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Impact of global left ventricular afterload, aortic stenosis severity and left ventricular hypertrophy on global myocardial work

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Background: Myocardial work (MW) is an innovative tool, that derives from myocardial strain with the advantage to incorporate measurement of deformation and load. Therefore, it could be useful in conditions of increased afterload, such as aortic stenosis (AS). To date, little is known about the changes in MW related to AS severity, left ventricle (LV) geometry and arterial compliance.

Purpose: We investigated the effect of valvulo-arterial impedance (Zva), stroke volume and LV hypertrophy in patients with AS and preserved LV ejection fraction (EF).

Methods: We retrospectively analyzed 283 patients (60% males, mean age 71±12 years old) with AS (aortic valve area $\leq$1.5 cm^2) and LVEF$\geq$50%. Exclusion criteria were more than mild associated cardiac valve lesion, left bundle branch block, and suboptimal quality of speckle-tracking image analysis. The control group included 50 patients matched for age and sex. Clinical, demographic and resting echocardiographic data were recorded, including quantification of 2D global longitudinal strain (GLS), global work index (GWI), global constructive work (GCW), global wasted work (GWW) and global work efficiency (GWE).

Results: Patients with AS had higher systolic (p=0.017) and diastolic arterial pressure (p=0.007), increased LV wall thickness, mass index (p$<$0.001) and volumes (p=0.045) compared to controls. Greater indexed left atrial volume, E/e' and trans-tricuspid gradient were also observed in the AS group (p$<$0.001). As expected, speckle tracking analysis revealed significant lower GLS in AS than in control group (18.7±3.2 vs 20.7±2.1%, p$<$0.001). Conversely, increased values of GCW and GWI (respectively 2965±647 vs 2360±353 mmHg%, and 2535±559 vs 2005±302 mmHg%, p$<$0.001) were observed in patients with AS. Besides, GWW was significantly increased in AS vs controls (147±108 vs 90±49 mmHg%, p=0.001), with no changes in terms of GWE (95±4 vs 96±2%, p=0.110). When patients were stratified according to the AS severity, the analysis of variance revealed that GCW, GWI and GWW significantly increased with higher transaortic mean gradient and lower aortic valve area (p$<$0.001). Also Zva demonstrated to impact on CGW (p=0.040) and GWW (p$<$0.001), with increased values in presence of increased global LV afterload (Zva$>$4.5 mmHg/ml/m^2). Conversely, patients with low-flow AS (stroke volume index $<$35 ml/m^2) showed lowers values of GCW (p=0.014) and GWI (p=0.001) compared to normal flow AS, but increased GWW (p=0.041) and reduced GWE (93±7 vs 95±4%, p=0.010). Finally, LV geometry didn't influence significantly GCW and GWE, only an increase of GWW was observed in patients with eccentric hypertrophy (p=0.031).

Conclusion: In patients with AS and preserved LVEF, GLS reduction is accompanied by an increase of GCW, GWI and GWW, without affecting the GWE. These modifications seem to be correlated to the severity of AS, low-flow state and increased global LV afterload but not on the grade of LV hypertrophy.