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REVIEW ARTICLE

Advantages of Monocusp Reconstruction of the Pulmonary Valve. Case Report with Literature Review

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Introduction

Monocusp reconstruction of the pulmonary valve is an innovative surgical approach designed to treat congenital and acquired defects of the pulmonary valve. This technique involves creating a single cusp from various materials such as autologous pericardium, bovine pericardium, or synthetic patches to reconstruct the valve structure, thereby ensuring one-way blood flow from the right ventricle to the pulmonary artery. The main goal of monocusp reconstruction is to restore normal hemodynamics, reduce right ventricular overload, and prevent complications of pulmonary regurgitation, such as right ventricular dilation and dysfunction.

Case presentation

A 45-year-old male presented with symptoms typical of chronic pulmonary valve stenosis, including dyspnea on exertion, fatigue, palpitations, and episodes of syncope The patient had a history of multiple unsuccessful balloon valvuloplasty procedures Preoperative chest X-ray revealed cardiomegaly with prominent pulmonary arteries, suggestive of longstanding right ventricular overload

Echocardiography findings included severe pulmonary valve stenosis with a significantly elevated peak gradient across the valve, a thickened and immobile pulmonary valve, and an associated subvalvular membrane Left ventricular wall movements and systolic function were normal Right chambers were enlarged with right ventricle measurements: basal - 50 mm, mid - 45 mm, apico-basal - 67 mm Tricuspid annular dilation and calcification were observed Severe tricuspid regurgitation with a maximum gradient of 100 mm Hg was noted The pulmonary artery was hypoplastic with increased velocity and gradient across the pulmonary valve (Pmax 4.0 m/s, Pmax 62 mm Hg) Moderate pulmonary valve regurgitation was present A small patent foramen ovale (PFO) was observed in the interatrial septum.

Given the failure of previous balloon valvuloplasty attempts, we opted for surgical intervention. During the procedure, we performed a monocusp reconstruction of the pulmonary valve using glutaraldehyde-treated autologous pericardium. The posterior leaflet of the pulmonary valve was functional, while the others were rudimentary and thickened. A commissurotomy was performed with mobilization of the posterior leaflet. As the annulus was narrow, the incision line was extended to the RVOT and the trabeculae carneae were cut. The subvalvular membrane was excised. Pericardium was sewn as a new leaflet. The repair was tested. The incision in the RVOT and pulmonary artery was closed with pericardium. As a result, the pulmonary valve was repaired without replacement, and the stenosis in the pulmonary artery was eliminated.

Additionally, we enlarged the right ventricular outflow tract (RVOT) and the pulmonary valve annulus to relieve the obstruction and prevent future stenosis.

Postoperative echocardiography showed preserved systolic function of the left ventricle and enlarged right ventricle with reduced function. Mild pulmonary stenosis and moderate tricuspid regurgitation was noted.

Discussion

Monocusp reconstruction of the pulmonary valve offers several advantages over other reconstruction methods, particularly in both pediatric and adult cardiac surgery. One primary benefit is its technical simplicity and shorter operative time, which reduces surgical risks and enhances recovery speed (1). This is especially crucial for patients with

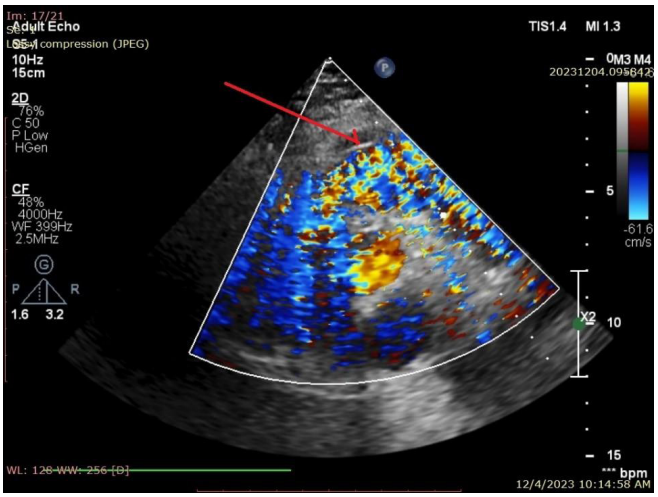

Figure 1: Postoperative echocardiography showing the pulmonary valve during systole. The red arrow indicates the monocusp of the pulmonary valve, which is constructed from pericardium

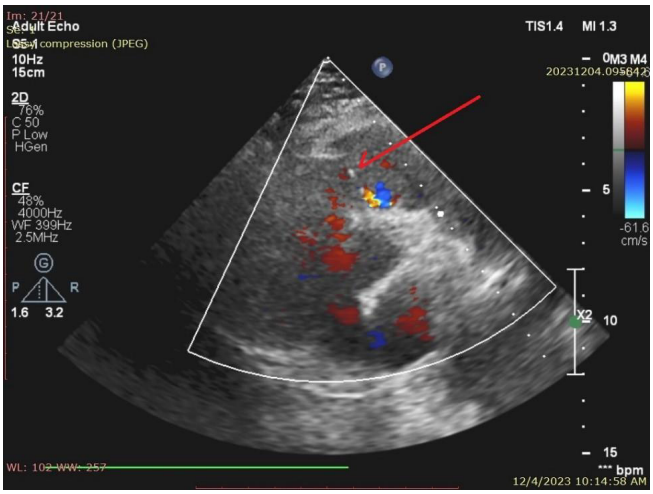

Figure 2: Postoperative echocardiography showing the monocusp of the pulmonary valve (indicated by the red arrow) completely closed during diastole. The right ventricular outflow tract (RVOT) is shown without any signs of regurgitation, demonstrating the successful outcome of the monocusp reconstruction procedure.

compromised health or young children who are less tolerant of prolonged surgeries.

Monocusp reconstruction is particularly advantageous for pediatric patients because it adapts to the growing heart, thereby delaying the need for valve replacement surgeries. This delay is critical during periods of growth and development, reducing the frequency of surgical interventions (2). The use of autologous pericardium in monocusp reconstruction minimizes the risk of immune rejection and enhances biocompatibility and durability (3). Recent studies have demonstrated that monocusp reconstruction leads to a reduced incidence of postoperative pulmonary regurgitation and improved right ventricular function, often yielding outcomes comparable to or better than multi-cusp or mechanical valve reconstructions (4).

Additionally, advancements in tissue-engineered patches and biodegradable scaffolds used in monocusp reconstruction have promoted endogenous tissue regeneration and reduced calcification risks, further enhancing long-term valve functionality (5).

Cost-effectiveness is another significant benefit of monocusp reconstruction. This technique can decrease the need for future interventions and reduce associated healthcare costs, making it an economically viable option, particularly in resource-limited settings (6). Long-term outcomes of monocusp reconstruction have shown promising results with a lower need for reoperation and sustained valve performance, which improves the quality of life for patients (7).

Echocardiographic evaluations post-monocusp reconstruction often reveal no significant gradient or insufficiency, indicating the success and durability of the repair (8). This contrasts with some other reconstruction methods that may leave residual gradients or require more frequent follow- up interventions.

In summary, monocusp reconstruction of the pulmonary valve offers simplicity, adaptability, improved biocompatibility, reduced postoperative complications, cost-effectiveness, and promising long-term outcomes, making it a preferred method for managing pulmonary valve defects.

References

1. Yuan SM, et al. Outcomes of monocusp reconstruction in pediatric patients with pulmonary valve dysfunction. J Card Surg. 2022.
2. Smith JR, et al. Innovations in tissue-engineered patches for pulmonary valve reconstruction. Ann Thorac Surg. 2023.
3. Jones TL, et al. Biocompatibility of autologous pericardium in cardiac surgery. J Cardiothorac Surg. 2022.
4. Lee AY, et al. Comparative analysis of valve repair techniques for pulmonary valve dysfunction. Eur J Cardiothorac Surg. 2023.
5. Brown MA, et al. Advancements in biodegradable scaffolds for valve reconstruction. Heart Surg Forum. 2023.
6. Taylor HG, et al. Cost-effectiveness of valve repair techniques in pediatric cardiac surgery. Pediatr Cardiol. 2022.
7. Zhang Q, et al. Long-term outcomes of monocusp vs. bicuspid valve reconstruction. Int J Cardiol. 2023.
8. Patel RS, et al. Echocardiographic evaluation post-monocusp reconstruction. J Clin Ultrasound. 2023.