Three for one – Cardiac perforations at three sites following atrial septal defect device closure

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ABSTRACT

The interventional cardiac catheterization for treating congenital heart disease has evolved. Complications following interventional procedures might need emergency surgery as a bailout. Here, we report a case of cardiac perforations in three different sites following device closure of atrial septal defect (ASD). In literature, the major sites of ASD device erosion are at the roof of the right atrium (RA), left atrium (LA), or at the atrial junction with the aorta. In our patient, the device eroded at all three sites: the roof of the LA, RA, and the aorta, causing hemopericardium.

Keywords: Atrial septal defect device erosion, complications, pericardial effusion, torus aorticus

INTRODUCTION

Device erosions occur due to an abrasive mechanical force between the device and the cardiac structures. The two main reasons for device erosion are deficient antero-superior rim and device oversizing. From the literature, the absolute risk of cardiac erosion after atrial septal defect (ASD) closure with an Amplatzer septal occluder (ASO) device is substantially <1% and likely <1 in 1000.[1] Although there are multiple reports on erosions related to an ASO, the device eroding into three cardiac structures was not reported in the literature. This is the report of the first patient with device erosion among the 1519 patients who underwent ASD device closure in our institute from 2013 to 2023.

CASE REPORT

We report a case of an 8-year-old male child weighing 17 kg who presented to our emergency room 2 weeks following ASD device closure with complaints of chest pain, palpitations, and vomiting for a day. He was apparently normal till the age of 8 years, following which he was evaluated for a history of poor weight gain, and he was diagnosed with ostium secundum ASD. He underwent successful transcatheter ASD device closure using an 18 mm Amplatzer device 2 weeks ago. On examination, his heart rate –120 beats/min, blood pressure –102/60 mmHg, SpO_2 –96% in room air, jugular venous pressure was elevated 3 cm above the clavicle, S2 was widely split, and ejection systolic murmur was heard in the left upper sternal border along the midclavicular line. His preprocedural hemoglobin was 11.6 g/dl, dropping to 10.1 g/dl over 2 weeks. Chest X-ray showed that the ASO device was within the cardiac silhouette. Screening echocardiogram [Figure 1] revealed moderate pericardial effusion and congested inferior vena cava with no inspiratory collapse. Short-axis echocardiographic view at the aortic valve level showed that the ASD device was impinging on the noncoronary sinus (NCS) of the aorta. In view of the above findings, we decided to proceed with surgery, suspecting cardiac perforation.

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On opening, the pericardial cavity was filled with dark blood. A large fibrinous clot was adherent at the aortic root level, which was not disturbed. The autologous pericardium was harvested and treated with glutaraldehyde. The patient was heparinized, and cardiopulmonary bypass (CPB) was initiated through aortic and bicaval cannulation [Figure 2]. Before cross-clamping the aorta, the clot in the aortic root region was removed. When the aorta was retracted, there was a perforation in the roof of the left atrium (LA). We could also appreciate blood spurting from the perforation in the aortic NCS. Once the diagnosis of the two perforations was clean and clear, the aorta was cross-clamped, and hypothermic del Nido cardioplegia was administered through the aortic root. The patient was cooled to 32°. The right atrium (RA) was opened parallel to the right atrioventricular groove. On dissecting the RA disc of the Amplatzer device, we also noted a perforation in the RA that was in direct contact with the perforation in the NCS of the aorta [Figure 3]. The device was then explanted, and the heart was vented through ASD. The perforation in the LA roof and the torus aorticus area of RA was closed by direct sutures, and the one in the NCS of the aorta was closed with direct sutures using pericardial pledgets. The ASD was closed using a glutaraldehyde-treated autologous pericardial patch [Figure 4]. The heart was de-aired, and RA was closed. The cross-clamp was released, and the heart picked up in sinus rhythm. After complete rewarming, the patient was weaned from CPB uneventfully. The chest was closed in layers. We ventilated him overnight, and he was extubated the next day. He was discharged home with stable hemodynamics, and an intact patch at the interatrial septum was visualized in two-dimensional (2D) echocardiography on the 7th postoperative day. The patient reviewed with us 1 month postsurgery; his 2D echocardiogram revealed an intact ASD patch with no residual shunting and good biventricular function.

DISCUSSION

Surgical ASD closure is reserved for cases not amenable to transcatheter closure. The size of the device plays a

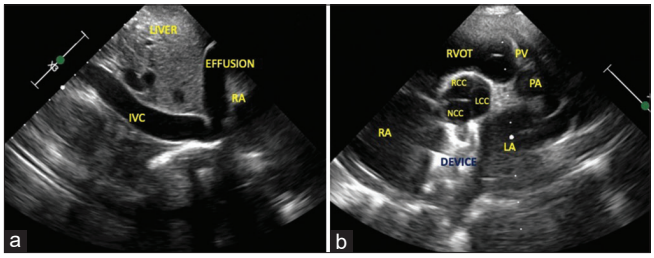

Figure 1: (a) Subcostal long-axis echocardiographic view showed congested inferior vena cava with no inspiratory collapse and moderate pericardial effusion, (b) Parasternal short-axis view with atrial septal defect device impinging on the noncoronary sinus of the aorta. IVC: Inferior vena cava, RA: Right atrium, LA: Left atrium, RVOT: Right ventricular outflow tract, PV: Pulmonary valve, PA: Pulmonary artery, RCC: Right coronary cusp, LCC: Left coronary cusp, NCC: Non-coronary cusp of aortic valve

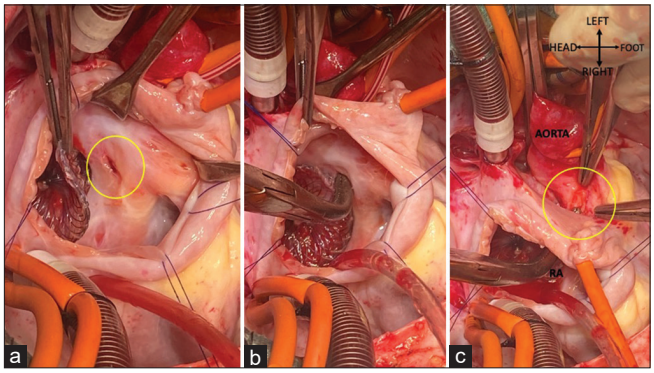

Figure 3: (a) The right atrium (RA) disc of the device was dissected, and there was a perforation (yellow circle) in the RA, (b) A right-angled forceps was inserted into the RA perforation, (c) The forceps was hitting the NCS perforation in the aorta and the yellow circle demonstrates torus aorticus RA: Right atrium, NCS: Non-coronary sinus

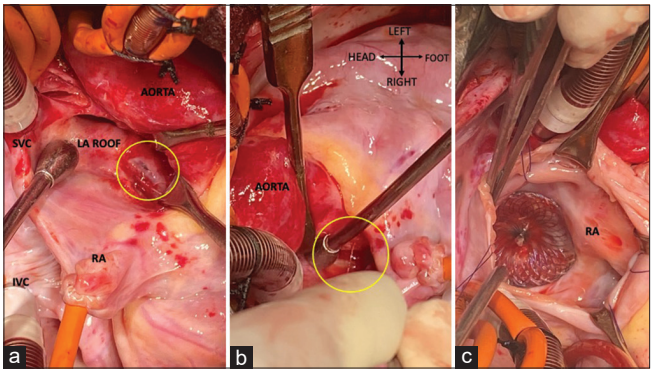

Figure 2: (a) After initiation of cardiopulmonary bypass, perforation (yellow circle) in the roof of the left atrium is shown, (b) Once the clots near the aorta were removed, a blood spurt (yellow circle) from the aorta was seen, (c) The right atrium was opened, and the atrial septal defect device was seen. SVC: Superior vena cava, IVC: Inferior vena cava, RA: Right atrium, LA: Left atrium

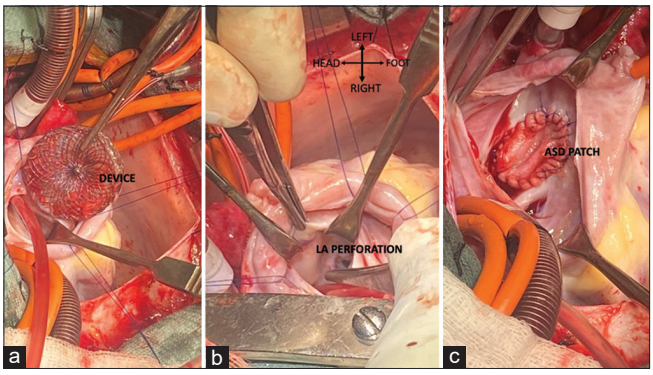

Figure 4: (a) The atrial septal defect (ASD) device was explanted, (b) Through the ostium secundum ASD, perforation in the left atrium was visualized and closed with direct sutures, (c) ASD closed with an autologous pericardial patch. LA: Left atrium, ASD: Atrial septal defect

vital role in the advent of complications. Our patient's age-to-ASO device ratio was 0.44, and weight-to-ASO device ratio was 0.94; these data are far less as compared to age: device size ratio of 1.21 ± 0.84 and weight: device size ratio of 2.52 ± 1.39 in the case–control study by McElhinney *et al*. We inferred that this discrepancy might be because, in their study, the median age was 25 years. However, it is evident that both in their study and in our patient, the median duration from implant to device erosion diagnosis was 14 days.[1] Crawford *et al*.[2] reviewed 25 articles and concluded that erosion occurs because of device over-sizing or deficient retro-aortic rims. Boon *et al*.[3] described the three methods of sizing the ASD: balloon sizing, 2D transesophageal echocardiography (TEE), and three-dimensional TEE. The ASD devices were chosen to be 2–4 mm larger than the largest dimension measured. In our patient, the ASD measured 14 mm, and we used an 18 mm ASO. López-Fernández *et al*.[4] reported a case of ASD device complication similar to our case involving RA, LA, and the aorta, though it was a fistulous tract from the aorta to both atria. Kumar *et al*. reported two cases of pericardial tamponade[5] due to a fractured nitinol wire component of the device occluder eroding through the torus aorticus in the RA wall. In our patient, the RA disc eroded the RA wall through the torus aorticus, causing perforation in the aortic non-coronary sinus (NSC), and the LA disc eroded the roof of LA, causing perforation, leading to pericardial effusion.

CONCLUSIONS

Whenever a patient with pericardial effusion following an interventional procedure is being taken up for surgery, the surgeon should have a high index of suspicion of device erosion and cardiac perforation. The surgical team must be prepared with a perfusionist and CPB machine before making a skin incision in the operating theater.

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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