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Percutaneous edge-to-edge mitral regurgitation valve repair after transcatheter aortic valve implantation

Reparo valvar percutâneo borda a borda da insuficiência mitral após implante transcater de válvula aórtica

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ABSTRACT - Moderate to severe mitral regurgitation is observed in 17 to 35% of patients undergoing transcatheter aortic valve implantation. A study reporting mitral regurgitation after transcatheter aortic valve implantation due to aortic stenosis demonstrated 50% of patients with moderate to severe reflux showed improvement in regurgitation, and 8.7% showed worsening of the condition, which led to increased mortality. This progression suggested conventional management, based on medication optimization, may not be able to prevent poor outcomes. We report a case on the clinical course of a patient with mitral regurgitation after transcatheter aortic valve implantation, and the use of MitraClip® as an alternative treatment and its benefits.

Keywords: Aortic valve stenosis; Heart failure; Mitral valve insufficiency; Heart valve prosthesis implantation; Transcatheter aortic valve replacement

RESUMO - A insuficiência mitral moderada a grave é observada em 17 a 35% dos pacientes submetidos a implante transcater de válvula aórtica. Estudo que reporta a insuficiência mitral pós-realização de implante transcater de válvula aórtica por estenose aórtica demonstra que 50% dos pacientes com refluxo moderado a grave apresentaram melhora da regurgitação, e 8,7% evidenciam piora do quadro. Nesses pacientes com piora, houve aumento da mortalidade. Essa progressão sugere que condutas convencionais, baseadas em otimização medicamentosa, podem não ser capazes de prevenir quadros negativos. Relatamos um caso sobre a evolução da insuficiência mitral após implante transcater de válvula aórtica e o uso do MitraClip® como alternativa de tratamento e benefícios.

Descritores: Estenose da valva aórtica; Insuficiência cardíaca; Insuficiência valva mitral; Implante de prótese de valva cardíaca; Substituição da valva aórtica transcater

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INTRODUCTION

Aortic stenosis (AS) is currently considered the most common valvar disease, with the greatest increase in incidence in recent years. In developing countries, the main etiologies are rheumatic valve stenosis, congenital valve disease with the presence of a bicuspid valve, and degenerative valve disease, which is common in the elderly.¹ In turn, mitral regurgitation (MR) can be classified into two types: primary MR (PMR), due to a structural or degenerative abnormality in the valve, and functional MR (FMR), which occurs due to changes in the geometry of the left ventricle or the left atrium.^{2,3} Statistical data from the *American Heart Association* (AHA) show more than 5 million FMR cases in the United States alone. It is estimated that this number is higher due to the aging of the population, leading to a poor prognosis, and it is also an independent predictor of mortality.⁴ Even with optimized clinical treatment, there is no data verifying any change in the progression of the disease, just relief and control of symptoms, with an annual mortality rate of 5%.⁵

Over the years, we have observed that the indication of percutaneous procedures presents consistent results in improving quality of life, reducing hospitalizations

and lowering the risks of postoperative complications. The benefit of a transcatheter aortic valve implantation (TAVI) in severe symptomatic AS is well established by guidelines in patients with high, intermediate and, more recently, low risk surgical risk, in specific groups.⁶

For mitral valve disease, a method known as percutaneous edge-to-edge valve repair was developed for treating patients with severe MR and high surgical risk. The technique uses a mechanical device introduced into the left atrium, via transseptal access, to approximate the anterior and the posterior mitral leaflets, leading to a reduction in the regurgitant volume; and there are studies showing its benefits when compared to optimized clinical treatment.³

Moderate to severe MR is observed in 17 to 35% of patients undergoing TAVI.⁷ A study reporting post-TAVI MR due to AS demonstrates that 50% of patients with moderate to severe reflux showed improvement in regurgitation, and 8.7% showed worsening of the condition, which led to increased mortality. This progression suggests that conventional management, based on medication optimization, may not be able to prevent poor outcomes.⁸

The objective of the report was to describe the benefit of using MitraClip® in the scenario of worsening MR after TAVI. The Research Ethics Committee of the *Hospital de Urgências de Goiânia*, associated with *Plataforma Brasil*, approved the present study (CAAE: 71097223.4.0000.0033).

CASE REPORT

An 86-year-old male patient with hypertension, dyslipidemia, diabetes mellitus, chronic kidney disease, coronary artery disease (CAD), paroxysmal atrial fibrillation (AF), carotid atherosclerotic disease with a stent implanted in the right carotid artery, AS and aortic regurgitation (AR), MR, undergoing periodic monitoring at the Cardiology Outpatient Clinic. Through periodic outpatient follow-up, in the 2019 transthoracic echocardiography (TTE), moderate AS, moderate AR, mild/moderate MR, mitral annular calcification, and mitral valve prolapse were identified. He was in New York Heart Association (NYHA) Functional Class (FC) I.

In 2022, a new examination was carried out, with a diagnosis of severe AS, moderate AR, moderate MR, and mitral valve prolapse. At that moment, he was in NYHA FC III. The case was discussed with the Heart Team and, due to the high surgical risk, TAVI was selected. In the pre-procedure coronary angiography, a 40 to 50% stenosis was observed in the distal third of the left main coronary artery (LMCA). An intracoronary ultrasound (IVUS) of the LMCA was performed, which demonstrated the presence of a mixed plaque in the distal third of the LMCA extending to the proximal segment of the left anterior descending artery (LAD), with discrete stenosis in the ostio-proximal segment of the LAD. The minimum luminal area measured in

the distal third of the LMCA was 6mm². An instantaneous wave-free ratio (iFR) was performed on the LMCA, and an index of 0.98 was obtained, when the pressure wire was positioned in the distal third of the LAD, and of 0.97, when the pressure wire was positioned in the distal third of the left circumflex artery.

Due to the IVUS findings and physiological assessment, the decision was to perform TAVI with no previous revascularization of the LMCA. In August 2022, the patient underwent TAVI, with implantation of an Edwards Sapien® 3 n°. 29 aortic prosthesis. Complete atrioventricular block (CAVB) was observed immediately after implantation, and the block persisted, requiring a permanent pacemaker (PM) implantation. The immediate post-procedure TTE showed a peak aortic transvalvular gradient of 12mmHg, and a mean of 6mmHg. In the control TTE performed 48 hours after the procedure and after PM implantation, we observed an aortic prosthesis in appropriate position, and no periprosthetic leak; calcification in the mitral valve; a prolapse in the presence of flail in the A3 anterior leaflet and P3 posterior leaflet, i.e., a phenomenon in which the tip of the leaflet between A3 and P3 during ventricular systole everts towards the atrium, generating an important reflux, with an eccentric and swirling jet, in a Coanda effect pattern. An important MR and a significant ventricular desynchrony were observed.

The patient was admitted to hospital many times due to pulmonary vascular congestion, and the possibility that worsening MR would be induced by desynchrony was considered. Discussing the case with the Heart Team, the decision was to implant a PM with physiological stimulation (hisian pacing). There was no success using hisian stimulation, due to intraoperative technical difficulties. Due to this failure, and in an attempt to improve ventricular synchronism, a resynchronizer was implanted, and synchrony was reestablished, but with minimal improvement of MR symptoms, which remained significant.

Due to the relevant and symptomatic mitral valve disease, the decision was to correct it through a minimally invasive procedure using a MitraClip® system 3 months after TAVI. Figure 1 shows the implanted devices.

Percutaneous edge-to-edge repair was performed with the implantation of a single NTW clip for clipping in the A3 and P3 positions, considerably reducing the mitral regurgitation. In the final post-procedure assessment, the regurgitation was assessed as mild. A follow-up TEE was performed with good echocardiographic findings, as shown in figure 2.

The patient had a satisfactory clinical evolution with improved quality of life, with no recurrence of pulmonary vascular congestion. He has been followed up for heart failure (HF) in the outpatient setting, and is clinically compensated, with continuous use of medications.

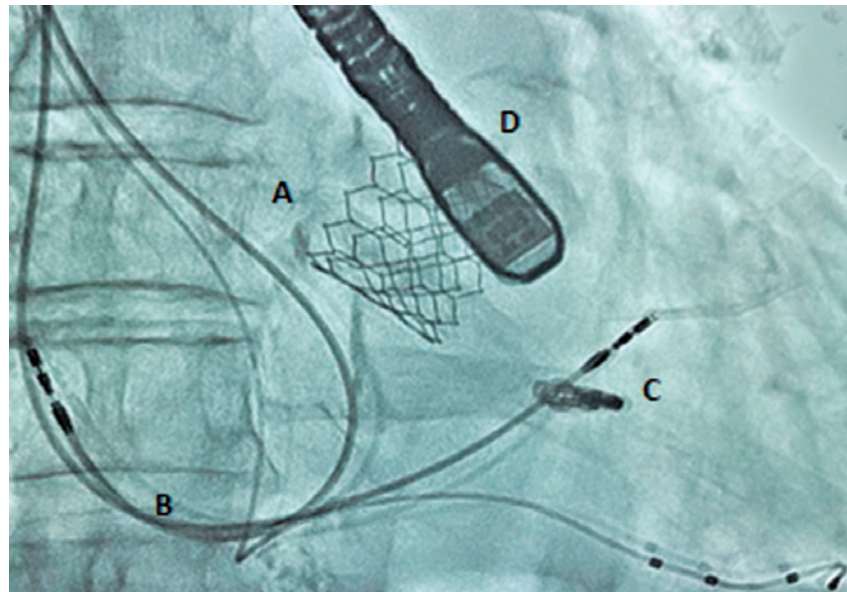


Figure 1. Cardiac catheterization post-implantation of a MitraClip® device, showing aortic valve implantation (A), cardiac resynchronization therapy device (B), MitraClip® system device (C), and transesophageal echocardiogram (D).

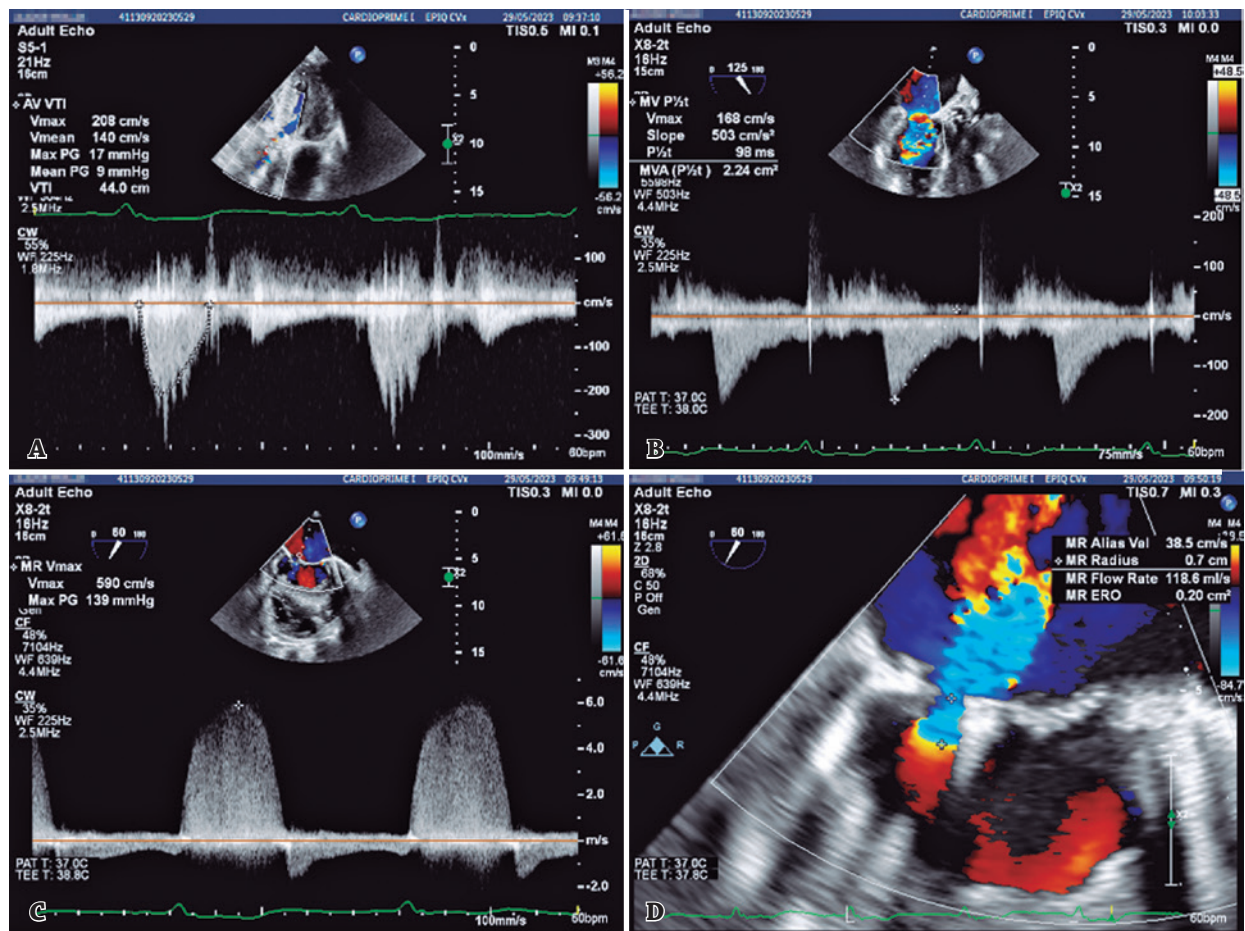


Figure 2. Control transesophageal echocardiography. (A) Continuous Doppler echocardiogram at the level of the transcatheter aortic valve implantation, with a maximum gradient of 17mmHg and a mean gradient of 9mmHg; (B) mitral inflow curve during diastole, with a maximum diastolic gradient of 11mmHg and a mean diastolic gradient of 3mmHg; (C) continuous Doppler echocardiogram of mitral regurgitation; (D) PISA method measurement to estimate the mitral regurgitation effective regurgitant orifice, measuring 0.2cm², denoting mild to moderate mitral regurgitation.

DISCUSSION

Moderate to severe MR is observed in 17 to 35% of individuals with AS who undergo TAVI. After TAVI, data from the literature show that 8.7% may progress to worsening MR. In these patients, increased mortality was observed. In one study reported in the literature, the division of FMR into two phenotypes was observed. Ventricular FMR originates from pathological changes in left ventricular geometry and systolic function, and atrial FMR originates from atrial enlargement with subsequent dilation of the mitral annulus.⁷

In the literature review, we observed a high prevalence of moderate to severe MR associated with AS and worsening of MR after TAVI, in some groups,^{7,8} with little expectation of improvement when it is a primary regurgitation, as observed in this report.

In the case reported here, AV block was a possible post-TAVI procedure complication. The cardiac stimulation therapy of choice in this case was traditional PM implantation. The device may cause harmful effects, such as intraventricular desynchrony, which, in turn, is related to worse prognoses, especially in patients with HF.⁹ As an alternative, on an elective basis, the attending cardiologist suggested the implantation of a physiological PM, with the objective of acting on the His-Purkinje system, through his-bundle or left branch stimulation, attenuating the intraventricular desynchrony induced by traditional pacing.¹⁰ Due to technical difficulties during the intraoperative period, the Heart Team's cardiac surgeon opted for implanting cardiac resynchronization therapy (CRT).

CRT emerged as a complementary option to drug treatment in patients with HF with reduced ejection fraction, with symptoms refractory to optimized clinical treatment. The purpose of right atrium, left ventricle, and right ventricle stimulation, in addition to adequate programming of the device, was to achieve atrioventricular and ventriculoventricular resynchronization, improving the ventricular synchrony and the MR, whose worsening might be induced by dyssynchrony.¹¹ There was no considerable post-procedure response, and the patient remained in NYHA FC III and with significant MR.

When evaluating patients with MR in the clinical office, it is extremely important to determine the degree of valve impairment, its severity, and the appropriate indication for therapy. To this end, echocardiographic methods, measurements of regurgitating fraction, regurgitant volume, and the regurgitant orifice area are used.¹² In cases of moderate or severe functional valvar disease, the indication is repair through traditional thoracotomy. However, considering the aging profile of the population and patients with prohibitive surgical risk, transcatheter techniques have been developed in minimally invasive approaches, to improve the functional status of patients with high surgical risk. The MitraClip® system emerged as an alternative for percutaneous mitral valve reconstruction,¹³ and was the choice in the case presented.

The prospective, multicenter, randomized study EVEREST II including 279 patients, and published in 2011, demonstrated the MitraClip® could be employed in patients with PMR, improving surgery safety after a 30-day follow-up, despite less effectiveness at 12 months.¹² For FMR, two large randomized clinical studies, COAPT and Mitra-FR, evaluated the efficacy of MitraClip®. Although the eligibility profile criteria in each study caused interference in the result, both were unanimous in defining the safety of the procedure, with low rates of complications related to the intervention or the device.¹³ In the last publication of the 5-year results of the COAPT study, presented at the *American College of Cardiology Annual Scientific Session, in 2023*, there was a sustained improvement in decreasing cardiac hospitalization and mortality, in the long-term follow-up of patients undergoing MitraClip®.¹⁴

In conclusion, the case reported in this article demonstrated the great potential of a percutaneous treatment for mitral valve regurgitation using MitraClip® system, a minimally invasive intervention with growing popularity, which relieves symptoms and improves quality of life, benefiting a growing number of patients.

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None.

CONFLICTS OF INTEREST

The other have no conflicts of interest to disclose.

CONTRIBUTION OF AUTHORS

Conception and design of the study: JCS and FBA; data collection: PFL, MVD and ET; data interpretation: JCS, FBA, ET and GG; text writing: PFL and MVD; approval of the final version to be published: JCS, FBA, PFL, MVD, ET and GG.

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