

Tough, but not impossible – Retrieval of large atrial septal occluder devices embolized to left atrium

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Abstract: Atrial septal defect (ASD) is a congenital heart defect that is being increasingly treated using percutaneous interventions. However, these techniques are not devoid of complications. One such complication is device embolization. Removal of such closure device poses tremendous risk and consequent complications both by percutaneous retrieval and surgical removal. Herein, we present two cases of ASDs that were closed using atrial septal occluder, but the devices were subsequently embolized into left atrium. These devices were then percutaneously retrieved without any further complication or injury.

Keywords: atrial septal defect, congenital heart disease, complication, percutaneous, snare

Introduction

Atrial septal defect (ASD) represents insufficiency of the tissue, tiny to substantial, in the atrial septum [1]. It constitutes 7%–10% of the congenital heart defects in adults [2]. At inception, surgery was considered to be the gold standard method for ASD closure [3, 4]. But, with time, percutaneous ASD closure was found to be an alternative to the surgical closure, as it had lower rates of morbidity, shorter hospital stay, and lack of a scar [4, 5]. However, percutaneous ASD closure also showed various complications [6, 7]. One such complication is device embolization, which occurs in up to 0.5% of cases even when the interventionalists are experienced [8].

Aspects related to risk of device embolization were the type of device used, larger size of defect with floppy rim, thin rim of atrial tissue, change in the position of device post-deployment, and the use of undersized device [3, 9].

The time of device embolization after its implantation was erratic in various situations. Some cases reported immediate embolization [8], whereas other cases reported it to occur from several days to several months after the procedure [10, 11]. Percutaneous and surgical methods were applied for retrieval of the embolized device [12]. Use of large sheaths, snares, or endomyocardial biopsy forceps [13] along with the assistance of stiff guidewire [14] or a biopptome [15, 16] led to successful percutaneous retrieval of devices. Herein, we present two similar yet different cases of immediate embolization of ASD closure device and their successful percutaneous retrieval, followed by surgical closure of the ASD.

Case 1

A 44-year-old woman checked in our institute with the complaint of increasing shortness of breath on exertion

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and fatigue. Oxygen saturation, determined by pulse oximetry, was found to be normal. On physical examination, ejection systolic murmur was audible in the pulmonary area, and there was a wide, fixed splitting of second heart sound (S₂). ECG examination revealed sinus rhythm with QRS axis of 100°. Also, a distinct rSr' pattern was observed in lead VI. Chest X-ray exhibited a cardiothoracic ratio of 55% with prominent pulmonary artery shadow. Transthoracic echocardiography showed a 26-mm secundum ASD with dilated right atrium, right ventricle, and left to right shunt. Transesophageal echocardiography (TEE), which was performed to determine whether defect was suitable for percutaneous closure, also revealed a 30-mm secundum ASD along with adequate rims except the inferior vena cava (IVC) rim and posterior rims, which was slightly thin and flimsy. The patient underwent percutaneous closure of secundum-type ASD with atrial septal occluder (ASO).

As IVC rim and posterior rims were inadequate, a large 34-mm Cera ASD occluder [Lifotech Scientific (Shenzhen) Co. Ltd., China] device was chosen for the ASD closure. As per the standard procedure, a 6-Fr multipurpose catheter and a 0.035-in. Amplatz exchange guide-wire (Boston Scientific, Marlborough, MA) were used to cross the ASD and enter the left upper pulmonary vein and the device was placed; but soon it was observed that

the device was not being properly placed, so it was recaptured and the procedure was repeated through the right upper pulmonary vein. On this attempt, position of the device seemed correct and it was placed (*Fig. 1A*).

Few minutes after the placement of the device, while performing echocardiography, the device moved from its initial position (*Fig. 1B*). Consequently, it was embolized into the left atrium (LA). As the device was large, there was a possibility that the device may obstruct the mitral inflow. So, cardiovascular surgeons were immediately informed, and percutaneous retrieval was attempted, while preparing for surgery. To prevent thrombus formation, extra unfractionated heparin was given to maintain activated clotting time above 200 s.

Initially, attempts were made to hold the right atrial (RA) screw with indigenous snare. This snare was found to be large. Moreover, this snare was not being properly aligned with the RA disk screw. Then, a 15-mm Amplatz gooseneck snare (eV3 Endovascular, Inc., Plymouth, MN) was used. Multiple views were used to locate the device position. As the device was large and less mobile, the RA disk screw was properly held through the snare (*Fig. 1C*). Thereafter, the device was successfully recaptured back in 14-Fr delivery sheath without any entanglement or complications (*Fig. 1D*). Repositioning of the device was not attempted because of inadequate IVC rim

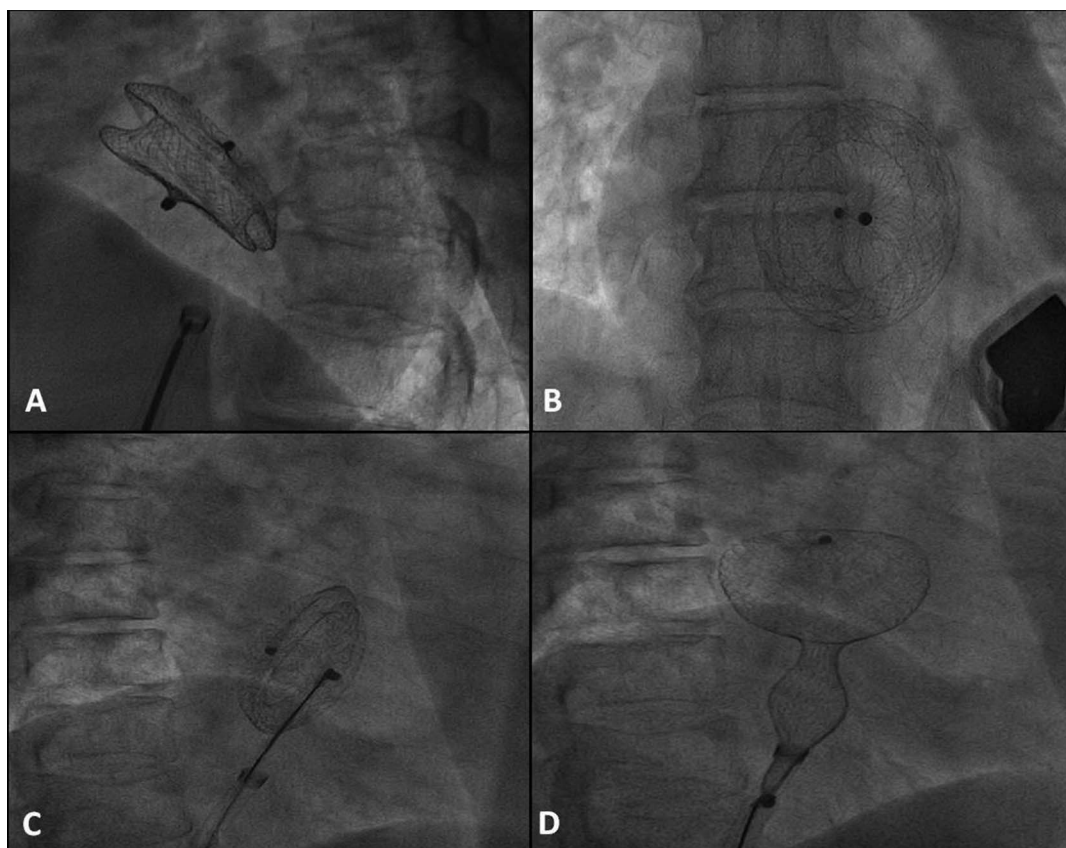


Fig. 1. (A) Successful deployment of closure device in patient 1. (B) Immediate embolization of the device in left atrium. (C) Catching the device with 15-mm Amplatz gooseneck snare through right atrial disk screw. (D) Retrieval of device into 14-Fr delivery sheath

and posterior rims; moreover, a large device was already used. Patient was then referred for elective surgery.

Case 2

A 45-year-old woman checked in our institute with shortness of breath (NYHA class II). She was diabetic and hypertensive. TEE showed situs solitus with congenital heart disease, depicting a 24-mm large ostium secundum ASD with left to right shunt, with some adequate and some deficient rims. Moreover, TEE also showed ASD size of 24 mm. Patient was taken for transcatheter closure of ASD. A 26-mm Cera ASD occluder [Lifetech Scientific (Shenzhen) Co. Ltd., China] device was successfully placed across ASD (Fig. 2A). Few minutes after the placement of the device, patient complained of giddiness in cath ward. Therefore, echocardiography was re-performed, which showed that the device had embolized into LA (Fig. 2B). It was decided to retrieve the device percutaneously. A 15-mm Amplatz gooseneck snare (eV3 Endovascular, Inc., Plymouth, MN) was passed through a 6-Fr multipurpose catheter through 14-Fr Cook's sheath. But the device could not be caught with gooseneck snare. Therefore, an indigenous snare with 300-cm

cougar wire was used. With the help of indigenous snare, the device was held at screw point and pulled into the Cook's sheath. The RA disk entered into the Cook's sheath, but later the indigenous snare slipped out (Fig. 2C). Further attempts to catch the device with the indigenous snare failed. Therefore, a 15-mm Amplatz gooseneck snare, passed into the 14-Fr Cook's sheath over 6-Fr multipurpose catheter, caught the device and pulled the whole device (Fig. 2D). Before pulling the device, a wire was passed through the Cook's sheath to maintain access. The retrieval of the device was successful (Fig. 3), without any further complication.

After the removal of embolized device, the same procedure was repeated, and the same device was placed across ASD. But it was felt that the size of device was small so that device was replaced with another 30-mm Cera ASD occluder [Lifetech Scientific (Shenzhen) Co. Ltd., China]. On echocardiography, this new device was found to be impinging on mitral valve. Therefore, it was taken out, and the patient was sent for elective surgery.

Discussion

This report presented the cases of two patients who underwent percutaneous ASD closure with ASD devices

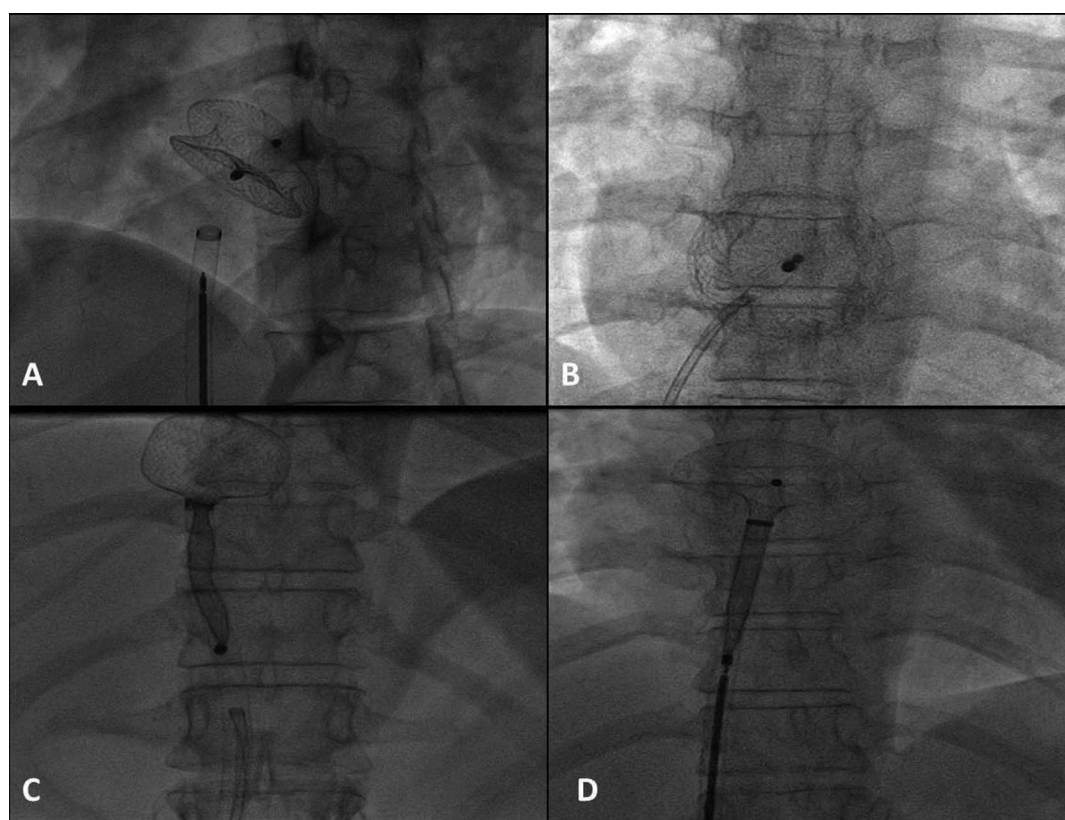


Fig. 2. (A) Successful deployment of closure device in patient 2. (B) Catching the embolized device in left atrium with indigenous snare. (C) Slipped out indigenous snare after the entry of right atrial disk into the Cook's sheath. (D) Retrieval of device with gooseneck snare into Cook's sheath

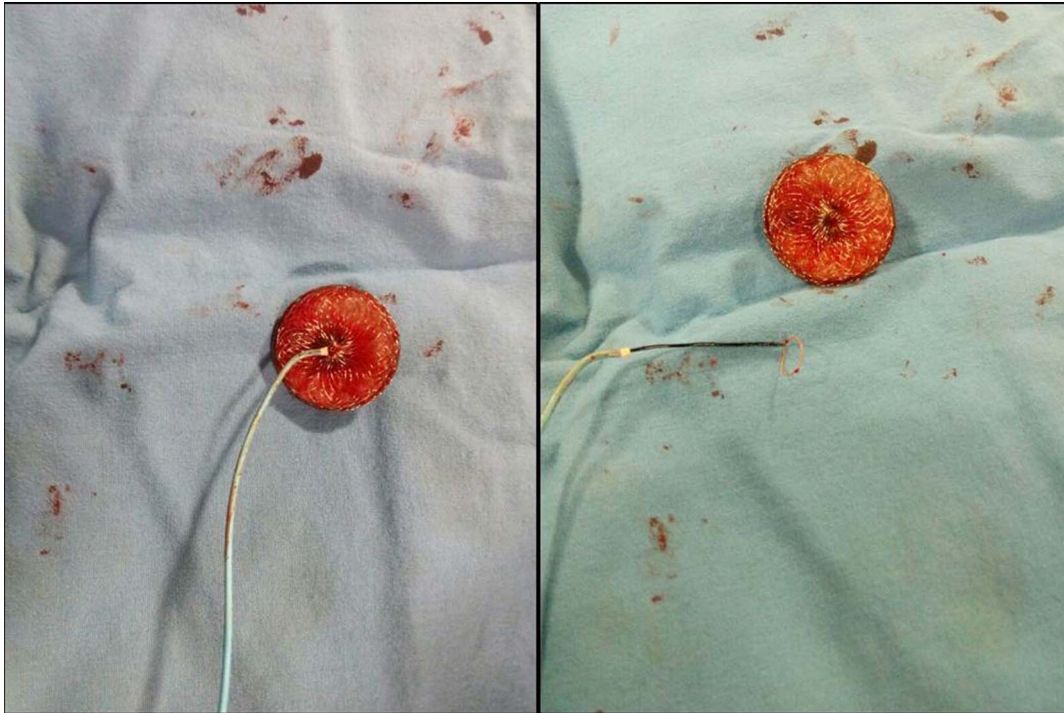


Fig. 3. Retrieved device from patient 2 along with the gooseneck snare

followed by device embolization and subsequent successful percutaneous retrieval of each device. These two cases differed in sizes of ASD and in symptoms of embolization (i.e., one patient was asymptomatic but was diagnosed incidentally when performing post-procedural echocardiography and the other patient experienced giddiness). Although there was disparity between both cases, similarity was that some rims in both the patients were adequate and some were slightly deficient, the embolization of device was immediate in both cases, and the location of embolization and overall method of retrieval were identical.

As mentioned earlier, there were many reasons for embolization of ASD closure devices. The most common being undersized ASD device and the other most common being inadequacy of ASD rims. To the best of our knowledge, inadequate rim was the cause of embolization in the first case, leading to the use of oversized device. In the second case, the embolization was probably because of the deficient rims and undersized device. Device embolization because of inadequate IVC rim has been reported earlier by Kannan et al. [17], Varma et al. [18], and Remadevi et al. [19].

In both our cases, the detection of device embolization was early, and therefore, the device was restricted to the LA without being further migrated into different locations, where it would have been difficult for percutaneous retrieval. But in some other case reports, the devices were found to be embolized to pulmonary artery [20], right ventricle [21], and even abdominal aorta [22], where the

percutaneous retrieval of the device becomes difficult leading to surgery.

The first step in retrieval was stabilizing the device by preventing its migration and subsequently slenderizing it. Some researchers have used stiff guidewire, which was passed across the mesh of the device for stabilization [14], whereas others have used a biopptome to stabilize the LA disk of device and to restrict the movement [8, 15, 16]. However, none of the above techniques were used in our cases as the devices used herein were large and less mobile. Instead, multiple views to catch hold of the RA disk screw with snare were used. There are many studies that have reported the use of snare for retrieval of embolized ASD closure devices from different locations in body [14, 15].

The second step in retrieval was pulling ASD into sheath using the screw on RA disk. To pull the device into sheath, proper application of force and degree of alignment of device with the sheath were imperative [12]. A 2-Fr sheath larger than the proper fit delivery sheath, use of stiff sheath that are less likely to kink, and cutting a bevel at distal end of sheath to facilitate entry of RA disk screw into the sheath assist easy retrieval of the device out of the body [8]. In our cases, 14-Fr sheath was used because the devices were large.

In both our cases, retrieval was successful without any further complication or vessel injury. It is important to protect the device with the sheath while retrieving to prevent injury to valves and chambers of heart and blood vessels.

Conclusion

This report underscores the importance of careful selection of appropriate approach for ASD closure depending on patient peculiarities and thereby close monitoring for occurrence of early embolization or complications as well as monitoring the possibilities of delayed complications. Percutaneous retrieval should be attempted before sending the patient to surgery on an emergency basis. All interventionalists should be aware of retrieval techniques.

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References

- Rao PS (2012): Atrial septal defect – A review. In: Atrial Septal Defect, ed Rao PS, INTECH Open Access Publisher, Croatia, pp. 1–20
- Bissessor N: Current perspectives in percutaneous atrial septal defect closure devices. *Med Devices* 8, 297–303 (2015)
- Misra M, Sadiq A, Namboodiri N, Karunakaran J: The 'aortic rim' recount: Embolization of interatrial septal occluder into the main pulmonary artery bifurcation after atrial septal defect closure. *Interact Cardiovasc Thorac Surg* 6, 384–386 (2007)
- Hopkins RA, Bert AA, Buchholz B, Guarino K, Meyers M: Surgical patch closure of atrial septal defects. *Ann Thorac Surg* 77, 2144–2149 (2004)
- Butera G, Carminati M, Chessa M, Youssef R, Drago M, Giamberti A, Pomè G, Bossone E, Frigiola A: Percutaneous versus surgical closure of secundum atrial septal defect: Comparison of early results and complications. *Am Heart J* 151, 228–234 (2006)
- Chessa M, Carminati M, Butera G, Bini RM, Drago M, Rosti L, Giamberti A, Pomè G, Bossone E, Frigiola A: Early and late complications associated with transcatheter occlusion of secundum atrial septal defect. *J Am Coll Cardiol* 39, 1061–1065 (2002)
- Berdatsky PA, Chatterjee T, Pfammatter J-P, Windecker S, Meier B, Carrel T: Surgical management of complications after transcatheter closure of an atrial septal defect or patent foramen ovale. *J Thorac Cardiovasc Surg* 120, 1034–1039 (2000)
- Goel PK, Kapoor A, Batra A, Khanna R: Transcatheter retrieval of embolized AMPLATZER Septal Occluder. *Tex Heart Inst J* 39, 653–656 (2012)
- Butera G, Lovin N, Paola Basile D, Carminati M: Goose-neck snare-assisted transcatheter ASD closure: A safety procedure for large and complex ASDs. *Catheter Cardiovasc Interv* 87, 926–930 (2016)
- Verma PK, Thingnam SK, Sharma A, Taneja JS, Varma JS, Grover A: Delayed embolization of Amplatzer septal occluder device: An unknown entity – A case report. *Angiology* 54, 115–118 (2003)
- Şahin DY, Koç M, Çakır H, Arık OZ, Elbasan Z, Çaylı M: A silent and late embolization of atrial septal defect occluder device into the right pulmonary artery: A case report. *Korean Circ J* 42, 781–783 (2012)
- Levi DS, Moore JW: Embolization and retrieval of the Amplatzer septal occluder. *Catheter Cardiovasc Interv* 61, 543–547 (2004)
- Balbi M, Pongiglione G, Bezante GP: Percutaneous rescue of left ventricular embolized Amplatzer septal occluder device. *Catheter Cardiovasc Interv* 72, 559–562 (2008)
- Peuster M, Boekenkamp R, Kaulitz R, Fink C, Hausdorf G: Transcatheter retrieval and repositioning of an Amplatzer device embolized into the left atrium. *Catheter Cardiovasc Interv* 51, 297–300 (2000)
- Chan KT, Cheng BCW: Retrieval of an embolized amplatzer septal occluder. *Catheter Cardiovasc Interv* 75, 465–468 (2010)
- Shirodkar S, Patil S, Pinto R, Dalvi B: Successful retrieval of migrated Amplatzer septal occluder. *Ann Pediatr Cardiol* 3, 83 (2010)
- Kannan BRJ, Francis E, Sivakumar K, Anil SR, Kumar RK: Transcatheter closure of very large (≥ 25 mm) atrial septal defects using the Amplatzer septal occluder. *Catheter Cardiovasc Interv* 59, 522–527 (2003)
- Varma C, Benson LN, Silversides C, Yip J, Warr MR, Webb G, Siu SC, McLaughlin PR: Outcomes and alternative techniques for device closure of the large secundum atrial septal defect. *Catheter Cardiovasc Interv* 61, 131–139 (2004)
- Remadevi K, Francis E, Kumar RK: Catheter closure of atrial septal defects with deficient inferior vena cava rim under transesophageal echo guidance. *Catheter Cardiovasc Interv* 73, 90–96 (2009)
- Gur AK: Device embolization associated with percutaneous closure of atrial septal defect. *Turk Gogus Kalp Dama* 21, 1061–1063 (2013)
- Yuce M, Ozer O, Cakici M, Cine N, Sari I, Davutoglu V: Embolized Amplatzer septal occluder device presenting with ventricular fibrillation. *Cardiovasc Revasc Med* 12, 131–132 (2011)
- Ferrero E, Ferri M, Viazzo A, Beqaraj F, Gibello L, Berardi G, Santovito D, Nessi F: Migration of an AMPLATZER atrial septal occluder to the abdominal aorta. *Am J Cardiol* 112, 612–613 (2013)