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Brief Report

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Successful retrieval of embolised Occlutech atrial septal defect occluder from descending aorta in a 4-year-old child using a "mother and child" technique: a case report and literature review

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Abstract

A 9 mm Occlutech septal occluder Flex II device was retrieved in a 4-year-old 22 kg child; A 6 Fr Cook® Flexor sheath (child) was inserted into a 9 Fr Occlutech® ASD Delivery Set (mother). Once the tip of the smaller sheath was close to the device, a 4 Fr right Judkins catheter was introduced with a snare. The right atrial hub was captured and withdrawn to the level of the 6 Fr sheath which was then withdrawn into the 9 Fr sheath before being removed completely. The "mother and child" technique offers a greater likelihood of slenderising and retrieving embolised devices.

Transcatheter closure of secundum atrial septal defects is often considered as the first option for closure of haemodynamically significant atrial shunts. Device embolisation is a known complication and occurs in approximately 0.5% of all cases.[1] The Figulla® Flex I or Flex II septal occluder (FSO) (Occlutech International AB, Helsingborg Sweden) uses a smooth spherical hub on the right atrial disc, to facilitate its positioning during deployment. This, however, is not easy to grip with a snare. We describe a novel "mother and child" technique to help slenderise the device allowing the snare mechanism to work more effectively without slipping.

Case presentation

A 4-year-old patient weighing 22 kg and a 7 mm **atrial septal defect** had device closure with a 9 mm FSO through a 7 French sheath. The device appeared to be in a stable position and was released uneventfully. Transthoracic echocardiography performed 5 hours later confirmed the device had embolised into the proximal descending aorta (Fig 1). The patient remained asymptomatic. A heparin infusion was commenced at therapeutic doses, and the patient returned to the lab the same day.

Ultrasound interrogation of both femoral arteries before access showed an internal diameter of 4.1–4.5 mm, indicating that a 9 Fr sheath could be accommodated. Bilateral femoral arterial access with 4F and 5F short sheaths was obtained, in case manipulation of the device from an additional left-sided catheter was required to snare the right atrial hub. Biplane fluoroscopy confirmed that the device was oriented vertically, with the right atrial hub directed anteriorly with a favourable slight caudal tilt.

The retrieval apparatus was then assembled: a 90 cm 6 Fr Cook® Flexor® Check-Flo® (Cook medical, Bloomington Indiana USA) introducer sheath ("child") with its dilator was mounted coaxially with a 70 cm 9 Fr Occlutech® ASD Delivery Set ("mother"). This was exchanged for the short sheath over a 0.035" Amplatz Extra-Stiff straight wire (Cook medical, Bloomington Indiana USA). Once the tip of the smaller sheath was close to the device, the dilator was removed and a 4 Fr Judkins Right catheter (Terumo®, Leuven Belgium) was inserted, followed by a 5 mm eV3 Amplatz Goose Neck Snare Kit (Medtronic Limited, Minnesota USA). This allowed precise movement and manipulation of the snare. The right atrial hub was easily captured using this technique. The 6 Fr sheath with the Judkins Right catheter provided a good anchoring mechanism allowing the device to be stretched and slenderised before being withdrawn into the larger 9 Fr sheath. Once this was seen, the device was removed completely from the patient in one single smooth action (Fig 2). **The time taken from inserting the sheath to the device being retrieved was 7 minutes.**

After re-interrogation of the septum, a 12 mm FSO was selected and deployed successfully. The patient recovered well, but a weak pulse on the side of the larger sheath necessitated the use of 24 hours of intravenous heparin followed by 6 weeks of subcutaneous heparin administration.

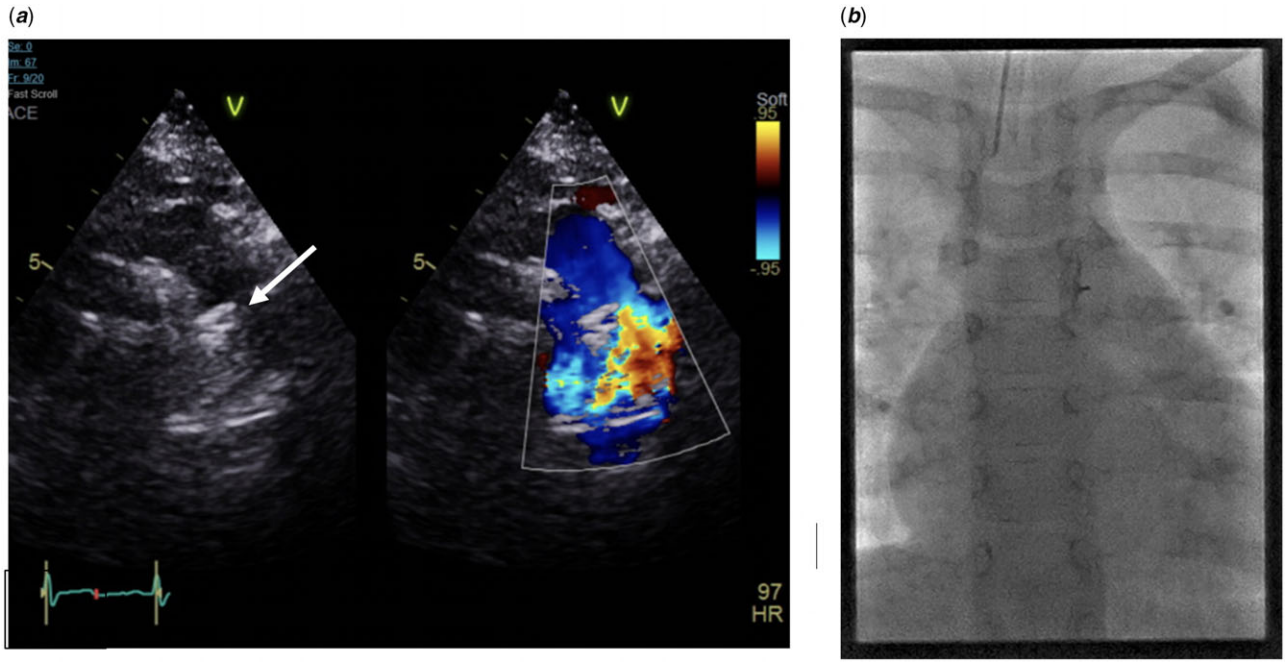

Figure 1. Device (arrow) seen distal to left subclavian artery with aliasing of flow on colour doppler (***a***) and fluoroscopy (***b***).

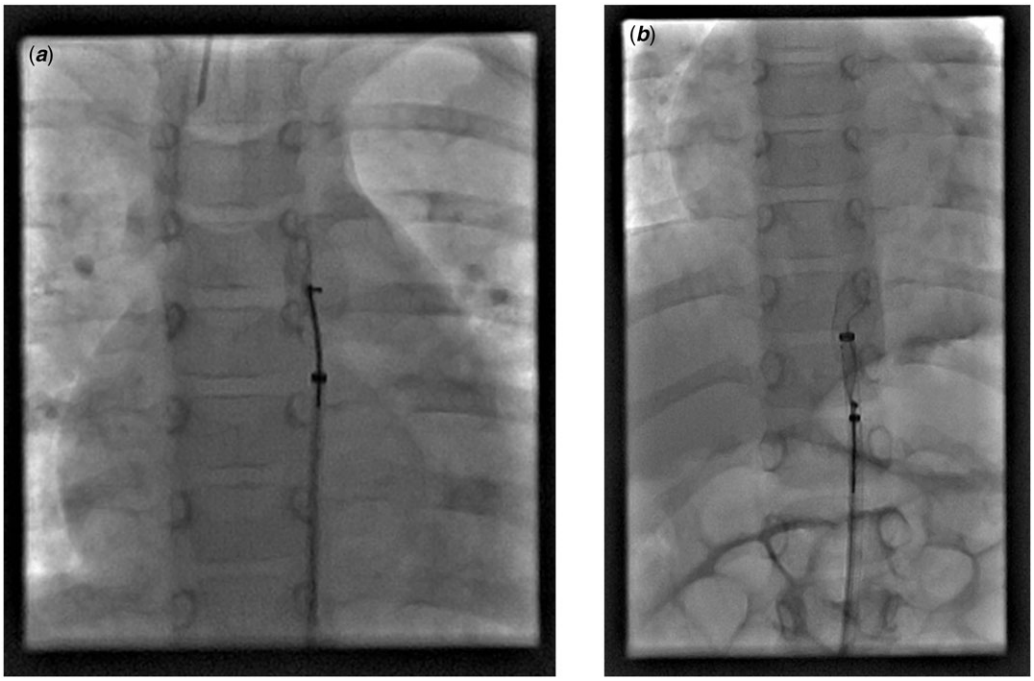

Figure 2. Right atrial hub captured using snare (***a***) and device withdrawn into 9 Fr "Mothering" sheath (***b***).

Follow-up has shown that the device remains in a stable position and ultrasound imaging of the vessels showed that both common femoral arteries were patent and unobstructed.

Discussion

The FSO is a flexible titanium-oxide-coated nitinol mesh double-disk device. It has minimised metal contents and no clamping hub on the left atrial disk. Its release mechanism resembles a bioptome – attaching to a smooth spherical right atrial hub, allowing for tension-free alignment to the atrial septal margins.

The principles of dealing with embolised devices are early detection, heparinisation to avoid thrombosis, and early intervention either by transcatheter means or surgery. For devices like the Amplatzer Septal Occluder (Abbott, Illinois, USA), standard gooseneck/triple loop snares have been used to capture the ridged right/left pins or the body of an embolised device before withdrawing it into a sheath.[1–3] Simply snaring and withdrawing these

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Table 1. Reported cases of FSO devices successfully retrieved after embolisation to the aorta

Age (y)	Device size (mm)	Sheath recommended to deploy (Fr)	Sheath used to retrieve (Fr)	Technique used to retrieve
Shebani et al[4]				
45	10.5	7	12	25 mm Gooseneck snare around right atrial hub
15	9	7	10	10 mm Multi-Snare around right atrial hub
54	18	9	14	15 mm gooseneck snare to right atrial hub
56	10.5	7	12	15 mm snare around right atrial hub
Georgiev et al[7]				
18	15	9	12	Snare
67	24	11	12	Original delivery forceps
8	10	7	10	Snare
Khosravi et al[6]				
37	18	9	14	Coronary wire trap technique
Pala et al[10]				
35	7	7	12	Bioptome to right atrial hub

Fr, size in French; mm, millimetres; y, years.

devices into large sheaths, sometimes ≥3F larger than that used for delivering the device, is often successful, but can be problematic when embolised to the aorta in a young child due to the associated vascular morbidity.

With the FSO in particular, more than the size of sheath itself, the key to success lies in the ability to slenderise the device, making it coaxial to a sheath within the anatomic constraints of its location. Successful snaring of the right atrial hub of the FSO and simply applying traction in the same way as in retrieving an Amplatzer Septal Occluder is likely to fail, as slenderising will not be possible. In one multi-centre study, in 12/15 attempts to snare the right atrial hub of FSOs, the snare slipped with the device at the tip of the sheath or when only the right atrial disc was withdrawn within the sheath. Furthermore, in 8/15 attempts, snaring eventually failed.[4] **Alternative techniques include capturing the waist of the device (requires the use of a very large sheath), using a coronary wire to "harpoon" a device (can be technically challenging and requires very large sheaths), the double snare technique (not shown to be successful in FSO embolisation to the aorta) or even use commercially available modified bioptome forceps to recapture an embolised device (requires non-standard equipment).**[5–8]

To our knowledge, our patient is the smallest child to have had successful percutaneous retrieval of an embolised device within the aorta (Table 1). First described in 2004, the "mother and child" technique was devised for complex coronary interventions.[9] Our repurposing of the technique for retrieval of a device within the aorta permits the use of an overall smaller outer (mothering) sheath, as the inner (child) sheath provided additional support. The assembly allows the use of smaller catheters, wires, and balloons when used in coronary intervention. **In this setting, our preference is to mount the snare within the more rigid Judkins Right catheter rather than the un-braided catheter provided in the snare kit; the added stiffness enhances control when anchoring and aligning apparatus close to the device.**

In our case, the device being partially constrained in the aorta was helpful in slenderising the device, but a snared device in the right or left atria could be moved to a caval vein using the catheter-child combination. Subsequently, the "mother and child" ensemble allows stable traction to be applied to the device, enabling slenderising. This manoeuvre avoids the risk of the snare slipping over the surface of the right atrial hub just prior to withdrawal into the mothering sheath. **We recommend using a mothering sheath 2F larger than that used to deliver the device to maximise chances of successful retrieval, but sheaths only 1F larger may accommodate an adequately slenderised device.**

Conclusion

Retrieval of the FSO is a technically challenging procedure, and success rates are likely to depend on the ability to elongate the device as well as obtaining a coaxial orientation of the device to the sheath. A "mother and child" technique allows both of these to occur and can be used for embolised or malpositioned devices

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Conflicts of interest. None.

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