Case report
First-in-man implantation of a trans-catheter aortic valve in a mitral annuloplasty ring: novel treatment modality for failed mitral valve repair

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Abstract
The trans-catheter valve-in-valve concept has become a feasible therapeutic option for patients with failing degenerated bioprosthesis, who are deemed inoperable. However, little is known about the feasibility of this technique in failed valve annuloplasty. We report the first-in-man implantation of a trans-catheter aortic valve within a mitral annuloplasty ring. Through a trans-apical trans-catheter approach, a 26-mm Sapien-Edwards valve was successfully implanted in a 72-year-old man with ischemic heart failure and failed mitral-valve annuloplasty. The present case report provides a critical appraisal of the procedural technique.

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1. Introduction

The operative risks for re-operation of degenerated bioprosthetic valves significantly outweighs the risks for first-isolated native valve replacement [1]. In the presence of comorbidities, these risks increase exponentially. The encouraging results of trans-catheter heart-valve implantation have prompted several experienced centers to explore the feasibility of these techniques in patients with failed mitral and aortic bioprostheses. Various successful experiences have been recently reported [2—4]. Webb et al. described the largest series so far. However, little is known about the feasibility of this technique in patients with failing mitral-valve annuloplasty [5].

Mitral valve repair is the treatment of choice for mitral valve regurgitation, providing excellent operative results and superior survival and long-term outcomes, as compared to mitral valve replacement. However, postoperative recurrence of mitral valve regurgitation may occur [6,7]. In patients with functional mitral valve regurgitation, the prevalence of recurrent mitral valve regurgitation after mitral valve annuloplasty ranges between 11% and 22% [6—8]. In this subgroup of patients, repeat mitral valve repair or replacement may carry significant risks.

2. Case report

We report a trans-catheter aortic valve implantation within a mitral annuloplasty ring in a 72-year-old man with ischemic cardiomyopathy, who underwent coronary artery bypass grafting and mitral valve reconstruction 8 years ago. An Edwards Lifesciences Physio semi-rigid ring size 28 mm (Edwards Lifesciences Inc., Irvine, CA, USA) was implanted. The patient presented with acute pulmonary edema and renal failure. A transthoracic echocardiogram demonstrated left ventricular systolic dysfunction (ejection fraction 35%) and severe mitral regurgitation with an eccentric regurgitant jet. According to the logistic European System for Cardiac Operative Risk Evaluation (EuroSCORE), the calculated operative risk was 32.1% for repeat mitral valve operation. Therefore, after careful evaluation, the possibility of performing a trans-catheter aortic valve implantation within a mitral annuloplasty ring was considered. On three-dimen-

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Edwards aortic valve (Edwards Lifesciences Inc., Irvine, CA, USA) was implanted via a trans-apical approach. The 26-mm Sapien-Edwards aortic valve was advanced and positioned within the mitral annuloplasty ring, at the center of the mitral valve with equal proportions within the left ventricle and the left atrium, using fluoroscopy and transesophageal echocardiography guidance. The Sapien-Edwards aortic valve was successfully deployed during rapid right ventricular pacing (Fig. 1). Transesophageal echocardiography demonstrated the position of the trans-catheter valve in relation to the native mitral valve (Fig. 2). A minimal paravalvular leakage was observed and the mean transmitral diastolic gradient was 4 mmHg. The operation was uneventful and the patient could be extubated in the operating room, and transferred to the ward after 1 day of monitoring at the intensive care unit.

3. Discussion

Trans-catheter aortic valve implantation within a mitral annuloplasty ring for recurrent mitral valve regurgitation after mitral valve annuloplasty has several technical aspects.
that make this intervention unique. Trans-catheter valve-in-valve implantation procedures have been described in patients with failed bioprostheses showing [2–4]. The trans-catheter valve is implanted within the bioprosthesis, displacing the degenerated prosthetic leaflets. The sewing ring of the bioprosthesis is circular and, therefore, the trans-catheter Sapien-Edwards aortic valve can be adequately deployed within the failed bioprosthesis. However, in recurrent mitral valve regurgitation after mitral valve annuloplasty, the trans-catheter valve must accommodate an asymmetric annuloplasty ring and make it circular. In vitro testing proved that the Sapien valve causes the ring to become almost circular. In addition, during deployment of the trans-catheter prosthesis, the native anterior mitral leaflet will be displaced toward the left ventricular outflow tract and, consequently, it may result in risk of obstruction. In addition, this position may induce malfunction of the valve due to the lack of counter pressure at the top of the valvular commissures. The leaflets of the trans-catheter valve may remain open and a significant central regurgitation may be observed. Positioning the trans-catheter valve too high (with two-thirds of the trans-catheter valve within the left atrium) increases the risk of paravalvular leak. In this position, the pericardial skirt of the trans-catheter valve may not properly cover the surface of the mitral annuloplasty ring, resulting in significant paravalvular regurgitation, in addition, there may be a risk of valve embolization during systole and ejection out of the mitral annuloplasty ring.

The Sapien valve has to be mounted on the balloon upside down compared with the standard trans-apical aortic implantation. Before implantation, the team should double check this orientation of the valve (green line toward the left atrium).

By positioning the trans-catheter valve at the center of the mitral valve with equal proportions within the left ventricle and the left atrium, the risk of leaflet flaring is almost eliminated, and there may be less left ventricular outflow tract obstruction. The pericardial skirt of the trans-catheter valve permits sufficient coverage of the annuloplasty ring surface, minimizing the risk of paravalvular leakage. Another technical aspect to take into consideration is the placement of the guide wire. Positioning the guide wire in the superior pulmonary vein is the preferable approach as is the placement of the guide wire. Positioning the guide wire in the inferior pulmonary vein may cause a too-sharp angle, resulting in unfavorable tilting of the trans-catheter valve during balloon expansion (Fig. 1, Video 1).

In this case, as in other valve-in-valve procedures within prosthesis with a clear radio-opaque marker, usually no contrast is necessary for the procedure. Placement can be done with fluoroscopy alone.

The present case report demonstrates the feasibility of this procedure in patients with failed mitral valve annuloplasty and a high risk for re-operation. This therapeutic technique may provide new treatment alternatives for patients with high operative mortality and morbidity risk. Accurate pre-procedural evaluation and interventional strategy are crucial to achieve successful results.

References


Appendix A. Supplementary data

Supplementary data associated with this article (Video 1) can be found, in the online version, at doi:10.1016/j.ejcts.2010.09.021.