

Dual Mechanism of Mitral Valve Injury: Additional Value of Three-Dimensional Transesophageal Echocardiography

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Abstract

Infective endocarditis (IE) is a life-threatening condition and during its course several complications may occur, including embolic events, perivalvular extension and valvular destruction. Echocardiography is fundamental across all stages of the disease, from the diagnosis until the follow-up after completion of the definitive therapy. Three-dimensional transesophageal echocardiography (TEE) can demonstrate a better anatomical definition and it is especially useful in the assessment of perivalvular extension of the infection, prosthetic valve dehiscence and valve perforation. In this article we report a case of double damage in the same mitral valve: leaflet perforation and rupture of chords in a patient with IE.

Introduction

Echocardiography has a known important role in the diagnosis of IE, the prediction of embolic risk, the prognostic assessment of the patients, as well as for their follow-up under therapy, helping the physician in decision-making, mainly when a surgical intervention is considered. In this rare case, we demonstrate the additional value of the 3D TEE in the assessment of double lesion in the same mitral valve (perforation and ruptured chords) in the presence of IE with a realistic, single and peculiar *en face* view of the mitral valve.

Case Presentation

A 55-year-old male patient with *Acquired Immunodeficiency Syndrome (AIDS)* and chronic kidney disease, undergoing dialysis, was admitted to a hospital complaining of progressive dyspnea for 3 months, lower-limb edema and sporadic episodes of fever. He had multiple reports of previous hospitalizations due to dialysis catheter infection and currently with multiple dental abscesses.

Keywords

Endocarditis; Echocardiography, Three-Dimensional; Mitral Valve.

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Antibiotic therapy was introduced, and the patient was submitted to cardiac evaluation.

A transthoracic echocardiography (TTE) showed diffuse left ventricular hypokinesia with an ejection fraction estimated at 45% (Simpson's method). The valve was diffusely thickened with multiple, small, movable thread-like strands structures carpeting the entire atrial surface of both leaflets. It was also observed that the mitral valve had a suggestive image of perforation in the anterior leaflet, which was responsible for generating a significant regurgitation jet at the Color Doppler flow mapping. Furthermore, the presence of a second regurgitation jet was demonstrated from the posterior leaflet (Figure 1; Video 1). Two-dimensional TEE (2D TEE) showed a characteristic anterior leaflet perforation image with significant regurgitation (Figure 2A, 2B; Videos 2 and 4). Additionally, a chordal rupture image was observed in the apical two-chamber view, related to the medial scallop of the posterior leaflet (P3) with a second and eccentric valve regurgitation jet (Figure 2C, 2D). The 3D TEE in the *en face* view of the mitral valve realistically demonstrated the two valve dysfunction mechanisms (Video 3). In a single and peculiar image, the presence of an evident perforation and its precise location were observed in the attachment basis of the anterior mitral leaflet at the aortic-mitral curtain associated with the presence of ruptured chords in the P3 scallop of the posterior leaflet (Figure 3A).

After a period of antibiotic therapy, the patient underwent cardiac surgery. The intraoperative findings related to the double damage in the same valve - rupture of the posterior leaflet chordal and perforation of the anterior leaflet of the mitral valve - were confirmed (Figure 3B, 3C). Mitral valve replacement was performed with implantation of a biological prosthesis, without complications.

Discussion

IE may be responsible for acute mitral regurgitation through several mechanisms, including leaflet perforation, mitral valve annulus alteration secondary to abscess formation, or chordae tendineae rupture.¹

Native valve perforations develop in 10% to 30% of patients with IE.² An accurate differentiation between true vegetations and other IE-related changes, such as ruptured chordae, is frequently difficult to establish.³

Even with 2D TEE, which is much more sensitive than TTE (90% vs 45%), perforations can be difficult to visualize using 2D imaging alone. 3D TEE imaging can significantly enhance detection of valvular perforations complicating IE.⁴

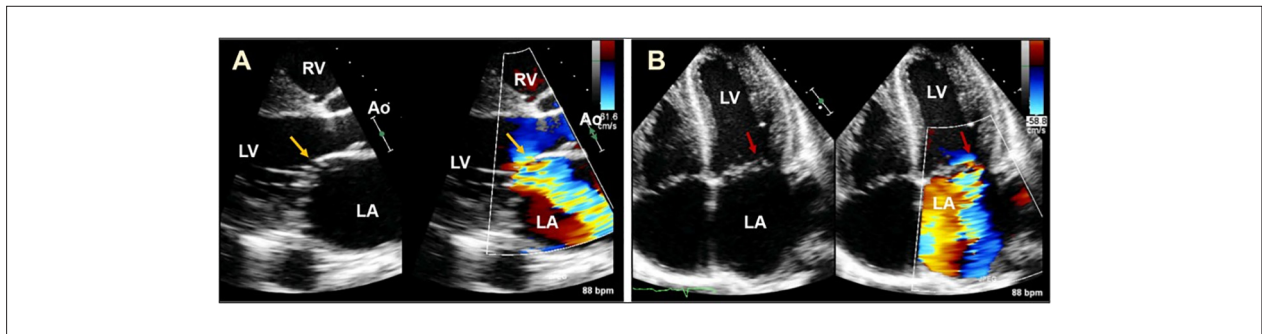


Figure 1 – TTE. A) Parasternal long-axis view showing a thickened mitral valve with characteristic image of perforation (orange arrow) in the anterior leaflet (left) and significant severe mitral regurgitation jet at the color Doppler flow mapping (right) originating from the perforation orifice; B) Apical four-chamber view showing the thickened aspect of the entire valve (left) with a second jet of severe eccentric mitral regurgitation related to the posterior leaflet. RV: right ventricle; LV: left ventricle; LA: left atrium; Ao: aorta.

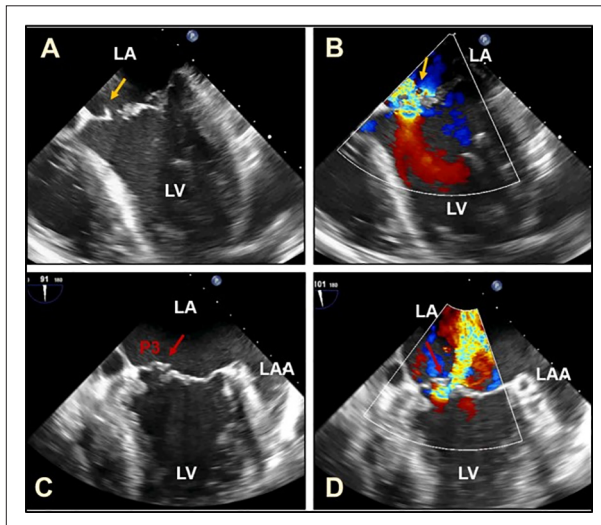


Figure 2 – A) Four-chamber view showing the characteristic perforation image in the anterior mitral leaflet (orange arrow); B) Color Doppler flow mapping showing the regurgitation jet (orange arrow) originating from the orifice; C) Two-chamber view showing ruptured chord associated with P3 scallop of the posterior leaflet of the mitral valve; D) Significant jet of severe mitral regurgitation related to the rupture of the P3 scallop chords. RV: right ventricle; LV: left ventricle; LA: left atrium; LAA: left atrial appendage.

Real-time 3D TEE is particularly useful in the assessment of perivalvular extension of the infection, prosthetic valve dehiscence and valve perforation.⁵ We present a rare case of two dysfunction mechanisms present in the same valve.

But that is the question: Is the chordae rupture of primary etiology (since we have a diffusely thickened valve, even without a previous diagnosis of mitral valve prolapse - MVP) or secondary to the infection itself?

It is known that there are multiple causes of chordae tendineae rupture. IE was considered the main etiology in the remote past. However, currently, after some studies of case series, it appears that the main etiology is primary, with mitral valve prolapse being the leading cause.⁶

It is worth remembering that mitral valve prolapse is considered a predisposing condition for both chordae tendineae rupture and IE, since it makes the valve anatomically abnormal and, therefore, a substrate for the occurrence of vegetations.

Once an infection is installed, it is not a simple task to identify the cause of the rupture: primary etiology or endocarditis.

In a study conducted by Shirley Portuguese et al.,⁶ 66% of patients diagnosed with endocarditis were previously aware of the presence of MVP, while only 9% of the primary etiology group knew that they had the pathology.

This allows us to affirm that it is not safe, in this case, to state that the chordae rupture is due to IE. It is possible that this is a patient with rupture secondary to MVP, which was a predisposing condition for the occurrence of endocarditis.

Still regarding this case, although the 2D TEE established the diagnosis, the 3D TEE, through the singular *en face* view, was able to demonstrate additional information, such as extension and actual location of the valve perforation and the ruptured chords with a realistic and peculiar view of the mitral valve.

Especially in the context of IE, providing valuable data such the mechanisms intrinsically responsible for valve regurgitation, the exact location of the perforation is of great importance and have not only diagnostic but also prognostic value. The three-dimensional echocardiographic imaging is ideal for interrogating the anatomy of each individual components of the mitral apparatus.⁷⁻¹⁰ So it is a better approach to plan the surgical procedure, since it is possible to define the valve dysfunction mechanism, as well as the precise lesion location.

Conclusion

The 3D TEE is important for the accurate characterization of the complexity of mitral valve lesions through a better anatomical definition of the valve. This accurate characterization of valve disease is fundamental for the determination and planning of the surgical procedure.

Case Report

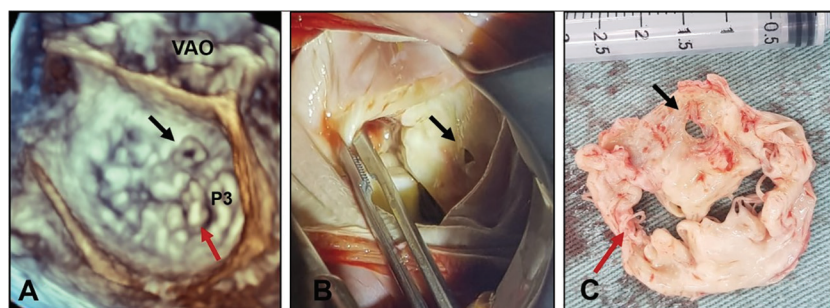
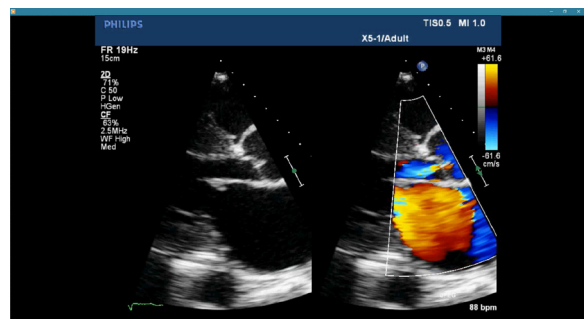
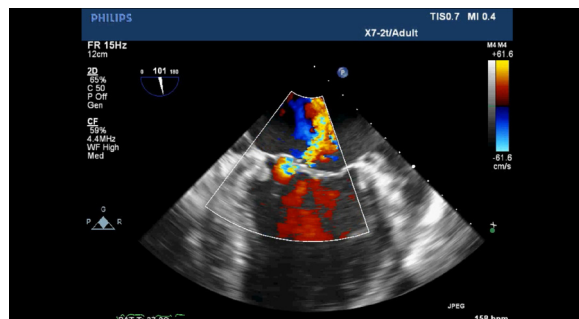


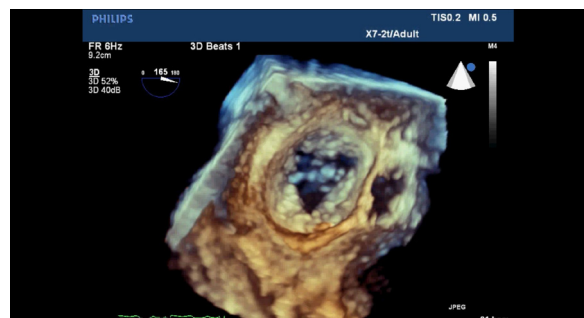
Figure 3 – A) Zoomed three-dimensional TEE imaging through en face view of the mitral valve, as seen from the left atrium showing the evident perforation orifice (black arrow) in the attachment basis of the anterior mitral leaflet - scallop A2 - and ruptured chords (red arrow) in the P3 scallop of the posterior leaflet; B) Surgical view of the mitral valve after opening the left atrium showing perforation in the anterior leaflet (black arrow); C) Surgically removed mitral valve seen on its left ventricular face corroborating the echocardiographic image, showing perforation (black arrow) in the anterior leaflet and the P3 scallop (red arrow) of the posterior leaflet, where the presence of ruptured chords (red arrow) can be observed.



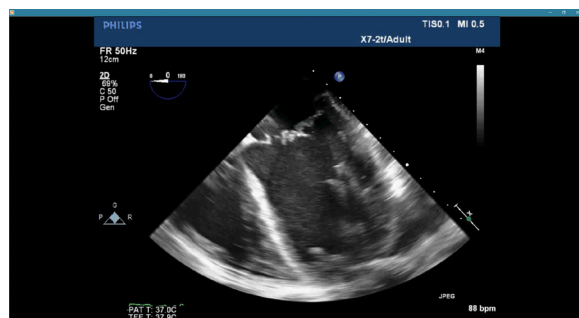
Video 1 – TTE showing a thickened mitral valve with image of perforation and a significant regurgitation mitral jet origination from the orifice. Link: <http://abcimaging.org/supplementary-material/2023/3602/abc-322-video-1.mp4>



Video 2 – 2D TEE showing a significant jet of mitral regurgitation related to the rupture of P3 scallop chords. Link: <http://abcimaging.org/supplementary-material/2023/3602/abc-322-video-2.mp4>



Video 3 – 3D TEE mitral en face view showing the double damage: perforation and ruptured chords. Link: <http://abcimaging.org/supplementary-material/2023/3602/abc-322-video-3.mp4>



Video 4 – 2D TEE 4 chamber view showing the perforation image in the anterior mitral leaflet. Link: <http://abcimaging.org/supplementary-material/2023/3602/abc-322-video-4.mp4>

Author Contributions

Conception and design of the research and critical revision of the manuscript for intellectual content: Mattoso AAA; acquisition of data Mattoso AAA, Couto GS, Espíndola LN, Britto PS; analysis and interpretation of the data: Mattoso AAA, Couto GS, Espíndola LN; writing of the manuscript: Espíndola LN, Mattoso, AAA;

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

References

1. Austin WJ, Ambrose J, Greenberg BH. Acute Presentations of Valvular Heart Disease. *Cardiac Intensive Care*. 2010;339-354. doi: 10.1016/b978-1-4160-3773-6.10027-8.
2. Tribouilloy C, Rusinaru D, Sorel C, Thuny F, Casalta JP, Riberi A, et al. Clinical Characteristics and Outcome of Infective Endocarditis in Adults with Bicuspid Aortic Valves: A Multicentre Observational Study. *Heart*. 2010;96(21):1723-9. doi: 10.1136/hrt.2009.189050.
3. Bayer AS, Bolger AF, Taubert KA, Wilson W, Steckelberg J, Karchmer AW, et al. Diagnosis and Management of Infective Endocarditis and Its Complications. *Circulation*. 1998;98(25):2936-48. doi: 10.1161/01.cir.98.25.2936.
4. Hansalia S, Biswas M, Dutta R, Hage FG, Hsiung MC, Nanda NC, et al. The Value of Live/Real Time Three-Dimensional Transesophageal Echocardiography in the Assessment of Valvular Vegetations. *Echocardiography*. 2009;26(10):1264-73. doi: 10.1111/j.1540-8175.2009.01042.x.
5. Liu YW, Tsai WC, Lin CC, Hsu CH, Li WT, Lin LJ, et al. Usefulness of Real-Time Three-Dimensional Echocardiography for Diagnosis of Infective Endocarditis. *Scand Cardiovasc J*. 2009;43(5):318-23. doi: 10.1080/14017430902737940.
6. Portugese S, Amital H, Tenenbaum A, Bar-Dayana Y, Levy Y, Afek A, et al. Clinical Characteristics of Ruptured Chordae Tendineae in Hospitalized Patients: Primary Tear versus Infective Endocarditis. *Clin Cardiol*. 1998;21(11):813-6. doi: 10.1002/clc.4960211106.
7. Lancellotti P, Moura L, Pierard LA, Agricola E, Popescu BA, Tribouilloy C, et al. European Association of Echocardiography recommendations for the Assessment of Valvular Regurgitation. Part 2: Mitral and Tricuspid Regurgitation (Native Valve Disease). *Eur J Echocardiogr*. 2010;11(4):307-32. doi: 10.1093/ejehocardiography/jeq031.
8. Baddour LM, Wilson WR, Bayer AS, Fowler VG Jr, Tleyjeh IM, Rybak MJ, et al. Infective Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications: A Scientific Statement for Healthcare Professionals From the American Heart Association. *Circulation*. 2015;132(15):1435-86. doi: 10.1161/CIR.0000000000000296.
9. Lang RM, Badano LP, Tsang W, Adams DH, Agricola E, Buck T, et al. EAE/ASE Recommendations for Image Acquisition and Display Using Three-Dimensional Echocardiography. *J Am Soc Echocardiogr*. 2012;25(1):3-46. doi: 10.1016/j.echo.2011.11.010.
10. Schwalm SA, Sugeng L, Raman J, Jeevanandam V, Lang RM. Assessment of Mitral Valve Leaflet Perforation as a Result of Infective Endocarditis by 3-Dimensional Real-Time Echocardiography. *J Am Soc Echocardiogr*. 2004;17(8):919-22. doi: 10.1016/j.echo.2004.04.013.



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