.S.], 6.74±1.30 vs. 6.76±1.31mm² for 20 vs. 40mm/s, [N.S.]).

Conclusions: Quantitative analysis of OFDI obtained at different pullback speeds in non-stented coronary arteries could potentially vary in LA measurement. OFDI with high-speed pullback allows quantitative analysis of stented vessels while reducing the amount of contrast and the cardiac motion artefacts.