Calcic Embolization with Acute Myocardial Infarction and Ventricular Septal Defect after Bioprosthetic Mitral Valve Implantation using the Valve-in-Valve Technique

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Introduction

Since the beginning of cardiac surgery, valvular pathologies have been treated by plastids or prostheses in open procedures with extracorporeal circulation. Over the past few years, with the technological development, the possibility of surgical treatment with minimally invasive techniques has emerged. These techniques are recommended for patients at high risk of complications and death with conventional procedures. Transcatheter valve implantation in the aortic valve has revolutionized the treatment of major aortic stenosis. Several techniques, devices and skills have progressively evolved, reducing the rates of complication after the procedure.[1-3] Since 2009, valve-in-valve (ViV) transcatheter mitral implantation for prosthesis dysfunction has been described.[4] The potential complications of this procedure are still evident. In this case, we report an example of embolic complication during the ViV transcatheter mitral implantation resulting in acute myocardial infarction and ventricular septal defect (VSD).

Case Report

A 69-year-old female patient was admitted to the emergency room with congestive heart failure with progressive worsening. She presented a history of rheumatic fever with mitral stenosis, atrial fibrillation and epilepsy. She had two previous surgical procedures: mitral commissurotomy, in 1976, and bioprosthetic mitral implantation, in 2002. On physical examination at admission, she had systemic blood pressure of 110/70 mmHg, heart rate of 70 bpm, respiratory rate of 14 irpm, 95% oxygen saturation, body mass index of 17.4 kg/m^2 and bilateral jugular stasis. Cardiac auscultation revealed arrhythmic sounds, first hyperphonectic sound, diastolic murmur in rhythm without pre-systolic 2+/6+ reinforcement in the mitral focus, increasing in left lateral decubitus. Lung auscultation revealed bilateral vesicular murmur with crackles in both lung bases. Liver palpable at 4 cm from the right costal edge. Symmetrical edema +/4+ in the lower limbs. The remaining part of the physical examination revealed no abnormalities.

Transthoracic echocardiography revealed left atrium with 51 mm; left ventricular diastolic diameter of 45 mm and systolic diameter of 30 mm; and septal and posterior wall thickness of 9 mm. Left ventricular ejection fraction was estimated at 62% and the pulmonary artery systolic pressure at 70 mmHg. The bioprosthesis in the mitral position was thickened, calcified, with decreased mobility of its leaflets, discrete central reflux on Doppler, with color flow mapping. Maximum transprosthetic gradient was estimated at 24 mmHg and the medium one was estimated at 13 mmHg. The effective valve orifice was 0.7 cm^2. Coronary angiography did not find any obstructive coronary lesions. No factors triggering acute decompensation of heart failure were found, and congestion was attributed to degeneration of the mitral prosthesis. Due to the patient's fragility and high operative risk (EuroSCORE II: 6.4%), percutaneous transcatheter implantation with mitral bioprosthesis was chosen after discussion with the Heart Team.

Findings on the intraoperative echocardiogram confirmed those previously described (Figure 1). Inovare valvular endoprosthesis (Braile Biomédica, São Paulo, Brazil) number 30 was implanted by transapical catheter, with access via left minithoracotomy (Figure 2). During the endoprosthesis implantation, a large quantity of calcium and hypokinesia of the left ventricular apical area were noted. Such segmental abnormality was attributed to the transapical surgical approach. Post-procedure echocardiography revealed good positioning of the endoprosthesis. At the end of the procedure, 12-lead electrocardiography was performed at the intensive care unit and revealed ST-segment elevation in the lateral wall (V5-V6-D1-AVL). Emergency transthoracic echocardiography revealed akinesia of the apical region, with ejection fraction estimated at 45%. There was no abnormality in the endoprosthesis. Maximum diastolic gradient was estimated at 11 mmHg, and the medium one was estimated at 5 mmHg. The valve area was estimated at 1.9 cm^2. At this moment, we chose to optimize the intensive clinical measures.

Good progression was observed in the first 4 postoperative days, but the patient had pulmonary congestion. Another echocardiography was done and showed discontinuity of the interventricular septum in the middle segment, of an irregular shape, with a sinuous path in the muscle and tunnel-shape look, and transeptal flow from the left to the right ventricle on Doppler (VSD, Figure 3). Pulmonary artery systolic pressure was estimated at 87 mmHg.

Keywords

Heart Septal Defects Ventricular/surgery; Embolism/complications; Myocardial Infarction/complications; Aortic Valve Stenosis; Bioprosthesis/adverse effects; Echocardiography/methods; Transcatheter Aortic Valve Replacement/methods.

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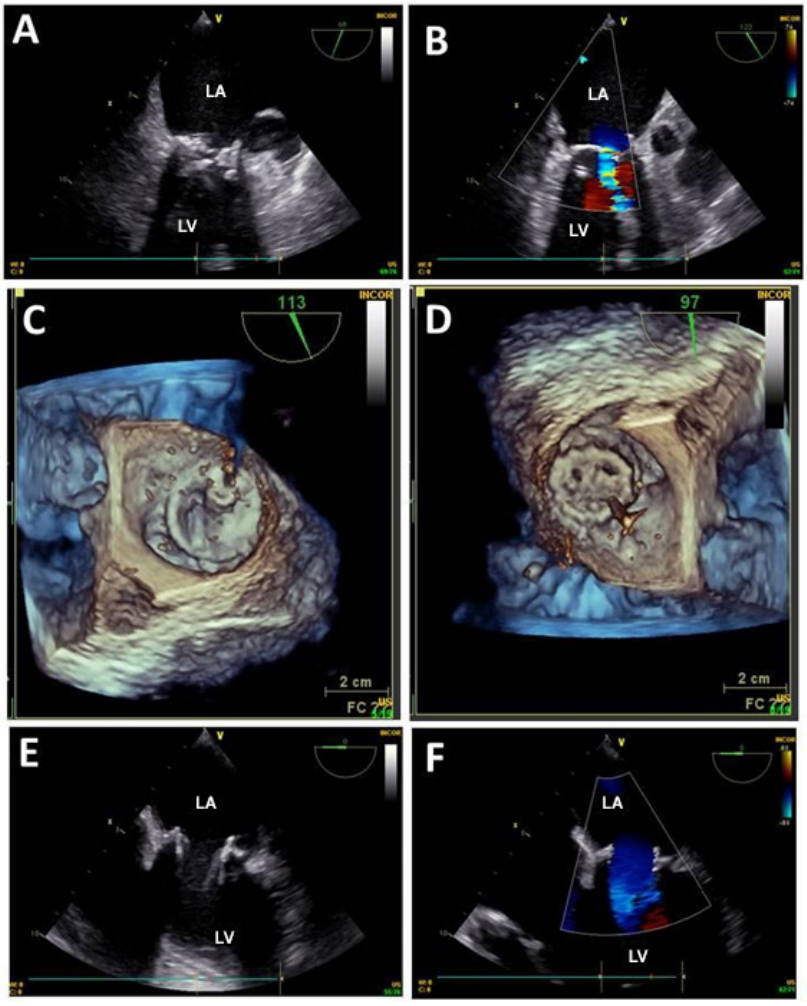

Figure 1 – *Sequence of transesophageal echocardiography images during implantation of percutaneous valve endoprosthesis. (A) Accentuated calcification of the mitral biological prosthesis; (B) Color Doppler showing acceleration of the flow through the prosthesis; (C) three-dimensional echocardiography showing severe thickening of the mitral prosthesis (atrial view); (D) guidewire going through the prosthesis; (E) endoprosthesis in normal position with normal mobility and opening; (F) normal hemodynamic profile, with laminar flow through the endoprosthesis on color Doppler. LA: left atrium; LV: left ventricle.*

The patient underwent coronary angiography, which showed occlusion of the distal third of the anterior descending artery and small mid-muscular apical VSD.

The case was, again, discussed with the valvopathy team, which decided to try to close the VSD using a plug. The procedure was partially successful with a discrete residual shunt, but with good clinical evolution. Finally, she was discharged asymptomatically on the 46th day after ViV, 30th day after implant of the plug.

Discussion

Transcatheter mitral valve implantation (TMVI) has recently emerged as a new frontier in the field of structural cardiac interventions. Considering that after 20 years of mitral bioprosthesis implantation, dysfunction of the mitral bioprosthesis occurs in approximately 67% of the cases, the use of ViV in this position has been seen as an increasingly viable option for the treatment of dysfunction, especially in patients with high risk.[1,4] Although transcatheter aortic valve implantation (TAVI) is a well-established treatment option for patients with severe symptomatic calcified aortic stenosis, the experience with TMVI remains at an early stage. There are important challenges in the development of this technology, including the complexity of mitral valve anatomy involving an oval saddle shape, the subvalvar apparatus, interaction with the left ventricular outflow tract and the aortic valve, as well as the large size of valvular devices and large catheters for implantation. The great variety of mitral pathology, from stenosis to multiple mechanisms of regurgitation, also contributes to implantation difficulties in the mitral valve. In addition, patients being considered for TMVI are generally at high surgical risk with multiple comorbidities, including fragility, pulmonary hypertension or severe left ventricular systolic dysfunction — each of which adversely

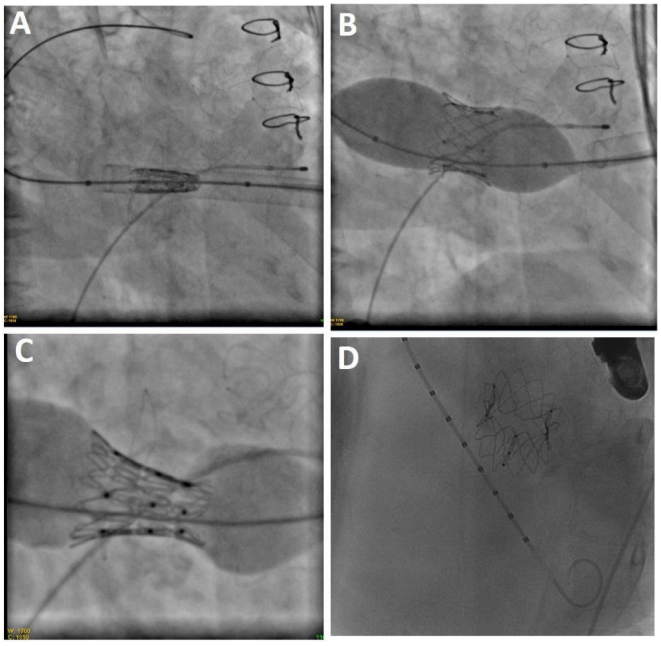

Figure 2 – *Fluoroscopy showing (A) passage of the guidewire with the endoprosthesis "going up"; (B and C) balloon insufflation for valve-in-valve implantation; (D) Inovare valvular endoprosthesis in its position at the end of the procedure.*

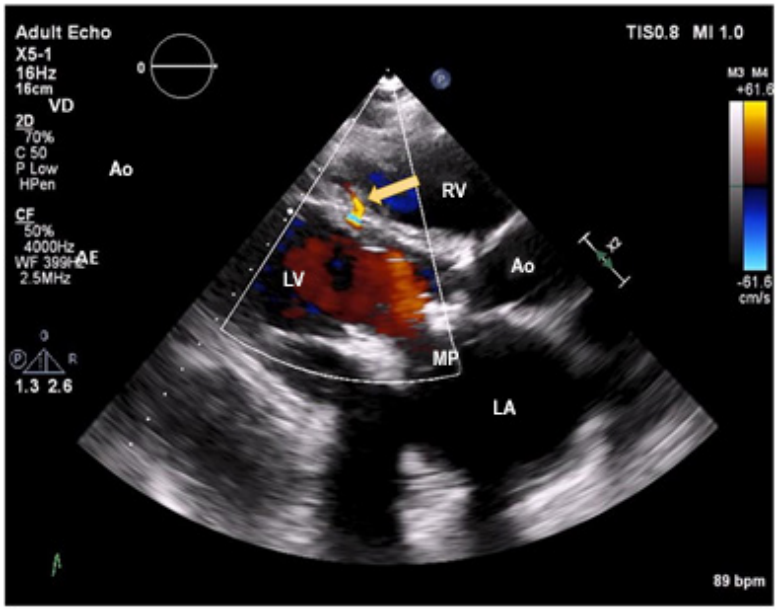

Figure 3 – *Transthoracic echocardiography performed on the fourth postoperative day showing left-right transeptal shunt on Doppler, corresponding to ventricular septal defect (arrow). LA: left atrium; Ao: aorta; RV: right ventricle; LV: left ventricle; MP: mitral prosthesis.*

affects the overall clinical outcome. Despite these technical, anatomical and clinical limitations, there has been significant progress in recent years.[4-7] Patients with dysfunctional mitral bioprostheses are treated with off-label aortic transcatheter valve devices. The preexisting circular structure provided by a surgical bioprosthesis can be used as an anchoring zone for an expandable balloon and for the aortic valve device. Therefore, aortic valve prosthesis technology has been used for this purpose prior to the development of dedicated transcatheter devices specifically for the mitral position.[5,7]

In the TMVI MAC Registry (transcatheter mitral valve implantation in native mitral valve disease with severe mitral annular calcification), the biggest record of this type of procedure, the transapical approach was used in 45.3% of the patients, transeptal in 40.6% and transatrial in 14.1%. Although the transapical technique is more invasive, the advantages over the femoral approach are greater ease in the valvular implantation due to the proximity of the valvular annulus of the cardiac apex, less manipulation of the aorta and peripheral arterial system, reducing vascular complications and stroke.[3]

Regarding the complications of TMVI in ViV, there are still few studies. In an 8-year follow-up of 32 patients undergoing TMVI, greater bleeding was detected in six patients, and none of them had cardiac tamponade. One patient presented valve migration and required a new surgery, two patients had a stroke, two had prosthesis thrombosis and one had a definitive pacemaker implanted. There was no acute myocardial infarction, vascular complications, obstruction of left ventricular outflow tract or endocarditis.[2]

In another study, 23 patients were followed up for 5 years. There were no cases of valve malposition or embolization. Repetition of balloon dilatation was successfully performed in one patient due to the presence of uncomplicated moderate perivalvular regurgitation. Major bleeding occurred in 6 patients, but reoperation due to bleeding or tamponade was not required. One patient had a stroke while in hospital and two had acute renal failure, one requiring temporary hemodialysis. A patient with preexisting atrioventricular conduction disorder required permanent pacemaker insertion. There was no intraoperative or 30-day mortality.[1]

The event described in this case report is very unusual. Specifically for the protection of coronary embolism, there is nothing available in the literature to date. What can be found are devices for neuroembolic protection; even so, in a recent meta-analysis, there was only a non-significant trend for stroke reduction and death.[8]

TMVI has evolved as an alternative for patients with severe mitral valve disease with a higher risk for conventional surgery. This field is at an early stage, and progress will be significantly slower than the development of TAVI due to the complexity of mitral valve anatomy and the diversity of pathology. There are major challenges with the technology currently available. Better and less bulky valve designs and implant methods can optimize technical success and decrease complications. In this report, we present a rare complication of coronary embolism during transapical implantation of Inovare prosthesis followed by acute myocardial infarction and post-infarction IVC.

Authors' contributions

Data acquisition: Peron MTB, Borges RGL, Spina GS and Lima MSM. Data analysis and interpretation: Peron MTB and Spina GS. Manuscript writing: Peron MTB, Borges RGL and Lima MS. Critical revision of the manuscript for important intellectual content: Lima MSM and Tsutsui JM.

Potential Conflicts of Interest

There are no relevant conflicts of interest.

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Academic Association

This study is not associated with any graduate programs.

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