

Real-time Three-Dimensional Echocardiogram in the Identification of Late Complications in the Follow-Up After MitraClip® Implantation

Aplicação do Ecocardiograma Tridimensional em Tempo Real para Detecção de Complicações Tardias no Seguimento Pós-Implante de MitraClip®

Alexandre Costa¹ , Bruna de Mattos Ivo Junqueira¹ , Carolina Thé Macedo¹ , Marcus Vinicius Silva Freire de Carvalho¹ , Cristiano Guedes Bezerra¹ , Rodrigo Morel Vieira de Melo¹ 

¹Hospital São Rafael, Salvador, BA, Brazil.

Introduction

Conventional surgery is the treatment of choice for severe mitral valve regurgitation.¹ However, it is not feasible for patients at high surgical risk, who have high morbidity and mortality rates despite clinical treatment. Percutaneous valve treatment (*MitraClip*) has been evolving as a therapeutic perspective for this population, with reduced heart failure (HF) hospitalization and all-cause mortality rates.^{2,3,4}

Three-dimensional transesophageal echocardiography (3DTEE) has an additive role during clinical follow-up, especially in cases of suspected late complications with high detail of valve anatomy and clip positioning with cardiac structures. Additionally, due to the greater anatomical accuracy of this test, complications resulting from the procedure can be safely detected in real time.

This report describes a case of 3DTEE use in the diagnosis and evaluation of complications in the traditional follow-up of *MitraClip* implantation.

Case report

A 67-year-old man with a history of hypertension with dilated cardiomyopathy and significant functional mitral regurgitation who underwent *MitraClip* implantation in October 2021 was admitted five months after the procedure with chest pain and dyspnea on usual exertion. A transthoracic echocardiogram (TTE) showed two clips in the mitral position and significant mitral regurgitation in addition to significant bi-atrial and left ventricular enlargement with diffuse hypokinesia (25% ejection fraction calculated by the Simpson method).

Real-time 3DTEE to confirm mitral regurgitation and loss of the late result demonstrated that one of the clips had lost the capture zone related to the posterior leaflet. (Figure 1 and

Video 1) Color Doppler showed two eccentric regurgitant jets, one directed at the interatrial septum and the other, of greater magnitude, related to the lateral wall of the left atrium (Figure 2 and Video 2), totaling a significant degree of regurgitation (*Vena Contracta* 3D: 0.9 cm²). The patient's HF was compensated for with clinical measures and diuretic therapy, and the heart team chose a new outpatient percutaneous approach with a third clip implant strategy to treat the lateral mitral regurgitation jet (A1/P1 segments).

In April 2022, the patient was electively admitted for 3DTEE-guided implantation of the third clip without complications. This new implanted clip stabilized the one that had lost capture of the posterior leaflet and treated the lateral regurgitation jet (A1/P1) with consequent mitral regurgitation reduction. (Figure 3 and Video 3)

Discussion

Real-time 3DTEE, a fundamental imaging modality for the careful evaluation of patients eligible for *MitraClip* implantation, plays an important role in all stages of the procedure. Its role was established in the assessment of patient eligibility for device implantation through a systematic evaluation and use of recommended objective measurements.^{4,5} Moreover, 3DTEE aids the dynamic intraoperative assessment of each procedural step.^{5,6}

The *MitraClip* system is safe and features low rates of adverse events. Although the complication rate is low, the ideal format for clinical and echocardiographic follow-up should be better understood.⁵ This case report reinforces the additional value of the three-dimensional resource in pre- and intraoperative assessments as well as in the late follow-up of patients undergoing percutaneous mitral valve repair (*MitraClip*).

In the case described here, conventional echocardiography showed signs of device failure with recurrent severe mitral regurgitation. The use of real-time 3DTEE provided detailed anatomical data of the different segments of the mitral valve with anatomic correlation and allowed the exact identification of the mechanism of mitral regurgitation, showing that *MitraClip* failure captured the posterior leaflet of the mitral valve and related clip hypermobility. TTE was limited by artifacts generated by the attached clip, which impaired the identification of the cause of the loss of the late result by the device. Moreover, 3DTEE allowed the topographical identification of the segment related to loss of capture (A1/P1) and helped plan treatment with an additional clip to approach the residual lateral insufficiency jet.

Keywords

Echocardiography, Three-Dimensional; Mitral Valve Insufficiency; Postoperative Complications, Cardiovascular Surgical Procedures.

Mailing Address: Alexandre Costa Souza •

Hospital São Rafael, Av. São Rafael, 2.152, São Marcos. CEP: 41253-190 – Salvador, BA, Brazil.

E-mail: alexandrecoastahr@gmail.com

Manuscript received 4/26/2022; revised 7/6/2022; accepted 8/8/2022

Editor responsible for the review: Daniela do Carmo Rassi Frota

DOI: 10.47593/2675-312X/20223504eabc298i



Case Report

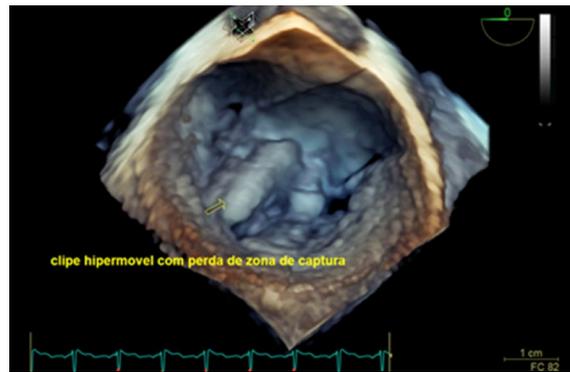


Figure 1 – Three-dimensional transesophageal echocardiogram (3DTEE) with three-dimensional reconstruction showing MitraClip capture loss.

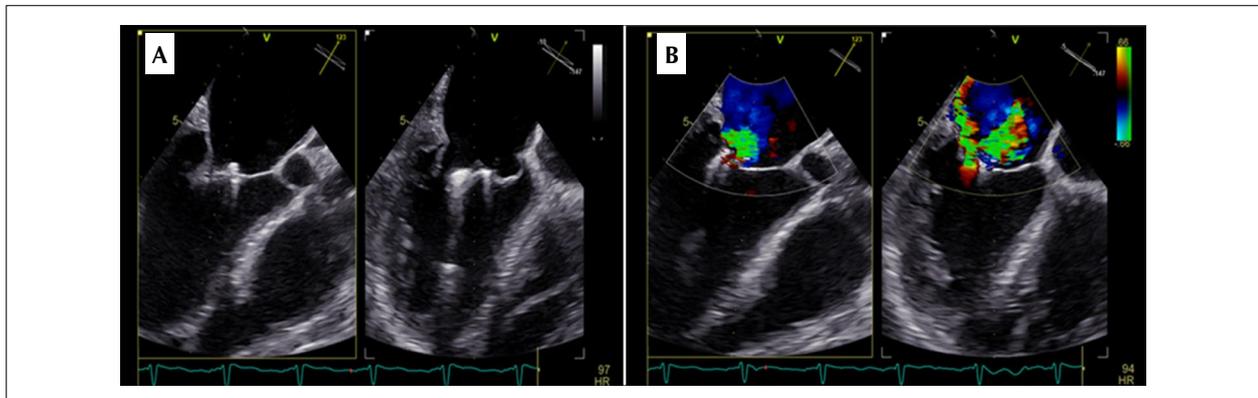


Figure 2 – (A) TEE with multiplanar slices showing the MitraClip with loss of the posterior leaflet capture zone. (B) The presence of two jets, one eccentric, directed to the lateral wall and compatible with significant mitral valve regurgitation in the post-MitraClip implantation follow-up.

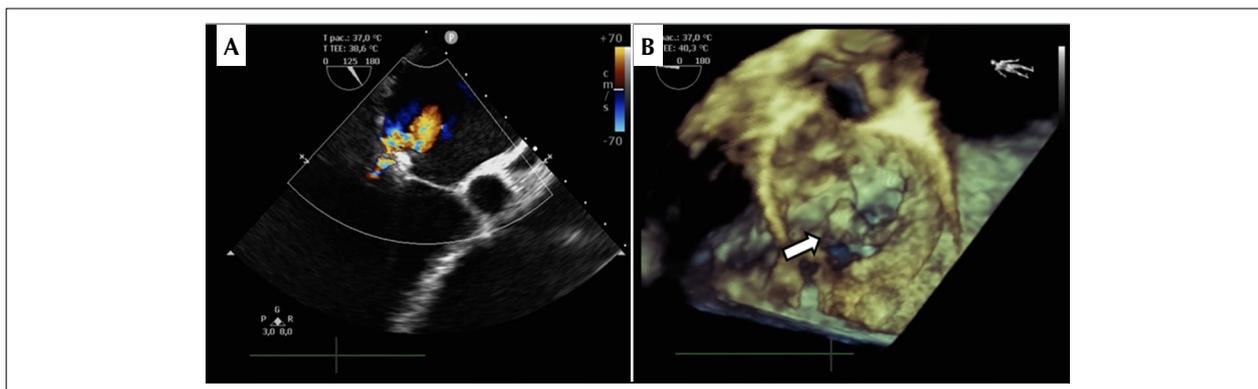


Figure 3 – (A) TEE showing mild mitral valve regurgitation in intraoperative control after implantation of the third MitraClip. (B) Three-dimensional reconstruction of the mitral valve with the presence of a double fenestration and a percutaneous device (MitraClip).

Mitral regurgitation severity was assessed using conventional parameters and 3D color Doppler echocardiography with quantification of the Vena Contracta 3D area. Buck *et al.* demonstrated that mitral valve geometry and left ventricle size and function may be associated with mitral regurgitation progression in the post-MitraClip⁶ follow-up; such parameters,

especially those related to the complex geometry of the mitral valve and its annulus, can be assessed through the three-dimensional resource. Partial clip displacement was described in 4–10% of cases.^{7,8} Decisions about patient management should consider new clip implantation and optimal clinical therapy. In exceptional cases, mitral valve surgery may be indicated, but it

must always be a shared heart team decision since most patients, especially those with HF, are at high surgical risk.

The amount of leaflet tissue captured at the time of device implantation and aspects related to mitral valve and left ventricle geometry influence the late outcomes of patients undergoing *MitraClip* device implantation. Follow-up should include TTE and, in cases of suspected results loss, 3DTEE is indicated since it can add relevant anatomical information to aid our understanding of the exact mechanism of result failure and subsequent planning.

References

1. Mackensen GB, Lee JC, Wang DD, Pearson PJ, Blanke P, Dvir D, et al. Role of Echocardiography in Transcatheter Mitral Valve Replacement in Native Mitral Valves and Mitral Rings. *J Am Soc Echocardiogr*. 2018;31(4):475-90. doi: <https://doi.org/10.1016/j.echo.2018.01.011>
2. Obadia JF, Messika-Zeitoun D, Leurent G, Lung B, Bonnet G, Piriou N, et al.; MITRA-FR Investigators. Percutaneous Repair or Medical Treatment for Secondary Mitral Regurgitation. *N Engl J Med*. 2018;379(24):2297-306. doi: 10.1056/NEJMoa1805374
3. Feldman T, Foster E, Glower DD, Kar S, Rinaldi MJ, Fail PS, et al.; EVEREST II Investigators. Percutaneous repair or surgery for mitral regurgitation. *N Engl J Med*. 2011;364(15):1395-406. doi: 10.1056/NEJMoa1009355. Epub 2011 Apr 4. Erratum in: *N Engl J Med*. 2011 Jul 14;365(2):189. Glower, Donald G [corrected to Glower, Donald D].
4. Wunderlich NC, Siegel RJ. Peri-interventional echo assessment for the MitraClip procedure. *Eur Heart J Cardiovasc Imaging*. 2013;14(10):935-49. doi: 10.1093/ehjci/jet060
5. Schnitzler K, Hell M, Geyer M, Kreidler F, Münzel T, von Bardeleben RS. Complications Following MitraClip Implantation. *Curr Cardiol Rep*. 2021;23(9):131. doi: 10.1007/s11886-021-01553-9.
6. Buck T, Eiswirth N, Farah A, Kahlert H, Patsalis PC, Kahlert P, et al. Recurrence of Functional Versus Organic Mitral Regurgitation After Transcatheter Mitral Valve Repair: Implications from Three-Dimensional Echocardiographic Analysis of Mitral Valve Geometry and Left Ventricular Dilation for a Point of No Return. *J Am Soc Echocardiogr*. 2021;34(7):744-56. doi: 10.1016/j.echo.2021.02.017.
7. Franzen O, Baldus S, Rudolph V, Meyer S, Knap M, Koschyk D, et al. Acute outcomes of MitraClip therapy for mitral regurgitation in high-surgical-risk patients: emphasis on adverse valve morphology and severe left ventricular dysfunction. *Eur Heart J*. 2010;31(11):1373-81.
8. Gheorghe L, Ielasi A, Rensing BJ, Eefting FD, Timmers L, Latib A, et al. Complications Following Percutaneous Mitral Valve Repair. *Front Cardiovasc Med*. 2019;6:146. doi: 10.3389/fcvm.2019.00146

Authors' contributions:

Research conception and design: Costa A, Junqueira BMI; data collection: Macedo CT, Carvalho MVSF, Bezerra CG; manuscript writing: Costa A, Junqueira BMI; critical review of the manuscript: Melo RMV, Costa A

Conflict of interest

The authors have declared that they have no conflict of interest.