Valvular Heart Disease

IMR or CFR - Which parameter is better suited to determine microvascular disease in patients with severe aortic stenosis?

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Background: Chest pain in patients with severe aortic stenosis (AS) may result from the valve stenosis itself, a coronary atherosclerotic lesion or even microvascular dysfunction (MVD). MVD in severe AS may be purely functional or the consequence of structural left ventricular (LV) remodelling. Unfortunately, there is no data available about invasive quantification of MVD using the index of microvascular resistance (IMR) in this patient group.

Purpose: To study the microcirculation in patients with severe AS by means of IMR and coronary flow reserve (CFR) and to determine the relation between these indices and standard echocardiographic parameters.

Methods: Forty-five patients with severe AS (according to the focused 2017 EACVI/ASE update) were prospectively included and underwent invasive intracoronary hemodynamic assessment and dedicated transthoracic echocardiography (TTE). On TTE we measured LV ejection fraction (EF), diastolic function parameters (E/A, e' septal and lateral, E/e', TR velocity), left atrial volume (index) (LAVI), aortic valve (AV) pressure gradients, the aortic valve area (index) (AVA(I)) and LV mass (index). The invasive measurements comprised the calculation of the CFR and IMR via thermodilution with the use of an intracoronary guidewire with a dual pressure and temperature sensor and administration of IV adenosine.

Results: Mean IMR and CFR were 22.9 ± 14.2 and 2.5 ± 1.5, respectively (Fig. 1). When using the commonly used cut-offs (increased IMR ≥ 25; impaired CFR < 2.0), 29% of patients had high IMR and 33% had low CFR. Patients with normal and high IMR had similar LV EF (p = 0.54), grade of diastolic dysfunction (DD)(p= 0.18), AV peak (p = 0.80) and mean pressure gradient (p = 0.86), AVA (p= 0.80), AVAI (p = 0.92), E/e' (p = 0.97), LAVI (p = 0.75), LV mass (p = 0.34) and LV mass index (p = 0.59). In contrast, patients with impaired CFR had significantly lower AVA (0.63 vs 0.80 cm², p = 0.033) and AVAI (0.32 vs 0.43 cm²/m², p = 0.035) (Fig. 2A). Moreover there was a significant negative correlation between CFR and LAV (r= -0.354, p= 0.019) as well as LAVI (r= -0.428, p= 0.004)(Fig. 2C). Similarly, patients with different DD grades had no significantly different IMR values (p= 0.71), while there was a significant difference with their CFR values (Grade I: 2.9 ± 1.6; Grade II: 3.1 ± 1.7; Grade III: 1.8 ± 0.6, undetermined DD (due to Atrial Fibrillation): 1.6 ± 0.7, ANOVA p= 0.033) (Fig. 2B).

Conclusion: Approximately 30% of patients with severe AS exhibit MVD as assessed by IMR and CFR. In contrast to CFR, IMR values were not related to the severity of valve disease or systolic and diastolic function of the LV. Interestingly, the IMR was also not related to LV hypertrophy. IMR may therefore be the more objective and independent marker of microvascular disease, better suited to evaluate MVD in severe AS patients with chest pain.

Abstract Figure 1

[Image of a graph showing the relationship between IMR and CFR, with IMR on the x-axis and CFR on the y-axis, and two clusters indicating high and normal IMR and low and normal CFR]

Abstract Figure 2

[Image of a graph showing the relationship between IMR and CFR, with IMR on the x-axis and CFR on the y-axis, and two clusters indicating high and normal IMR and low and normal CFR]
Figure 2A: Aortic valve area (AVA)

- AVA (Vmax) for Normal CFR: 0.80, 0.63
- AVA (Vmax) for Low CFR: 0.43, 0.35

p = 0.033

Figure 2B: Diastolic dysfunction grade vs CFR

- CFR for DD grade 1: 2.9, 3.1
- CFR for DD grade 2: 1.8, 1.6
- CFR for DD grade undetermined: 1.6

p = 0.033

Figure 2C: Correlation between CFR and LAVI

- r = -0.428
- p = 0.004