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Sutureless aortic valve replacement and direct Sapien 3 valve-in-valve implantation: a challenging case

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Clinical vignette

A 72-year-old female was referred to our center for heart failure due to concomitant mitro-aortic biological prosthesis malfunction (severe mitral stenosis with mean gradient 11 mmHg and severe aortic stenosis AVA 0.55 cm^2) and severe tricuspid regurgitation. The patient was very frail (body mass index of 19.11 kg/m^2, Logistic euroSCORE II 22.9%; Society of Thoracic Surgeons score 12.9%), with a history of permanent atrial fibrillation and post-capillary pulmonary hypertension (PAPs/d/m 76/29/46 mmHg) requiring supplemental oxygen. We performed sutureless aortic valve replacement (SU-AVR) with Perceval S (LivaNova, London, United Kingdom), open mitral valve-in-valve procedure with Edwards Sapien 3 (Edwards Lifescience, Irvine, California, USA) and tricuspid valve annuloplasty.

Surgical technique

Preparation & exposition

The patient was intubated with a standard endotracheal tube and positioned supine. Through a full median sternotomy, cannulation of the ascending aorta and superior vena cava was performed. A percutaneous femoral vein cannulation was used for inferior vena cava drainage.

Myocardial protection was achieved with antegrade single dose of HTK solution crystalloid cardioplegia (Custodiol®).

Operation

Mitral valve prosthesis was exposed through a transseptal access. In order to avoid partial obstruction of the left ventricular outflow tract (LVOT), the bioprosthesis cusp corresponding to the native anterior annulus of the mitral valve was removed. A 29 mm Edwards Sapien 3 transcatheter heart valve prosthesis was prepared with a simplified fully crimping process. The prosthesis was then inserted into the old degenerate bioprosthesis ring and expanded under direct vision according to the valve-in-valve technique. The correct movement of the valve leaflets and the appropriate positioning was checked intraoperatively with a water test. The interatrial septum was then closed with direct suture. We then proceeded to transverse aortotomy and exposure of aortic bioprosthesis. The old degenerate prosthesis was removed. The transcatheter mitral valve (TMV) was nicely visible through the aortic valve in its position with no interferences with the LVOT. After aortic annulus sizing, a size S Livanova Perceval sutureless prosthesis was then selected and prepared for implant. Three monofilament 4-0 guiding suture were placed in the virtual nadir of the aortic sinus. The collapsed prosthesis was then crimped and implanted with its delivery system through the 'nadir' guide-wires. The Perceval S release system was then carefully extracted to avoid any collision with the TMV stent emerging in the LVOT. After good positioning of the atrial valve, we proceeded with the balloon dilatation. The absence of interference between the TMV and the Perceval prosthesis was verified and the aortotomy was restored with continuous double layer suture. Finally, a tricuspid valve repair was performed with a size 28 Contour 3D (Medtronic, Minneapolis, Minnesota, USA) ring with a good intra-operative result.

Completion

Postoperative echocardiogram showed good performance of the Perceval valve in the aortic position as well as the Sapien valve in the mitral position. The relationship between the new prosthesis compared with preoperative ones could be appreciated on the postoperative computed tomography angiography scan.

Postoperative course was uneventful and the patient was discharged twelve days after the surgery in good clinical condition.

At 18-month follow up, the patient was in NYHA class II with no signs or symptoms of heart failure, a reduction in pulmonary arterial pressures and no requirement for supplemental oxygen.

Comments

Clinical results & advantages

Surgical planning in high risk patients is demanding, especially in patients not suitable for transcatheter therapy. A tailored treatment is then mandatory to reduce surgical trauma and improve the outcomes. The choice of surgical access, cannulation site and valvular prosthesis is crucial to reduce operative time and surgical burden.

Though central cannulation is preferable, it is not always suitable in cases of easy re-entry. The use of both central and peripheral cannulation, as proposed in this case, makes for easier and faster anatomical dissection, improves cardiopulmonary bypass performance and makes the surgical field clearer.

Sutureless rapid deployment and transcatheter valve prosthesis have demonstrated a significant reduction in cross-clamp and cardiopulmonary bypass times and surgical trauma, both in minimally invasive or conventional approach, becoming a safe and effective option for high risk patients (1). Sutureless aortic prostheses have been suggested in cases of small aortic root and minimally invasive AVR, reducing cardiopulmonary bypass and clamp time with excellent hemodynamic performance and low rate of patient-prosthesis mismatch rather than conventional aortic valve prosthesis (2). Recently, sutureless prostheses have been also approved for their use in combined mitro-aortic procedure and successful multivalvular implants have been reported (3).

Transcatheter prosthesis nowadays is the gold standard for treatment of atrial valve stenosis in high- and medium-surgical risk patients; furthermore, this technology can be used in the 'open' method.

Open mitral valve replacement with transcatheter prosthesis is an acknowledged bailout resource for extensive calcification of native annulus or in cases of reintervention for structural valve deterioration (4). Furthermore, it is used more and more with off-label indications in extremely complex situations.

Caveats

In mitro-aortic surgery the mitral valve is usually replaced first, preserving mitral geometry and favoring a correct sizing. Moreover, a challenging drawback of mitral prosthesis deployment is the LVOT partial obstruction, which depends on anatomical features such as aorto-mitral angle and anterior leaflet dislocation (5). In order to avoid this complication, the prosthetic "anterior leaflet" has to be removed.

The nitinol cage of Sapien prosthesis was clearly visible from the aortic root, with patent LVOT, but it may potentially interfere with the correct introduction of the delivery system of Perceval prosthetic valve.

Whilst the conventional order of transcatheter mitral valve replacement (TMVR) followed by AVR was effective in this case, we felt that changing this order (AVR first, TMVR second) would have been a good option.

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Footnote

Conflicts of interest: The authors have no conflicts of interest to declare.

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