Cardiology in the Young

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Closure of small fenestrations without optimal rims with a PDA coil far from primary atrial septal defects: a new approach

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Abstract

An ostium secundum atrial septal defect (ASD) is a CHD that can be treated percutaneously since 1974, mostly cases with only one main defect. In cases with fenestrations close to the main defect, a single occluder can be used for treatment because the discs extend beyond the waist of the device. In some cases where the defects are far from each other, they may require either more than one device or surgical closure. We present two patients in whom we observed fenestrations far from the primary defect. Initially, the main ASDs were closed with an ASD occluder, and then the fenestrations were closed with a patent ductus arteriosus (PDA) coil, resulting in complete closure of both defects. This shows that closing small fenestrations that are far away from the primary interatrial defect without rims and using other devices instead, such as a PDA coil, is feasible and can avoid the need for an open-heart surgical procedure; moreover, it is important to note that leaving these fenestrations open can have the same physiology as a patent foramen oval.

Introduction

Since 1974, when the first percutaneous closure of an atrial defect was described,[1] different devices have been developed, and the number of patients undergoing interventional closure for this congenital heart disease (CHD) has increased both in paediatric and adult populations. Atrial septal defects (ASDs) that are suitable for percutaneous closure are those within the limbus of the fossa ovalis, commonly called "ostium secundum",[2] and they are usually single defects; sometimes, there are one or more additional defects called fenestrations. Most fenestrations are close to the main or primary defect and can usually be closed with a single device since the discs extend beyond the waist of the device by several millimetres. In other cases where fenestrations are further away (more than 7 mm) from the primary defect, a second occluder may be required if there is an adequate position and useful rims (greater than 5 mm) are present. In cases where the fenestration is very far from the primary defect and does not have adequate rims, surgical treatment is required.

There are reports in the literature of closure via a second procedure involving residual shunts with coil devices after the closure of a patent foramen ovale in adult patients.[3–5] However, the primary closure of a fenestration with a coil device has not been reported, which is the purpose of this article.

We present two patients with an ostium secundum ASD who at the time of the interventional catheterisation with intracardiac echocardiogram had a small fenestration, in addition to the main defect, that was lacking optimal rims and was located far from the primary defect.

Patient 1

A 6-year-old female, weighing 17 kg, was sent to our institution for a heart murmur. The patient was able to participate in normal physical activity. Physical examination revealed rhythmic heart sounds and a systolic ejection murmur over the pulmonary area (grade II/VI), with a wide, fixed splitting of S2. Non-congestive liver was observed without cyanosis. Chest X-ray revealed mild cardiomegaly with slight growth of the right ventricle, a mild increase in pulmonary flow, and a slightly dilated pulmonary trunk. An electrocardiogram revealed sinus rhythm, a mean ventricular frequency of 88 bpm, and a QRS axis to the right with incomplete blockage of the right bundle branch. A transthoracic echocardiogram (TTE) revealed an ostium secundum ASD with adequate rims except for the aortic rim which was small (a very common situation in our country where most of the atrial defects do not have an aortic rim or tend to be very small; less than 5 mm), mild dilation of the right cavities, and a systolic pressure of 30 mmHg in the pulmonary artery. Cardiac catheterisation from both femoral veins

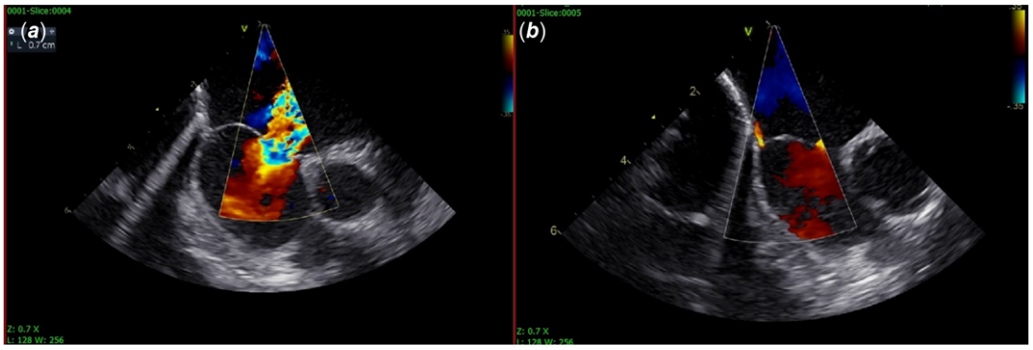

Figure 1. Intracardiac echocardiogram. (***a***) Primary OS ASD 9 x 12 mm. (***b***) Distal fenestration 1.2 mm L–R shunt.

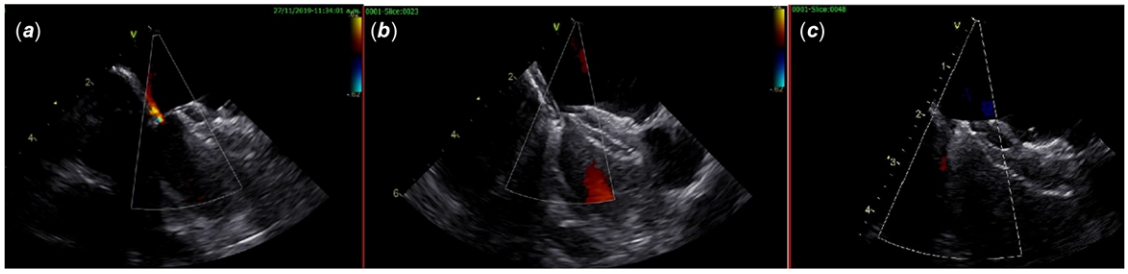

Figure 2. (***a***) Closure of the primary defect with a 15-mm Figulla flex II Occluder. (***b***) Deployment of PDA coil device. (***c***) After confirmation, PDA coil is released.

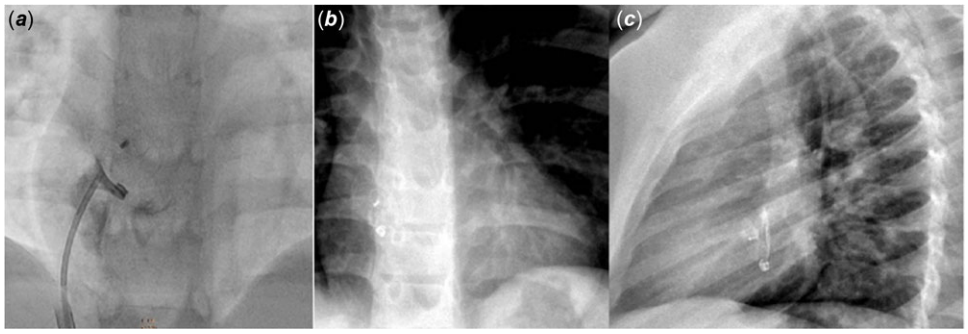

Figure 3. (***a***) Right atrium angiography showing the coil and ASD device in adequate positions. (***b/c***) Follow-up chest X-ray showing both devices in good positions.

revealed that the pressure of the pulmonary artery was normal, and in the intracardiac echocardiogram, there was a slight aneurismatic septum and an ostium secundum ASD of 9 × 12 mm with adequate rims except for the aorta, which was less than 5 mm. In addition, a small fenestration measuring 1.2 mm in the posterior and lower part of the interatrial septum was observed far from the primary defect and that had no posterior rim (Figure 1).

Initially, the primary defect was successfully closed with a 15-mm Figulla Flex II occluder device; later, a 3 mm × 3 loop patent ductus arteriosus (PDA) coil (Cook®) was used to close the fenestration. First, a loop and a half were deployed in the left atrium and placed in position in the interatrial septum; later, another loop and a half were deployed on the right side of the interatrial septum (Figure 2). Before release of the coil, intracardiac echocardiogram was performed, corroborating total closure of the fenestration, and by fluoroscopy, the coil was observed in an appropriate position.

Once the coil was released, intracardiac echocardiography revealed its proper position without a residual shunt. Angiography of the right atrium at the level of the interatrial septum revealed adequate positioning of the coil on both the left and right sides of the septum (Figure 3*a*).

After 36 months of follow-up with no cardiovascular symptoms, X-ray revealed that both devices were well placed and ETT showed no residual shunts (Figure 3 *b,c*).

Patient 2

The second patient is a 5-year-old female, 15 kg in weight, with normal physical activity. Physical examination revealed systolic ejection murmur over the pulmonary area grade I/VI, with a wide, fixed splitting of S2, noncongestive liver and no cyanosis. Her EKG had an anterior fascicular block. TTE showed an ostium secundum ASD. Cardiac catheterisation from both femoral veins was performed, and intracardiac echocardiography revealed an 11 × 14 mm ostium secundum ASD with optimal rims, except for the one of the aorta (2 mm). A 15-mm Figulla flex II device was placed in the defect. Echocardiography revealed a small fenestration measuring 1.5 mm in the posterior–inferior portion of the interatrial septum, so we decided to place a Boston semicontrolled release coil measuring 4 mm × 4.5 cm, leaving a loop and a half in

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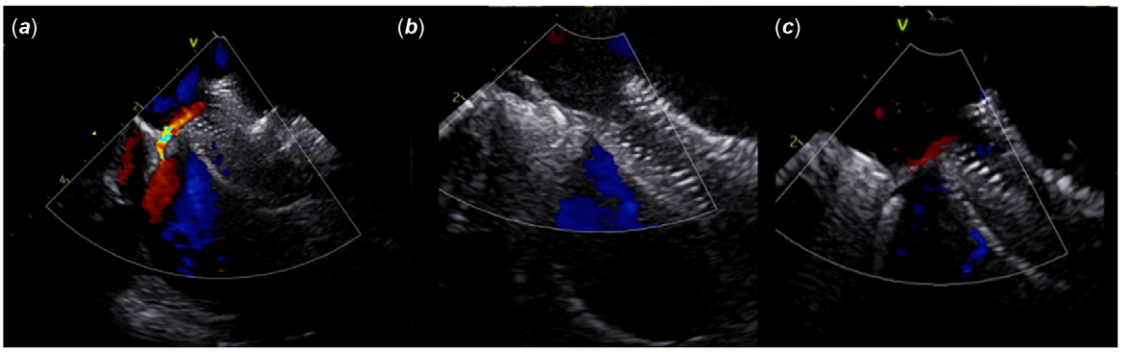

Figure 4. (***a***) Closure of the primary defect with a 15-mm Figulla flex II occluder. (***b***) Deployment of the PDA coil device. (***c***) After the PDA coil was released, no residual shunt was observed.

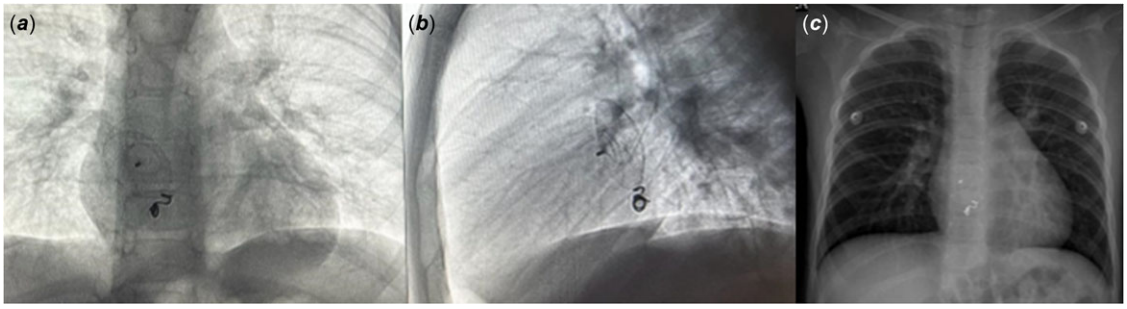

Figure 5. (***a/b***) Right atrium fluoroscopy showing the coil and ASD device in adequate positions. (***c***) Follow-up chest X-ray showing both devices in good positions.

the left atrium and the rest of the loops in the right atrium (Figure 4).

Fluoroscopy revealed that the coil was in an adequate position on both the left and right sides of the septum (Figure 5 *a,b*). Follow-up X-ray at 9 months after treatment showed good positioning of the devices (Figure 5*c*).

Discussion

An ASD is a CHD that can be treated percutaneously, and most ostium secundum defects are centrally located; in recent years, there have been advances in extending this treatment to different kinds of ASDs. By searching the literature, we found different reported cases of PFO closures with residual shunts that were treated with coils.[3–5] However, to our knowledge, this is the first report of ASDs with fenestrations without rims far from the main defect, which were closed via the same procedure used for PDA coils. This is a viable alternative to making the patient undergo an open-heart surgical procedure or leaving them with a fenestration that behaves in a similar manner as a patent foramen ovale, with the risk of mainly neurological complications in cases of paradoxical embolism.

According to different studies, such as that published by Yuichiro Ohya et al. (2022) and by Pedro A Villablanca et al. (2020), having an ASD or patent foramen ovale in adulthood can predispose patients to ischaemic cerebrovascular events.[6,7] In addition, as described in the study by Girotra et al., the costs of medical treatment increase. The U.S. adjusted annual direct costs for each stroke participant in this study were $4317 (95% CI $3828–$4807) higher than those of the control participants, resulting in a net incremental expenditure of $38 billion. Based on the wage gap, number of lost workdays, and mortality rate, the indirect cost of underemployment was $38.1 billion, and that of premature mortality was $30.4 billion.[8] Currently, in our country, a PDA coil with a delivery system costs $1567, which is significantly lower than the referred costs when there is an ischaemic cerebrovascular event.

It is unknown whether these fenestrations can close later progressively or spontaneously; therefore, we consider it important to close the fenestrations once they are detected via intracardiac or transesophageal echocardiography instead of leaving them and increasing the risk of ischaemic vascular events later in life.

Conclusion

These cases show that first-intention treatment of ASDs and small fenestrations without rims away from the primary ASD with other devices, such as the PDA coil, is feasible via the same procedure.

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Competing interests. None.

References

1. King TD, Mills NL. Nonoperative closure of atrial septal defects. Surgery 1974; 75 383–388.
2. Alkashkari W, Albugami S, Hijazi ZM. Current practice in atrial septal defect occlusion in children and adults. Expert Rev Cardiovasc Ther 2020; 18: 315–329. DOI: 10.1080/14779072.2020.1767595.
3. Donti A, Giardini A, Formigari R et al. Transcatheter coil occlusion of residual shunt in a patient with recurrent cryptogenic stroke after PFO

percutaneous closure. Catheter Cardiovasc Interv 2004; 61: 415–417. DOI: 10.1002/ccd.10770.
4. Butera G, Sarabia JF, Saracino A, Chessa M, Piazza L, Carminati M. Residual shunting after percutaneous PFO closure: how to manage and how to close. Catheter Cardiovasc Interv 2013; 82: 950–958. DOI: 10.1002/ccd.25097.
5. Meier B. Coil closure of residual shunt after amplatzer PFO occlusion. Catheter Cardiovasc Interv 2011; 77: 720–721. DOI: 10.1002/ccd.22845.
6. Ohya Y, Matsuo R, Sato N et al. Investigators for Fukuoka stroke registry. Causes of ischemic stroke in young adults versus non-young adults: a multicenter hospital-based observational study. PLoS One 2022; 17: e0268481. DOI: 10.1371/journal.pone.0268481.
7. Villablanca PA, Lemor A, So CY et al. Increased risk of perioperative ischemic stroke in patients who undergo noncardiac surgery with preexisting atrial septal defect or patent foramen ovale. J Cardiothorac Vasc Anesth 2020; 34: 2060–2068. DOI: 10.1053/j.jvca.2020.01.016.
8. Girotra T, Lekoubou A, Bishu KG, Ovbiagele B. A contemporary and comprehensive analysis of the costs of stroke in the United States. J Neurol Sci 2020; 410: 116643. DOI: 10.1016/j.jns.2019.116643.

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