Comparison of Real-Time Three-Dimensional Transesophageal Echocardiography to Two-Dimensional Transesophageal Echocardiography for Quantification of Mitral Valve Prolapse in Patients With Severe Mitral Regurgitation

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Real-time 3-dimensional (3D) transesophageal echocardiography (TEE) provides more accurate geometric information on the mitral valve (MV) than 2-dimensional (2D) TEE. The aim of this study was to quantify MV prolapse using real-time 3D TEE in patients with severe mitral regurgitation. In 102 patients with severe mitral regurgitation due to MV prolapse and/or flail, 2D TEE quantified MV prolapse, including prolapse gap and width in the commissural view. Three-dimensional TEE also determined prolapse gap and width with the use of the 3D *en face* view. On the basis of the locations of MV prolapse, all patients were classified into group 1 (pure middle leaflet prolapse, n = 50) or group 2 (involvement of medial and/or lateral prolapse, n = 52). Prolapse gap and prolapse width determined by 3D TEE were significantly greater than those by 2D TEE (all p values <0.001). The differences in prolapse gap and prolapse width between 2D TEE and 3D TEE were significantly greater in group 2 than group 1 (Δ gap 1.3 ± 1.4 vs 2.4 ± 1.8 mm, Δ width 2.5 ± 3.0 vs 4.4 ± 5.1 mm, all p values <0.01). The differences in prolapse gap and width between 2D TEE and 3D TEE were best correlated with 3D TEE−derived prolapse width (r = 0.41 and r = 0.74, respectively). Two-dimensional TEE underestimated the width of MV prolapse and leaflet gap compared to 3D TEE. Two-dimensional TEE could not detect the largest prolapse gap and width, because of the complicated anatomy of the MV. In conclusion, 3D TEE provided more precise quantification of MV prolapse than 2D TEE. **(Am J Cardiol 2013;111:588−594)**

Mitral valve (MV) prolapse is a relatively common disease in clinical practice, and the estimated prevalence rates vary from 0.6% to 2.4%.[1,2] Conventional 2-dimensional (2D) echocardiography with Doppler capability is a widely accepted diagnostic tool for the assessment of MV disease. However, the complex anatomy of the MV apparatus exposes the limitations of this routine technique. A high level of expertise is also required for the accurate interpretation of 2D images. As surgical and catheter techniques improve over time, more detailed quantification of MV prolapse is being required. Recently introduced real-time 3-dimensional transesophageal echocardiography (TEE) can provide more accurate geometric information on the MV than 2D TEE.[3,4] Earlier studies have reported the feasibility and accuracy of 3D TEE for identifying the locations of MV prolapse.[5−8] However, the quantification of MV prolapse using 3D TEE relative to 2D TEE has not been fully elucidated in these studies. Therefore, in this study, we aimed to (1) quantify MV prolapse using 3D TEE, and (2) compare the quantification with 2D TEE to that with 3D TEE.

Methods

This study consisted of 125 consecutive patients with severe mitral regurgitation (MR) caused by MV prolapse and/or flail who were clinically referred for TEE from January to November 2010. All patients underwent complete 2D TEE and 3D TEE on the same day. Patients with histories of MV replacement (n = 3 [2.4%]), atrial fibrillation (n = 11 [8.8%]), irregular heart rhythm (n = 1 [0.8%]), and significant mitral stenosis (n = 2 [1.6%]) were excluded from this study. Patients with poor-quality images (n = 3 [2.4%]) and those whose prolapse gap could not be measured (n = 3 [2.4%]) were also excluded. Finally, 102 patients were enrolled. This study was approved by the institutional review board of the Cedars-Sinai Medical Center.

TEE was performed using an iE33 ultrasound imaging system (Philips Medical Systems, Andover, Massachusetts) equipped with a fully sampled matrix-array TEE transducer that can display 2D and live 3D images. All patients underwent TEE in the left lateral decubitus position. Complete 2D, color, pulsed-wave, and continuous-wave Doppler images were obtained for assessing cardiac structures and function. Multiplane 2D transesophageal echocardiographic evaluation included the complete standard

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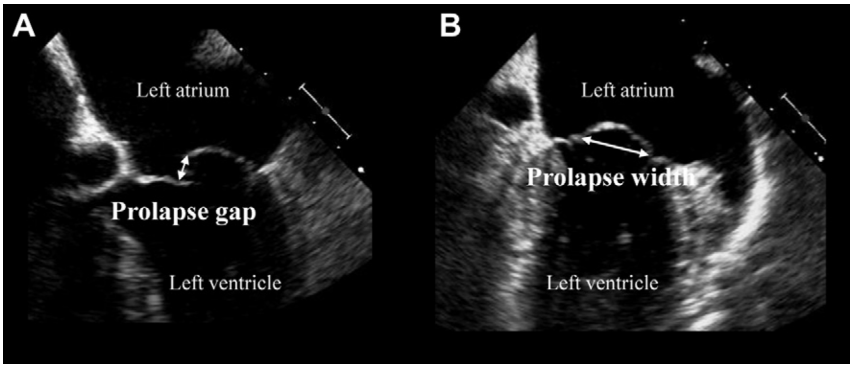

Figure 1. An example of a 2D transesophageal echocardiographic image for the assessment of MV prolapse.

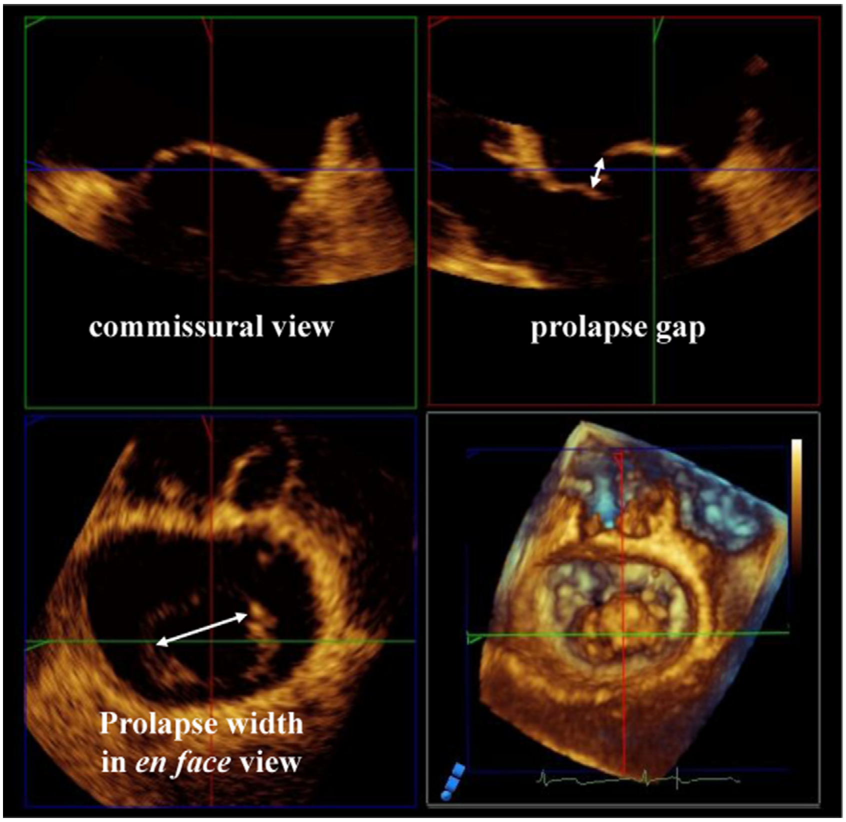

Figure 2. An example of a 3D transesophageal echocardiographic image for the assessment of MV prolapse. The 3D data set was manually cropped using the plane perpendicular to the MV until the largest cross-sectional prolapse gap and width of the MV were observed.

protocol for the evaluation of the MV, allowing complete description of all segments of the valve.[9,10] The Carpentier nomenclature was applied to the locations of MV prolapse (anterior leaflet: A1, A2, and A3 for the lateral, middle, and medial scallops, respectively; posterior leaflet: P1, P2, and P3 for the lateral, middle, and medial scallops, respectively).[11] Two-dimensional prolapse gaps were measured quantitatively from the 4- or 5-chamber view obtained at the midesophageal level with 0° and from the 3-chamber view obtained at the midesophageal level with 120° to 160° using 2D TEE (Figure 1) in each patient. Of these, the largest 2D prolapse gap was adopted in this study. Two-dimensional

Table 1
Locations of mitral valve prolapse (n = 102)

Variable	n (%)
Isolated P1	5 (5)
Isolated P2	40 (39)
Isolated P3	8 (8)
Isolated A1	0 (0)
Isolated A2	3 (3)
Isolated A3	1 (1)
Posterior leaflet (>1 scallop)	19 (19)
Anterior leaflet (>1 scallop)	5 (5)
Bileaflet	21 (21)