Myocardial work in hypertension and mitral regurgitation: insights from non-invasive assessment of left ventricular pressure-strain relations

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Topic(s):
Echocardiography: Systolic and Diastolic Function

Citation:
Funding Acknowledgements:
Background and aim: Non-invasive left ventricular (LV) pressure estimates and speckle-tracking deformation curves can be used to quantify an index of myocardial work (MWI) which may offer insight into the early changes and work distribution in hypertension (HTN) and mitral regurgitation (MR) – cardiac diseases related to pressure and volume overload. The aim is to assess segmental strain and MW indices in patients with HTN, MR, and in healthy controls.

Methods: An echocardiogram was performed in 73 participants: 31 patients with a diagnosis of long-standing HTN with signs of LV hypertrophy, 22 patients with MR without hypertension, and 20 healthy age- and sex-matched controls. LV speckle-tracking was performed in 4C, 2C, and 3C apical views. MWI was calculated between mitral valve closing and opening. Average regional values of strain and MW indices were calculated by averaging the 4C, 3C, and 2C basal, mid, and apical segments, as based on the 18-segment model of the LV. Total MW per minute (MWI/min) was calculated by multiplying global MWI by the heart rate.

Results: LV ejection fraction and global longitudinal strain (GLS) were preserved and similar in all groups (GLS, controls vs. mild/moderate MR vs. severe MR vs. HTN: -21.28±2.36 vs. -21.30±1.49 vs. -20.93±2.46 vs. -20.93±2.46, p=0.602). MR was classified as mild or moderate in 45% (n=10) and severe in 55% (n=12). A strong trend of higher global MWI (controls vs. mild/moderate MR vs. severe MR vs. HTN: 2098±373 vs. 2036±341 vs. 2237±351 vs. 2297±427 mmHg%, p=0.171), as well as MWI/min could be noted in patients with hypertension and severe MR. Averaged regional deformation values showed a gradient increasing from base to apex in all groups, significantly more pronounced in the HTN patients. This deformation pattern was reflected in myocardial work distribution. In HTN, the basal region performed a lower percentage of total work, with the apex performing an increased workload. In the MR subgroups, the work was distributed similarly to the healthy controls Results are shown in Figure 1.

Conclusion: Non-invasive pressure strain relations offer additional information on cardiac function in HTN and MR with preserved LVEF and GLS. In HTN, MW is elevated and redistributed in the LV with an apex-to-base gradient signaling an apical compensation of basal impairment in the setting of increased afterload. Mild and moderate MR is associated with a compensated state of normal global MWI and work distribution, however, MWI/min in severe MR reveals an overall increase in workload - potentially predicting further LV remodeling in these patients over time.
Abstract:

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* - significant difference compared to healthy controls
† - significant difference compared to patients with mild or moderate mitral regurgitation
‡ - significant difference compared to patients with severe mitral regurgitation