AbstractID: 3632 Title: Experimental validation of an angiographic method for determining coronary fractional flow reserve

Purpose: To investigate an angiographic technique for determining fractional flow reserve (FFR) for assessing anatomic and physiologic significance of intermediate coronary stenoses from routine coronary arteriography.

Method and Materials: A swine animal model was used to investigate an angiographic method for determining FFR for different severity stenoses. The proximal portion of the left anterior descending (LAD) artery was dissected free from the epicardium. An ultrasonic transit-time flow probe was implanted distal to the left main coronary artery bifurcation. A vascular occluder was positioned distal to the flow probe to apply different levels of stenoses. Acquired angiograms were corrected for scatter-veiling glare and pincushion distortion. Coronary arterial flow and lumen volume were determined angiographically from a first-pass distribution analysis. A computer simulation utilizing a fully reconstructed swine coronary arterial system was used to study the coronary arterial flow-volume relation. Results from this simulation study were used to determine hypothetical normal flows from measured arterial lumen volumes. Angiographic FFR was calculated from the ratio of the measured hyperemic flow to the hypothetic normal flow derived from the arterial lumen volume and compared to FFR measured directly with the flow probe.

Results: Simulation studies showed that coronary flow (Q) was related to cumulative lumen volume (V) through a power-law relation. For vessels detectable by coronary angiography (>0.1 cm^3), a linear relationship was observed between coronary flow and lumen volume (Q= 5.2+45V; R=0.992). Experimental validation of this flow-volume relation showed similar results (Q= -0.503+52.4V, R=0.997). A comparison between FFR measured with angiography and with the flow probe showed good correlation (r>0.9).

Conclusion: Regional coronary flow can be determined with angiography, and normal regional flow without the presence of stenosis can be calculated using flow normalized to arterial lumen volume. Thus FFR can be calculated from the same images obtained from routine coronary arteriography.