Cardiology in the Young

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The "Peanut Sign" is a useful tool to detect spiral atrial septal defects

Jule Marie Dittmer Hein, Anja Tengler and Nikolaus Haas

Department of Paediatric Cardiology and Paediatric Intensive Care, Ludwig Maximillians University of Munich, Grossharden Clinic, Germany

Case Report

Cite this article: Hein JMD, Tengler A, and Haas N (2026) The "Peanut Sign" is a useful tool to detect spiral atrial septal defects. *Cardiology in the Young* page 1 of 3. doi: 10.1017/S1047951126124603

Received: 7 December 2025 UTC
Revised: 4 June 2026 UTC
Accepted: 27 September 2026 UTC

Keywords:
device embolisation; mal-attachment of septum primum; spiral atrial septal defect; transcatheter closure

Corresponding author:
Jule Marie Dittmer Hein;
Email: jule.dittmerhein@med.uni-muenchen.de

Abstract

Spiral atrial septal defects may complicate transcatheter closure and increase the risk of device embolisation. We describe a 5-year-old boy with pulmonary stenosis and a secundum atrial septal defect in whom an initially implanted 9 mm device embolised. At repeat intervention, balloon sizing revealed a bilobed, peanut-shaped configuration with a double waist, suggestive of a spiral atrial septal defect. A 15 mm device was subsequently implanted, achieving stable closure. The "Peanut Sign" may serve as a useful marker for identifying spiral atrial septal defects and guiding appropriate device selection.

Introduction

Anatomical variations of secundum atrial septal defects substantially influence the success of transcatheter closure. Incomplete fusion of the atrial septum creates a spectrum of interatrial communications, ranging from patent foramen ovale to large, irregularly shaped secundum atrial septal defects.[1] Echocardiographic assessment of septal morphology is therefore critical to optimise device selection and prevent complications.[1]

Vettukattil et al. described an unusual "spiral" atrial septal defect configuration in which the septum primum is widely separated from the septum secundum, resulting in a double-layered atrial septum.[2] This morphology—also referred to as malattachment of the septum primum—is uncommon but clinically important, as it has been associated with device embolisation and technical failure of transcatheter closure.[1,3]

Case presentation

A 5-year-old boy was referred for evaluation of a heart murmur and exertional dyspnoea. Echocardiography revealed moderate valvular pulmonary stenosis (peak gradient 43 mmHg, mean 18 mmHg) and a secundum atrial septal defect measuring 6–8 mm by transoesophageal echocardiography, with apparently adequate rims.

Cardiac catheterisation was performed under moderate sedation. Pulmonary valvuloplasty was carried out with 16 and 18 mm balloons. Subsequent balloon sizing of the atrial septal defect yielded a stretched diameter of 8 mm. A 9 mm Occlutech® Figulla Flex II occluder was implanted. Transoesophageal echocardiography confirmed correct device alignment without residual shunt, and the wiggle manoeuvre indicated stable positioning (see Figure 1) .

On the first post-procedural day, routine transthoracic echocardiography revealed embolisation of the occluder into the aortic arch. The patient remained haemodynamically stable without neurological or respiratory compromise. Urgent percutaneous retrieval and re-closure were planned.

Through an arterial sheath, a pigtail catheter was advanced into the transverse arch to stabilise the embolised device. The sheath was upsized to a 10 F long sheath, and a snare successfully captured the proximal hub of the occluder. The device was withdrawn into the sheath and removed without complication. Ascending aortography confirmed the absence of vascular injury, dissection, or stenosis, and no femoral artery complications were observed.

The atrial septal defect was re-crossed, and balloon sizing was repeated using a 20 mm balloon. The balloon assumed a characteristic bilobed contour with two distinct waists measuring 14 and 15 mm, producing a "Peanut Sign" appearance (see Figure 2). This was interpreted as diagnostic of a spiral atrial septal defect. In retrospect, the same configuration had been visible, though overlooked, during the initial sizing. TEE corroborated the presence of overlapping septal structures. Guided by this finding, a 15 mm Occlutech® Figulla Flex II occluder was deployed under TEE guidance. Both septum primum and septum secundum were securely captured between the device discs, with no residual shunt (see Figure 2). The patient's subsequent course was uneventful. He was discharged the following day, and follow-up at 6 months confirmed a stable device position without erosion, residual shunt, or embolisation.

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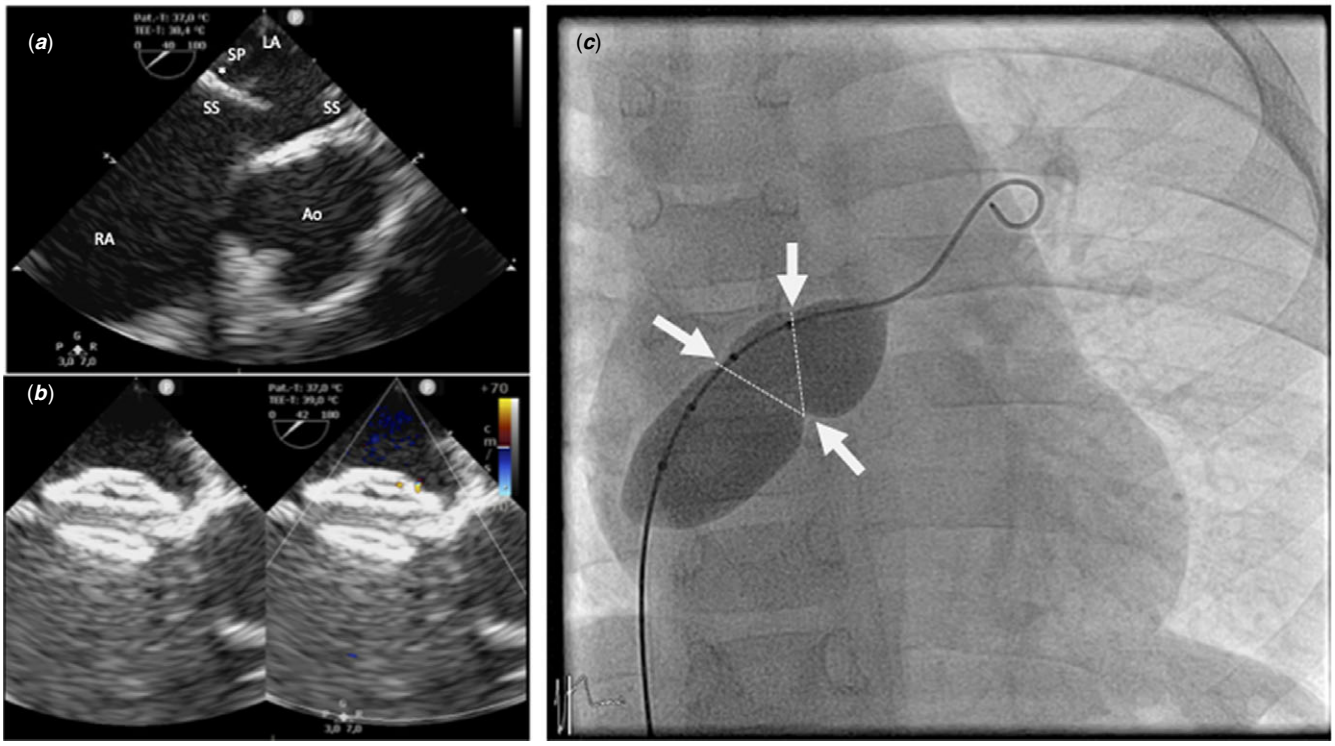


Figure 1. First attempt of transcatheter occluder implantation in a spiral atrial septal defect (ASD) with consecutive device embolisation. (***a***) Mid-oesophageal transesophageal echocardiography (TEE) view demonstrating a secundum ASD measuring approximately 8 mm. The anteroinferior septum primum (SP) is displaced posteriorly and leftward relative to the septum secundum (SS), creating a characteristic spiral ASDmorphology with an interatrial space (*). (***b***) Mid-oesophageal TEE view after initial device deployment. A 9 mm Figulla Flex II ASD occluder is well seated across the defect without residual shunt; both discs are firmly opposed to the septal rims, confirming satisfactory placement. (***c***) Fluoroscopic frame from the first balloon sizing attempt. In retrospect, the sizing balloon (stretched diameter ~8–10 mm) shows a subtle bilobed contour, suggesting compression by two septal structures, consistent with a spiral ASD.

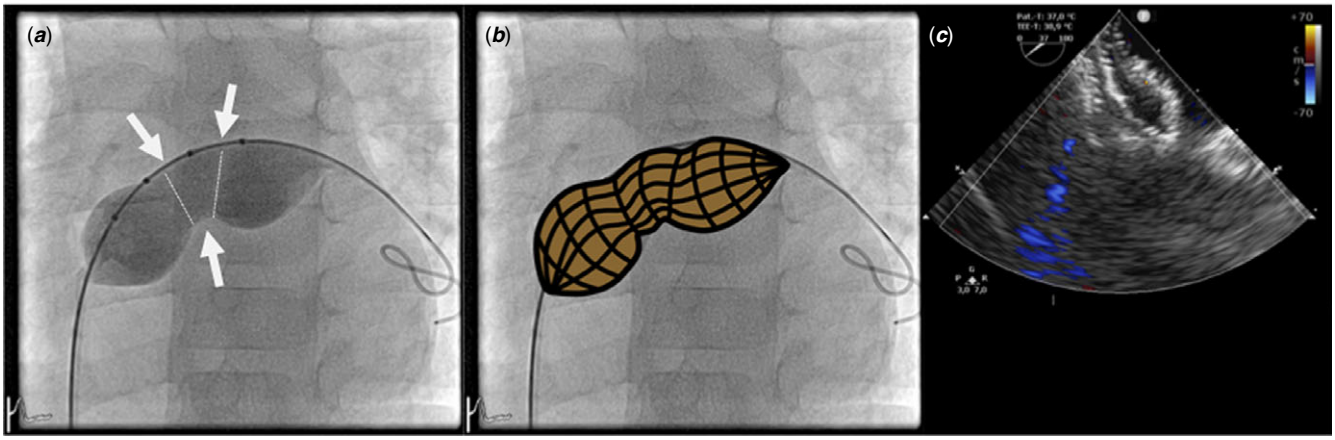


Figure 2. Final transcatheter occluder implantation in a spiral atrial septal defect (ASD) with stable device positioning. (***a–b***) Fluoroscopic frame from the second balloon sizing. The 20 mm balloon is clearly pinched into two distinct waists (14 and 15 mm), confirming compression by separate septal structures. Recognition of this characteristic bilobed balloon contour or "Peanut Sign" should prompt suspicion of a spiral ASD and consideration of a larger occluder to capture both septal components. (***c***) Mid-oesophageal two-dimensional transesophageal echocardiography (TEE) after deployment of the 15 mm occluder. The device fully encompasses both septum primum and septum secundum, with no residual shunt on colour Doppler and no interference with adjacent structures.

Discussion

This case highlights the importance of recognising complex septal anatomy during transcatheter atrial septal defect closure. The key finding was the deformation of the sizing balloon into a bilobed configuration with two consecutive waists, consistent with compression between two distinct septal planes. We propose that this angiographic morphology—the "Peanut Sign"—is pathognomonic of a spiral atrial septal defect.

The spiral atrial septal defect, first described in detail by Roberson et al.,[1] results from a wide separation of the septum primum and septum secundum.

These defects are prone to device embolisation if the occluder does not encompass both septal layers.[3,4] In our patient,

https://doi.org/10.1017/S1047951126124603 Published online by Cambridge University Press

undersizing with a 9 mm device failed to trap the mal-attached septum primum, resulting in embolisation. Subsequent recognition of the "Peanut Sign" during balloon sizing prompted appropriate upsizing, leading to durable closure.

Previous reports support this strategy. Alobaidan et al. described a similar case in which an initially unstable device required replacement with a larger occluder to achieve secure anchoring of both septal components.[4] Ostermayer et al. demonstrated that deficient rims in spiral atrial septal defects independently predict closure failure.[3] Our experience is consistent with these observations and suggests that careful attention to balloon morphology may improve pre-implantation recognition of spiral atrial septal defects.

Although balloon sizing is primarily used to determine stretched defect diameter, our findings suggest it may also reveal valuable anatomical information. A bilobed balloon with a pair of adjacent waists should alert the operator to the possibility of a spiral atrial septal defect, prompting confirmation with echocardiography and consideration of an oversized occluder. This approach aligns with the principle that both septal components must be securely captured to avoid embolisation.[4]

Finally, this case also illustrates the safe management of device embolisation. Percutaneous retrieval with a large sheath and snare was effective and uncomplicated, allowing re-closure in the same session. The safety and efficacy of transcatheter atrial septal defect closure with occluder devices have been confirmed in large cohorts. In the IRFACODE registry, Occlutech® occluders achieved successful closure in more than 1,300 patients with excellent outcomes and low complication rates, and balloon sizing was shown to significantly reduce the risk of embolisation.[5] Our case further demonstrates that even in complex anatomy such as a spiral atrial septal defect, reliable closure can be achieved when careful sizing guides device selection.

Conclusion

We report a paediatric case of spiral atrial septal defect in which the characteristic bilobed deformation of the sizing balloon with two consecutive waists—the "Peanut Sign"—proved to be a key diagnostic indicator. Recognition of this sign enabled correct anatomical interpretation, leading to the choice of a larger occluder, and facilitated successful percutaneous closure after an initial complication.

Clinicians performing atrial septal defect interventions should be aware that unusual balloon morphologies may signal complex septal anatomy such as spiral atrial septal defect. Recognition of the "Peanut Sign," combined with thorough echocardiographic assessment, can guide appropriate device selection, prevent embolisation, and ensure durable closure.

Acknowledgements. None.

Financial support. This research received no specific grant from any funding agency, commercial, or not-for-profit sectors.

Competing interests. Nikolaus Haas is working as a scientific consultant for Occlutech®. The other authors have no conflict of interest relevant to this article to declare.

Ethical standard. The patient's guardians provided informed consent for the publication of this case report.

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