

# Unique mechanism of mitral valve prolapse in atrial septal defect: Three-dimensional insights into mitral complex geometry using real-time transesophageal echocardiography

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## Abstract

**Background:** Mitral valve prolapse (MVP) is often identified in patients with atrial septal defect (ASD), which occasionally require surgical intervention at the time of ASD closure or even long after the surgery. Ventricular and valvular geometric characteristics in preoperative ASD patients were evaluated by three-dimensional (3D) transesophageal echocardiography.

**Methods and Results:** Mitral valve (MV) complex geometry was quantitatively measured by 3D transesophageal echocardiography in 11 ASD patients ( $Q_p/Q_s > 1.5$ ) and 11 controls. The ASD group had a significantly larger indexed prolapse volume and height, with a larger anterior mitral leaflet than controls ( $0.53 [0.33-0.75]$  vs  $0.057 [0.027-0.11]$  mL/m<sup>2</sup>,  $P = .0001$ ;  $2.89 [2.13-3.50]$  vs  $0.92 [0.48-1.32]$  mm/m<sup>2</sup>,  $P < .0001$ ;  $391.3 [346.4-445.1]$  vs  $295.3 (281.9-330.0)$  mm<sup>2</sup>/m<sup>2</sup>,  $P = .011$ , respectively). The right ventricular (RV)-to-left ventricular (LV) end-systolic diameter ratio was larger in the ASD group than in the control group ( $1.34 [0.96-1.45]$  vs  $0.85 [0.75-0.88]$ ,  $P = .004$ ). The indexed inter-papillary muscle distance (IPMD) was significantly shorter in the ASD group than in the control group ( $7.77 [6.55-8.24]$  vs  $9.71 [8.64-10.8]$  mm/m<sup>2</sup>,  $P = .011$ ). IPMD was significantly correlated with the RV-LV end-systolic diameter ratio ( $r = -.70$ ,  $P = .017$ ).

**Conclusions:** Inward shift of the LV papillary muscle tips due to RV dilation may be a major mechanism of MV prolapse in ASD. At the same time, positive remodeling of the anterior leaflet was observed in the ASD group, which may compensate for the billowing leaflet geometry to maintain effective coaptation. Three-dimensional assessment of the MV apparatus geometry will help to further understand perioperative mitral regurgitation in patients with ASD.

## KEYWORDS

atrial septal defect, mitral valve prolapse, real-time transesophageal echocardiography