ACTA SCIENTIFIC CLINICAL CASE REPORTS

Volume 4 Issue 11 November 2023

Case Report

Prosthesis-Patient Mismatch in Normal Functioning Valve – Scenario in a Growing Adult

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Received: September 14, 2023

Published: October 20, 2023

Abstract

Prosthesis-Patient mismatch (PPM) is a well-known complication following valve replacement surgery. Even though, various measures are taken to avoid PPM at operation, few patients may develop later in life due to normal growth, pannus development and prosthetic valve stenosis. We describe a young adult who underwent mitral and aortic valve replacement with 25 mm and 17 mm single tilting disc valve at the age of 11 with successful outcome.

Seven years later, he developed PPM with increased gradients across the mitral and aortic valves (28/14 & 46/26 mm Hg). He was re-operated to replace mitral valve with 27 mm StJude Medical (SJM) Masters and aortic valve with 19 mm SJM Regent bi-leaflet mechanical valves. Post-operatively, there was significant improvement in symptom status, reduction in prosthetic valve gradients (mitral & aortic: 18/7 & 16/7 mm Hg), improvement in left ventricle dimensions and function (EF: <25% Vs 35%).

Keywords: Age Related Growth; Double Valve Replacement; Prosthesis-Patient Mismatch;; Left Ventricular Dysfunction

Introduction

Prosthesis-patient mismatch is a serious, yet avoidable complication following valve replacement. Since its description by Rahimtoola., *et al*. [1], various changes in valve design and modifications in intra-operative techniques have emerged to reduce the incidence and progression later in life. In the majority of cases, PPM develops after initial operation as a result of various processes like somatic growth, weight gain, pannus formation, prosthetic valve stenosis secondary to mechanical damage of the valve or structural valve degeneration.

In small children, who receive mechanical prosthesis during their young age, re-replacement of these prosthesis is almost inevitable due to the PPM caused by somatic growth. Any degree of PPM significantly decreases long-term survival and increased re-admission for heart failure and reoperation for valve replacement [2]. We describe a young adult who developed significant PPM after seven years following his double valve replacement. This case report emphasizes that, even though mechanical valve replacement is an acceptable prosthesis for young children, strict follow-up is required for timely intervention.

Case Report

A 11-year-old boy was diagnosed of rheumatic heart disease with severe mitral and severe aortic regurgitation, mild - moderate pulmonary artery hypertension (PAH) with mild left ventricular (LV) dysfunction. He underwent double valve replacement – mitral valve with # 25 mm and aortic valve with # 17 mm single tilting disc leaflet mechanical valve (TTK Chitra) in 2014. He had uneventful post-operative period. He remained asymptomatic following surgery and was on irregular follow-up.

Seven years later, he presented with progressively worsening dyspnoea on exertion (New York Heart Association class III) and exertional palpitations for 6 months. He had no orthopnoea or features of right heart failure. His transthoracic echocardiography (TTE) showed, increased prosthetic valve gradients (peak/mean) at both mitral valve (28/14 mm of Hg) and aortic valve (46/26 mm of Hg) with normal leaflet excursion. His LV was severely dilated with LV internal dimensions (diastole/systole: 67/58 mm) and severe LV dysfunction (Ejection Fraction < 25%). His LV reserve was assessed with dobutamine strain echo (Figure 1), which showed improvement in his LV function and EF. He had moderate PAH and mild tricuspid regurgitation. His body surface area was 1.4 m^2.

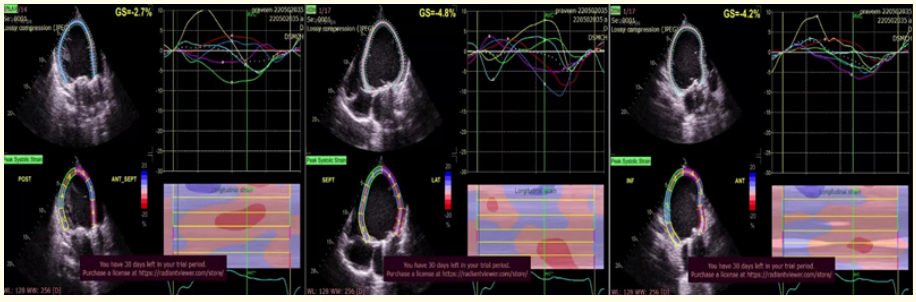

Figure 1: Left Ventricular dobutamine strain echo depicting longitudinal strain in various segments of ventricle.

He underwent pre-operative work up with CT thorax for retrosternal anatomy and peripheral vessel doppler. Secondary median sternotomy was performed and dense adhesions around the heart were released. He was kept under standard cardiopulmonary bypass (aorto-bicaval cannulation) and cardiac arrest was achieved using delnido cardioplegia. Patient was cooled to 28^0 C and double valve replacement was performed. Intra-operatively, aortic prosthetic valve leaflet movements were normal without pannus, however, mitral valve had sub annular pannus with restricted motion of one leaflet. Both prosthetic valves were explanted. Aortic valve was replaced with # 19 StJude Medical (SJM) regent and mitral valve was replaced with # 27 SJM masters bileaflet mechanical valve. The immediate post-operative period was uneventful.

His post-operative TTE showed reduced prosthetic valve gradients at mitral position of 18/7 mm of Hg (Figure 2) and aortic position of 16/7 mm of Hg (Figure). He is asymptomatic at his latest follow-up. His LV function improved with EF of 35% as compared to < 25% (pre-op). His LV dimensions also improved post-surgery LVID d/s 62/48 mm Vs 67/58 mm (pre-op). He is on regular follow-up with oral anticoagulation.

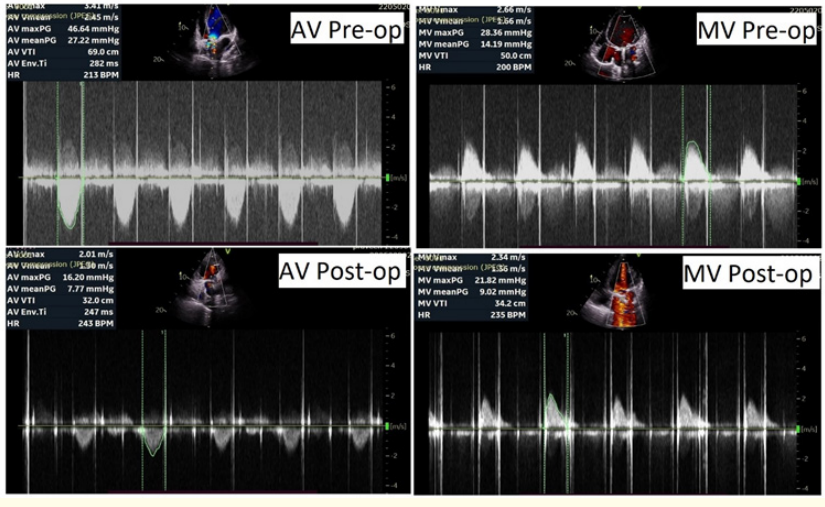

Figure 2: Transthoracic echo images comparing prosthetic valve gradients of initial and re-do double valve replacement. AV: Aortic valve, MV: Mitral valve.

Discussion

The basic concept and potential complications of prosthesis-patient mismatch were introduced 40 years ago by Rahimtoola., *et al*. [1]. However, temporal trends show a significant decrease in the incidence of PPM over the past decade [2].

In children, valve repair should be preferred to replacement as a result of somatic growth. However, rheumatic heart disease and other patient factors limit this consideration. Mechanical valve prostheses are a valuable option for left-sided heart valve replacement in paediatric patients. In a study done by Sachweh., *et al*. operative mortality and long-term morbidity are acceptable following mechanical heart valve prosthesis [3]. In their series, perioperative morbidity was exclusively seen in children with MVR. Oversizing was often possible to avoid early reoperation for outgrowth.

Identification of PPM as a result of patient's somatic growth or pannus formation in children by non-invasive methods have not been well established. In a Japanese study by Makuda., *et al*. valve orifice area index was not shown to be a reliable index to predict PPM [4]. However, they found that maximum trans-prosthesis flow velocity was a useful index for pulmonary capillary wedge pressure. Invasive cardiac catheterization to determine re-replacement of the prosthesis should be considered when maximum trans-prosthesis flow velocity exceeds 270 cm/s.

A study done by palanisamy., *et al*. showed weight gain following mitral valve replacement surgery has definitive influence over hemodynamics [5]. In this study, Patients who developed PPM, as a result of weight gain had significantly increased PA systolic pressure at follow-up. Young, < 50 kg weight and PPM patients at initial post-operative echo should be advised to maintain their weight post MVR for better hemodynamics.

In isolated aortic valve disease, aortic annular enlargement can be done for AVR in selected children and intermediate-term results after aortic valve replacement using bileaflet mechanical prosthetic valve in children was satisfactory [6]. Ross procedure might be considered in limited cases.

In children, where adequately sized mechanical prosthesis was implanted as per BSA, strict echocardiographic follow-up is advised frequently to identify increasing prosthetic valve gradients, as they grow to assess the need for surgery and to prevent irreversible LV dysfunction.

Acknowledgments

We thank cardiology team and echo technicians for providing the technical support.

Author's Contributions

Made substantial contributions to conception and design of the study and performed data analysis and interpretation: Dr. Sameer Md, Dr.Ashiq N.

Provided administrative, technical and material support: Dr. S Anbu, Dr. Ram Kumar S, Dr. Bhavidra R.

Financial Support and Sponsorship

None.

Conflicts of Interest

All authors declared that there are no conflicts of interest.

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