Webbed left atrial septal pouch mimicking septal abnormality on imaging: a case report

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- Three video clips showing the webbed left atrial septal pouch and contrast flow are available at www.hkmj.org.

VIDEO CLIPS at <www.hkmj.org>: (1) Transoesophageal echocardiography dynamically displays the webbed left atrial septal pouch. (2) Three dimensional-transoesophageal echocardiography showing the webbed left atrial septal pouch more stereoscopically and intuitively. (3) Right echocardiography showing no contrast medium in the left atrium in multiple cardiac cycles.

Case presentation

A 65-year-old male presented to Xinqiao Hospital Army Medical University on 29 November 2023 with a 6-month history of frequent palpitations, fatigue, and reduced exercise tolerance. His heart rate was 114 bpm and blood pressure was 138/87 mm Hg. Auscultation revealed irregular heart sounds and laboratory tests showed an elevated brain natriuretic peptide level (1411.25 pg/mL). An electrocardiogram revealed atrial fibrillation with intraventricular differential conduction (Fig 1a). Transthoracic echocardiography demonstrated enlargement of the left atrium and left ventricle, along with mild mitral and tricuspid valve regurgitation, and slight thickening of the atrial septum (Fig 1b). The patient was diagnosed with heart failure with persistent atrial fibrillation and was initially scheduled for radiofrequency catheter ablation.

Preoperative transoesophageal echocardiography (TEE) revealed a sandwiched foramen ovale under calm breathing conditions, with the depth of the left atrial surface approximately 7.6 mm and the height of the open end around 0.13 mm, while the right atrial surface remained well closed. During the Valsalva manoeuvre, the opening end of the left atrial surface widened while the right atrial surface remained closed, with no evident shunt observed. Additionally, an irregularly shaped webbed structure with compartmented echoes was identified in the middle of the primary septum (Fig 2a and b, Video 1). These findings were confirmed by three-dimensional TEE (3D-TEE), which measured the pouch to be approximately 19.2 × 10.5 × 24.5 mm^3, oriented towards the mitral ring. The pouch exhibited a cobweb-like appearance, with its largest opening directed towards the roof, measuring approximately 20.7 × 10.5 mm^2. Within the pouch, a small polycystic division was observed. Colour Doppler imaging showed low-velocity blood flow within the septal valve but no flow across the atrial septum into the right atrium (Fig 2c, Video 2). Right heart contrast echocardiography confirmed no contrast images in the left atrium for 30 consecutive cardiac cycles following calm breathing and the Valsalva manoeuvre (Fig 2d, Video 3). Additional diagnostic evaluations with computed tomography angiography (Fig 1c) and cardiac magnetic resonance imaging (CMR) [Fig 1d] revealed a band-like abnormality on the left atrial side of the septum without any abnormal shunt. Following a multidisciplinary team discussion, the patient was diagnosed with a variant atrial septal pouch (ASP). After consulting with the patient, the medical team opted to alter the treatment strategy, discontinuing radiofrequency catheter ablation for atrial fibrillation in favour of conservative management. The patient has been followed up for over 1 year and remains in a stable condition with conservative treatment.

Discussion

An atrial septal anatomical variant known as the ASP was first described by Krishnan and Salazar in 2010.[1] It is a pouch-like structure resulting from the incomplete fusion of the primary and secondary septa, with openings into the left, right, or both atria. This patient presented with a left ASP with an accompanying web-like structure that did not involve the secondary septum, as evidenced by the absence of microbubbles during right-heart contrast echocardiography. We hypothesise that this web-like formation may represent a developmental variation of the primary septum, independent of the fusion between the primary and secondary septa. Nonetheless, this remains speculative due to limited research on web-like ASP, and we propose referring to it as a 'webbed left ASP'.

Left ASP is recognised as a potential risk factor for cardioembolic stroke and blue toe syndrome.[2] The pouch's structure can promote blood stasis, facilitating in situ microthrombus formation and increasing the risk of embolic events.[3] In this case, the additional presence of a web-like septal structure may further exacerbate the risk of thrombus formation. A polycystic, web-like septum over the primary septum with multiple floating ends was revealed on the 3D-TEE. The rupture of

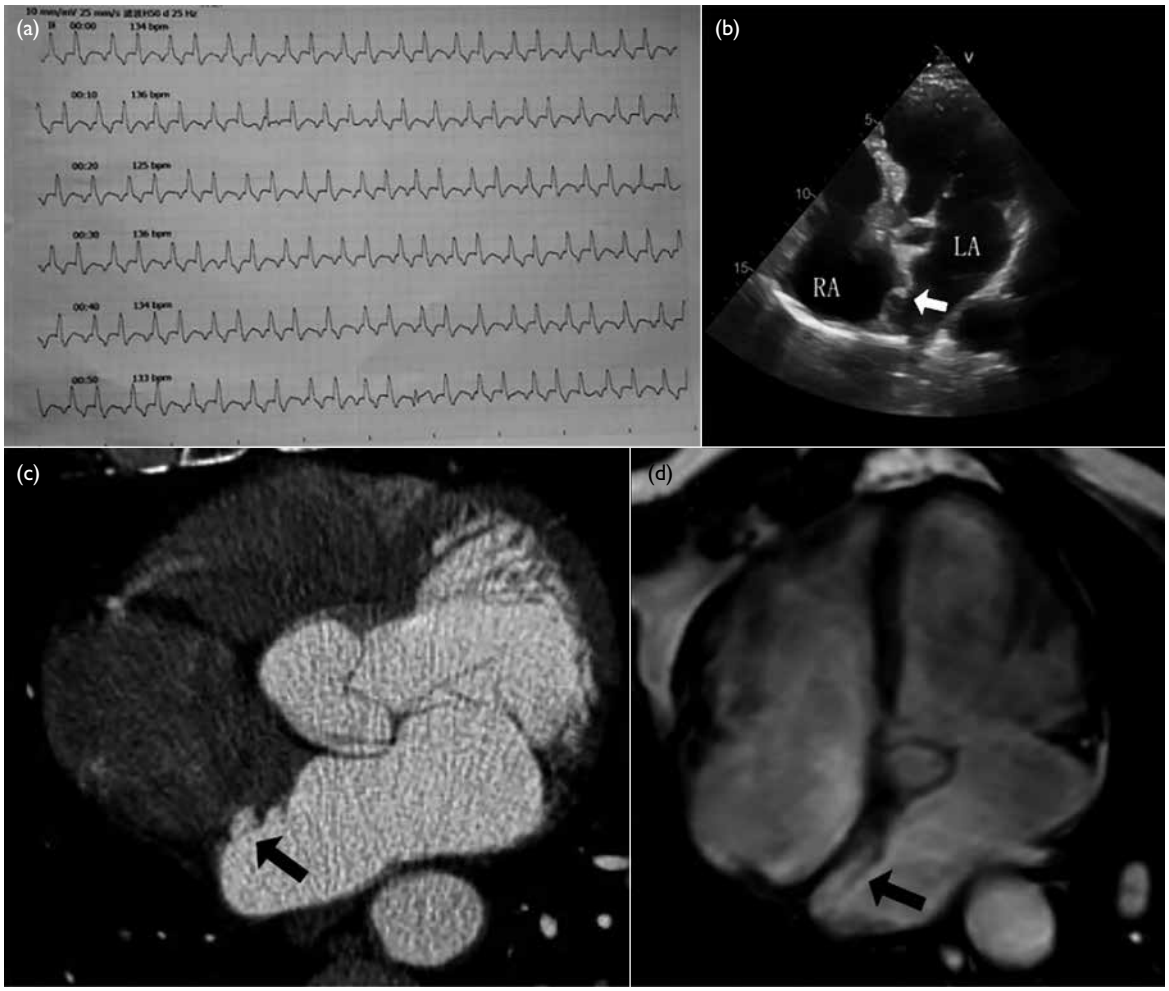

FIG 1. (a) Typical electrocardiogram findings of atrial fibrillation and (b) transthoracic echocardiography showing an enlarged heart and unevenly thickened atrial septum (arrow). (c) Computed tomography angiography and (d) cardiac magnetic resonance imaging suggest abnormal manifestations of an enlarged heart and abnormality in the atrial septum (arrows)
Abbreviations: LA = left atrium; RA = right atrium

these delicate reticular structures could potentially result in a stroke. Furthermore, slow blood flow within the septation contributes to a haemodynamic environment prone to thrombus formation.

The atrial septum may receive high-velocity blood flow from the right pulmonary vein, with the contraction of transverse muscular fibres aiding in clearing the blood and reducing thrombus risk. Nonetheless, in conditions such as atrial fibrillation, heart failure, or mitral stenosis, this protective mechanism may fail.[4] In the present case, atrial fibrillation impaired this mechanism, increasing the risk of thrombus formation. Given the high embolic risk associated with this complex anatomy, the patient opted for conservative treatment to avoid complications related to atrial septal puncture.

Multi-slice spiral computed tomography, CMR, and TEE are primary diagnostic tools for assessing atrial septal structural variations and thrombi.[5] Although multi-slice computed tomography offers high-resolution imaging, it is less effective in patients with irregular heart rhythms, such as atrial fibrillation, due to the potential for image distortion. Detailed 3D morphology can be obtained using CMR, although it has limited resolution for thin structures such as the atrial septum.[6] Transoesophageal echocardiography, particularly 3D-TEE, offers superior spatial resolution and is less affected by cardiac rhythm disturbances.[7] It enables real-time visualisation of septal anatomy, variations, and haemodynamic flow, making it the ideal tool for diagnosing complex structures such as the webbed left ASP.

The web-like left ASP must be differentiated from bronchogenic atrial septal cysts and hydatid cysts.[8] Bronchogenic cysts are benign congenital cystic masses, most commonly located in the mediastinum and lungs, with atrial septal involvement being extremely rare. Ultrasound typically reveals a thin-walled, well-defined anechoic

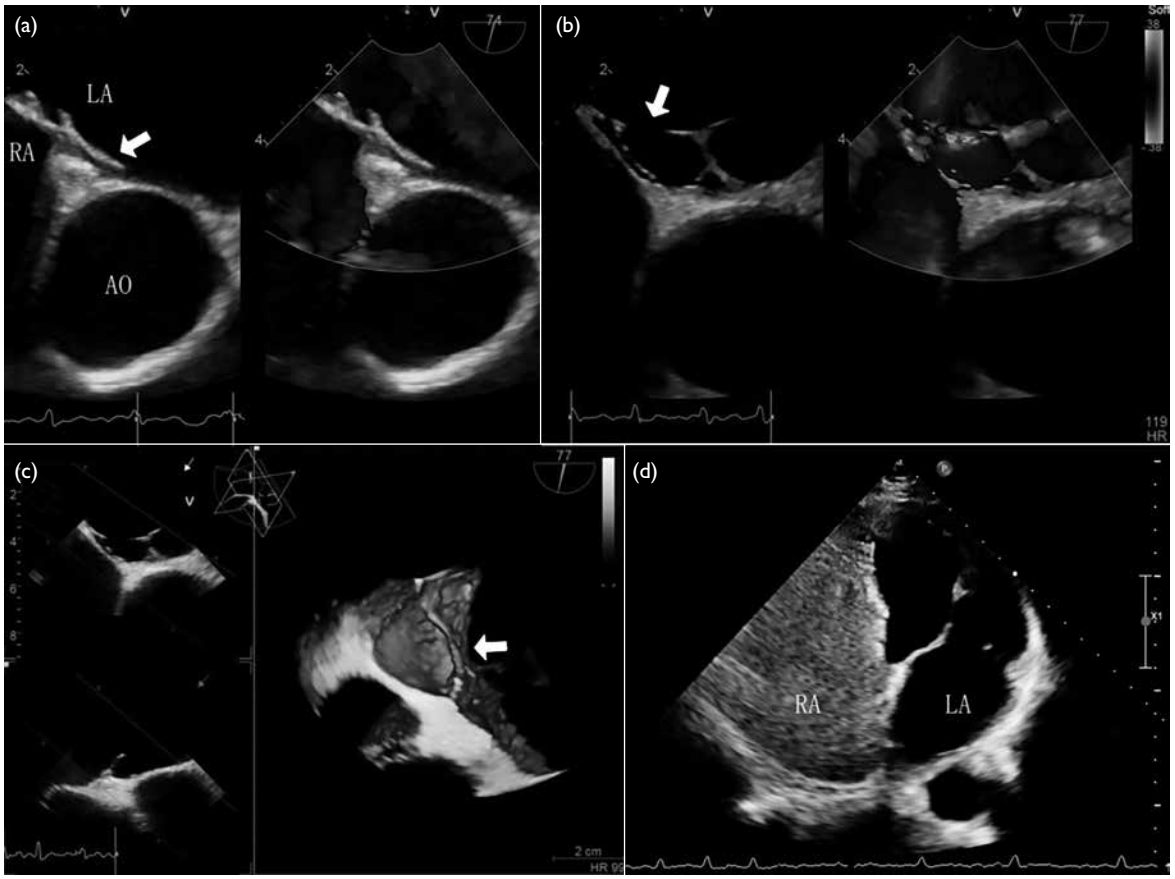

FIG 2. (a) The transoesophageal echocardiography showing a sandwich-like appearance of the foramen ovale during calm breathing (arrow). (b) An irregularly shaped webbed structure with compartmented echoes was identified in the middle of the primary septum (arrow). (c) Three-dimensional transoesophageal echocardiography delineated the webbed structure as sac-like, attached to the primary septum, with a cobweb appearance towards the mitral ring (arrow). (d) Right echocardiography confirmed the absence of contrast in the left atrium
Abbreviations: AO = aorta; LA = left atrium; RA = right atrium

or hypoechoic area, sometimes with internal septations and posterior acoustic enhancement, and no Doppler blood flow signals—features that differ significantly from this case. Hydatid cysts are caused by parasitic infections, usually associated with a history of contact with endemic areas. Their sonographic features and medical history make them relatively easy to identify.

This case highlights a novel variant of the left ASP with a web-like structure. Nonetheless, our understanding of ASP remains limited, and further research and observation are needed. Urgent questions remain regarding risk stratification in ASP, identification of high-risk cases, the need for interventional occlusion or surgical resection, and the optimal treatment approach post-thrombosis. We hope this case enhances understanding of this anatomical variation and informs future research.

Author contributions

Concept or design: G Yang, P He.
Acquisition of data: G Yang, J Yang.
Analysis or interpretation of data: Y Zou, S Xiao, J Yang, N Li.
Drafting of the manuscript: G Yang, P He, Y Zou.
Critical revision of the manuscript for important intellectual content: All authors.

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Ethics approval

The patient was treated in accordance with the Declaration of Helsinki. The patient provided written consent for all

treatments, procedures, and consent for publication, including the publication of the accompanying clinical images.

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