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Correction of extensive mitral paravalvular leak with three occlusion devices via transapical access: a case report

Correção de leak paravalvar mitral extenso com três dispositivos oclusores por acesso transapical: um relato de caso

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ABSTRACT – Heart valve diseases account for a significant portion of hospitalizations due to cardiovascular diseases in Brazil. Prosthetic heart valves, which are often part of treatment, are susceptible to complications, such as paravalvular leak. Surgical intervention remains the treatment of choice for correcting this defect. However, transesophageal echocardiography-guided catheter correction has emerged as a less invasive alternative for paravalvular leak treatment in patients at high surgical risk. We report a case of extensive mitral paravalvular leak in a patient who had two previous cardiac surgeries and a high surgical risk, who underwent successful transcatheter closure with three prosthesis implantation by transapical access.

Keywords: Heart valve prosthesis; Prosthesis failure; Mitral valve; Echocardiography, transesophageal; Cardiac catheterization

RESUMO – As valvopatias respondem por significativa parcela das internações por doenças cardiovasculares no Brasil. As próteses valvares, que muitas vezes fazem parte do tratamento, estão sujeitas a complicações, como o *leak* paravalvar. O tratamento cirúrgico persiste como a principal escolha para correção desse defeito. No entanto, a intervenção com cateter guiada por ecocardiografia transesofágica aparece como uma alternativa menos invasiva para sua correção em pacientes com elevado risco cirúrgico. Relatamos um caso de *leak* paravalvar mitral extenso em paciente com duas cirurgias cardíacas prévias e alto risco cirúrgico, submetido à oclusão por via transapical com três próteses com sucesso.

Descritores: Próteses valvulares cardíacas; Falha de prótese; Valva mitral; Ecocardiografia transesofágica; Cateterismo cardíaco

INTRODUCTION

Prosthetic heart valves are susceptible to complications, such as paravalvular leak (PVL), which consists in an abnormal communication between the prosthetic valve structure and the perivalvular cardiac tissue.¹ In severe cases, the condition leads to intense blood regurgitation, heart failure and hemolysis, and a new surgical intervention may be indicated.²

Although re-operation has been established as the gold standard for PVL correction, transcatheter closure has emerged as an alternative treatment for patients at high surgical risk, considering the poor prognosis resulting from re-operation in these patients, in whom an increase in the number of re-interventions leads to a progressive increase in mortality rates.³

We describe a case of mitral PVL in a patient at high surgical risk, who underwent a transapical transcatheter correction with the implantation of three Amplatzer™ Vascular Plug II devices. The Research Ethics Committee of the *Instituto de Cardiologia de Santa Catarina* approved this study on July 17, 2020 (opinion 4.160.536, CAAE 34219220.4.0000.0113).

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CASE REPORT

A 63-year-old female patient, body mass index 18.7kg/m^2 , with a history of two previous heart surgeries, the most recent performed 28 years ago, when a metallic prosthesis valve was implanted in the mitral position. Clinical presentation of heart failure New York Heart Association (NYHA) Functional Class (FC) IV, refractory to drug treatment, due to progressive PVL, unrelated to infective endocarditis. On regular use of warfarin.

Three-dimensional transesophageal echocardiography (TEE) revealed dehiscence of the medial suture of the mechanical prosthesis, causing slight displacement of the annulus and marked paraprosthetic regurgitation. The coronary angiography showed no obstructive lesions. The Heart Team opted for transcatheter closure of the mitral PVL, ruling out a new valve replacement surgery due to the high surgical risk.

With the patient under general anesthesia in the cath lab, the intraprocedural three-dimensional TEE showed that the defect had a slit shape, with 22mm in the long axis and 7.8mm in the short axis, and was located between 8 and 12 o'clock position, medially to the annulus (Figures 1 and 2). The heart surgery team performed a lateral mini-thorac-

tomy for transapical access. Anticoagulation was performed with 100U/kg unfractionated heparin. A 20F sheath was positioned at the left ventricular (LV) apex. The PVL was easily crossed with 0.035" hydrophilic guidewires, and three multipurpose diagnostic 5F catheters were advanced towards the left atrium (LA). Through the catheters, three 0.035" extra-support guidewires were positioned in the LA, crossing the PVL. Through two of these guidewires, 5F sheaths were advanced, through which two 10mm Amplatzer™ Vascular Plug II devices were positioned, and partially expanded at the PVL site, with the third guidewire remaining in the LA. Subsequently, through the third extra-support guidewire, a third 5F sheath was advanced and, through it, a third 8mm Amplatzer™ Vascular Plug II device was positioned and expanded next to the first two prostheses. The three 5F sheaths were positioned through the 20F introducer at the LV apex. After an echocardiographic control verified an almost complete reduction of the PVL, the three prostheses were released from their wires (Figure 3). The echocardiography showed fixed, stable devices, not interfering with the mitral valve prosthesis or adjacent structures (Figure 4). The pre-procedure three-dimensional TEE revealed severe regurgitation and, at the end of the intervention, it showed a slight residual regurgitation.

Figure 1. Mitral paravalvular defect. (A and B) Intraoperative three-dimensional transesophageal echocardiography showing a 2.2x0.7cm paravalvular leak.

Figure 2. Mitral paravalvular regurgitation. (A and B) Transesophageal Doppler echocardiography showing paraprosthetic regurgitation.

Figure 3. Post-procedural image: presence of three Amplatzer™ Vascular Plug II devices positioned in the mitral paravalvular leak.

Figure 4. Post-procedural image. Three-dimensional transesophageal echocardiography showing closure of mitral paravalvular leak.

The choice and size of the plugs were based on the total leak size, shown on three-dimensional TEE. Therefore, three devices were selected, slightly oversizing the defect – an objective based on the previous experience of the operators.

The postoperative period went uneventfully. Hospital discharge occurred after 8 days. The TEE performed 2 months after the intervention showed LV with preserved systolic function, the mechanical prosthesis in a normal functioning mitral position, presence of three devices occluding the PVL with slight residual regurgitation, and absence of intracavitary thrombi. In addition, the control TEE after 9 months showed mild to moderate PVL.

The patient showed clinical improvement, and was in NYHA FC I. She performed domestic activities, works in gardening and feels good. She remains under clinical follow-up and has had no complications during the period.

DISCUSSION

Mitral PVL is a complication that affects 7% to 17% of patients undergoing valve replacement surgery, who have a significant probability of developing heart failure and hemolysis.⁴ PVL may be the result of dehiscence of suture between the prosthesis and valve annulus, due to annular calcification, weakening of the tissue resulting from an infectious process, or positioning of sutures during valve insertion.³

Alkhouli et al. demonstrated the three-year survival rate of patients with mild PVL was 61%, whereas in patients with moderate or significant leaks, the three-year survival rate was 47% ($p=0.009$). This means that PVL reduction to a mild degree by percutaneous approach is associated with a significant benefit in mid- and long-term survival.⁵

Surgical treatment of PVL is the gold standard for repair.⁴ However, due to high surgical risk, not all cases are eligible for this therapeutic modality. Therefore, transcatheter closure becomes a safer alternative for this group, especially those who have undergone two or more previous surgeries, considering that reoperation in these patients is associated with a 16% mortality rate.⁶

Transcatheter closure can promote a significant reduction in the paravalvular regurgitation, promoting an improvement in FC and better quality of life.⁷ Confirming the safety of this procedure, a recent study demonstrated short-term adverse events, such as stroke, kidney failure with progression to dialysis, pneumonia, prolonged ventilation, hemothorax and cardiac tamponade, occurred significantly more frequently in patients undergoing surgical repair, when compared to those submitted to transcatheter closure (22.5% versus 7.7%; $p<0.001$).⁴ In addition, the transapical transcatheter approach has lower post-procedural morbidity when compared to surgery, as well as lower blood transfusion rate and shorter length of hospital stay.⁴

On the other hand, there are studies showing that, after 1-year follow-up, the transcatheter treatment group had higher risk of re-intervention and mortality when compared to the surgical treatment group. The studies discussed the fact that patients referred for transcatheter treatment usually have more comorbidities, raising the risk of complications.^{1,8} Based on this, Millán et al., in a study comparing surgical and transcatheter methods, showed that, despite its higher perioperative morbidity and mortality, surgery still leads to the best outcomes in the long follow-up.⁸

Although the transfemoral approach is the most discussed access route in the literature,⁶ it can become a real technical challenge, especially in more medial and larger leaks,

due to excess of curvatures and angulations along the path between the femoral vein and the PVL.⁹ The transapical access, on the other hand, offers short and direct access to the PVL, with easier control of catheters and devices, and more precise handling of the material – an important factor when planning the implantation of multiple occlusive prostheses.¹⁰ A study by Swaans et al. showed transapical PVL closure was successful in 100% of patients undergoing the intervention, whereas the transfemoral approach has success rates ranging from 30% to 80%.⁹

Success in PVL treatment depends on a collaborative work by the echocardiographer and the interventionist to precisely determine the dimensions of the PVL and to locate its regurgitation site.^{2,6} The aid of three-dimensional TEE allows a better evaluation of the characteristics of the cardiac defect and the actions during the procedure.² This technique was of paramount importance in the present report, since it helped positioning the three occlusive devices and adjusting them to the PVL shape.

The dimensions of the PVL vary in each case, and it may have a crescent (most prevalent), oval, round, or slit shape.⁷ This structural diversity, besides increasing the technical complexity of the procedure, renders a complete PVL occlusion difficult to be achieved.^{2,6} For this reason, the development of new devices with multiple shapes and sizes is needed to improve the results of this intervention.^{4,5}

In patients with mitral valve prosthesis who develop PVL and are at high surgical risk, a transapical transcatheter correction is an alternative therapy that can be successfully performed, with significant clinical improvement for the patient. The choice of the best treatment, whether surgical or transcatheter, must be individualized, according to the risks and benefits in the short- and long-term.

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None.

DECLARATION OF CONFLICTS OF INTEREST

The authors declare there are no conflicts of interests.

CONTRIBUTION OF AUTHORS

Conception and design of the study: LEKST and LSCL; data collection: LSCL, ALCVR and WJC; data interpreta-

tion: LEKST, LSCL, ALCVR, WJC, LW and LCG; text writing: LEKST, LSCL, ALCVR and WJC; approval of the final version to be published: LEKST, LSCL, ALCVR, WJC, LW and LCG.

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