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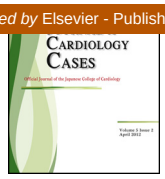

Case Report

Cardiac erosion after catheter closure of atrial septal defect: Septal malalignment may be a novel risk factor for erosion

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ABSTRACT

Pericardial tamponade occurred 3 days after the catheter closure of an atrial septal defect (ASD) using Amplatzer Septal Occluder (St. Jude Medical, St. Paul, MN, USA). Before the closure, two-dimensional and real-time three-dimensional transesophageal echocardiography demonstrated a deficient aortic rim and atrial septal malalignment. Perforation of the right atrium toward the non-coronary sinus of the aortic root was confirmed at the emergent surgery. Cardiac erosion is one of the most catastrophic complications in ASD patients undergoing catheter closure with Amplatzer Septal Occluder. Hence, several risk factors for this complication are discussed and identified. Oversized device deployment and a deficient aortic rim are accepted factors potentially causing cardiac erosion. Besides, atrial septal malalignment, which is a morphological characteristic of ASD, may be a novel risk factor for cardiac erosion.

<**Learning objective**: Cardiac erosion is a potentially lethal complication when catheter closure of atrial septal defects using Amplatzer Septal Occluder (St. Jude Medical, St. Paul, MN, USA) is provided to the patients. However, mechanisms of this complication remain to be completely elucidated. Atrial septal malalignment may be one of the novel risk factors for this catastrophic complication.>

Introduction

Catheter closure of atrial septal defect (ASD) is an accepted highly successful alternative to surgical repair [1,2]. In catheter closure of ASD using Amplatzer Septal Occluder (St. Jude Medical, St. Paul, MN, USA), a cardiac erosion followed by a pericardial tamponade is an infrequent but potentially lethal complication and is difficult to anticipate its occurrence before the device deployment [3,4].

Case report

A 44-year-old woman with dyspnea on exertion was referred to our institution for catheter closure of an ASD. Transthoracic echocardiography (TTE) demonstrated a secundum ASD with a significant left-to-right shunt with right ventricular dilatation. Transesophageal echocardiography (TEE) revealed a maximal defect diameter of 21 mm with adequate rims surrounding the defects except for a deficient aortic rim (Fig. 1A). Morphological characteristics including atrial septal malalignment were visualized using two-dimensional TEE (Fig. 1B and C) and real-time three-dimensional TEE (Fig. 1D). Written informed consent was obtained from the patient prior to the procedure.

Catheter closure was performed under general anesthesia. Pulmonary to systemic flow ratio was 3.14. Balloon-sizing with stop flow technique demonstrated a 25 mm stretched diameter. A 26-mm Amplatzer Septal Occluder device was deployed in a stable and a proper position without any procedural complications. Images from TEE demonstrated the device properly deployed against the atrial septum and a residual shunt between the device and the aortic root (Fig. 2A–C).

Three days after the procedure, the patient developed pericardial tamponade. The patient was transferred to emergent surgery. Surgical findings demonstrated perforation in the right atrium

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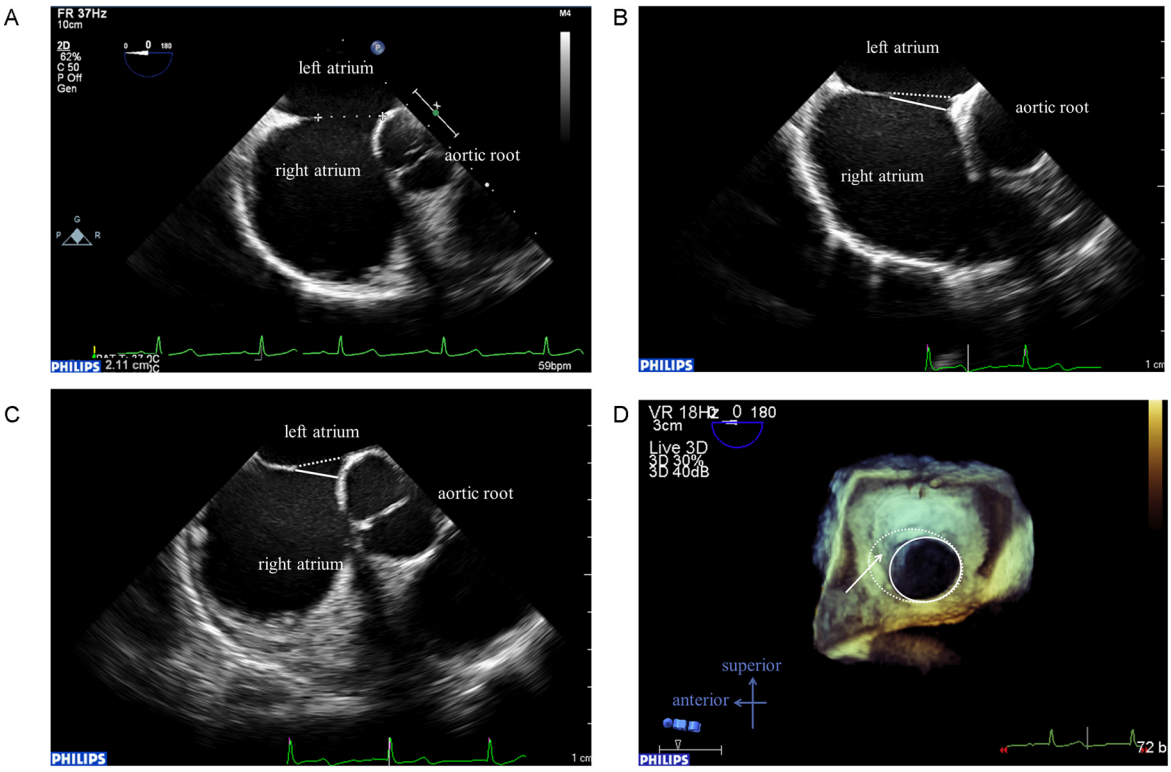

Fig. 1. Transesophageal echocardiography (TEE) images of atrial septal defect before the procedure. (A) Two-dimensional 0° TEE image shows that the maximal defect diameter of septum primum was 21 mm. (B and C) Two-dimensional 30° TEE image shows that the defect surface of the septum primum (dotted-line) is different from that of the septum secundum (solid-line). Images of the defect on end systolic phase (B) and early diastolic phase (C). (D) Three-dimensional TEE image shows an en face view from the left atrium. Arrow indicates the deficient aortic rim. Surface of the left atrial side consists of septum primum (dotted-line) while surface of the right atrial side consists of septum secundum (solid-line). These two surfaces construct the morphological characteristic of the malaligned atrial septum.

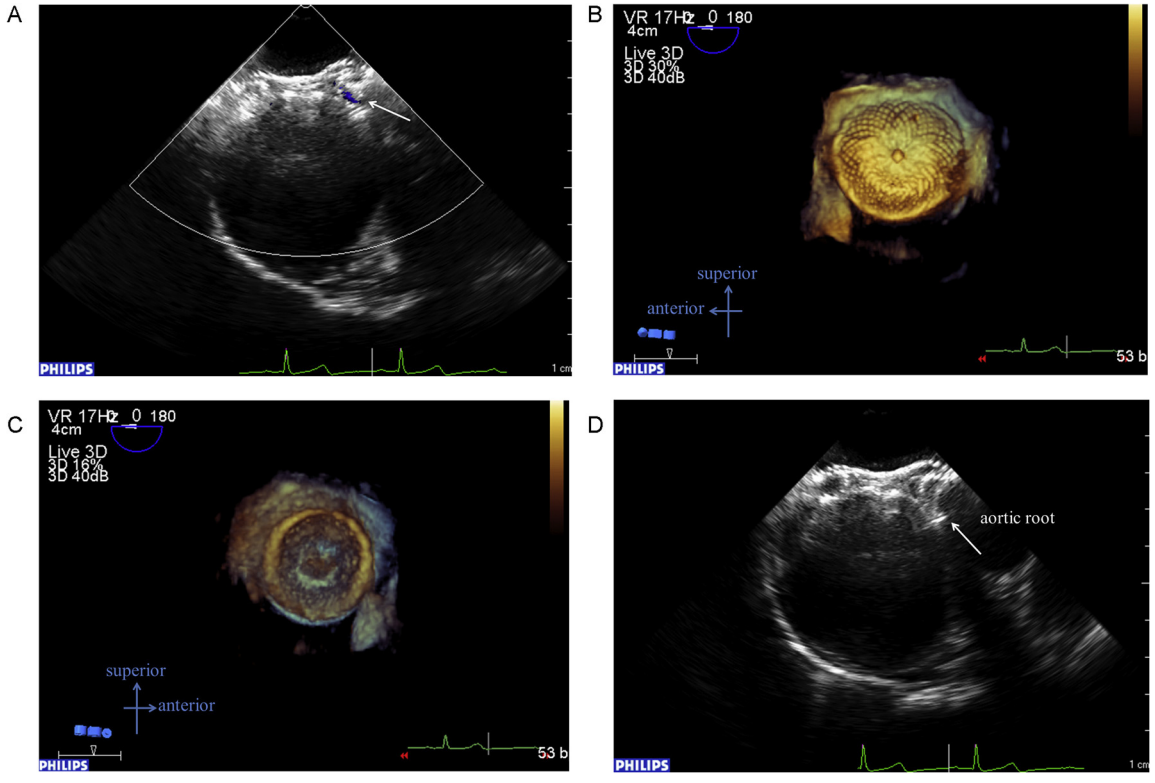

Fig. 2. Deployed images of the device. (A) The image shows the device deployed in an appropriate position against the atrial septum. A small residual shunt from the aortic side is demonstrated in a color Doppler image (arrow). (B and C) Three-dimensional transesophageal echocardiography (TEE) shows the device properly deployed against the atrial septum visualized in views from the left atrium (B) and from the right atrium (C). (D) TEE image of the deployed device. Right atrial side of the device is tightly impinging on the aortic root (arrow).

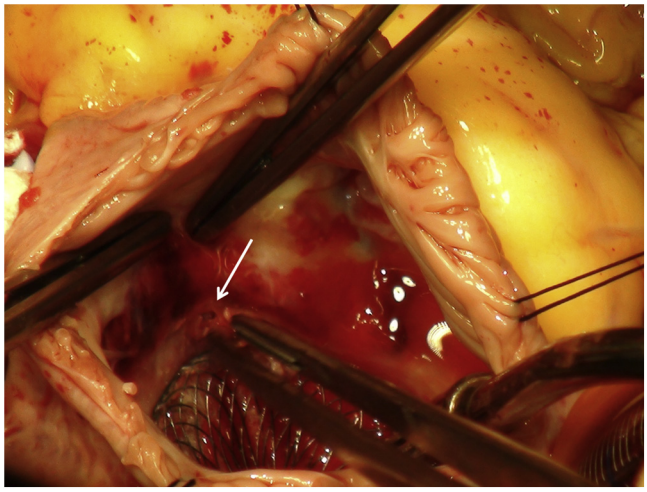

Fig. 3. Surgical findings. Intraoperative photograph demonstrated that the device perforated the right atrium toward the aortic root. Arrow shows a pin-hole penetration in the right atrium.

toward the non-coronary sinus of the aortic root with a pin-hole penetration (Fig. 3). The site of erosion was sutured and the ASD was repaired with a pericardial patch. The patient was discharged without any events 2 weeks after the surgery.

Discussion

Cardiac erosion is a potentially lethal complication in catheter closure of ASD and occurs even after a technically adequate procedure [3–5]. Previous reports suggested that a deficient aortic rim and oversized occlusion device may be at higher risk for cardiac erosion [6,7]. However, a large number of cases with an aortic rim deficiency have resulted in a successful deployment without complicating cardiac erosion. Morphological factors additional to a deficient aortic rim should be considered in cases with cardiac erosion. In our case, a residual shunt was observed from the aortic root side after the device deployment. Thus, it was difficult to conclude that choice of the oversized device was the primary cause for cardiac erosion.

Meanwhile, previous reports described that the cause of erosion was the right atrial disk impinging anteriorly on the non-coronary sinus of the aortic root [8,9]. Although observation of both sides of the disk is important, assessment of this situation before device deployment is difficult. In our case, the right atrial disk impinged on the aortic root more tightly after releasing the device (Fig. 2D).

Surfaces arising from septum primum and septum secundum are different in a defect with malaligned atrial septum which may provoke vertical displacement and tight impingement of the right atrial disk toward the right atrium. Atrial septal malalignment causes a change in the device axis angle against the aortic root and

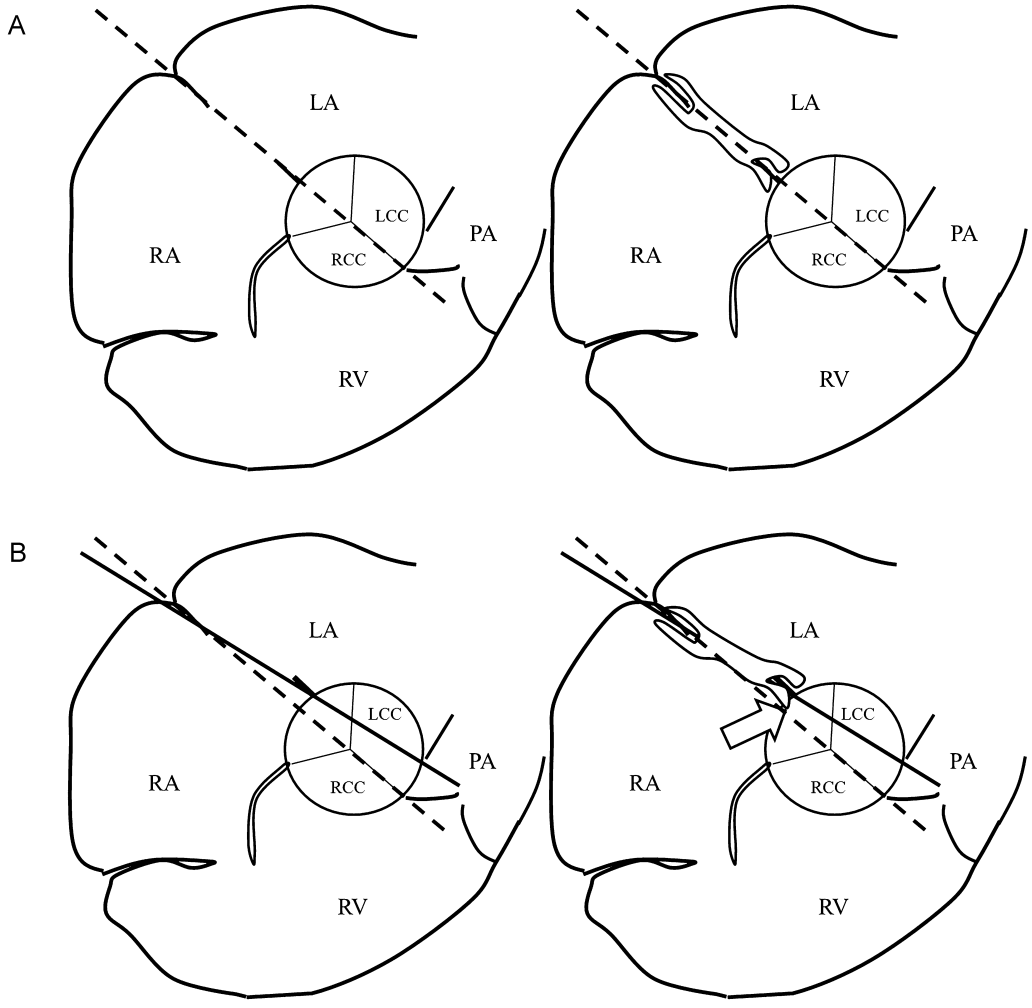

Fig. 4. Hypothetical mechanism of cardiac erosion in a patient with atrial septal malalignment. (A) Illustration of atrial septal defect (ASD) with normal atrial septal alignment. (B) Illustration of ASD with atrial septal malalignment. Impinging of the right atrial disk on the right atrium toward the aortic root is indicated (arrow). LA: left atrium, PA: pulmonary artery, RV: right ventricle, LV: left ventricle, LCC: left coronary cusp, RCC: right coronary cusp.

may be a risk for cardiac erosion in catheter closure of ASD using this device (Fig. 4A and B).

A deficient aortic rim combined with atrial septal malalignment may be a novel risk factor for cardiac erosion. Keeping in mind the potential for this serious complication is required when catheter closure using Amplatzer Septal Occluder is provided to ASD patients with atrial septal malalignment, although death from such mechanical complications remains rare.

Conflict of interest

Authors declare no conflict of interest.

Acknowledgments

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