Three-Dimensional Echocardiography in the Evaluation of the Dehiscence of Mitral Valve Annuloplasty Ring

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Today, 3-dimensional transesophageal echocardiography (3D TEE) represents a novel technique for the assessment of significant paravalvular prosthetic reflux. This test allows us to improve the spatial location of the cardiac pathology in question.

Major prosthetic paravalvular regurgitation may result in the development of symptoms of heart failure and hemolytic anemia, with an incidence of up to 1% to 5% in all cases.[1,2] Up to 60% of prosthetic leaks occur during the first year after valve replacement,[1,2] and an estimated 10% of prosthetic aortic valves and 15% of prosthetic mitral valves show a nonsignificant degree of paravalvular regurgitation.[2]

Kronzon et al[3] compared in 18 patients with dehiscence of mitral valvular prosthetic ring the use of 2-dimensional TEE and 3D TEE and concluded that, unlike the 2-dimensional ultrasound, 3D ultrasound can identify the exact size, shape, and area of the affected segment.[1,4,5] The 2-dimensional technique still has a role in the initial assessment, which allows us to suspect that there might be an anomaly by the existence of a significant paravalvular reflux in the presence of a prosthetic dehiscence. However, there is a greater possibility that the 2-dimensional techniques underestimate the size of the defect, mistake its location, and even suggest the presence of defects not subsequently observed during surgery.[1]

In line with previous authors,[6] we describe the following case in which 3D TEE was both a complementary and a primary weapon for the comprehensive evaluation and definitive diagnosis of mitral valve ring dehiscence.

Case Presentation

A 66-year-old patient who was former smoker with chronic obstructive pulmonary disease was diagnosed with severe symptomatic mitral valve prolapse failure by P2 scallop and functional tricuspid insufficiency III/IV. He underwent surgery in which a mitral repair with quadrangular resection of the P2 segment was performed, followed by reconstruction of the posterior leaflet plasty and sliding ring annuloplasty (CE PHYSIO II No. 30) and tricuspid annuloplasty ring (CE PHYSIO TRICUSP No. 34). On discharge, transthoracic echocardiography showed a left ventricle that was not dilated, left ventricular systolic function of 50%, and a regurgitant mitral valve between A3 and P3 with a 4-mm vena contracta that was of moderate intensity, pansystolic, and of a moderate degree qualitatively.

The patient returned to the hospital 2 weeks after discharge for worsening functional class characterized by increased progressive dyspnea at rest and ankle edema. Repeat transthoracic echocardiography showed a dilated left ventricle with inferobasal and basal medium segment dyskinesia with proper contraction of other segments. The right cavities were slightly dilated. The mitral valve had severe mitral insufficiency of a central origin, a slightly eccentric jet toward the posterolateral wall of the left atrium, and systolic investment of the right pulmonary veins. These findings made it difficult for us to assess the cause of the mitral insufficiency because of ring interference but suggested an impaired leaflet coaptation. Given these findings, we decided to perform TEE, which objectively demonstrated a severe mitral regurgitation with systolic flow reversal in left and right pulmonary veins (Figure 1 and Movie I in the online-only Data Supplement). The underlying pathology causing mitral insufficiency was not clear because of the diagnostic restrictions in the bidimensional technique. A hyperechogenic structure was visible in the left atrium that appeared to be a part of the mitral ring, but we were unable to identify its location, dimension, or cause (Movie II in the online-only Data Supplement). Through the use of 3D techniques, a dehiscence of the posterior mitral annulus toward its posteromedial segment was seen (covering an area of ≈90°; Figures 2 and 3 and Movies IIII–V in the online-only Data Supplement) whereby the mitral insufficiency that hits the ring was interleaved, generating 2 large eccentric jets (Figure 4). For this reason, in conjunction with the clinical impact on the patient, the decision was made for urgent reintervention with mitral valve replacement with a mechanical prosthesis (type 31, St. Jude Medical). The patient had a poor hemodynamic evolution and postoperative complications during his stay in the intensive care unit such as respiratory infection, subsequent septic shock, and death within a week of surgery.

Discussion

TEE allowed us to reach the precise diagnosis of the severe mitral insufficiency seen through transthoracic access, the

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eccentricity of which made it difficult to measure and objectify the cause. Moreover, applying 3D technology helped us achieve the exact measures to clarify the shape, size, and position of the patient's dehiscence compared with bidimensional technology, which lacked the necessary precision. This led us to decide to intervene by open surgical access, providing the surgical team a superior and more accurate vision compared with that provided by bidimensional techniques, thus improving spatial location and surgical approach.

In our patient, the mitral valve dehiscence defect was in the posterior region (Figures 5– 8), confirming, as in the cases described in the literature, that there is a greater likelihood of mitral valve dehiscence defect in the posterior and lateral region, very rarely seen in the anterior location.[2–4] Several theories have been proposed to explain the increased likelihood of the occurrence in the posterior region of the mitral annulus, related primarily to limitations of the surgical field and structures surrounding the mitral valve apparatus.[2] First, the deeper location of the mitral valve annulus in its posterior part represents a more remote surgical field with a limited window that hinders the successful completion of the suture by the surgeon.[2–4] Second, the surgeon avoids placing sutures deep in the posterior part so as not to affect the circumflex artery anatomically close by, leading to the suture being placed in the surface of the region.[2–4] Finally, the presence of fibrosis and calcification of the mitral ring are more prevalent on the posterior part, which impedes proper suture placement on it.[2–4] Moreover, the anterior mitral annulus is constituted by fibrous tissue, which is a relatively firm surface for proper suture placement by the surgeon with greater comfort and safety; however, because it lacks flexibility, it could set the ring fixed, generating tension and dragging the posterior part, with a consequent increased risk of dehiscence on it.[2]

Conclusions

This case, despite the drastic result of the death of our patient after reoperation, allows us to confirm the important role of 3D TEE in the diagnosis and assessment of prosthetic valve dehiscence, demonstrating its superiority over the 2-dimensional technique for a more accurate determination of its location, size, shape, and echocardiographic impact. There are limitations in the 3E echocardiographic technology such as bad electrocardiographic synchronization in patients with arrhythmias that may result in the presence of artifacts and a worse timing resolution when color Doppler is used in a 3D image. Therefore, although it is true that 3D technology undoubtedly represents the future of echocardiography section, it is no secret that this is just the beginning.

Disclosures

None.

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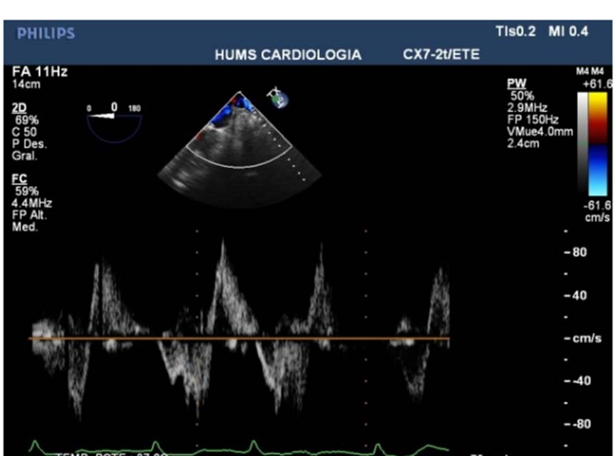

Figure 1. Systolic inversion of pulmonary venous flow.

Figure 2. Dehiscence of the posterior mitral annulus.

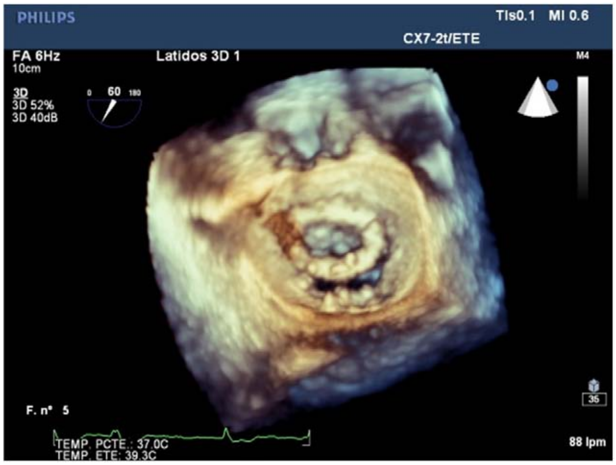

Figure 3. Dehiscence of mitral annulus.

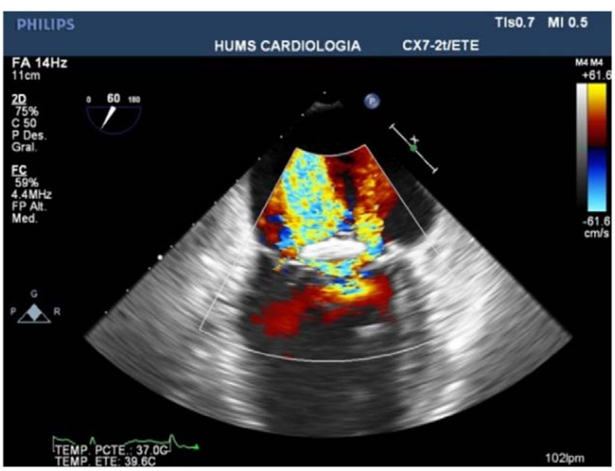

Figure 4. Severe myocardial insufficiency on the ring, creating 2 large mitral regurgitation jets.

Figure 5. Three-dimensional transesophageal echocardiography: mitral ring dehiscence.

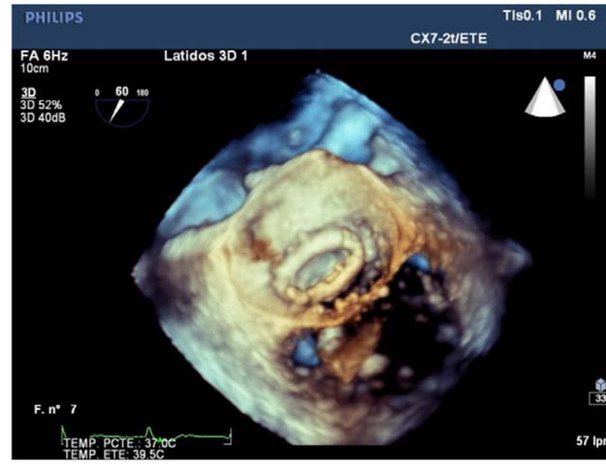

Figure 6. Three-dimensional transesophageal echocardiography: mitral ring dehiscence.

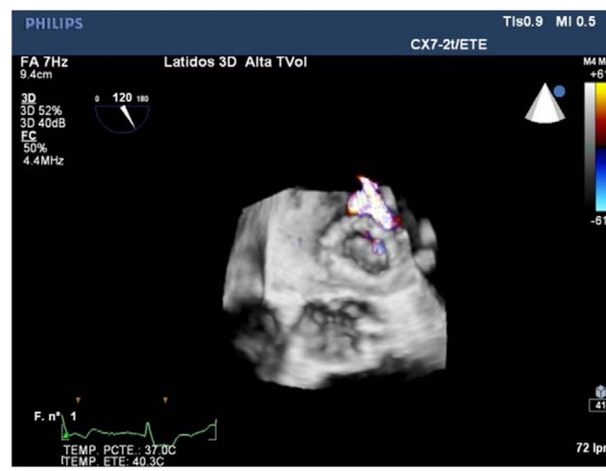

Figure 7. Three-dimensional transesophageal echocardiography: regurgitation jet in mitral dehiscence with color Doppler.

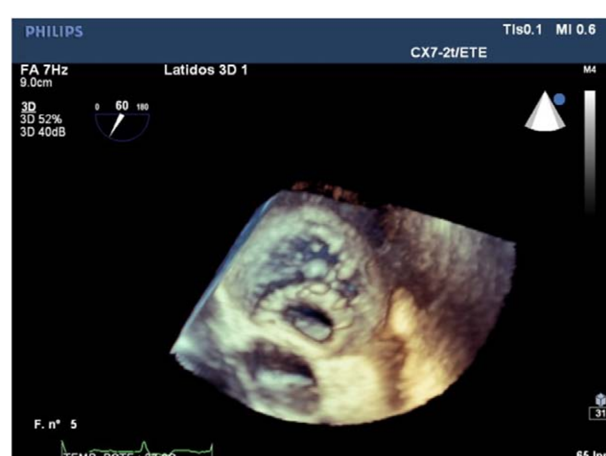

Figure 8. Three-dimensional transesophageal echocardiography: mitral ring dehiscence.