

Cardiac Imaging

Real-Time 3-Dimensional Transesophageal Echocardiography: Its Incremental Value over 2-Dimensional Echocardiography in Assessing Acute Mitral Regurgitation

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A 62-year-old man with a medical history of hypertension and smoking presented with acute severe dyspnea. Twenty-four hours before he had had an episode of retrosternal chest pain which lasted for ~2 hours. The ECG on admission showed sinus tachycardia, 1.5 mm ST-segment elevation and q waves in the inferior leads. Heart auscultation revealed a holosystolic murmur best heard at the apex of the heart. A transthoracic echocardiographic examination showed a non-dilated left ventricle, inferior wall akinesis and severe mitral regurgitation due to prolapse of the posterior mitral leaflet. In view of the patient's hemodynamic deterioration, an intra-aortic balloon pump was inserted. Emergent cardiac catheterization showed occlusion of a dominant right coronary artery and severe mitral regurgitation (Figure 1). Pre-operative transesophageal echocardiography (TEE), confirmed severe mitral regurgitation secondary to head rupture of the posteromedial papillary muscle (Figure 2). Real-time three-dimensional (3D) TEE showed the detached papillary muscle head hanging from a band of *chordae tendineae* and identified the precise location and extent of the valve defect (P3

scallop; Figure 3). The patient underwent emergency coronary bypass grafting and mitral valve replacement with a mechanical valve. Figure 4 shows the detached head of the papillary muscle during surgery.

Rupture of a papillary muscle complicates 1-3% of all myocardial infarctions (MIs) and it carries an unacceptably high mortality without prompt surgical treatment.¹ The posteromedial papillary muscle has a solitary blood supply (posterior descending artery) while the anterolateral has a dual blood supply (left anterior descending artery and circumflex coronary artery). This explains the 6-12 times more frequent involvement of the posteromedial than the anterolateral papillary muscle and the fact that papillary muscle rupture is more common with inferior MIs. Each papillary muscle gives *chordae tendineae* to both leaflets and often (~50%) splits into two or more heads.² In our case, one of the two heads of the posteromedial papillary muscle had been ruptured. It should be noted that complete transection of the whole papillary muscle results in massive acute mitral regurgitation, which is usually immediately fatal.

The evaluation of mitral valve pa-

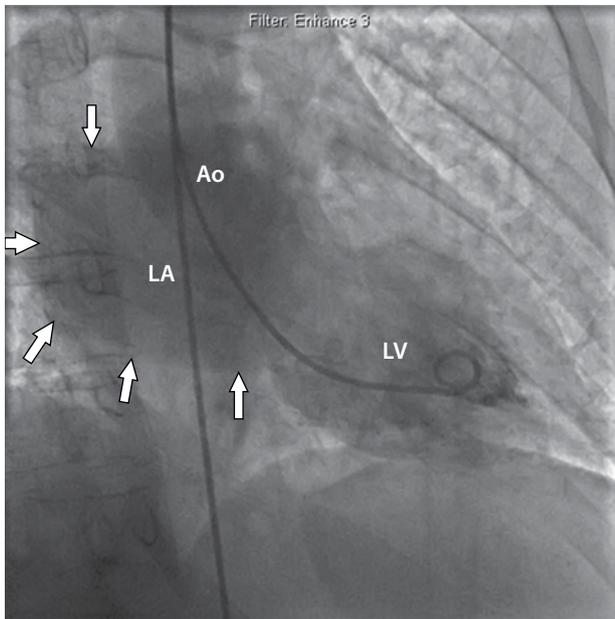


Figure 1. Left ventriculography in right anterior oblique view, showing the opacification of the entire left atrium with one beat. The white arrows show the margins of the dilated left atrium. The history of hypertension might also have contributed to the dilatation of the left atrium. LA – left atrium; LV – left ventricle; Ao – ascending aorta.

thology is one of the most challenging clinical applications of real-time 3D echocardiography.^{3,4} In our case, the initial diagnosis of severe mitral regurgitation due to prolapse of the posterior mitral leaflet was made by 2D echocardiography and 2D TEE showed the ruptured papillary muscle head. However, only real-time 3D TEE provided an accurate evaluation of the location and extent of the pathology, demonstrating its incremental superiority over 2D echocardiography.

References

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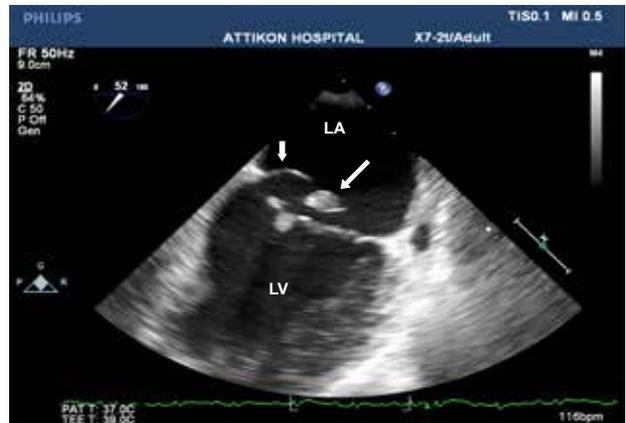


Figure 2. Transesophageal mid-esophageal view at 56°, showing an echogenic mass protruding into the left atrium during systole (large arrow). The prolapsed portion of the posterior leaflet is also shown (small arrow). LV – left ventricle; LA – left atrium.

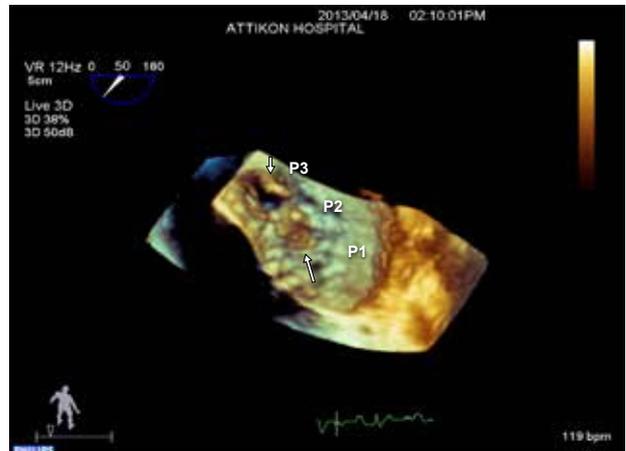


Figure 3. Transesophageal three-dimensional real-time echocardiography, showing the ruptured papillary muscle head protruding during systole into the left atrium (large arrow) as visualized from the left atrium. Note that the ruptured head is hanging from a band of *chordae tendineae*. Next to the head is the flail P2 scallop, which entirely lacks supporting subvalvular tissue (small arrow).

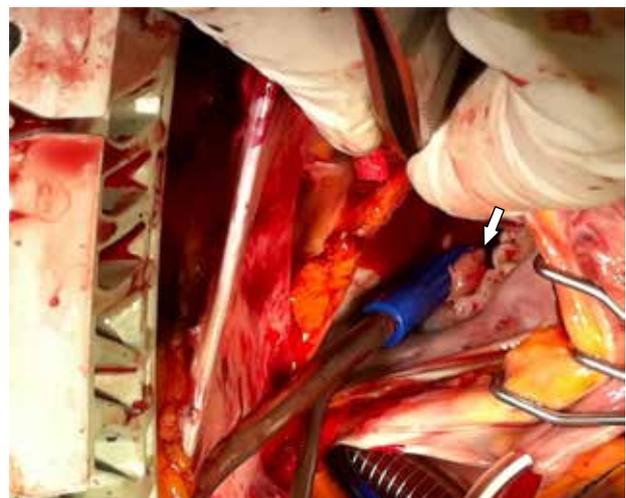


Figure 4. The ruptured head of the papillary muscle (white arrow) is shown in the middle field during surgery.