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Transcatheter Mitral Valve Implantation in Open Heart Surgery: An Off-Label Technique

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Extensive mitral annulus calcifications are considered a contraindication for valve surgery. We describe the case of a 76-year-old female with severe mitral and aortic stenosis associated with extensive calcifications of the heart. The patient underwent an open mitroaortic valve replacement using transcatheter aortic valve implantation with an Edwards SAPIEN XT valve (Edwards Lifesciences Corp., Irvine, CA, USA) in the mitral position. The aortic valve was replaced using a stentless valve prosthesis (LivaNova SOLO; LivaNova PLC, London, UK). Postoperative echocardiography showed that the prosthetic valve was in the correct position and there were no paravalvular leaks. A bailout open transcatheter valve implantation can be considered a safe and effective option in selected cases with an extensively calcified mitral valve.

Key words: 1. Mitral valve
2. Ventricle
3. Calcifications
4. Aortic valve
5. Heart valve prosthesis

Case report

A 76-year-old female patient was admitted to S.Orsola Hospital, Bologna for the worsening of dyspnea and reduced tolerance to exercise (New York Heart Association [NYHA] functional class III). She had a history of aortic and mitral valve rheumatic disease; twice in the past year, this had progressed to the point where the patient required hospitalization. Four years ago, a pacemaker was implanted to treat a high-grade atrioventricular block. Her medical history included tonsillectomy for recurrent tonsillitis, polyarthritis, and moderate chronic renal insufficiency (glomerular filtration rate, 48.3 mL/min/1.73 m^2). During the hospital stay, she underwent a series of diagnostic examinations. Transthoracic and transesophageal echocardiography confirmed the presence of rheumatic valve disease with a moderate mitral steno-insufficiency (valve area, 1.2 cm^2; mean gradient, 3 mm Hg) and a severe aortic stenosis (valve area, 0.6 cm^2; mean transvalvular pressure gradient, 40 mm Hg); both valve apparatuses appeared massively calcified. The left ventricular ejection fraction was preserved (68%). High-resolution chest computed tomography showed diffuse calcifications extending to the myocardial wall (porcelain heart) (Fig. 1A). Coronary angiography confirmed a calcified heart and showed no significant disease of the coronary arteries. Catheterization of the right side of the heart showed postcapillary pulmonary hy-

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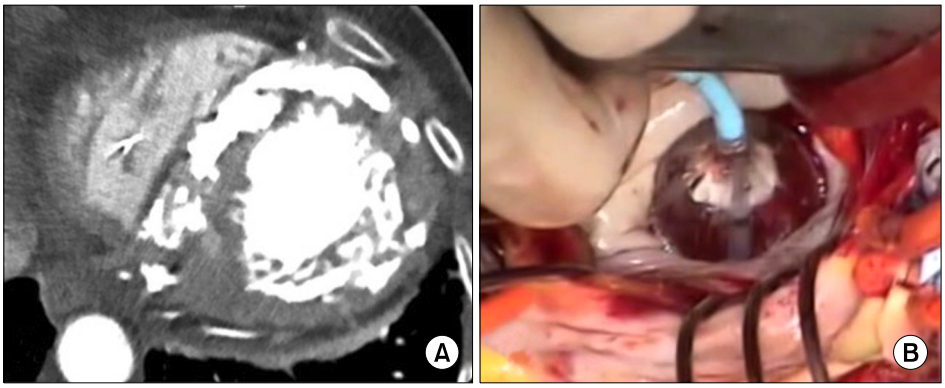

Fig. 1. (A) Myocardial calcifications (porcelain heart). (B) Balloon inflation of the mitral prosthesis.

pertension with a precapillary component (mean pulmonary arterial pressure, 30 mm Hg; pulmonary arterial wedge pressure, 17 mm Hg; pulmonary vascular resistance, 4.5 Wood units [WU]) and a reduced cardiac index (1.9 L/min/m^2). After a multidisciplinary heart team discussion, we decided to perform an open surgical intervention using a transcatheter valve. The patient, adequately informed, provided verbal and written consent for the surgical treatment. Cardiopulmonary bypass was performed using the ascending aorta and the caval veins. After cardioplegic arrest, the aorta was opened and the calcified aortic valve was removed. The left atrium was entered through the interatrial groove. The mitral valve presented extensive circumferential annular calcifications that extended deeply into the left ventricle muscle. Mitral annulus decalcification was avoided due to the risk of ventricle rupture, and only the valve leaflets were carefully removed. Subsequently, using a transapical Ascendra System (Edwards Lifesciences Corp., Irvine, CA, USA), we inserted, a 26-mm Edwards SAPIEN XT valve (Edwards Lifesciences Corp.) under visual control through the left atriotomy. Finally, a balloon was inflated into the stented prosthesis to promote anchoring to the mitral annulus (Fig. 1B). When we checked the valve competence using a saline test, a small paravalvular leak was found. Therefore, to better anchor the prosthesis, a ring of bovine pericardium was sutured between the ring and the left atrium using a polypropylene running suture (Fig. 2). Subsequently, no more leakage was evident. As the final step in the procedure, a next-generation stentless tissue prosthesis (LivaNova SOLO, 23-mm; LivaNova PLC, London, UK) was implanted in the aortic position. A postoperative echocardiogram showed normal functioning mitral (valve area, 2.3 cm^2; mean transvalvular pressure gradient, 3 mm Hg) and aortic (valve area, 1.9 cm^2; mean transvalvular pressure gradient, 5 mm Hg) prostheses. Only a mild paravalvular leak in the anteromedial region of the mitral valve was reported (Fig. 3).

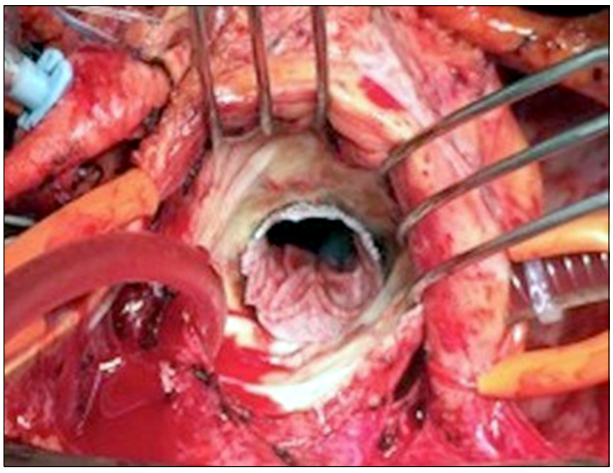

Fig. 2. Pericardial patch used to suture the endovalve to the calcified mitral annulus.

During the patient's in-hospital stay, we did not observe hemolysis due to the paravalvular leak. No signs of anemia or elevated bilirubin levels were present before the patient was discharged. After 6 months, catheterization of the right side of the heart revealed a slight reduction in postcapillary pulmonary hypertension (mean pulmonary arterial pressure, 28 mm Hg; vascular resistance, 2.3 WU) and a normalized cardiac index (2.9 L/min/m^2). The echocardiographic findings at follow-up were not different from those observed at discharge, and the patient's

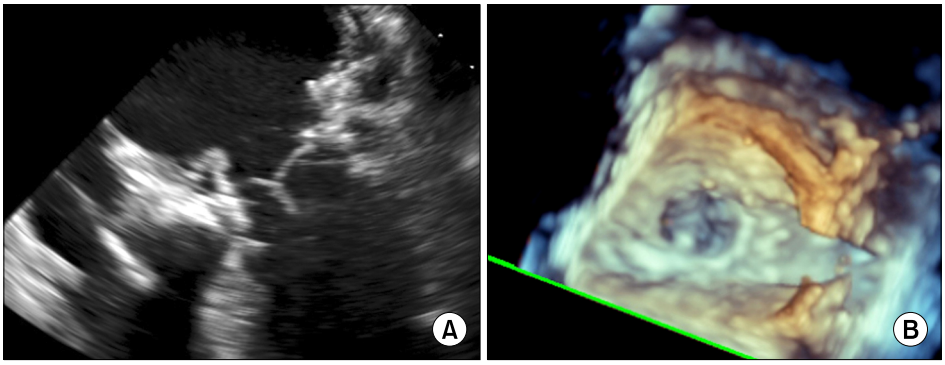

Fig. 3. Postoperative (A) 2-dimensional and (B) 3-dimensional echocardiograms.

functional capability improved to NYHA functional class II.

Discussion

In epidemiological studies, the prevalence of carditis in the setting of acute rheumatic fever is about 70% [1]. Rheumatic valvular lesions predominantly result in mitral regurgitation (59%), followed by aortic regurgitation (37%), mitral (30%) and aortic (9%) stenosis, and a systolic left ventricular dysfunction is present in 17% of cases [2]. In mitral valve surgery, the presence of extensive annular calcifications is a major surgical challenge, because the procedure of decalcification and reconstruction leads to severe complications, including massive bleeding, left ventricular rupture, atrioseptal defects, and atrioventricular fistulas. Several surgical techniques have been proposed to minimize surgical complications and to improve outcomes. Carpentier proposed a surgical technique that included annulus decalcification, detachment of the mural leaflet, en bloc resection of the calcium deposit with reconstruction of the atrioventricular junction, and annular reconstruction followed by valve repair [3]. Other authors described techniques of mitral valve annulus reconstruction using pledgeted-supported sutures or an autologous pericardium patch [4-6]. After the introduction of transcatheter aortic valve implantation (TAVI), refinements of the technique enabled the treatment of a malfunctioning mitral prosthesis (valve-in-valve) using the retrograde transapical or antegrade transatrial approach. Percutaneous replacement of the native atrioventricular valves is not yet possible due to the large size and irregular shape of the annulus, which potentially could result in prosthesis fluctuation and perivalvular leakage. In 2010, Webb et al. [7] presented a large series of valve-in-valve implantations to treat 24 failed bioprosthetic valves. The failed valves were aortic (n=10), mitral (n=7), pulmonary (n=6), or tricuspid (n=1) bioprostheses. The success rate of the procedures was 98.6%; there were no intraprocedural deaths, and the 30-day mortality rate was 4.2% (1 patient).

Although, as described above, many authors proposed surgical techniques for annulus decalcification and reconstruction, these procedures remain challenging and have a high risk of intraoperative and postoperative complications. Therefore, surgery is indicated only in selected patient populations, in which the early mortality rate has been reported to be between 3% and 10% [4-6]. Because of the high-risk profile of our patient, in order to reduce the likelihood of surgical complications and take advantage of the potential of the new transcatheter technologies, we opted for an off-label TAVI mitral procedure. The only study available in the literature describing a similar case of native transcatheter mitral valve replacement was reported by Astarci et al. [8]. Like us, they implanted a TAVI in a calcified mitral annulus through left atrium access, under visual control, and used a pericardial patch to anchor the valve. They also replaced the aortic valve with a stented bioprosthesis. In contrast, we employed a stentless prosthesis to minimize the risk of atrioventricular block and to improve valve performance.

In conclusion, in selected cases with an extensively calcified mitral valve, the less invasive bailout open approach can be considered a safe and effective treatment option, especially to reduce the surgical risks of full mitral decalcification.

Conflict of interest

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

References

1. Vasan RS, Shrivastava S, Vijayakumar M, Narang R, Lister BC, Narula J. *Echocardiographic evaluation of patients with acute rheumatic fever and rheumatic carditis*. Circulation 1996;94:73-82.
2. Hara H, Kimura K, Mackey-Bojack S, Schwartz RS. *Pottery heart: a case of porcelain heart*. Cardiovasc Revasc Med 2007;8:80-1.
3. Carpentier AF, Pellerin M, Fuzellier JF, Relland JY. *Extensive calcification of the mitral valve anulus: pathology and surgical management*. J Thorac Cardiovasc Surg 1996;111:718-29.
4. Papadopoulos N, Dietrich M, Christodoulou T, Moritz A, Doss M. *Midterm survival after decalcification of the mitral annulus*. Ann Thorac Surg 2009;87:1143-7.
5. El Asmar B, Acker M, Couetil JP, et al. *Mitral valve repair in the extensively calcified mitral valve annulus*. Ann Thorac Surg 1991;52:66-9.
6. Kim GS, Beom MS, Kim SR, et al. *Modified surgical intervention for extensive mitral valve endocarditis and posterior mitral annular calcification*. Korean J Thorac Cardiovasc Surg 2016;49:46-9.
7. Webb JG, Wood DA, Ye J, et al. *Transcatheter valve-in-valve implantation for failed bioprosthetic heart valves*. Circulation 2010;121:1848-57.
8. Astarci P, Glineur D, De Kerchove L, El Khoury G. *Transcatheter valve used in a bailout technique during complicated open mitral valve surgery*. Interact Cardiovasc Thorac Surg 2013;17:745-7.