TCT-618
Fractional Flow Reserve Assessment of Left Main Stenosis in the Presence of Downstream Coronary Stenoses: Validation in Humans

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Background: Fractional flow reserve (FFR) measurement can aid in the assessment of left main coronary stenosis. We have previously shown in an animal model that the presence of downstream epicardial stenosis can affect left main FFR measurement. The aim of this study is to explore the effect of stenosis in a downstream epicardial artery on left main FFR assessment in humans.

Methods: After elective coronary intervention of either the left anterior descending (LAD) or left circumflex (LCX) artery, an intermediate left main stenosis was created using an uninflated “winged” balloon. Variable stenoses were then created in the downstream vessel using a balloon inflated within the newly placed stent. A total of 67 pairs of left main FFR assessments in 16 patients were obtained, before and after creation of a stenosis in the downstream vessel, with a pressure wire in the non-stenosed downstream vessel.

Results: The apparent left main FFR in the presence of downstream stenosis (FFRapp) was modestly higher than the true FFR in the absence of downstream stenosis (FFRtrue) (0.82±0.07 vs. 0.80±0.07, p<0.001). The difference between FFRtrue and FFRapp correlated with composite FFR of the left main plus stenosed downstream vessel (FFRepicardial) (r=0.36, p<0.001), and this difference was only significant when FFRepicardial was severe (figure below). Among the 67 measurements, only 2 (3%) had a difference between FFRtrue and FFRapp of >0.5, and the FFRepicardial was <0.2 in both cases.

Conclusions: A clinically significant effect on the FFR assessment of left main disease occurs only when the stenosis in the other vessel is severe.

TCT-619
Single Bolus Regadenoson Injection Versus Central Venous Infusion Of Adenosine To Induce Maximum Coronary Hyperemia For Measurement Of FFR

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Background: Regadenoson is an A2A-receptor selective hyperemic stimulus known for its rapid onset and duration of maximum hyperemia. Its ease in administration, rapid onset and duration of maximum hyperemia make it an excellent hyperemic stimulus. Repeated injections of regadenoson is safe.

Methods: Peripheral injections of regadenoson were compared, and safety of repeated injections measuring Fractional Flow Reserve (FFR). Moreover, time intervals to onset and maximum hyperemia of regadenoson (R2fl) and FFRtrue and FFRapp correlated with composite FFR of the left main plus stenosed downstream vessel.

Results: Since 2008, several studies have shown the increases in flow are limited to mild stenoses and unobstructed vessels, whilst the incremental benefit of vasodilator administration to more significant stenoses may be negligible. In this study, we assess this in humans, using FFR as a physiological measure of stenosis severity over various phases of the cardiac cycle.

Methods: Pressure and flow velocity were simultaneously measured at rest and during adenosine-mediated hyperemia using intra-coronary wires in 146 stenoses in patients undergoing stenosis assessment. Resting and hyperemic whole-cycle flow (FlowHwc and Flowwfp) for both signiﬁcantly less than when FFR <0.80 and Flowwfp was 0.03±0.01m/s when FFR<0.80 and 0.02±0.01m/s when FFR<0.75, both signiﬁcantly less than when FFR>0.80 or >0.75 (p<0.001). Overall in physiologically signiﬁcant stenoses deﬁned by FFR <0.75 or FFR <0.80, resting Flowwfp represented 100%, and 97% of hyperemic FlowHwc, respectively. In contrast, resting whole cycle ﬂow represented a signiﬁcantly smaller fraction of FlowHwc, in signiﬁcant stenoses (76% and 74% respectively, p<0.001 for both) and was signiﬁcantly lower than Flowwfp, for both signiﬁcant and non-signiﬁcant stenoses (p<0.001 for all).

Conclusions: Adenosine does not signiﬁcantly increase ﬂow compared to the wave-free period in stenoses deﬁned as signiﬁcant by FFR. Adenosine only increases ﬂow compared to resting whole cycle and wave-free period when stenoses are physiologically non-signiﬁcant. This may have important implications for physiological stenosis assessment.

TCT-620
Mean Hyperemic Flow is Not Increased Following Adenosine Administration in Physiologically Significant Lesions

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Background: A central tenant of fractional flow reserve (FFR) is that flow increases following administration of vasodilators. However, animal studies show the increases in flow are limited to mild stenoses and unobstructed vessels, whilst the incremental benefit of vasodilator administration to more significant stenoses may be negligible. In this study, we assess this in humans, using FFR as a physiological measure of stenosis severity over various phases of the cardiac cycle.

Methods: Pressure and flow velocity were simultaneously measured at rest and during adenosine-mediated hyperemia using intra-coronary wires in 146 stenoses in patients undergoing stenosis assessment. Resting and hyperemic whole-cycle flow (FlowHwc and Flowwfp) for both signiﬁcantly less than when FFR <0.80 and Flowwfp was 0.03±0.01m/s when FFR<0.80 and 0.02±0.01m/s when FFR<0.75, both signiﬁcantly less than when FFR>0.80 or >0.75 (p<0.001). Overall in physiologically signiﬁcant stenoses deﬁned by FFR <0.75 or FFR <0.80, resting Flowwfp represented 100%, and 97% of hyperemic FlowHwc, respectively. In contrast, resting whole cycle ﬂow represented a signiﬁcantly smaller fraction of FlowHwc, in signiﬁcant stenoses (76% and 74% respectively, p<0.001 for both) and was signiﬁcantly lower than Flowwfp, for both signiﬁcant and non-signiﬁcant stenoses (p<0.001 for all).

Conclusions: Adenosine does not signiﬁcantly increase ﬂow compared to the wave-free period in stenoses deﬁned as signiﬁcant by FFR. Adenosine only increases ﬂow compared to resting whole cycle and wave-free period when stenoses are physiologically non-signiﬁcant. This may have important implications for physiological stenosis assessment.

TCT-621
Advanced Computed Tomographic Modeling of Plaque Geometry for Prediction of Fractional Flow Reserve in Intermediate Coronary Lesions

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Background: There is still much room for improvement in developing a robust non-invasive model for predicting fractional flow reserve (FFR). We aimed to determine the application of advanced coronary computed tomography angiography (A-CCTA) for predicting invasive FFR in intermediate coronary lesions.

Methods: Sixty-one patients with 71 single intermediate coronary lesions (≥50-80% stenosis) on CCTA prospectively underwent coronary angiography and FFR. Advanced anatomical and morphometric plaque analysis was performed based on CCTA data set to determine optimal criteria for significant flow impairment. A significant stenosis was defined as FFR <0.80.

Results: FFR averaged 0.85±0.09, and 14 lesions (27%) were functionally significant. FFR correlated with minimum lumen area (MLA) (r=0.456, p<0.001), minimum lumen diameter (MLD) (r=0.326, p=0.006), reference LD (r=0.245, p=0.039), plaque burden (r=-0.313, p=0.008), lumen area stenosis (r=-0.305, p=0.01), lesion length (r=-0.692, p<0.001), and plaque volume (r=-0.669, p<0.001). There was no relationship between FFR and CCTA morphometric plaque parameters. By multivariate analysis the independent predictors of FFR were lesion length (beta=-0.581, p<0.001), MLA (beta=0.360, p=0.041), and reference LD (beta=0.255, p=0.036). The optimal cutoffs for lesion length, MLA, MLD, reference LD, and lumen area stenosis were >18.5mm,