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Validation of Physiological Principles of Non-Invasive Fractional Flow Reserve

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Background: CT-coronary-angiography (CTCA) simulation of fractional flow reserve (FFR) is computationally derived from the basis of allometric and morphometric scaling. These assumptions describe the relationship of baseline coronary flow and microvascular resistance with quantitative measures such as left-ventricular (LV) mass and coronary luminal dimensions. The validity of these assumptions in humans remains unknown with historic data only available from animal models.

Methods: Twenty patients (age 64.5 ± 7.9, 60% male) with non-obstructive disease underwent proximal-LAD intravascular-ultrasound (IVUS) and Combowire assessment at rest and hyperaemia. Coronary volumetric flow (Q, cm3/sec) was derived from average baseline peak-velocity (cm/sec) x IVUS luminal cross-sectional-area (cm2). Baseline microvascular resistance (mmHg/cm2) was calculated: distal coronary pressure (mmHg) - right atrial pressure (mmHg) divided by Q. Patients underwent same-day CTCA to provide quantitative measures including LV mass (g) and coronary luminal volume (mm3).

Results: Mean FFR was 0.93 ± 0.05 and median coronary flow reserve velocity was 2.6 [IQR 2.1-3.1]. Baseline Q and BMVR were 2.17 ± 1.03cm3/sec and 45.6 ± 21.2 mmHg/cm2, respectively. Average LV-mass was 147.6 ± 32.0g and coronary luminal volume 1038.6 ± 485.2mm3. LV mass exhibited the strongest and most significant correlation with coronary flow (r = 0.87, p < 0.001). The scaling coefficient describing the relationship between coronary flow and LV-mass was 1.91, which differs significantly from experimental data. CT-defined coronary luminal volume also exhibited strong and significant negative correlation with BMVR (r = -0.79, p < 0.001).

Conclusion: Although these results support the basis for estimation of coronary flow and microvascular resistance from non-invasive indices, use of revised human-specific scaling coefficients may improve the diagnostic performance of FFR calculated from CTCA.

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Valve-in-valve Transcatheter Aortic Valve Implantation for Failing Aortic Valve Prostheses: An Australian Interventional Experience

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Background: Surgical bioprosthetic aortic valves are increasingly utilised for younger patients, given long-term implications of mechanical valves and anticoagulation. As these valves are less durable, there is increasing need for a longer-term strategy in the event of valve failure. Re-entry sternotomy can be high risk, with transcatheter aortic valves (TAVI) becoming an excellent alternative.

Aim: This study aims to retrospectively analyse outcomes of valve-in-valve TAVI replacements in a single Australian centre.

Methods: All patients who underwent valve-in-valve TAVI replacement between February 2015 and January 2019 were included, valve characteristics, patient demographics, clinical data and outcomes were all analysed.

Results: A total of 20 patients were included in the valve-in-valve cohort. Nineteen had previous surgical bioprostheses, and one paravalvular leak during initial TAVI. Indications included AS (2), AR (13) and AS/AR (2). The average age of patients was 76.1 (±11.5), with a mean Euroscore of 6.3 ± 5.1. Average pre-operative mean gradient was 27.8 mmHg ± 18.3 mmHg. Average post-operative mean gradient was 12.3 mmHg ± 5.1 mmHg. There have been no deaths in this cohort. One patient developed heart block and required pacemaker insertion, one required surgical closure of femoral access site and one patient had redo surgical replacement due to valve malposition.

Conclusions: Valve-in-valve TAVI can be successfully performed, with an acceptable morbidity profile and excellent outcomes, in a TAVI centre for patients who otherwise may have to undergo a high risk re-do sternotomy.

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