QUANTIFICATION OF CORONARY FRACTIONAL FLOW RESERVE USING ANGIOGRAPHIC IMAGE DATA

i2 Poster Contributions
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Background: Fractional flow reserve (FFR) has been shown to be a reliable functional assessment of a given coronary intermediate stenosis. However, an accurate assessment of FFR involves additional procedure time and cost because the use of a pressure wire. An angiographic flow measurement technique based on first-pass distribution analysis and scaling laws can be used to measure FFR. The purpose of this study is the in vivo validation of a FFR measurement technique only using images.

Methods: 8 anesthetized swine were instrumented with a transit-time ultrasound flow probe on the proximal segment of LAD. An extravascular occluder was placed distal to the flow probe to produce variable degrees of stenosis. Additionally, a coronary pressure wire was advanced into the distal segment of LAD. Adenosine was used to produce maximum hyperemia. Contrast material injections were made into the left coronary ostium during image acquisition. Volumetric blood flow from the flow probe (Q), coronary pressure (Pa), distal coronary pressure (Pd), and right atrium pressure (Pv) were continuously recorded. Flow probe-based FFR (FFRq) was measured from the ratio of flow with and without stenosis. Pressure-based FFR (FFRp) was measured as Pd-Pv divided by Pa-Pv. To determine the angiography-based FFR (FFRa), the ratio of blood flow in the presence of a stenosis (QS) to theoretically normal blood flow (QN) was calculated. QS was measured using the angiographic flow measurement technique and QN was estimated from the total coronary arterial volume using scaling laws.

Results: A total of 54 measurements of FFRa, FFRq and FFRp were made. FFRa showed a good correlation with FFRq (FFRa =0.84 FFRq +0.13, r=0.86). FFRa and FFRp correlated linearly with a good correlation coefficient (FFRa =1.06 FFRp -0.08, r=0.86). Additionally, the Bland-Altman analysis showed close agreements among FFRa, FFRq and FFRp.

Conclusion: A technique for FFR measurement using only angiographic images was validated in swine model. This angiographic FFR technique can potentially be used to evaluate both anatomical and physiological assessments of a coronary stenosis during routine diagnostic cardiac catheterization that requires no pressure wires.