Noninvasive Assessment of Valve Biology: Echocardiographic Measures of Mitral Leaflet Distensibility

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Background: Changes in mitral valve (MV) elasticity or distensibility occur in disease and directly affect MV function, contributing to MV prolapse (MVP) or flail vs restricted coaptation of stiffer leaflets in functional mitral regurgitation (FMR) and MV stenosis (MS). Recent studies suggest MV distensibility may be modified to reduce MR, but distensibility has only been measured in excised MVs. Our aim was to test the feasibility of obtaining a noninvasive measure of MV distensibility in patients by measuring systolic change in anterior leaflet length (ALL) or anterior leaflet strain; and to test the hypothesis that these measures vary in diseases with known altered MV elasticity.

Methods: ALL was quantified in a long-axis view standardized by 3D echo in 80 patients: 20 each with normal hearts, MVP, FMR and MS. Distensibility was measured as end-systolic minus end-diastolic (ED) total ALL normalized to an ED reference; and alternatively as mid-leaflet strain measured by tracking echo features.

Results: ALL was greater in all disease groups vs normal ($p<.001$). The maximum systolic increase in ALL relative to ED was 7.9±7.4% in normals vs >2-fold higher (16.5±7.7%) in MVP; it was 63-76% lower (2.9± 3.0%, 1.9±3.1%) in FMR and MS, with comparable results for segmental AL strain.

Conclusion: Noninvasive measures of MV distensibility based on systolic changes in total leaflet length or segmental strain are feasible and provide results consistent with excised valve biomechanics, showing that distensibility is increased in MVP and decreased in FMR and MS. Ultimately, these techniques have the potential to test hypo-theses regarding prediction of disease natural history and to monitor response to new therapies that aim to reduce MR by altering MV mechanics.