



Iatrogenic partial diversion of inferior vena cava to left atrium after surgical closure of atrial septal defect

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Case Report

Abstract

BACKGROUND: Atrial septal defects (ASDs) are one of the most common congenital cardiac abnormalities. Repair of these defects is a quite secure and routine operation. The most common complications were postoperative atrial arrhythmias, sinus arrhythmia, and atrioventricular (AV) blocks requiring pacemaker implantation, mediastinal bleeding, and transient ischemic attacks (TIAs) or strokes. Iatrogenic diversion of the inferior vena cava (IVC) to the left atrium (LA) during surgical closure of an ASD is a very rare complication.

CASE REPORT: We reported a patient who had a history of cardiac surgery in another center at the age of seven and was introduced to our clinic with complaints of dyspnea and cyanosis of extremities on exertion. She underwent surgery in our center with diagnosis of iatrogenic diversion of IVC to LA.

CONCLUSION: The most common mechanism suggested is a large eustachian valve being mistaken for the inferior rim of the ASD.

Keywords: Atrial Septal Defect; Heart Surgical Procedure; Inferior Vena Cava

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Introduction

Atrial septal defects (ASDs) are one of the most common congenital cardiac abnormalities. Repair of these defects is a quite secure and routine operation. The most common complications were postoperative atrial arrhythmias, sinus arrhythmia, and atrioventricular (AV) blocks requiring pacemaker implantation, mediastinal bleeding, and transient ischemic attacks (TIAs) or strokes.¹ Iatrogenic diversion of the inferior vena cava (IVC) to the left atrium (LA) during surgical closure of an ASD is a very rare complication. This complication was visualized in the period of time before cardiopulmonary bypass due to time limitations when the eustachian valve was mistaken for the inferior rim of the atrial septum.² It is infrequently met in current surgical procedures.² We reported a patient who had a history of cardiac surgery in another center and was introduced to our clinic with complaints of dyspnea and cyanosis of extremities on exertion, and she

underwent surgery in our center with diagnosis of iatrogenic diversion of IVC to LA.

Case Report

We describe a 30-year-old woman with a history of cardiac surgery when she was 7 years of age in another center. Description of operation was not available, but probably she had undergone surgical closure of IVC type of sinus venosus ASD (SVASD) or a low ostium secundum type of ASD expanding down to the IVC. Regarding her parent's ideas, the patient was taken to the operation room again immediately after the surgery due to unstable condition and then she was returned to the intensive care unit (ICU).

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She was introduced to our clinic with complaints of dyspnea and cyanosis on exertion. She also had two episodes of cerebrovascular attack with acute-onset left-sided weakness and dysphasia and she was cured entirely. Her parents detected mild bluish discoloration of nails two years following surgery that was not looked into because she was asymptomatic. After the brain attacks, she was assessed frequent times at the local center and the echocardiography was done that showed intact atrial septal patch without other abnormality. Moreover, the patient was treated with rivaroxaban and acetyl salicylic acid (ASA). No rhythm abnormality has been observed as a reason of stroke.

On physical examination, the blood pressure and heart rate were in the normal limit. But oxygen saturation was 84% in the air room. On general appearance, the patient was well developed. The nailbeds, lips, and mucous membranes were cyanotic and mild digital clubbing was noted; there was not any respiratory distress at rest. The lungs were clear. Cardiac auscultation revealed a normal first and second heart sounds and a grade II/VI systolic murmur at the left sternal border, with no diastolic murmur or gallop. The rhythm was regular. There was no peripheral edema, but there was digital clubbing. The pulses were regular and symmetric. In laboratory data, hemoglobin (Hb) was 12.6 gr/dl with hematocrit (HCT) of 41%. The electrocardiogram (ECG) showed normal regular and sinus rhythm with normal axis and deep S waves in I and augmented vector left (aVL) leads suggesting right ventricle (RV) overload, wide QRS duration [right bundle branch block (RBBB)], and ST-T changes in inferior leads and leads V1-V4. Chest X-ray (CXR) showed normal cardiothoracic ratio and normal pulmonary parenchyma and vascularity. Transthoracic echocardiography (TTE) revealed normal left ventricle (LV) size and preserved systolic function [LV ejection fraction (LVEF): 50%-55%], mild LA enlargement, normal right atrial (RA) size, mild RV enlargement, and mild to moderate systolic dysfunction. Heart catheterization was performed for the patient. In catheterization laboratory, a 0.035 guide wire was sent along the IVC and was visualized directly into the LA. Next, the guide wire was switched for a pigtail catheter that was situated in the IVC just below the diaphragm. Contrast angiography was done in anteroposterior (AP) and left anterior oblique views which showed that the contrast was going into the LA straightly through the IVC via a small caliber tract from IVC adjacent to the LA

without any fenestration or defect in the ASD patch, because the contrast did not fill the RA (Figure 1).

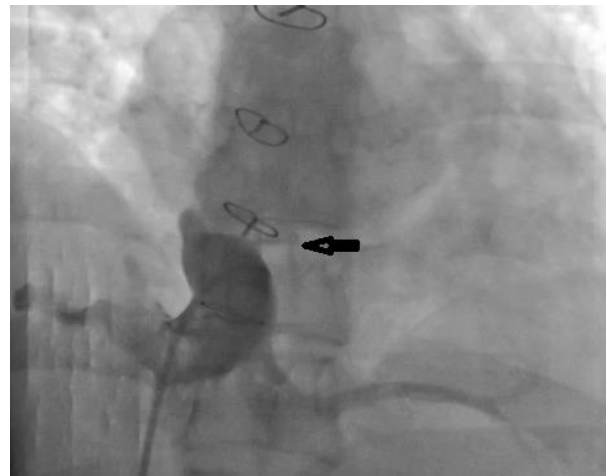


Figure 1. A small caliber tract from inferior vena cava (IVC) adjacent to left atrium (LA)

Angiogram in the superior vena cava (SVC) showed its normal drainage into the RA. At the first echocardiogram, we did not see the significant pathology, but after the catheterization, transesophageal echocardiography (TEE) was done and showed that IVC was deviated toward LA, probably by eustachian valve and pericardial patch; thus, contrast injection from lower extremity showed opacification of LA (Figure 2).



Figure 2. Contrast injection from upper extremity without opacification of left atrium (LA)

In fact, TEE revealed that there was a small caliber tract from IVC adjacent to the LA (size: 7.5 mm) with continuous turbulent flow (maximum pressure gradient: 9 mmHg), and this was the only connection between LA and IVC (Figure 3).

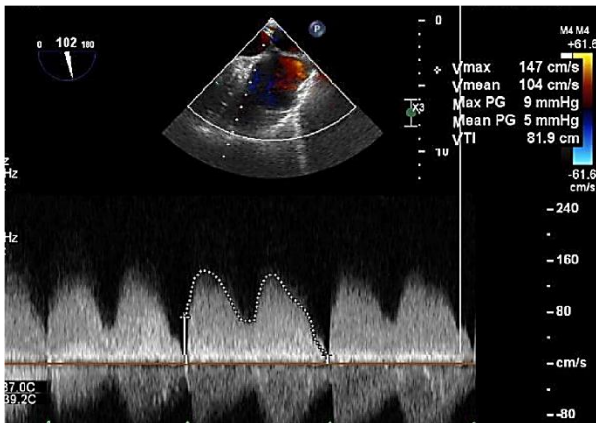


Figure 3. Small defect at inferior part of interatrial septum with continuous turbulent flow (max pressure gradient: 9 mmHg)

Coronary computed tomography (CT) angiography, done based on congenital protocols, showed normal epicardial coronary arteries and presence of IVC with interrupted appearance in RA confluence, and a suspicious small caliber tract to LA in most cephalad part of IVC adjacent to interrupted part was seen (Figure 4). The patient was scheduled for surgery to redirect the IVC to the RA. At this time, she became pregnant and according to the pregnancy team consult, she was advised to abort the fetus. After the abortion of fetus, the patient underwent cardiac surgery.

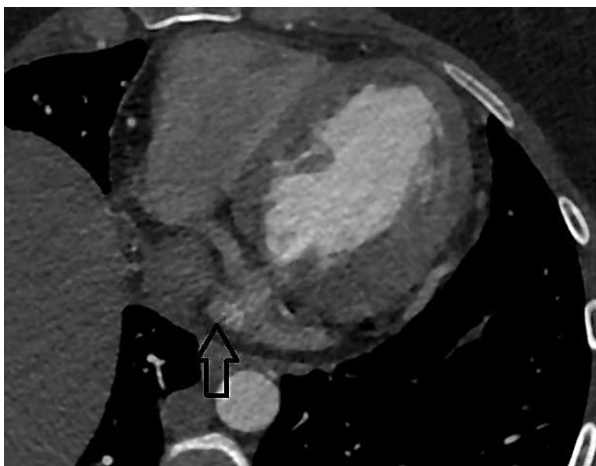


Figure 4. Computed tomography (CT) angiography showing the presence of inferior vena cava (IVC) with interrupted appearance in right atrium (RA) confluence and a suspicious small caliber tract to left atrium (LA)

When the surgeon opened the RA, he saw that the IVC was not draining into the RA and was draining into the LA with a significant stenosis. IVC was tunneled to RA and atrial septum was repaired using bovine patch.

Discussion

ASDs are one of the most common congenital cardiac abnormalities. Repair of these defects is a quite secure and routine operation. The most common complications were postoperative atrial arrhythmias, sinus arrhythmia, and AV blocks requiring pacemaker implantation, mediastinal bleeding, and TIAs or strokes.¹

Iatrogenic diversion of IVC to the LA during surgical closure of an atrial ASD is a very rare complication.³ This abnormality leads to dyspnea and hypoxemia, exertional desaturation, orthodeoxia, pulmonary hypertension (PH), and other life-threatening complications like stroke due to paradoxical embolism that may present at postoperative period at once or years later due to absence of restriction of physical activity. For this reason, the contrast echocardiography must be taken in patients with ASD closure showing hypoxemia or cyanosis regardless of the time of onset of symptoms.³

Our patient was a case of iatrogenic diversion of the IVC to the LA by the suture of the patch to the eustachian valve of the IVC, probably after closure of an IVC type of sinus venosus atrial septal defect (SVASD) or a low ostium secundum type of ASD expanding down to the IVC at the age of 7 years who presented 23 years later with clinical characteristics of dyspnea, cyanosis of extremities on exertion, and two episodes of stroke. A multidisciplinary meeting was held with the surgeon and a decision was taken to perform a surgical repair. Therefore, the patient was scheduled for surgery to redirect the IVC to the RA.

Cyanosis and hypoxemia in our patient might be misdiagnosed as Eisenmenger's syndrome and then, she did not receive proper treatment. This case highlights the importance of knowing about the possibility of such a complication and careful examination to find it.

Right-to-left shunt following repair of ASD is described in case report articles. During operation, either the eustachian valve of the IVC can be mistaken for the lower margin of the defect or the lower portion of the defect is not closed; blood flow is then diverted from the IVC into the LA. This possibility occurs particularly when the repair sutures are placed superiorly to inferiorly. To prevent this occurrence, the inferior margin of the ASD should be closed first.⁴

The most common mechanism that was suggested for that is a large eustachian valve being mistaken for the inferior rim of ASD. The superior

rim was sutured with the eustachian valve instead of the true inferior rim; therefore, the true inferior rim was not involved with the closure and a shunt persisted, resulting in a flow from the IVC to the LA. At the time being, an intraoperative TEE can be used to rule out such event. Moreover, other noninvasive modalities like a contrast echocardiography, magnetic resonance (MR), and contrast CT scan are often used to diagnose this complication. Particularly, contrast echocardiography, that is done with agitated saline injected into the lower extremity, is a fast, non-invasive, and safe way for diagnosing such lesions. It showed appearance of the contrast first in the LA and then in the other cardiac chamber. Early diagnosis of this condition can obviate complications associated with cyanosis and hypoxia as well as other life-threatening events like stroke due to paradoxical embolism.^{4,5} Nevertheless, if it occurs, the surgical management of this circumstance is partly easy and necessitates redirecting the IVC to RA with assistance of a patch. Percutaneous transcatheter device closure of the defects may be possible theoretically in cases where there is a residual shunt of low lying secundum ASD with partial diversion of the IVC to the LA. But there is not any reported case till now.^{3,6}

Conclusion

It is clear that the surgical management of this circumstance is partly easy and necessitates redirecting the IVC to RA with assistance of a patch. Percutaneous transcatheter device closure of the defects may be possible theoretically in cases where there is a residual shunt of low lying secundum ASD with partial diversion of the IVC to the LA. But there is not any reported case till now.

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Conflict of Interests

Authors have no conflict of interests.

Authors' Contribution

ZK and MKH participated in study concept and design. MKH and MSN contributed to critical revision of the manuscript for important intellectual content. MKH and FJ summarized and wrote the manuscript. MSN, ZK, and MGD contributed to the development of the protocol and prepared the manuscript.

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