

Iatrogenic Aortic Regurgitation Following Primary Closure of Ventricular Septal Defect: Role of Transesophageal Echocardiography

Abstract

Iatrogenic valvular regurgitation following cardiac surgery has been reported as a result of leaflet perforation or entrapment. Due to its central location, the aortic valve is one of the most vulnerable structures for iatrogenic injuries. Proper assessment of the aortic valve by transesophageal echocardiography (TEE) should be done after a cardiac surgery in the periaortic area. We hereby report a case of iatrogenic aortic regurgitation which was developed after primary closure of perimembranous ventricular septal defect. It was timely diagnosed by TEE after termination of cardiopulmonary bypass and helped in further management.

Keywords: *Iatrogenic aortic regurgitation, transesophageal echocardiography, ventricular septal defect*

Introduction

Surgical closure of ventricular septal defect (VSD) is commonly performed in pediatric cardiac surgery. It is associated with various complications such as complete heart block, infection, postoperative bleeding requiring re-exploration, residual VSD, valve injury, infective endocarditis, pulmonary hypertension with poor cardiac output, and death. Intraoperative transesophageal echocardiographic (TEE) assessment following VSD closure assesses not only the adequacy of VSD closure or left ventricular function but also the iatrogenic injury to the adjacent cardiac structures. We hereby report a case in which TEE has clearly demarcated the distortion of the aortic valve (AV) leading to the development of aortic regurgitation (AR) following direct closure of small perimembranous VSD.

Case Report

A 12-year-old male child was presented to our institute with complaints of shortness of breath and recurrent respiratory tract infections for 6 months. On physical examination, the patient had a heart rate of 89/min, blood pressure of 112/64 mmHg, respiratory rate 20/min, and oxygen saturation was 99% on room air. The

transthoracic echocardiographic assessment revealed a 5-mm perimembranous VSD with a left to right shunt, without any signs of pulmonary artery hypertension, left superior vena cava opening into the right atrium through the coronary sinus, and dilated left atrium and left ventricle. In addition, an indirect type of Gerbode shunt was detected in parasternal AV short-axis view [Figure 1 and Video 1]. Due to the small size of VSD, primary closure of VSD was planned. In the operating room, cannulation of the left-hand dorsal vein was done after instituting standard American Society of Anesthesiologist monitoring. Anesthesia was induced according to the institute protocol. Cannulation of the right radial artery and right internal jugular vein was accomplished after induction of anesthesia. A TEE probe (6VT-D; GE Healthcare; vivid E9; Norway) was inserted, and preoperative TTE findings were confirmed [Figure 2 and Video 2]. The cardiopulmonary bypass (CPB) was initiated after standard aorta bicaval cannulation. Primary closure of VSD was done with pledgeted Prolene 5-0 sutures. The CPB was terminated successfully without any inotropic support. Immediately after termination of CPB, an eccentric AR of moderate severity was detected in TEE which was not present before the surgery [Figure 3 and Video 3]. This eccentric AR was manifested due to

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the development of traction on the right coronary cusp from the adjacent tissue due to the direct closure of the VSD. Hence, the revision of surgery was planned. The takedown of direct closure of VSD was done under CPB, and it was closed with polytetrafluoroethylene patch. The severity of AR was decreased to trivial after revision of surgery [Figure 4 and Video 4]. The patient was shifted to the intensive care unit with stable hemodynamics without any inotropic support. The trachea was extubated after 4 h and he was shifted to the ward after 2 days without any sequelae.

Discussion

Iatrogenic valvular regurgitation following cardiac procedures has been reported as a result of leaflet perforation or entrapment. Due to its central location, the AV appears to be more vulnerable than the mitral valve.^[1] In the index case, the traction developed on the right coronary cusp from the adjacent tissue due to the direct closure of VSD leading to the development

of coaptation defect resulting in moderate eccentric AR. Various mechanisms have been suggested for the development of AR which include AV leaflet perforation, inadvertent suture placement, or leaflet tension. It has been documented mostly as case reports and some as case series. Hill *et al.*^[2] reported six cases of iatrogenic AR following non-AV surgeries, out of which two underwent AV repair, two had AV replacement, one required heart transplant, and one died due to transfusion reaction before any intervention. Ducharme *et al.*^[3] found severe AR following insertion of a Carpentier ring during mitral valve repair, which got corrected by releasing few sutures on the annuloplasty ring. Aboelnasr and Rohn^[4] documented a case of severe AR, due to perforation of the non-coronary cusp (NCC) after mitral valve repair. The perforated NCC was repaired with a pericardial patch. A similar case was reported by Dogan *et al.*^[5]

Iatrogenic AR was also documented following repair of congenital heart disease. Rey *et al.*^[6] reported a perforation

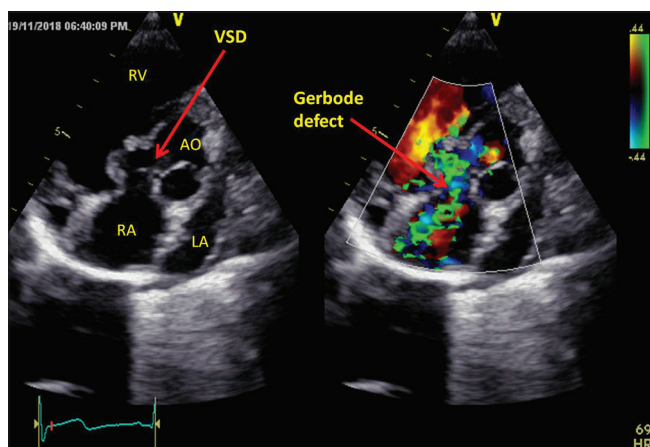


Figure 1: A transthoracic echocardiographic image showing a small perimembranous ventricular septal defect (VSD) with Gerbode defect in parasternal aortic valve short-axis view (AO, ascending aorta; LA, left atrium; RA, right atrium; RV, right ventricle)

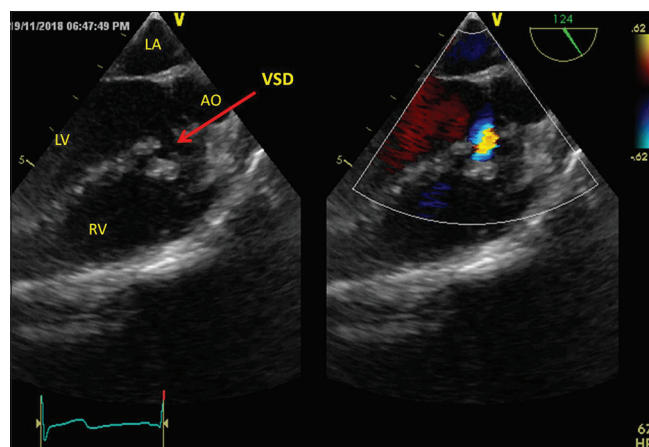


Figure 2: A transesophageal echocardiographic image showing a small perimembranous ventricular septal defect (VSD) with left to right shunt in midesophageal aortic valve long-axis view (AO, ascending aorta; LA, left atrium; LV, left ventricle; RV, right ventricle)

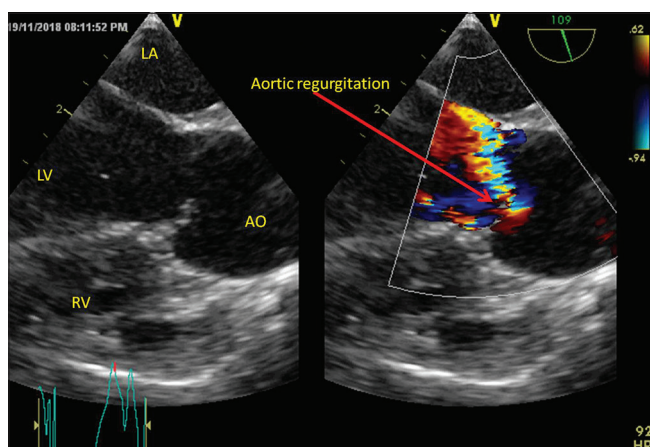


Figure 3: A midesophageal aortic valve long-axis view showing an eccentric aortic regurgitation of moderate severity developed after primary closure of ventricular septal defect (AO, ascending aorta; LA, left atrium; LV, left ventricle; RV, right ventricle)

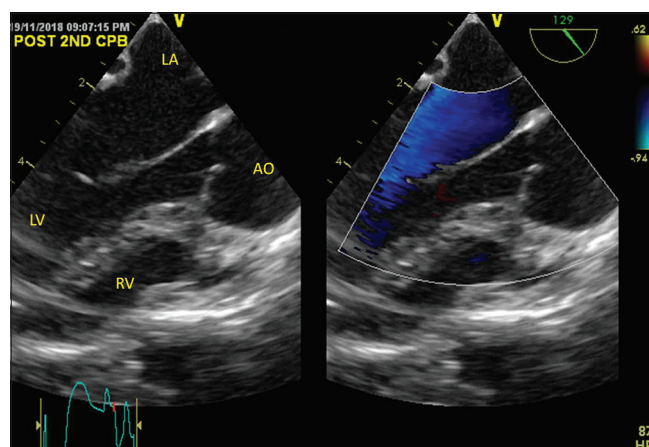


Figure 4: An image taken in midesophageal aortic valve long-axis view after patch closure of ventricular septal defect showing no or trivial aortic regurgitation (AO, ascending aorta; CPB, cardio pulmonary bypass; LA, left atrium; LV, left ventricle; RV, right ventricle)

of the NCC of AV following repair of ostium primum atrial septal defect in eight children. Zhang *et al.*^[7] reported a case of iatrogenic AR, following VSD closure requiring repair using the pericardial patch. Sabzi *et al.*^[8] reported a case of a 15-year-old boy who underwent VSD closure with Dacron patch leading to the development of AR due to the separation of NCC of AV from its ring caused by tension produced by the Dacron patch pulling on the neighboring tissue. Iatrogenic AR is also reported following left ventricular myectomy.^[9] Iatrogenic AR was also documented in the noncardiac case where Kirschner wires while wiring right clavicle fracture had migrated across the AV leading to the development of acute AR.^[10] The Kirschner wires were successfully removed, and AV replacement was done.

The intraoperative TEE is vastly recommended for open heart surgeries. It plays an important role in diagnosing accidental injury to adjacent cardiac structures during cardiac surgeries. Rother *et al.*^[11] reported a case of mitral valve (MV) repair for severe mitral regurgitation was found to have a non-mobile left coronary cusp of the AV on intraoperative TEE, causing moderate AR. Similarly, Santiago *et al.*^[12] reported a case in which TEE diagnosed a severe AR due to the restricted motion of left coronary cusp of AV following coronary artery bypass grafting and MV saddle ring repair. Importance of three-dimensional (3D) TEE over two-dimensional TEE was reported by Babu *et al.*^[13] in a case where 3D TEE helped in delineating the cause for aortic sinus distortion after mitral valve replacement and helped in successful intervention. In the index case, the distortion of RCC and moderate AR was timely identified by the intraoperative TEE and helped in the revision of surgery.

In summary, due to its central location, the AV is one of the most vulnerable structures for iatrogenic injuries. Primary closure of perimembranous VSD should be done under caution as it can lead to AR due to the development of traction on the aortic cusp. To the best of our knowledge, this is the first case reporting an iatrogenic AR developed after primary closure of perimembranous VSD, which was diagnosed intraoperatively by TEE and helped in further management.

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.

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Conflicts of interest

There are no conflicts of interest.

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