3D atrial stiffness in chronic mitral regurgitation: impact of sex, regurgitation mechanism and valve geometry - the 3D-PRIME study

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Background: Chronic mitral regurgitation (MR) is both a cause and a consequence of progressive left atrial (LA) remodeling. The degree of LA stiffness in relation to clinical risk factors as well as atrio-valvular remodeling has not been reported in patients with MR.

Aims: To assess the severity and determinants of 3D LA stiffness in chronic MR.

Methods: In the prospective 3D-PRIME (3D Echocardiography and Cardiovascular Prognosis in Mitral Regurgitation) study, 100 patients with chronic MR (70±13 years, 38% women, 55% with a history of atrial fibrillation (AF), 42% with severe MR) recruited at one heart valve center were investigated with 2D and 3D transesophageal and transesophageal echocardiography. MR severity was quantified by the regurgitant fraction and MR classified as primary (54%), atrial functional (26%) or ventricular functional (20%). 3D LA volume (LAV) was measured at end-diastole (min LAV) and end-systole (max LAV), and 3D LA function assessed by the emptying fraction (EF) and the peak strain in the reservoir phase (LASr). LA stiffness was estimated from the ratio: mitral peak E-wave velocity divided by the mitral annular e' velocity (E/e') / LASr and classified as high for age if ≥ 0.55.

Results: High LA stiffness for age was present in 58% of patients and more often in those with a history of AF (73% vs. 45%) and in severe vs moderate MR (70% vs. 42%) (both p < 0.01). Patients with high LA stiffness had larger LAVs with lower LA EF, lower right ventricular ejection fraction, increased mitral annulus area, and larger mitral valve leaflets (all p < 0.05).

Men had considerably larger LAVs in all MR subgroups, and highly stiff LAs in atrial functional MR compared to women (p < 0.05, Figure) despite similar MR severity (regurgitation fraction 50% vs 52%, respectively).

In multiple regression analysis, after stepwise removal of the following factors: MR severity, mitral leaflet to ring area ratio, and right ventricular ejection fraction, increased LA stiffness was independently associated with male sex, history of AF, lower LA EF and lower mitral intertrigonal diameter (R² 0.40, p < 0.001, Table).

Conclusion: LA is stiff for age in over half of patients with chronic MR, excessively stiff in men with atrial functional MR, and associated with specific changes in mitral valve geometry and LA function. This gives mechanistic insights into the complex atrio-valvular interplay in chronic MR.

Figure.

Table.