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was started 1 day postoperatively. He was discharged from the hospital 10 days after surgical decompression.

Discussion

RPH is a rare complication after cardiac catheterization (1). Clinicians should suspect RPH in the presence of related symptoms such as abdominal pain and signs of blood loss after a predisposing condition such as cardiac catheterization. RPH can be managed conservatively, percutaneously, or surgically (3). In cases where hemodynamic conditions are unstable, an early invasive approach may be considered to prevent further deterioration (4). Tachycardia, hypotension, significant anemia, and signs of hypovolemic shock may be alarming for the clinician.

ACoS can be caused by retroperitoneal bleeding with increasing intraabdominal pressure. Clinicians should closely monitor abdominal hypertension so as not to miss ACoS. Some factors such as warfarin use and ascites may act as triggers for the ACoS development (5). Acute renal failure is common in patients with ACoS; other intraabdominal organs may also be affected. Intraabdominal pressure increase leads to elevated intrathoracic pressure. Increasing lactate levels, metabolic acidosis, and increased intrathoracic pressure negatively affect cardiovascular performance by depressing myocardium and vasodilatation. Close monitoring for the development of ACoS is possible using various methods. Intravesical measurement of intraabdominal pressure is an indirect and noninvasive gold standard method (2). In the presence of objective evidence for ACoS, surgical decompression is the preferred treatment method (6). In our patient, we used a percutaneous approach for an unstable hemodynamic condition caused by retroperitoneal bleeding and performed surgical decompression for ACoS that had developed during follow-up. It is essential to increase awareness about the diagnostic and therapeutic approaches to this rare clinical condition. Furthermore, radial approach may be more suitable in patients who are prone to bleeding, such as our patient who was on anticoagulation because of the placement of mechanical prosthetic valves (7).

Conclusion

Occurrence of RPH after interventional procedures to the femoral artery is uncommon, and RPH can be complicated by ACoS. The affected patients can present with an unstable clinical condition; thus, suspecting the presence of ACoS is essential to manage critical patients. Close follow-up in RPH patients is advisable to recognize ACoS earlier to prevent further end-organ damage with appropriate treatment.

Informed consent: Informed consent was obtained from the patient and his relatives for publishing this case report.

Video 1. Extravasation of contrast medium from the femoral artery on angiography

Video 2. Disappearance of extravasation after graft-stent placement inside the femoral artery

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Percutaneous closure of a secundum atrial septal defect through femoral approach in an adult patient with interrupted inferior vena cava and azygos continuation

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Introduction

Percutaneous closure of an isolated secundum atrial septal defect (ASD) has become the first-line treatment in patients with sufficient rims (1). In patients with secundum ASD, the intervention is mostly performed through the femoral vein. However, in some cases, such as those of an interrupted inferior vena cava (IVC) and stenosed iliac or femoral vein thromboses, the femoral vein approach is not reliable. Transhepatic or transjugular approach may be preferred in these cases (2, 3). We present a case report of percutaneous ASD closure in an adult with interrupted IVC using the femoral venous approach.

Case Report

A 37-year-old female patient was admitted to our cardiology outpatient clinic with a recent complaint of dyspnea. She had a history of radiotherapy to the neck. Physical examination revealed 2/6 systolic murmur at the fourth right intercostal space with a fixed splitting second heart sound. An incomplete right bundle branch block on was observed on electrocardiography. Chest radiography showed prominent pulmonary vasculature.

Transthoracic echocardiography revealed enlarged right heart cavities. Transesophageal echocardiography (TEE) revealed an 18×12 mm secundum ASD and sufficient rims for percutaneous interventional closure.

The patient was admitted to catheter laboratory for percutaneous closure of secundum ASD through the femoral approach. Venography was performed because of the abnormal course of the catheter, and an interrupted IVC with azygos continuation was detected (Video 1). Percutaneous closure of secundum ASD through jugular vein approach was planned, but the femoral vein approach was preferred and chosen because of the history of radiotherapy to the neck.

The interatrial septal defect was passed through using a hydrophilic wire (Terumo Corp, Tokyo, Japan) and a 6F amplatz left-2 (AL-2) catheter (Cordis Corporation, Miami, FL, USA) (Fig. 1a). The soft hydrophilic wire was directed toward the left upper pulmonary vein. Then, this wire was we replaced with a superstiff-0.035″ Amplatzer wire (AGA Medical Corp, Golden Valley, MN, USA), using a microcatheter (Terumo navicross 150 cm). The superstiff wire could not be directed toward the pulmonary vein. A loop was made in the left ventricle (Fig. 1b). A 12F delivery long sheath (AGA Medical Corp.) was placed over the superstiff wire (Fig. 1c; Video 2). A 20-mm Amplatzer occluder (AGA Medical Corp.) was loaded and advanced through the sheath, and the defect was closed using the routine protocol (Fig. 2a, 2b; Videos 3, 4). The position and stability of the device were evaluated on echocardiography. No post-procedure residual shunt was detected.

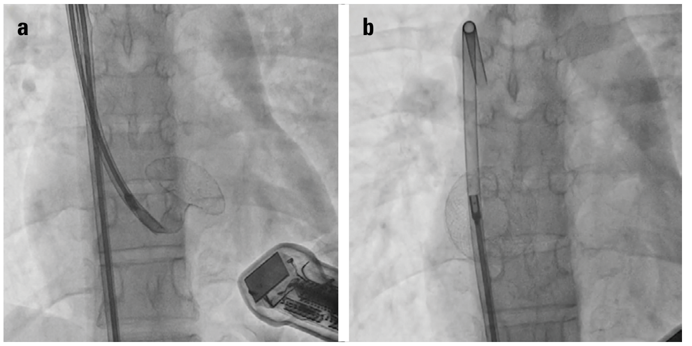

Figure 2. (a) Placement of the Amplatzer atrial septal defect (ASD) occluder device across ASD (b) Fluoroscopy in anteroposterior view showing the deployed Amplatzer atrial septal defect occluder after release

Postoperatively, computed tomography angiography was performed through the lower extremity; it revealed interruption of IVC (Fig. 3).

The patient was discharged 2 days later with oral aspirin and clopidogrel treatment.

Discussion

Percutaneous closure of a secundum ASD should be preferred to surgical procedures in appropriate patients. In this

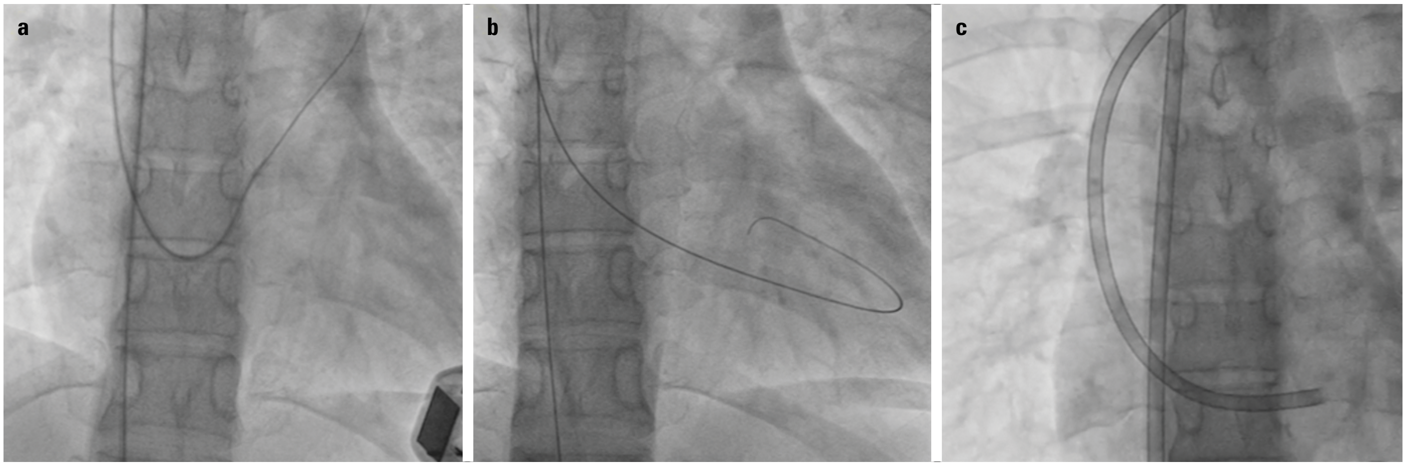

Figure 1. Fluoroscopy in anteroposterior view showing the hydrophilic wire and 6F am platz left 2 catheter passing through the interatrial septal defect (a); looped superstiff guidewire in thr left ventricle (b); the course of delivery of long sheath from the inferior vena cava through the azygous continuation and superior vena cava into the right side of the heart and continuing to the left atrium (c)

Figure 3. Computed tomography angiography showing continuation of the inferior vena cava into the superior vena cava through the azygos vein

regard, it is necessary that the size of the defect and the rims are sufficient. The femoral vein route is mostly used for this procedure. Transjugular and transhepatic approaches are also available to cover the defect in cases such as those of thrombosis, stenosed iliac veins, and interrupted IVC. Abdominal hemorrhage is a highly feared complication of hepatic vein access (4).

The transjugular route was not preferred in the present case because the patient had received radiotherapy to the neck, and the transhepatic route was excluded due to the high risk of complications. Review of the literature demonstrates that the transfemoral route has been successfully used in two adult patients and several pediatric patients with interrupted IVC (5-8).

It is essential to perform TEE in such patients as part of the detailed evaluation for percutaneous closure of secundum ASD. TEE allows sufficient evaluation of the rims and size of the defect.

The primary difficulty is to pass across the interatrial septal defect in these cases. Angled catheters may be preferred for this purpose. Left Judkins and Lima catheters have been used previously (6, 7). We preferred an AL-2 catheter because we aimed to approach the interatrial septal defect perpendicularly using the tip of the catheter, which mimics a multipurpose catheter.

Another difficulty is to place the stiff wire into the left upper pulmonary vein. We failed to direct the hard wire toward the left upper pulmonary vein at the end of a few attempts, but we managed to loop it in the left ventricle. We faced difficulty stablizing the wire and long sheath because of the anatomy of the azygos vein, with abrupt 180-degree return and 90-degree turn across secundum ASD.

Using this approach, another difficulty is the unsuitability of balloon sizing as the wire is not perpendicular to the interatrial septum. Therefore, a proper echocardiographic examination is important for appropriate selection of devices.

A steerable guide catheter may be used in selected cases (9). These catheters are specifically used in the electrophysiology laboratory. They allow access to hard-to-reach areas in the heart.

If the defect is large, the procedure may not be performed through the femoral aproach. Because a large delivery catheter is needed, it may be impossible to advance the catheter through the azygos vein.

Conclusion

Percutaneous closure of an isolated secundum ASD in patients with interrupted IVC and azygos continuation is feasible and safe through the femoral approach. AL-2 catheter can be used when passing through the interatrial septal defect, and TEE is essential for choosing the correct occluder device size.

Informed consent: Written informed consent was obtained from the patient for publication of the case report and the accompanying videos and images.

Video 1. Azygos vein continuation of the inferior vena cava

Video 2. Fluoroscopy in anteroposterior view showing the course of delivery of long sheath going from the inferior vena cava through the azygous continuation and superior vena cava into the right side of the heart and continuing to the left atrium.

Video 3. Fluoroscopy view showing the deployed Amplatzer atrial septal defect occluder before release

Video 4. Fluoroscopy view showing the deployed Amplatzer atrial septal defect occluder after release

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