Acta Scientific Clinical Case Reports

Volume 4 Issue 3 March 2023

Case Report

Pulmonary Valve Replacement Via Left Anterior Thoracotomy: An Alternative to High-risk Sternotomy

Sameh M Said[1]* and Jamie Lohr[2]

[1]Division of Pediatric and Adult Congenital Cardiac Surgery, Maria-Fareri Children's Hospital, Westchester Medical Center, Valhalla, New York, USA

[2]Division of Pediatric Cardiology, Department of Pediatrics, University of Minnesota, Minneapolis, MN, USA

***Corresponding Author:** Sameh M Said, Division of Pediatric and Adult Congenital Cardiac Surgery, Maria-Fareri Children's Hospital, Westchester Medical Center, Valhalla, New York, USA.

Received: December 30, 2022

Published: February 07, 2023

Abstract

Pulmonary valve replacement is considered the most common procedure in adults with congenital heart disease and the most common indication has been related to free pulmonary regurgitation after previous tetralogy of Fallot repair. The procedure is typically performed via a repeat median sternotomy, however recently left anterior thoracotomy has emerged as an alternative especially in challenging reoperative settings.

Keywords: Pulmonary Valve Replacement; Left Anterior Thoracotomy; Mini-PVR; Tetralogy of Fallot

Introduction

Progressive right ventricular (RV) enlargement (RVE) secondary to free pulmonary regurgitation (PR) after previous repair of tetralogy of Fallot (TOF) has been a classic indication to consider pulmonary valve replacement (PVR) to protect the RV. Despite the advances in transcatheter valve therapy, not all patients are considered appropriate candidates. The standard approach has been a repeat sternotomy; however, some anatomic features and patient-related factors significantly increase the operative risks such as multiple previous sternotomies, close proximity of the aorta and/or left innominate vein to the back of the sternum, and other features that contribute to what is known as "hostile mediastinum". We present a 57-year-old man with multiple comorbidities who underwent PVR via a left anterior mini-thoracotomy (LAMT) to minimize the risks associated with repeat sternotomy in his case.

Case Report

A 57-year-old man underwent previous repair of TOF with a transannular patch (TAP), followed by a second sternotomy for a modified Bentall procedure with a mechanical prosthesis due to aortic valve regurgitation and root enlargement. He developed progressive RVE secondary to free PR. Other comorbidities included: multiple previous cerebrovascular accidents, chronic obstructive pulmonary disease with bilateral emphysematous bullae, history of mycobacterium avium infection, lupus anticoagulant syndrome, and atrial fibrillation for which he underwent transcatheter ablation followed by placement of an endovenous permanent pacemaker/defibrillator. Due to the presence of symptoms and RVE, decision was made to proceed with surgical PVR. He had severely dilated main pulmonary artery and RV outflow tract (RVOT) and it was felt he was not a candidate for transcatheter valve therapy. Computed tomography (CT) scan showed adherence

of the ascending aorta (Figure 1 A) and aortic arch (Figure 1B) to the back of the sternum with multiple areas of aortic calcifications, in addition to several bilateral emphysematous bullae (Figure 2). No evidence of obstructive coronary artery disease was present on cardiac catheterization. Due to these multiple comorbidities and the high-risk features on the CT scan, decision was made to proceed with PVR via a LAMT.

Figure 1: Preoperative computed tomography scan showing: (A) the ascending aorta with calcifications and its close proximity to the back of the sternum (multiple black arrows), and (B) calcifications extending into the aortic arch which is also adherent to the back of the sternum (white arrows).

AA: Ascending Aorta; PA: Pulmonary Artery.

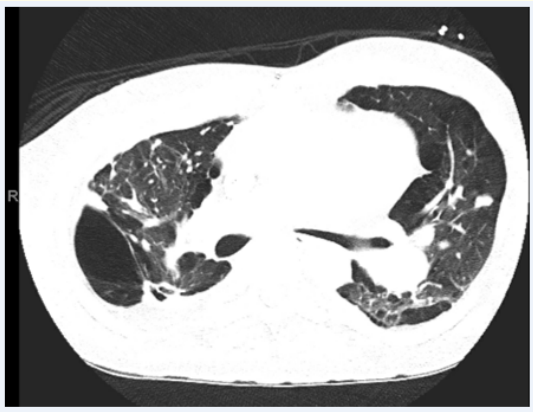

Figure 2: Preoperative computed tomography scan showing multiple bilateral emphysematous bullae.

The patient was positioned supine and after general endotracheal anesthesia with selective lung isolation, he was prepped and draped in the standard sterile fashion and the right femoral vessels were exposed via a cut down. Transesophageal echocardiogram (TEE) ruled out the presence of any intracardiac shunts. We then proceeded with a 6-7 cm LAMT incision along and parallel to the left third intercostal space. The left chest was entered, and minimal adhesions were encountered which were taken down with electrocautery. The pericardium and the previously placed TAP were identified. Cardiopulmonary bypass (CPB) was then initiated via cannulation of the right common femoral artery and vein using modified Seldinger technique and under TEE guidance. The procedure was performed at normothermia on a beating heart. Once the heart is decompressed, a longitudinal incision was made in the TAP and stay sutures were placed. The incision was extended further into the RVOT. Remnants of the pulmonary leaflets were resected. An appropriate size bioprosthesis was then secured to the native pulmonary annulus and RVOT using running 3/0 polypropylene suture. A bovine pericardial patch is then used to augment the main pulmonary artery and RVOT and is secured using running 4/0 polypropylene suture. The heart was then de-aired, and the patient was ventilated and weaned off CPB without difficulty. TEE confirmed satisfactory position of the prosthesis with no periprosthetic regurgitation. The femoral venous, followed by the femoral arterial cannulae were removed and the vessels were repaired followed by placement of a single chest drain and closure of both incisions in layers. The patient was extubated in the operating room (Figure 3 A&B), and the remaining postoperative course was uneventful. He was discharged on the ninth postoperative day after initiation of his aortic prosthesis anticoagulation.

Figure 3: (A) postoperative chest x-ray (antero-posterior view) showing the pulmonary bioprosthesis in position (red circle). Note, the mechanical aortic prosthesis and the previously placed pacemaker/defibrillator are shown, and the left anterior mini thoracotomy skin incision is shown in (B).

Comment

The current perioperative mortality risk of PVR has been estimated to be about 1% [1]. The traditional approach has been

through sternotomy, however repeat median sternotomy is not without risks. LAMT has emerged recently as an alternate approach to sternotomy for PVR. The proposed advantages of this approach have been related to its less invasive nature, quicker recovery, and faster return to activity in comparison to sternotomy. It provides direct access to the main pulmonary artery and the RVOT and can be performed in the settings of primary or repeat operations. LAMT is a reasonable approach to be considered in the presence of high-risk sternotomies such as described in our patient. While repeat sternotomy can be performed in the above described patient, the presence of a dilated ascending aorta with multiple areas of calcifications and the close proximity of the aortic arch and ascending aorta to the back of the sternum would have increased the likelihood of aortic injury upon reentry and despite it may be minimized by initiation of CPB prior to the sternotomy, it will result in prolonged CPB time and may require addition of ischemic time if cardioplegic arrest is to be needed. This would have definitely increased the perioperative risk in our patient especially in the presence of the multiple above-mentioned comorbidities.

Avoidance of mediastinal dissection in difficult reoperations minimizes the CPB time and minimizes risk of injury to cardiac/mediastinal structures which is a known risk factor for increased perioperative mortality and morbidity [2]. However, it is critical to rule out an intracardiac shunt prior to LAMT as de-airing will not be easy or safe. The PVR is performed in the same fashion as through median sternotomy.

We, similar to others [3], have presented our technique [4] and early experience with the LAMT approach previously [5]. In general, the data in the literature regarding this approach is limited and long-term outcomes remain to be determined. The procedure has been described in patients with infective endocarditis [6] as well as those with chest wall deformity [7]. We believe it should be in the cardiac surgeon's armamentarium and should be strongly considered to avoid risks of repeat sternotomy in the presence of a "hostile mediastinum".

Disclosure

The author (S.M.S) is a consultant for Stryker, Abbott and Artivion.

Funding

No funding.

Bibliography

1. Khanna AD., *et al*. "Benchmark outcomes for pulmonary valve replacement using the Society of Thoracic Surgeons databases". *The Annals of Thoracic Surgery* 100 (2015): 138-146.

2. Holst KA., *et al*. "Risk factors and early outcomes of multiple reoperations in adults with congenital heart disease". *The Annals of Thoracic Surgery* 92.1 (2011): 122-128; discussion 129-130.

3. Nellis JR., *et al*. "Left Anterior Mini-Incision for Pulmonary Valve Replacement Following Tetralogy of Fallot Repair". *Innovations* 15.2 (2020): 106-110.

4. Said SM. "Minimally invasive pulmonary valve replacement via left anterior minithoracotomy". *JTCVS Techniques* 3.6 (2020): 127-129.

5. Said SM., *et al*. "Pulmonary valve replacement via left anterior minithoracotomy: Lessons learned and early experience". *Journal of Cardiac Surgery* 36.4 (2021): 1305-1312.

6. Cheema FH., *et al*. "Pulmonary Valve Replacement Through a Left Minithoracotomy: An Alternate Approach". *The Annals of Thoracic Surgery* 98 (2014): 1827-1829.

7. Tatewaki H., *et al*. "Pulmonary valve replacement via left thoracotomy as an alternative to resternotomy". *The Annals of Thoracic Surgery* 110 (2020): 537-539.