Iatrogenic aortic regurgitation following percutaneous coronary intervention: Role of transesophageal echocardiography in the detection and management

Avneet Singh, Bhupesh Kumar, Gurpinder Singh Ghotra, Vikas Kumar, Shyam K S Thingnam

Departments of Anaesthesia and Intensive Care and Cardiothoracic and Vascular Surgery, Post Graduate Institute of Medical Education and Research, Chandigarh, India

INTRODUCTION

Aortic valve injury is a rare complication during percutaneous coronary intervention, with reported incidence of 0.008%-0.20%.[1] A handful of cases have been reported in the past, mostly causing acute decompensation due to injury to the aortic valve leaflets,[1-7] however, rarely such injury may get unnoticed in the acute phase and present as chronic aortic regurgitation. We describe a 51-year-old man with history of percutaneous coronary intervention for coronary artery disease and moderate aortic regurgitation scheduled for coronary artery bypass grafting and aortic valve replacement. Intra-operative transesophageal echocardiography was instrumental in deciding etiology of aortic regurgitation that change surgical management of the patient.

ABSTRACT

The incidence aortic valve injury during percutaneous coronary intervention is scarce, mostly resulting in acute aortic regurgitation. However, rarely patients may remain asymptomatic in the immediate post-procedure period and present latter with chronic aortic regurgitation. Determining etiology of such an aortic regurgitation may be challenging. We present a case of a 51-year-old man with history of percutaneous coronary intervention for coronary artery disease and moderate aortic regurgitation scheduled for coronary artery bypass grafting and aortic valve replacement. Intra-operative transesophageal echocardiography was instrumental in deciding etiology of aortic regurgitation that changed surgical management of the patient.

Keywords: Aortic regurgitation, iatrogenic aortic valve injury, transesophageal echocardiography

CASE REPORT

A 51-year-old man, weight 55 kg, height 160 cm, with known coronary artery disease presented to our outpatient department with complaints of easy fatiguability, dyspnea on exertion and palpitations for one year. He had undergone stenting of left anterior descending (LAD) and left circumflex (LCX) coronary artery 2 years back following which he remained asymptomatic until current presentation. He had undergone stenting of left anterior descending (LAD) and left circumflex (LCX) coronary artery 2 years back following which he remained asymptomatic until current presentation. He had associated hypertension and hypothyroidism for 10 years and 5 years, respectively, in detecting unusual cause of aortic regurgitation that changed the management plan.

Address for correspondence: Dr. Bhupesh Kumar, Department of Anaesthesia and Intensive Care, Post Graduate Institute of Medical Education and Research, Chandigarh - 160 012, India.
E-mail: bhupeshkr@yahoo.com
Submitted: 03-Jun-2020 Revised: 21-Aug-2020 Accepted: 29-Aug-2020 Published: 09-Jul-2021

How to cite this article: Singh A, Kumar B, Ghotra GS, Kumar V, Thingnam SK. Iatrogenic aortic regurgitation following percutaneous coronary intervention: Role of transesophageal echocardiography in the detection and management. Ann Card Anaesth 2021;24:392-5.

Videos Available on: www.annals.in

Access this article online

Quick Response Code:
Website: www.annals.in
DOI: 10.4103/aca.ACA_125_20

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com
Singh, et al.: Iatrogenic aortic regurgitation following percutaneous coronary intervention

In the operating room, after instituting standard monitoring, general anesthesia was induced as per standard protocol of our institute. An adult transesophageal echocardiography (TEE) probe 9T, 3-10 MHz (Vivid E9, GE, USA) was inserted after securing the airway. The TEE examination showed a freely mobile mass on the undersurface of left coronary (LCC) or non-coronary cusp (NCC) with a normal right coronary cusp (RCC) [Figure 1a]. Detailed examination showed flail aortic valve segment of NCC or LCC in the mid-esophageal aortic valve long axis view [Figure 1b and Video 1]. The color Doppler showed a severe eccentric aortic regurgitation jet away from the mitral valve. The mid-esophageal aortic valve short axis view revealed jets arising from the flail NCC and normal RCC and LCC [Figure 1c]. This was further confirmed by 3D-modified mid-esophageal five-chamber view [Figure 1d]. Based on TEE finding and absence of clinical evidence of infective endocarditis, surgeons were informed about the possibility of laceration due to traumatic injury and potential role of aortic valve repair.

Surgery proceeded following heparinization and institution of CPB using aortic and two staged venous cannulation. Cardiopulmonary arrest of the heart was achieved using combined antegrade-retrograde cardioplegia. Intraoperative surgical finding following aortotomy confirmed a linear tear in the free margin of NCC, normal RCC and LCC and no evidence of infective endocarditis [Figure 2a]. Using pericardial patch, a neo aortic cusp creation for NCC and a left internal mammary artery to left anterior descending artery coronary artery bypass grafting was performed [Figure 2b]. The patient was weaned off CPB using milrinone 0.3 mcg/kg/min and noradrenaline 0.05 mcg/kg/min. The post CPB, TEE showed normal aortic valve cusp movement [Videos 1 and 2], mild central aortic regurgitation (vena contracta 3 mm) and normal left ventricular systolic (ejection fraction 54%) [Figure 3a, b and Video 2]. The aortic valve cusp coaptation height measured was 7 mm. The patient had an uncomplicated post-operative course. He was extubated of elective mechanical ventilation after 12 hours, discharged from intensive care unit on day third and from hospital on day five. The patient has been in regular follow up since last 7 months after surgery and has been doing well.

DISCUSSION

The aortic leaflet perforations remain a rare but serious complication associated with percutaneous coronary
The central position of the valve makes it more likely to iatrogenic injuries during percutaneous interventions.\cite{1,2} These injuries are caused by the multiple passages of stiff guidewires\cite{3,4} or, protrusion of a right coronary artery ostium stent onto the valve.\cite{5,6} Transient aortic regurgitations have also been reported due to excessive movement of a rigid catheter in the aorta.\cite{7} The congenital fenestrations are located in the para-commissural area in the coaptation zone of the aortic valve leaflet and do not directly result in valve insufficiency when they are intact. However, a guidewire induced rupture of the congenital fenestration may cause an acute aortic regurgitation.\cite{8} In the previous reports, the right coronary cusp was the most commonly involved, probably due to the right ostial stent protrusion. In our patient, intraoperative TEE was helpful in localizing the origin of the regurgitation jet to the NCC.

The injured leaflet fragments may also be mimicked by papillary fibroelastomas. The papillary fibroelastomas are typically small tumors of about 9–12 mm in diameter mostly found on the ventricular surface of aortic valve. Typically they do not cause severe aortic insufficiency unless become entrapped in the valve apparatus; however, they can break away and embolize to the brain, causing strokes.\cite{9} On echocardiography, they usually appear pedunculated and mobile, with a homogeneous speckled pattern and characteristic stippling along their edges.\cite{10}

In contrast to this, in our case, TEE findings were more suggestive of fail segment of aortic cusp as freely mobile mass moved above and below the aortic annulus during systole and diastole, respectively. An infective endocarditis vegetation might have a similar echocardiography finding; however, in our case there was no clinical evidence of infective endocarditis and on TEE we could appreciate normal RCC, LCC and part of NCC while some part of NCC was freely mobile. Intraoperatively, we found clean straight tears on the NCC, without the presence of any root abscess or commissural tears.

Most of the traumatic aortic valve injury present as acute aortic regurgitation with feature of low cardiac output and heart failure. This complication usually requires immediate attention; however, in the present case, it remained unnoticed until he reached to the operating room after about 2 years of initial percutaneous intervention. This might have occurred because of smaller injury during the first percutaneous coronary intervention causing laceration which might have progressed over time or, due to a secondary insult during 2nd coronary angiogram.

The single aortic cusp reconstruction for aortic regurgitation is a sparingly used technique, especially in adults. Odim et al. and Tao et al. have demonstrated a relatively high success rates of this procedure with less than grade 2 residual regurgitation.\cite{11,12} Their patients were either children or young adults with congenital aortic valve diseases, unlike ours middle-aged adult with iatrogenic tear of the valve leaflet. The cusp reconstruction was feasible in our patient because of the single leaflet involvement and the absence of calcification which could have posed difficulty in suturing the cusp to the aortic annulus. In addition to diagnosing pathological abnormality, TEE is also very useful in the evaluation of adequacy of valvular reconstruction. The ideal post-operative goal following valve reconstruction is to have a flexible valve that opens well and is competent without any residual insufficiency. In addition, inter-cusp coaptation length >4 mm with an individual cusp effective height >9 mm, aortic annulus <25 mm and the mean transaortic gradient <10 mm Hg should be met to satisfy the adequacy of repair.\cite{13,14} Polain et al. found the inter-cusp coaptation length >4 mm as the single most important factor against the recurrence of aortic regurgitation while coaptation length <4 mm or below the aortic annulus was associated with the recurrence of aortic regurgitation.\cite{15} Cusp effective height <9 mm have been found to be associated with 50% probability of reoperation within a ten year.\cite{16} Our patient had mild residual aortic regurgitation with inter-cusp coaptation length 7 mm and cusp effective height 13 mm. The mean aortic valve gradient measured was 9 mm Hg, suggesting adequate repair.

**CONCLUSION**

The aortic valve injury during percutaneous catheterization is a potential catastrophic complication that may remain unnoticed and present as chronic aortic regurgitation. Intraoperative transesophageal echocardiography may be instrumental in its detection and aid in the assessment of the adequacy of the valve repair during the surgical repair of the injured valve.
Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES
1. Madigan M, McIsaac S, Garg A, Alqahtani A, Kumar A, Atoui R. Rare case of iatrogenic aortic valve leaflet tear following a diagnostic coronary angiogram. J Card Surg 2020;35:204-6.
2. Denyer MH, Elliott CM, Robicsek F. Pericardial patch repair of aortic cusp perforation caused by cardiac catheterization. J Card Surg 1988;3:155-57.
3. Kotoulas C, Bigeon JY, Patris K, Hasan R. Aortic valve as a victim of percutaneous coronary angioplasty and stenting. Ann Thorac Surg 2007;84:1765.
4. Bouabdallaoui N, Banfi C, Neicu DV, Juthier F, Ennezat PV. Repair of iatrogenic aortic regurgitation following cardiac catheterization. J Card Surg 2011;26:485-87.
5. Ong G, Bagur R, Barbeau G, Couture C, Trahan S, Déry J-P. Severe aortic regurgitation after transradial percutaneous coronary intervention. Circ Cardiovasc Interv 2011;4:e8-11.
6. Gamaza Chulián S, Camacho Freire SJ, León Jiménez J, Luna AA, Martínez TD, Otero MJO. Percutaneous coronary intervention: A rare cause of acute traumatic aortic regurgitation. Rev Esp Cardiol (Eng Ed) 2017;70:501-2.
7. Rolf T, Tozzi P, Roumy A, Iglesias JF, von Segesser LK. Aortic valve lesion after coronary angiography. Interact Cardiovasc Thorac Surg 2011;12:205-6.
8. Safar B, Milleron O, Mesnildey P, Catran S. Aortic regurgitation after cardiac catheterization. JACC Cardiovasc Interv 2010;3:984-5.
9. Aziz F, Baciewicz FA Jr. Lambi's excrescences: Review and recommendations. Tex Heart Inst J 2007;3:366-68.
10. Klarich KW, Enriquez-Sarano M, Gura GM, Edwards WD, Tajik AJ, Seward JB. Papillary fibroelastoma: Echocardiographic characteristics for diagnosis and pathologic correlation. J Am Coll Cardiol 1997;30:784-90.
11. Odim J, Laks H, Allada V, Child J, Wilson S, Gjertson D. Results of aortic valve-sparing and restoration with autologous pericardial leaflet extensions in congenital heart disease. Ann Thorac Surg 2005;80:647-53.
12. Tao I, Zeng XJ, Lim YP. Single cusp replacement for aortic regurgitation. Ann Thorac Surg 2008;85:946-48.
13. Berrebi A, Monin JL, Lansae E. Systematic echocardiographic assessment of aortic regurgitation- What should the surgeon know for aortic valve repair? Ann Cardiothorac Surg 2019;3:331-41.
14. Pushpa J, Ananda Bhat, Parimala Prasanna Simha, Prasanna Simha M, Manjanatha N. Perioperative echocardiography in Ozaki's procedure: An observational study-Single centre experience. MedPulse International Journal of Anaesthesiology. September 2019;11:211-16.
15. Le Polain de Waroux JB, Pouleur AG, Robert A, Pasquet A, Gerber BL, Noirhomme P, et al. Mechanisms of recurrent aortic regurgitation after aortic valve repair: Predictive value of intraoperative transesophageal echocardiography. JACC Cardiovasc Imaging 2009;2:931-9.
16. Aicher D, Kunihara T, Abou Issa O, Brittner B, Graber S, Schäfers HJ. Valve configuration determines long-term results after repair of the bicuspid aortic valve. Circulation 2011;123:170-85.