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LETTER TO THE EDITOR

Regional Left Ventricular Myocardial Mechanics in Degenerative Myxomatous Mitral Valve Disease

A Comparison Between Fibroelastic Deficiency and Barlow's Disease

Fibroelastic deficiency (FED) and Barlow disease (BD) are 2 phenotypes of degenerative mitral valve regurgitation characterized by excessive movement of the mitral leaflets and the saddle-shaped mitral annulus (1,2). Compared with FED, BD exhibits more pronounced excessive mitral annulus motion and characteristic late systolic flattening (2). This finding may be related to enhanced function of the basal segments of the left ventricle and weaker mitral valve annulus leading to more pronounced late systolic mitral regurgitation (MR) in BD. It has been suggested that fixation of the hyper-enhanced annular dynamics with a ring annuloplasty may be sufficient to restore mitral valve competence.

The hypothesis of the present study was to show whether BD has different left ventricular (LV) mechanics compared with FED that may explain the different mechanism of MR. In 104 patients with FED ($n = 62$) or BD ($n = 42$) with moderate to severe MR and 40 healthy subjects, transthoracic echocardiography and 2-dimensional speckle tracking strain analyses were performed to assess LV global longitudinal strain and level-based longitudinal strain (basal, mid, and apical) (EchoPAC BT13, GE Medical Systems, Horten, Norway) (**Figure 1A**). Comparisons between patients with FED, patients with BD, and control subjects were performed using linear mixed models.

Patients with FED were more symptomatic, more frequently had atrial fibrillation, and had a higher use of diuretic agents compared with patients with BD. No other differences in clinical characteristics were noted. LV volumes and left atrial diameter were larger in patients with FED and BD compared with control subjects, but only those with FED exhibited lower ejection fraction ($58 \pm 8\%$, $62 \pm 7\%$, and $63 \pm 5\%$, respectively; $p = 0.001$). Mitral regurgitant volumes were also similar between the FED and BD groups (52 ± 17 ml and 46 ± 18 ml; $p = 0.160$). LV global longitudinal strain did not differ across the groups after correcting for age, sex, and LV end-systolic and end-diastolic volumes (control subjects: $-21.5 \pm 1\%$; patients with FED: $-19.8 \pm 3\%$; patients with BD: $-21.4 \pm 3\%$; $p = 0.091$). A gradient in LV strain per level was noted in all groups, with lower values in the basal levels and higher values in the apical levels (**Figure 1B**). This gradient differed across the groups: patients with FED exhibited impaired LV strain at the basal levels but enhanced values at the apical levels compared with control subjects, whereas patients with BD had enhanced LV strain in the basal levels compared with both control subjects and patients with FED. This finding suggests that in patients with FED, valvular incompetence may be exclusively a valvular problem, whereas in patients with BD, the hyper-enhanced function of the LV basal segments may contribute to a functional prolapse.

Changes in regional LV forces may have a crucial role in abnormal annulus dynamics as hyper-enhanced LV strain in the basal segments could explain why the annulus is hyperdynamic at late systole: the mitral annulus, which is exposed to increased LV dynamics, is pulled outward at late systole, leading to annular dilatation, flattening, and leaflet malcoaptation (**Figure 1A**). Huttin et al. (3) reported the presence of abnormal strain in the LV segments characterized by increased post-systolic shortening in patients with mitral valve prolapse; however, no distinction was made between FED and BD. The present study is thus the first to characterize regional LV strain in these 2 etiologies of degenerative MR.

One of the limitations of the present study is the lack of sequential data to investigate how LV mechanics change across various grades of MR and at different time points. The chronicity of MR may affect LV mechanics differently according to the phenotype of degenerative MR. Better understanding of LV mechanics and its relation to mitral annulus dynamics in FED and BD can aid the decision-making in surgical techniques. Implantation of an annulus ring will help stabilize the hyper-enhanced LV basal segments in BD. Due to the small sample size, this study should be considered as hypothesis generating, and further validation with larger populations is necessary.

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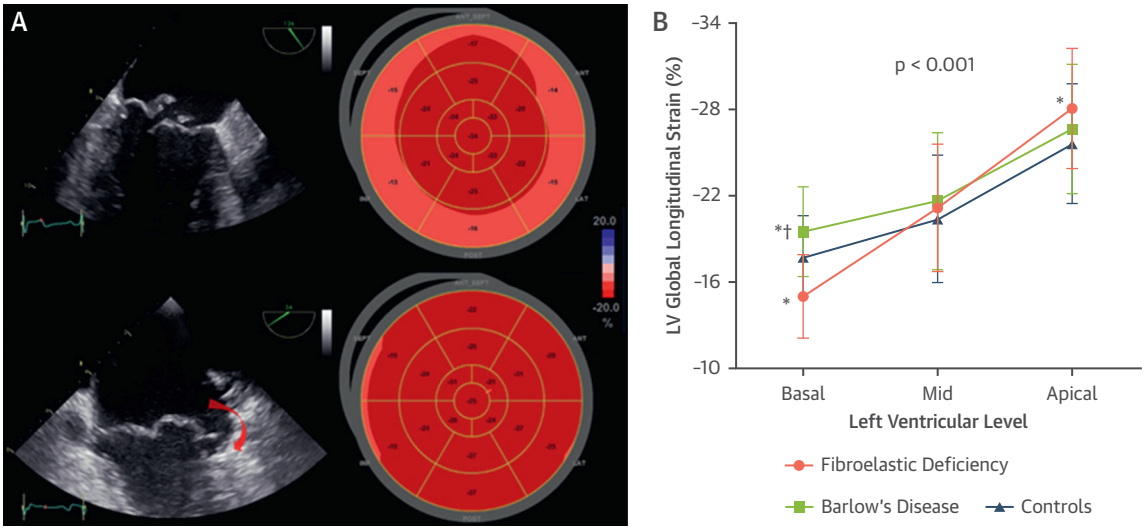
FIGURE 1 **Regional Assessment of LV Longitudinal Strain in Barlow Disease and Fibroelastic Deficiency**



(A) Examples of mitral regurgitation due to fibroelastic deficiency **(top)** and Barlow's disease **(bottom)** and the corresponding left ventricular (LV) longitudinal strain bull's-eye plots. In the fibroelastic deficiency mitral regurgitation, LV basal levels exhibit more impaired LV strain values than in Barlow disease mitral regurgitation. **(B)** Longitudinal strain values per LV level (basal, mid, and apical) for control subjects **(blue)** and patients with fibroelastic deficiency **(pink)** and Barlow's disease **(green)**. *Significant p value versus the same level in controls; †significant p value in Barlow's disease versus fibroelastic deficiency.

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