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Innovative Treatment for Degenerated Bioprosthetic Tricuspid Valves: Valve-in-Valve Approach

Dejenere Biyoprotez Triküspit Kapaklarda Yenilikçi Tedavi: Valve-in-Valve Yaklaşımı

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ÖZET

Transkateter kapak içinde kapak (TVIV) implantasyonu, özellikle yüksek cerrahi risk taşıyan, dejenerasyona uğramış triküspit biyoprotez kapak hastalarında umut verici bir tedavi seçeneği olarak ortaya çıkmıştır. Geleneksel cerrahi yöntemler, yüksek riskli hastalarda ciddi komplikasyonlar ve uzun iyileşme süreleriyle ilişkilidir, bu da alternatif tedavi seçeneklerinin önemini artırmaktadır. Bu raporda, daha önce fonksiyonel triküspit yetmezliği nedeniyle biyoprotez kapak replasmanı yapılmış ve 10 yıl sonra kapak dejenerasyonu ile başvuran bir vaka sunulmuştur. Hasta, 29 mm Myval transkateter kapak (Meril Life Sciences, Vapi, Gujarat, India) kullanılarak yapılan TVIV prosedürü ile başarılı bir şekilde tedavi edilmiştir. Bu tedavi yöntemi, dejeneratif biyoprotez kapakların yönetiminde önemli bir alternatif sunmakta ve yüksek riskli hastalar için güvenli ve etkili bir seçenek oluşturmaktadır. Bu vaka, TVIV'nin biyoprotez kapak patolojilerinin tedavisindeki potansiyelini vurgulamaktadır.

Anahtar Kelimeler: Biyoprotez triküspit kapak, dejenerasyon, Valf-in-Valf, transkateter kalp kapağı

ABSTRACT

Transcatheter valve-in-valve (TVIV) implantation has emerged as a promising treatment option for patients with degenerated tricuspid bioprosthetic valves, especially for those who are considered high-risk for traditional surgical interventions. This report highlights the case of a patient who had previously undergone bioprosthetic valve replacement due to functional tricuspid regurgitation. After 10 years, the patient presented with valve degeneration and was successfully treated with a TVIV procedure using a 29 mm Myval transcatheter heart valve (Meril Life Sciences, Vapi, Gujarat, India). The outcome was favorable, demonstrating the potential of TVIV for managing bioprosthetic valve failure in such high-risk patients.

Key words: Bioprosthesis tricuspid valve, Degeneration, Valve-in-Valve, transcatheter heart valve

INTRODUCTION

Bioprosthetic valves are generally preferred over mechanical valves for tricuspid valve replacement due to the lower risk of thrombosis. However, these valves are prone to progressive degeneration over time, which can limit their long-term effectiveness. When significant stenosis or regurgitation occurs in bioprosthetic valves, the typical approach is to perform reoperation. However, this decision is complicated by the increased surgical risks. In tricuspid valve surgery, the in-hospital mortality rate can reach up to 24%[2]. This has led to the consideration of alternative interventions. Tricuspid valve prostheses typically have shorter durability compared to those used in systemic valves [2]. Although less common than transcatheter valve-in-valve procedures for aortic or mitral valves, TVIV provides a valuable

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alternative to high-risk repeat surgeries for carefully selected patients. It is an effective treatment option for patients who are not suitable for surgery, have bioprosthetic valve dysfunction and have not completely lost their right ventricular capacity. In patient selection, the size and structure of the bioprosthetic valve, right ventricular functions, pulmonary hypertension, atrial fibrillation and dilatation are important. In particular, a careful hemodynamic assessment should be made before the procedure and it should be calculated whether the stenosis will worsen when the transcatheter is placed in the valve. Therefore, a comprehensive hemodynamic and anatomical analysis should be performed by putting the pieces together before the TVIV procedure. In this article, we describe the case of a patient with severe bioprosthetic tricuspid valve stenosis who underwent successful treatment using a transfemoral approach.

CASE REPORT

A 60-year-old woman with a known history of atrial fibrillation and a previous 33 mm St. Jude Medical (SJM) bioprosthetic valve replacement for functional tricuspid regurgitation 10 years prior, presented to our clinic with new-onset dyspnea and edema in the legs and abdomen. It was noted that the patient had been hospitalized multiple times in various clinics due to recurrent heart failure exacerbations. Abdominal ultrasound revealed findings consistent with stage 2 cirrhosis. It was noted that the patient experienced recurrent heart failure exacerbations despite treatment with an SGLT2 inhibitor, 100 mg of spironolactone, and 80 mg of oral furosemide daily. Transthoracic echocardiography revealed an ejection fraction of 60%, moderate mitral regurgitation, and mild right ventricular dysfunction. The tricuspid annulus diameter was measured as 36 mm. Additionally, an average gradient of 22 mmHg was measured at the tricuspid valve position. No thrombus or vegetation was identified to account for the observed gradient across the valve. The patient was assessed by the cardiology and cardiovascular surgery team, with an STS score of 14.7% and a calculated Euroscore II of 16.8%. Given the high risk associated with redo surgery, TVIV implantation was planned. Valve size was determined based on the dimensions of the pre-existing bioprosthesis, VIV mitral application, and multislice computed tomography (MCT) guidance.The procedure was conducted under general anesthesia via the transfemoral route with transesophageal echocardiography (TEE) guidance. Access to the pulmonary artery was achieved using a hydrophilic wire and a vertebral extra-stiff catheter. Support was enhanced by introducing a Lunderquist wire, which was advanced to the distal region of the pulmonary artery bed (Figure 1a). The balloon was carefully positioned under fluoroscopy to prevent advancement into the right ventricular outflow tract, and subsequent dilation

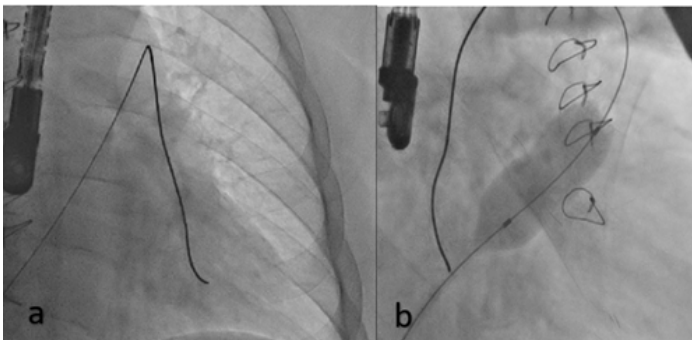

Figure 1a. It was advanced to the distal pulmonary bed with a Lunderquist wire. **Figure 1b:** Predilation was performed with a 25*40 mm balloon.

was performed using a 25 × 40 mm balloon (Figure 1b). Following balloon dilation, a 29 mm Myval transcatheter heart valve (Meril Life Sciences Pvt Ltd, Vapi, Gujarat, India) was successfully positioned under fluoroscopy (Figure 2). Post-procedure evaluation demonstrated satisfactory valve opening, with a mean gradient measured at 4 mmHg during follow-up echocardiography (Figure 3a, b). During the one-year follow-up, the patient did not experience any rehospitalizations, and the mean gradient measured on transthoracic echocardiography (TTE) remained at 4 mmHg. Additionally, the patient's requirement for furosemide decreased to 80 mg per week.

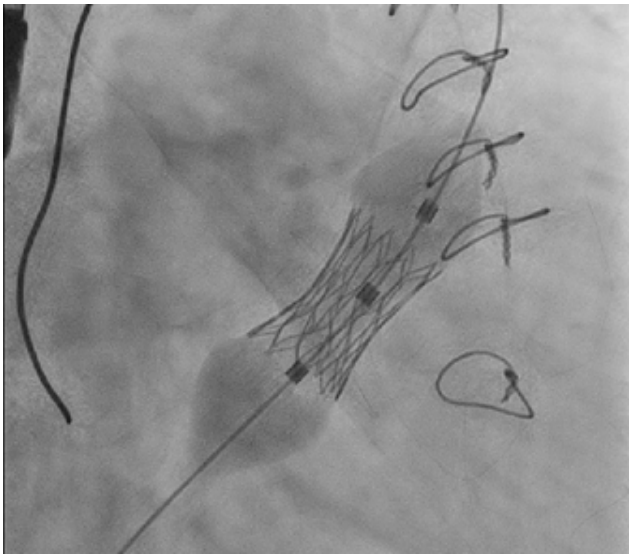

Figure 2. 29 mm Myval transcatheter heart valve (Meril Life Sciences Pvt Ltd, Vapi, Gujarat, India) implanted.

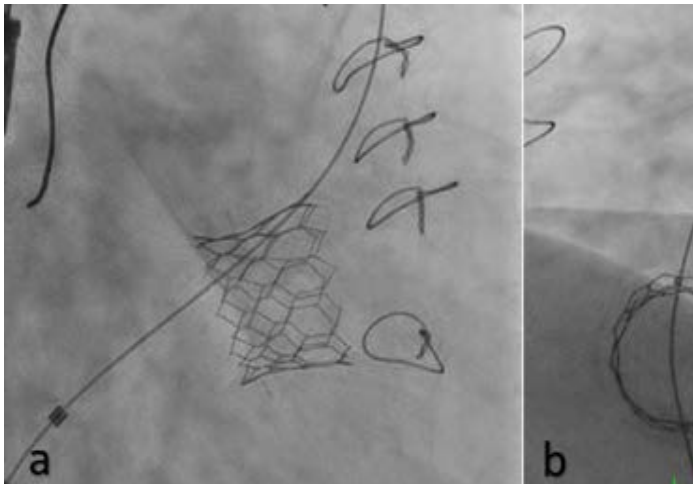

Figure 3a,b. Fluoroscopic images taken from different angles showed that adequate valve opening was achieved.

DISCUSSION

While mechanical valves are known for their long-term durability, bioprosthetic valves are often preferred for right-sided valve diseases due to the higher thrombosis risk associated with mechanical valves. However, bioprosthetic valves typically have a lifespan of 10-15 years, which can be a significant limitation. The conventional treatment for severe stenosis or regurgitation of bioprosthetic valves is reoperation. Yet, isolated reoperative tricuspid valve replacement, especially in patients with preexisting right ventricular dysfunction, is considered a high-risk procedure, as highlighted by the Society of Thoracic Surgeons registry. Recently, transcatheter valve-in-valve implantation has emerged as a viable therapeutic option for patients with degenerated bioprosthetic tricuspid valves, offering a promising alternative to traditional surgery.

The treatment of degenerated tricuspid bioprostheses with TVIV was first successfully performed in 2010 via the transjugular approach using Medtronic (Minneapolis, MN) valves [3]. While the transjugular route offers a coaxial approach to the tricuspid annulus, advancements in steerable and flexible valve systems have enabled the transfemoral approach to become the preferred method in most patients. While Edwards SAPIEN XT, SAPIEN 3 (Edwards Lifesciences, Irvine, CA), Medtronic (Minneapolis, MN) valves are frequently preferred for TVIV [4,5], there are cases where Myval transcatheter heart valve (Meril Life Sciences Pvt Ltd, Vapi, Gujarat, India) has been used, which has been indicated for TAVI so far [6].

Achieving optimal outcomes in transcatheter valve-in-valve procedures requires a comprehensive pre-procedural evaluation and precise determination of valve size. Due to the presence of valve leaflets, the actual internal diameter of a degenerated bioprosthetic valve is usually 1-2 mm smaller than the manufacturer's indicated size [7]. To ensure secure anchoring and fixation, the selected device should have an outer diameter that aligns closely with the true internal diameter of the surgical bioprosthesis [8]. Multislice computed tomography (MCT) plays a vital role in procedural planning, offering essential details on valve size, optimal fluoroscopic detector positioning, and the angulation of the tricuspid annulus. The valve size identified during this process can directly impact device selection. The availability of various sizes for the Myval transcatheter heart valve (Meril Life Sciences Pvt Ltd, Vapi, Gujarat, India), ranging from 20 mm to 32 mm, including intermediate sizes like 21.5 mm, 24.5 mm, and 27.5 mm, helps minimize the risk of prosthesis-patient mismatch and enhances the likelihood of a successful procedure.

While the full range of complications associated with transcatheter valve-in-valve (TVIV) procedures is still being explored, there are four anatomical structures that are particularly vulnerable to injury due to their proximity to the tricuspid valve. These include the atrioventricular node and right His bundle, the right coronary artery, the coronary sinus ostium, and the non-coronary sinus of Valsalva. Given the relatively limited experience with TVIV procedures, standardized follow-up protocols for valve assessment after the procedure have not been firmly established. However, it is recommended to perform a transthoracic echocardiogram (TTE) within the first 24 hours to evaluate valve function and identify any potential pericardial effusion. Subsequent clinical and echocardiographic evaluations should be conducted at 1 month, 6 months, and annually thereafter to monitor for complications and ensure optimal valve performance.

Low-flow right-sided valves carry an increased risk of thrombosis. While single antiplatelet therapy is generally recommended following TAVI procedures, long-term dual antiplatelet therapy may be considered for patients with tricuspid valve involvement who have a low risk of bleeding.

Recent advancements in interventional techniques for aortic and mitral valves are driving innovation in approaches to tricuspid valve procedures. As the importance of the tricuspid valve, often referred to as the 'forgotten valve,' gains greater recognition, there is expected to be an increase in surgical interventions for the tricuspid valve. This growing focus is likely to accelerate the development of specialized devices and transcatheter treatment options for tricuspid valve diseases.

CONCLUSION

The TVIV procedure can yield safe and effective outcomes in carefully selected patients when conducted with thorough pre-procedural evaluation. The success of this minimally

invasive approach mirrors the experiences and interventions associated with aortic and mitral valve procedures. However, further experience and research are essential to establish the long-term outcomes of this intervention.

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