Surgical Correction in a Redo Aortic Valve Replacement Patient with Severe Patient-Prosthesis Mismatch with Left-main Coronary Artery Occlusion : A Case Report

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Abstract

Background: Patient Prosthesis Mismatch (PPM) after surgical aortic valve replacement may exacerbate patient's symptoms which is worsened If coupled with coronary artery occlusion. Very few re-operations were reported in our population to correct such pathologies and to our best knowledge a repeat re-do (Tri-do) was never reported in our country.

Case Presentation: We hereby present a patient's report who was previously treated twice by Aortic Valve Replacement (AVR) and yet he was not relieved of PPM. To make things worse he also developed left main coronary artery occlusion and we had to perform a tri-do AVR with coronary artery bypass grafting and aortic root enlargement.

Conclusion: Our well-planned surgery with valiant efforts from the team members made the surgery very worthy for the patient as he was relieved of symptoms. Surgeons with skills and experience should perform this type of life saving surgery without much hesitations if everything permits.

Key words: Tri-do AVR; Post-AVR PPM; Post-AVR coronary stenosis; Redo Aortic Valve Surgery.

Introduction

The significance of adequate sizing during aortic valve replacement and Patient-Prosthesis Mismatch (PPM) was first described by Rahimtoola et al.[1] PPM is sometimes seen as residual stenosis after surgical aortic valve replacement resulting in residual symptoms. The adverse effects of residual stenosis like faster degeneration of bioprosthetic valve or incomplete LV mass regression may affect the long-term patient survival.[2] Two large meta-analysis, one comprising 27,000 patients and another with 40,000 patients showed significant impact of moderate to severe PPM on all cause and cardiac related survival after 5 years and the impact on mortality more seen in age <70 years and body mass index <28 kg/m^2.[3,4]

Moreover, iatrogenic coronary artery occlusion after surgical aortic valve replacement is a rare but fatal complication and the estimated incidence rate is 0.3%-3.4%.[5] We report a case who underwent mechanical aortic valve replacement twice and developed PPM along with left main coronary occlusion and was successfully treated surgically by us.

Case Presentation

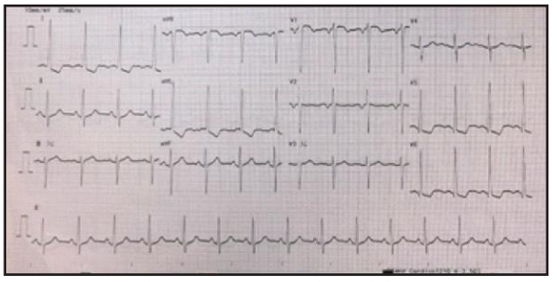

Figure 1 Pre-operative ECG

Mr. X, 21 years old, normotensive, non-diabetic, non-smoker, young male got admitted at Square Hospital Ltd, Dhaka on Jan, 2024 as a diagnosed case of severely re-stenosed prosthetic aortic valve and critical left main coronary artery disease. According to the patient's statement, he suffered from several episodes of low-grade fever with palpitation and fatigue in his childhood. With these complaints his parents consulted nearby physician and after proper evaluation he was diagnosed as a patient of severe aortic stenosis on

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2011, at the age of 8 years. He then underwent Aortic Valve Replacement (AVR) with 15 mm mechanical heart valve (Another hospital of Dhaka). Post-operatively he was doing fine but after three to four years (2015), he again developed fatigue, chest tightness, and dyspnoea on exertion. He was then re-evaluated and again severe prosthetic valve stenosis was detected. Redo-aortic valve replacement surgery (2022) was done and this time it was a 17 mm mechanical aortic valve. But his symptoms did not improve after the second surgery. He also suffered from COVID pneumonia in 2022. Gradually patients' symptoms were deteriorating and after physical evaluation he underwent coronary angiogram at Square Hospitals Ltd, which revealed severe left main coronary artery disease.

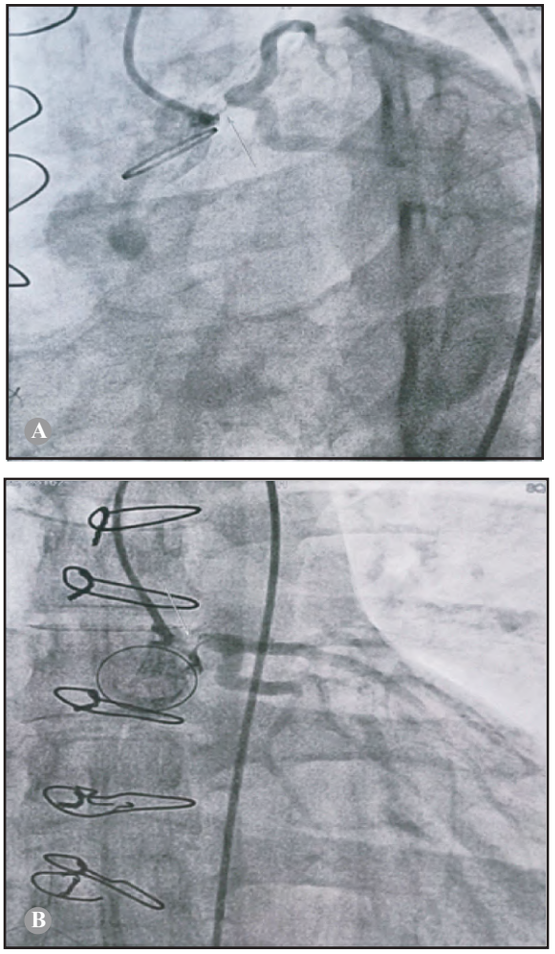

Figure 2 (a, b) Coronary angiogram showing severe left main stenosis

On admission blood picture, he was found anemic (Hb% 8.1 gm/dl, hematocrit 28.5%).

Color Doppler echocardiogram showed:

i) status post-redo AVR (BLMV SJM)

ii) Malfunctioning prosthetic aortic valve found in situ with severe stenotic gradient across the valve with PPG: 92.7 mm of Hg, MPG: 65.4 mm of Hg at HR 97 b/min (? Patient prosthesis mismatch)

iii) Moderate concentric LV wall hypertrophy

v) Normal chamber dimensions

v) Good LV RV systolic function, LVEF: 61%. TAPSE: 20 mm

vi) PASP: 30 mm of Hg.

ECG-gated contrast CT angiogram of aorta showed:

i) S/P redo AVR

ii) Prosthetic AV is seen in situ

iii) Left ventricular hypertrophy and mild thickening of the ascending aortic wall

iv) Right coronary artery: part of prosthetic aortic valve is located near the ostium of RCA

v) Left main coronary artery: Significant narrowing is noted at the origin of left main artery.

Coronary Angiography showed:

i) LMCA: 90-95% ostio-proximal LM stenosis

ii) LAD: Good caliber vessel and normal

iii) LCx: Non-dominant artery, medium caliber vessel & normal

iv) RCA: Anomalous origin, dominant artery, good caliber vessel and normal. PDA and PLB are normal

v) LV graphy: Not done, LVEF-55%, Diagnosis: Severe LM disease, right-dominant system. Recommendation: CABG with redo-AVR.

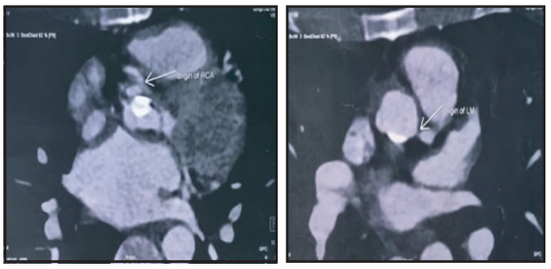

Figure 2 (a,b) CT angiogram showing severe left main stenosis

Operative Procedure

Under all aseptic precautions after proper painting and draping, median re-sternotomy was done through the previous scar using oscillating saw. LIMA and Saphenous Vein Harvested (EVH). Heparin given. After careful dissection, aortic, RA and CP purse-strings were taken. Cannulation done after achieving ACT. CPB established with Aortic and two-staged single venous cannula. Aortic X-clampapplied. Del-Nido cardioplegia delivered. Heart arrested at diastole. Aortotomy was done. Prosthetic aortic valve was inspected and was found severely stenosed. Left coronary ostium was found severely stenosed and covered with fibrous tissues. Valve explanted. All the neo-fibrotic tissues and calcifications were removed. Aortic root was enlarged with dacron patch using Bo-Yang technique ("Y" incision). AVR was done with 19 mm SJM Regent™ Mechanical heart valve. Aortotomy closed. Distal anastomosis LIMA to LAD was done with 8-0 prolene suture and RSVG to OM_1 was done with 7-0 prolene. Proximal anastomosis was done with 6-0 prolene suture. Aortic X-clamp released after de-airing and heart weaned from CPB to normal sinus rhythm. Protamine given. Decannulation done. After proper hemostasis of the other sites, the aortic suture line seemed to be leaking (Not controlled by sutures) at the posterior aspect of root enlargement site. So, we packed the posterior suture line with ribbon gauze pack (Typically used as nasal packs) bringing the end of ribbon gauze outside the skin, lateral to sternal edgethrough the second right intercostal space. Chest wound was closed in layers keeping chest drain tubes and pacing wire in situ. So, we had undergone coronary artery bypass graft (LIMA to LAD and Vein to OM_1). Although hemostasis was a critical issue in any redo-surgery, we only suffered from posterioraspect of root enlargement site, which we packed with ribbon gauze, as we described earlier. We started to remove the pack gradually from 3rd post-operative day onwards till the 5^{th}, keeping the chest tubes in-situ and ultimately chest tubes were removed on 6th post-operative day. Patient was ultimately discharged on eighth post-operative day without any complications. At 3 months follow up, patient was enjoying a symptom free life with admirable exercise tolerance.

Discussion

Significant coronary occlusion can happen after aortic valve replacement and both the coronary ostium can be affected but the left coronary is more affected than the right one.[6] The exact cause is yet unclear, and several theories have been proposed. In the acute phase (OT to hospital stays) sudden coronary spasm, embolization of calcium plaque, aortotomy or valve sutures, prosthesis oversizing in a small annulus, improper positioning of the sewing ring, etc, may contribute, in case of late presentation (1-6 months post-operative) injury to the coronary ostium, widespread fibrous proliferation and intimal thickening in the aortic root area or around suture materials, occlusion from aortotomy or valve sutures, use of surgical glue (directly at ostium or compressing from outside) may contribute to produce coronary stenosis.[7-10] We think, the main reason in our case there was extensive fibrous proliferation and a relatively small valve in a small native annulus. Hence, we removed all the excessive tissues, enlarged the root with Bo-Yang technique and replaced the valve with a larger one.

There are several predictors of PPM, like female sex, older age, hypertension,larger BSA and BMI, diabetes, renal failure and implantation of bio-prosthesis instead of mechanical one.[11] Interestingly, in our case, our patient was young male, non-diabetic, non-hypertensive, with normal renal functions and having history of mechanical valve implantation both the previous times. Butthe left main coronary stenosisworsened his symptoms.

Ethical clearance was taken from the institutional ethics review committee.Patient was informed about the importance of this type of study and its publication, assuring that his identity will be obscured and he has the right to withdraw for any reason from this study.

Limitation

Only one case in a single centered.

Conclusion

Post-operative patient prosthesis mismatch and coronary occlusion (both early and late) may occur after aortic valve replacement and surgeon should be well aware to combat this type of situations. Re-do valve surgery should be performed with proper planning, appropriate tools, suitable team members, and perfect timing which brings very well-deserved outcome.

Recommendation

This is a case report and a good number of cases should be studied for making a guideline to deal with this type of cases.

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Contribution of authors

SDG- Conception, drafting, reference citation & final approval.
SNE-Drafting, citing references & final approval.
SB-Drafting, critical revision & final approval.
FN-Drafting, data collection and final approval.
MH-Critical revision, reference citation & final approval.
PKC-Conception, critical revision & final approval.

Disclosure

All the authors declared no competing interest.

References

1. S H Rahimtoola. The problem of valve prosthesis-patient mismatch. Originally published 1 Jul 1978 Circulation. 1978; 58:20–24.
https://doi.org/10.1161/01.CIR.58.1.20

2. Bleiziffer S and Rudolph TK. Patient Prosthesis Mismatch After SAVR and TAVR. Front. Cardiovasc. Med. 9:761917.
https://doi.org/10.3389/fcvm.2022.761917.

3. Head SJ, Mokhles MM, Osnabrugge RL, Pibarot P, Mack MJ, Takkenberg JJ, et al. The Impact of Prosthesis-Patient Mismatch on Long-Term Survival after Aortic Valve Replacement: A Systematic Review and Meta-Analysis of 34 Observational Studies Comprising 27 186 Patients with 133 141 Patient-Years. Eur Heart J. 2012; 33:1518–29.
https://doi.org/10.1093/eurheartj/ehs003.

4. Dayan V, Vignolo G, Soca G, Paganini JJ, Brusich D, Pibarot P. Predictors and Outcomes of Prosthesis-Patient Mismatch after Aortic Valve Replacement. JACC Cardiovasc Imaging. 2016;9:924–933.
https://doi.org/10.1016/j.jcmg.2015.10.026.

5. Chavanon, O., Carrier, M., Cartier, R., Hebert, Y., Pellerin, M. and Perrault, L.P. Early Reoperation for Iatrogenic Left Main Stenosis after Aortic Valve Replacement: Perilous Situation. Cardiovascular Surgery. 2002;10:256-263.
https://doi.org/10.1016/s0967-2109(02)00008-x.

6. Funada, A., Mizuno, S., Ohsato, K., Murakami, T., Moriuchi, I., Misawa, K., Kokado, H., et al. Three Cases of Iatrogenic Coronary Ostial Stenosis after Aortic Valve Replacement. Circulation Journal. 2006;70:1312-1317.
https://doi.org/10.1253/circj.70.1312.

7. Sadek, M., Tammim, M., Abdelazeem Mahmoud, M., et al. Coronary Artery Occlusion, the Night Mare Post AVR. American Journal of Cardiovascular and Thoracic Surgery. 2019;4:1-4.
https://doi.org/10.15226/2573-864x/4/1/00153.

8. Tolah, M., Sadek, M., Tamim, M. and Elkady, Y. Delayed Coronary Ostial Stenosis after Surgical Aortic Valve Replacement and Root Enlargement Treated with Beating Heart On-Pump CABG. World Journal of Cardiovascular Diseases, 2023;13:657-663.
https://doi.org/10.4236/wjcd.2023.1310058.

9. Yates JD, Kirsh MM, Sodeman TM, Walton JA Jr, Brymer JF: Coronary ostial stenosis: a complication of aortic valve replacement. Circulation. 1974;49:530-534.

10. Pillai JB, Pillay TM, Ahmad J: Coronary ostial stenosis after aortic valve replacement, revisited. Ann Thorac Surg. 2004;78:2169-2171.

11. Dayan V, Vignolo G, Soca G, Paganini JJ, Brusich D, Pibarot P. Predictors and Outcomes of Prosthesis-Patient Mismatch after Aortic Valve Replacement. JACC Cardiovasc Imaging. 2016;9:924–933.
https://doi.org/10.1016/j.jcmg.2015.10.026.