ESC European Society of Cardiology
European Heart Journal - Case Reports (2025) **9**, ytaf014
https://doi.org/10.1093/ehjcr/ytaf014

CASE REPORT
Electrophysiology

'Disappeared balloon': the trap of transseptal puncture for a large closure device of atrial septal defect—a case report

Chao Liu†, Rongbing Peng, Xianxian Zhao, Zhifu Guo, and Manli Yu*

Department of Cardiology, Changhai Hospital, Shanghai 200433, China

Received 27 June 2024; revised 4 October 2024; accepted 13 January 2025; online publish-ahead-of-print 16 January 2025

Background Several studies have demonstrated a notable increase in the incidence of atrial arrhythmias among individuals with atrial septal defect (ASD) occluder. Although the sequential dilation technique has been proposed as the mainstream technique for transseptal puncture with ASD occluder, it is associated with substantial risks and technical difficulties.

Case summary We report a patient who underwent catheter ablation for atrial fibrillation and had a large ASD occluder. A balloon was dislodged into the patient's right superior pulmonary vein (RSPV) during a transseptal puncture and was successfully captured. The most notable feature of this case was the dislodgement of the dilation balloon, which has not been reported previously.

Discussion Repeated and gradual dilation of the pathway with a pressure balloon is unavoidable during the establishment of the left atrial channel. It is not recommended to choose a coronary balloon and Run-through guidewire. Since only the tip of the coronary balloon is connected to the guide wire, it cannot stably guide the balloon through the puncture hole. When using over-the-wire balloon or peripheral vascular balloon, the balloon can stably attach to the guide wire as a whole, which allows movement along the puncture hole. The puncture hole can be safely expanded using a peripheral vascular balloon combined with a loach guidewire in subsequent expansion. In addition, it is important to avoid violent manipulation. After confirming the dislodgement of the balloon, it is imperative to remove it. Relying solely on oral anticoagulation may not sufficiently decrease the risk of thrombosis.

Keywords Atrial septal defect • Occluder • Transseptal puncture • Catheter ablation • Case report

ESC curriculum 5.3 Atrial fibrillation • 7.5 Cardiac surgery • 9.7 Adult congenital heart disease

Learning points

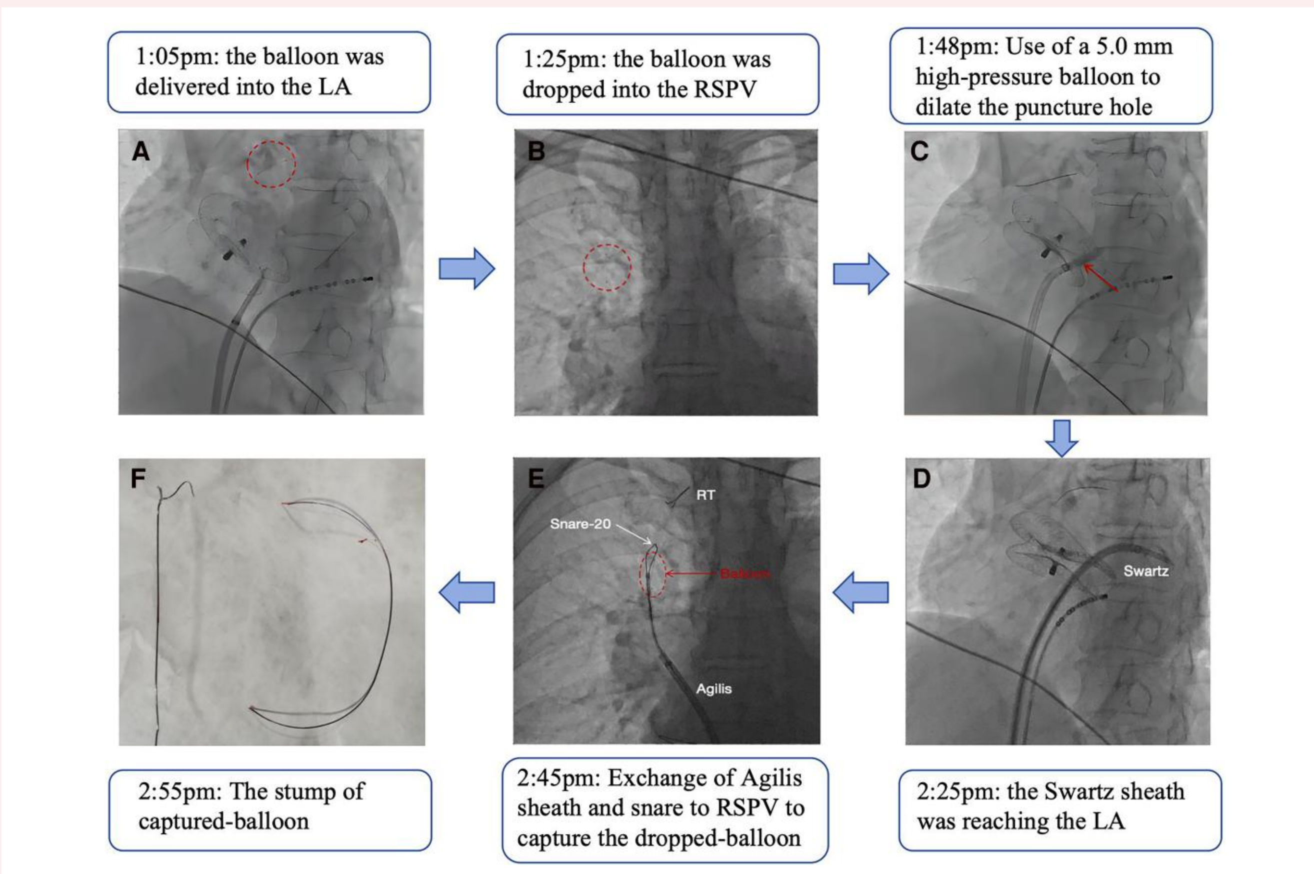
- To report a patient who had a large atrial septal defect (ASD) occluder encountered a situation where a balloon dislodged into the right superior pulmonary vein (RSPV) during a transseptal puncture.
- It is recommended to choose the over-the-wire balloon not the coronary balloon and Run-through guidewire, owing to only the tip of the coronary balloon being connected with the guide wire.
- The use of a deflectable sheath effectively aids in locating the pulmonary vein ostium, facilitating guide snare entry into the branch when capturing the detached balloon.

* Corresponding author. Tel: +861 500 188 6500, Email: yumanli2006@163.com
† The first author
Handling Editor: Felix Wiedmann
Peer-reviewers: Vera Maslova; Bogdan Enache
Compliance Editor: Piera Ricci

Introduction

The percutaneous closure of atrial septal defects (ASD) has emerged as the predominant method for closing ASDs.[1] Previous studies have demonstrated a marked increase in the risk of atrial arrhythmias among individuals with ASD.[2] We report a patient who had a large ASD occluder and encountered a situation. A balloon dislodged into the patient's right superior pulmonary vein (RSPV) during a transseptal puncture. The dislodged balloon was successfully retrieved using a snare, and radiofrequency ablation of atrial fibrillation (AF) was completed.

Summary figure



puncture space on the right atrial surface, necessitating a puncture through the closure device to the left atrium for pulmonary vein isolation (PVI).

A coronary sinus electrode was placed after a bilateral femoral vein puncture. Thereafter, Swartz sheath was delivered and BRK puncture needle was applied to the high right atrium via the right femoral vein to transseptal puncture. Initial attempts to pierce the atrial septum using a Swartz sheath and BRK puncture needle were unsuccessful (*Figure 2A*). The left atrium was finally reached using a guided needle through the BRK puncture needle (*Figure 2B and C*). Repeated and gradual dilation of the pathway using a pressure balloon was unavoidable when establishing the left atrial channel. A 2.0 mm percutaneous transluminal coronary angioplasty (PTCA) balloon slipped to the distal end of the Run-through guidewire and dropped into RSPV when repeatedly dilating the transseptal hole and attempting to advance it forward (*Figure 2D*). Subsequently, we repeatedly attempted to dilate the atrial septal route with high-pressure balloons measuring 3.0 mm, 4.0 mm, and 5.0 mm (*Figure 2E*). Finally, the transseptal hole was fully enlarged, and the Swartz sheath successfully reached the LA to establish access (*Figure 2F*).

Case presentation

A 63-year-old woman complained of 'intermittent palpitations for 4 years, worsening for 5 months'. The 24-h Holter exhibited persistent atrial fibrillation, and she was referred to the Cardiology Department for catheter ablation. She had a history of hypertension and a large atrial septal defect occluder. The patient also had a CHA2DS2-VASc score of 2. Physical examination revealed irregular heart rhythm. The patient had a left ventricular ejection fraction (LVEF) of 67% and a left atrial anterior–posterior diameter of 40 mm, and transesophageal echocardiography exhibited no thrombus. The closure device filled the whole atrial septal surface on left atrial computed tomography (CT) angiography (*Figure 1*). In this case with a giant ASD closure, there was no

The flexible sheath (Agilis, Abbott) was used to obtain access to the orifice of the RSPV (*Figure 3A*). A Run-through guidewire was then carefully positioned near the dislodged balloon. Fluoroscopy was used to confirm its position from multiple angles. An angiography catheter was inserted through the Agilis sheath, and a snare device was used to retrieve the dislodged balloon (*Figure 3B*). Initially, the

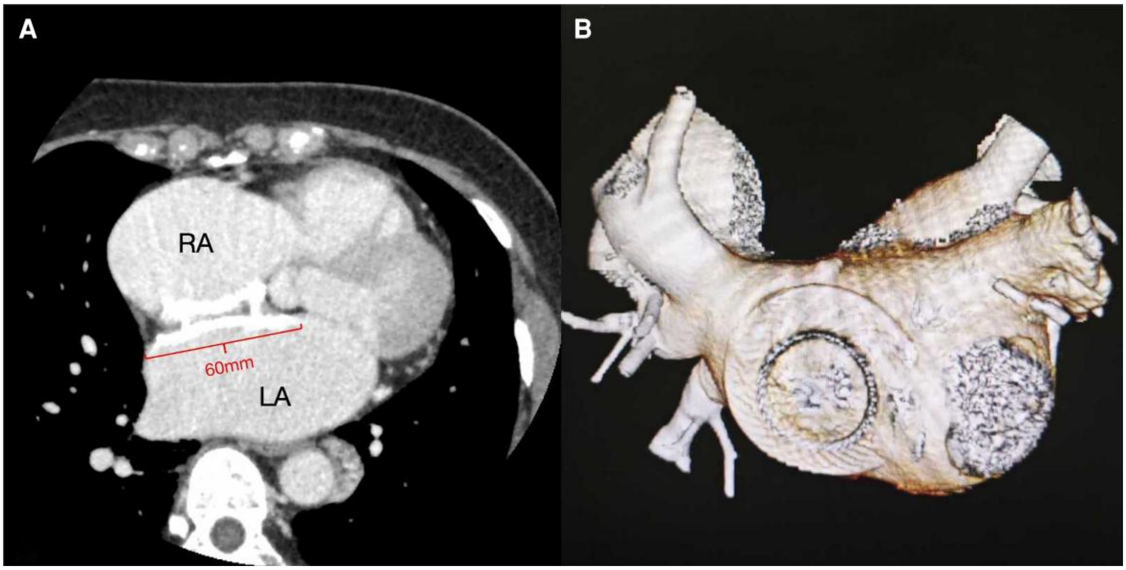


Figure 1 CT angiography of the LA. (*A*) Cross-sectional view showing the ASD occluder reaching the edge of the atrial septum; (*B*) Reconstruction model of the left atrium showing that the closure device occupied the entire atrial septum surface. ASD, atrial septal defect; RA, right atrium; LA, left atrium.

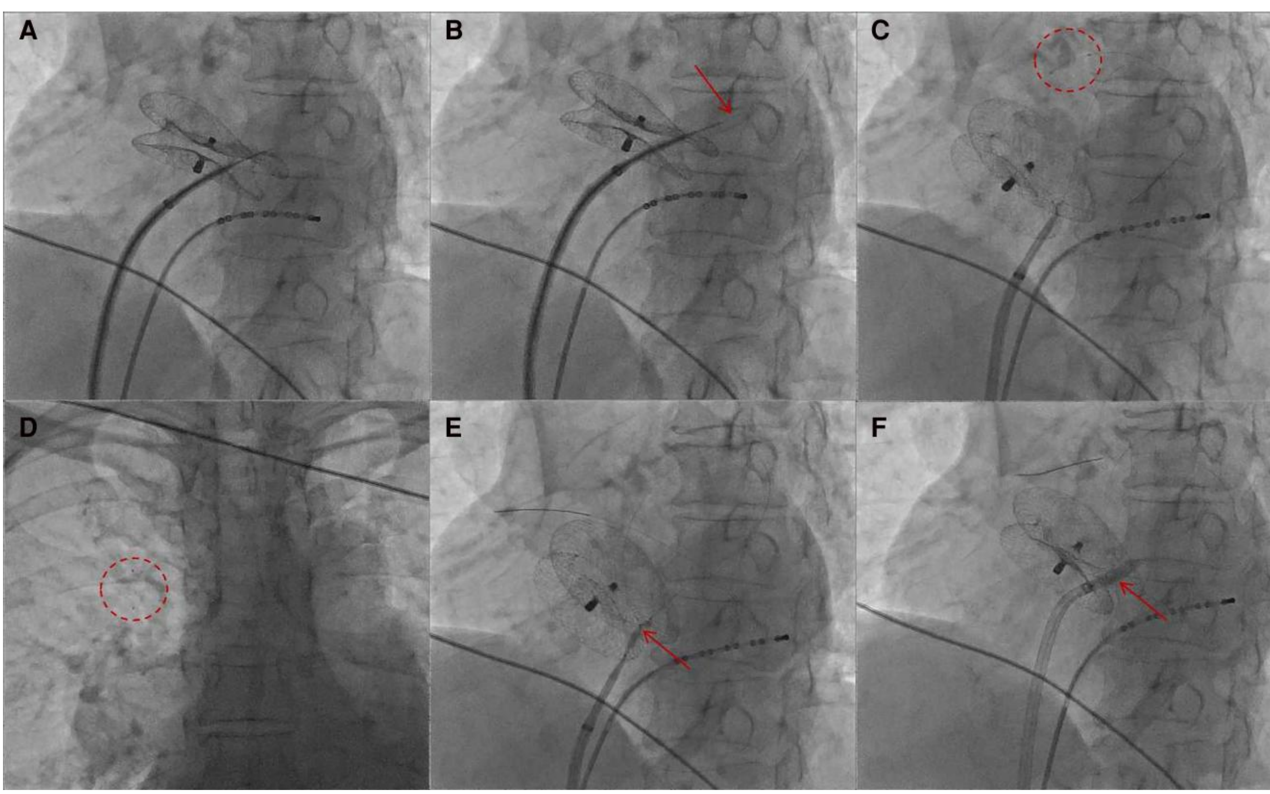


Figure 2 Transseptal puncture. (*A*) BRK puncture needle abutting against the closure device; (*B*) BRK puncture needle passing through the outer closure device; (*C*) passage of the Run-through guidewire into the left atrium through the balloon; (*D*) balloon dislodgement; (*E*) use of a 4.0 mm high-pressure balloon to dilate the puncture hole, showing the 'waist' compression phenomenon; (*F*) use of a 5.0 mm high-pressure balloon to dilate the puncture hole, assisting the outer sheath passage.

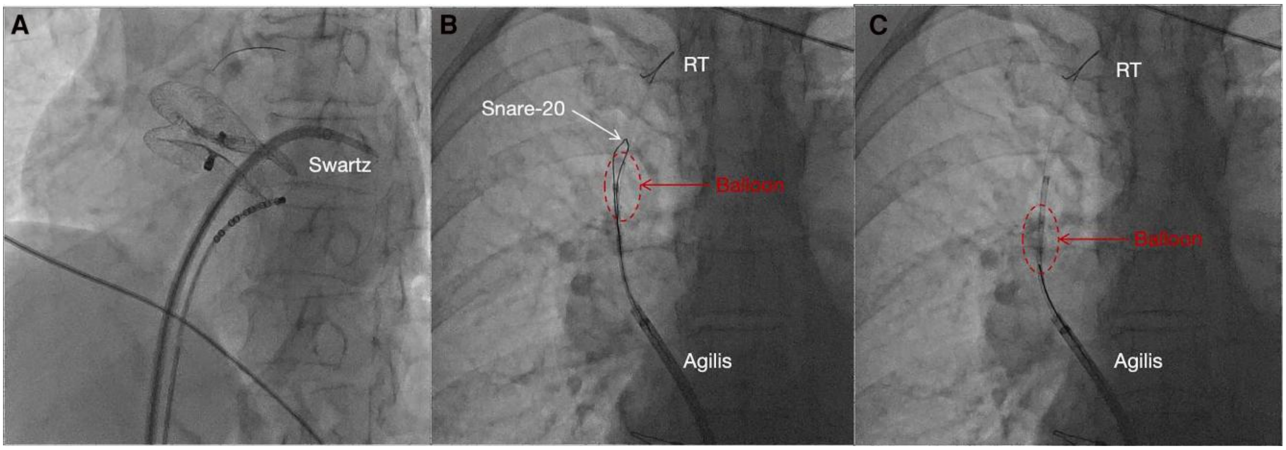


Figure 3 Capturing the balloon. (*A*) Swartz sheath reaching the LA; (*B*) exchange of Agilis sheath reaching the RSPV ostium, and insertion of a snare; (*C*) successful capture of the balloon; RSPV, right superior pulmonary vein; RT, Run-through guidewire.

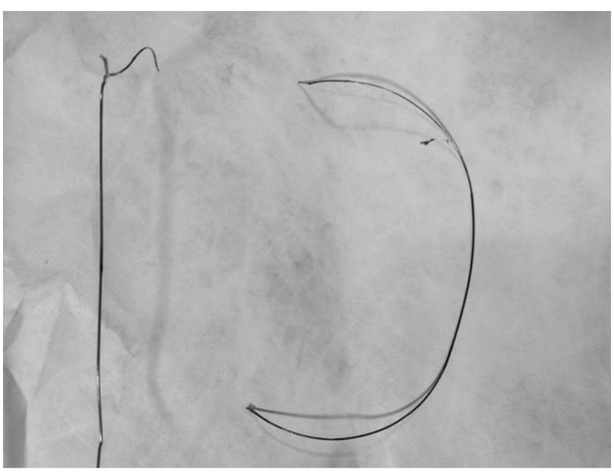


Figure 4 The captured-balloon and its stump.

snare was ineffective in capturing the balloon at the far end. After multiple efforts, it successfully captured the balloon at the near end (*Figure 3C*).

The balloon stump was removed from the heart (*Figure 4*). Given the difficulty of transseptal puncture, radiofrequency ablation was done as the first consideration for PVI. Thereafter, a single transseptal approach was utilized to conduct catheter ablation using a pressure-contacted ablation catheter (TCSE, Abbott) for the left atrial roof line and PVI (*Figure 5*), with a temperature of 43°C, power settings of 30–35 W, saline perfusion at 17 mL/min, and contact pressure of nearly 5–20 grams. Atrial flutter was persistently induced after conversion to sinus rhythm, and electroanatomical mapping suggested tachycardia associated with ASD occluder. Subsequently, focal ablation was conducted on the LA septal regions associated with closure device-induced atrial flutter. Focal ablation successfully restored normal heart rhythm (*Figure 5*). Throughout the 6-month follow-up period, the patient maintained a normal heart rhythm without abnormal communication between the atria.

Discussion

Percutaneous closure devices have emerged as the primary method for treating ASDs.[1] Previous studies have indicated a notable increase in the risk of atrial arrhythmias in individuals with ASD who are older than 40. The prevalence of this condition is estimated to be 15–20% in those who have previously undergone ASD closure.[2] This increased risk can be attributed to the prolonged enlargement of the atria, heightened volume stress, and anatomical obstructions due to closure devices.[3] Although catheter ablation is commonly used to treat atrial fibrillation, patients who have undergone ASD closure suffer from increased risks and technical difficulties when undergoing transseptal puncture. These challenges include the potential displacement or dislodgement of the device, blood clot formation, and the incidence of cardiac tamponade.[4]

The most notable feature of this case was the incidence of a rare complication, the dislodgement of the dilation balloon, which has not been reported previously. Although[5,6] the sequential dilation technique has been proposed as the mainstream technique for transseptal puncture atrial septal closure devices, the choice of dilation balloon is particularly important. In cases similar to our case, it is not recommended to choose a coronary balloon and Run-through guidewire because only the tip of the coronary balloon is connected to the guide wire, which cannot stably guide the balloon through the puncture hole. When the balloon passes through the puncture hole, sharp metallic edges may hook or cut the balloon, leading to its detachment from the guidewire. During guide wire manipulation, the balloon moved in the opposite direction and slipped into the RSPV in our patient. This was the most likely cause of the rare complication we reported. The balloon can stably attach to the guide wire as a whole when over-the-wire or peripheral vascular balloon is used, thereby allowing balloon movement along the puncture hole. The puncture hole can be safely expanded using a peripheral vascular balloon combined with a loach guidewire in subsequent expansion. In addition, it is important to avoid violent manipulation.

We effectively created the left atrial channel. A deflectable sheath was used to reach the right upper pulmonary vein and successfully localize the dislodged balloon. A snare was subsequently employed to effectively ensnare and recover the dislodged balloon. It is

Figure 5 The three-dimensional (3D) model of the LA showed circular PVI combined with roof line ablation, and ablation of the LA septal surface terminated atrial flutter.

important to highlight three key points when retrieving the balloon: (i) The use of a deflectable sheath effectively aids in localizing the pulmonary vein ostium, facilitating guide wire entry into the branch. (ii) Verification of the length of the dislodged balloon by comparing it with the distal end of a similar balloon. (iii) If multiple attempts to capture the snare near its origin remain unsuccessful, trying to retrieve it from a distant and reversed location may yield positive results. After confirming the dislodgement of the balloon, it is imperative to remove it. In this patient, the displaced balloon had a considerable length, and oral anticoagulants alone might not sufficiently decrease the risk of thrombosis.

This study had some limitations. Intracardiac echocardiography (ICE) was not used to guide the transseptal puncture, a technique that can improve the safety and accuracy of the puncture. In fact, we did not use ICE for this patient, mainly because the CT angiography showed that the huge occluder occupied the entire septum, and the perspective provided by ICE might be limited. In addition, the patient could not afford the expenditure of ICE and refused. If possible, ICE should be recommended to guide transseptal puncture for patients whose septum are not fully occupied by ASD occluder to reduce the potential risk of complications.

Furthermore, persistent ASD is a significant complication after transseptal puncture.[7] However, in subsequent examinations, this patient did not experience a shunt, most likely because of the elastic recoil of the closure device's memory alloy material and re-endothelialization.

Conclusion

There are risks and challenges in transseptal puncture with a large ASD occluder. Coronary dilated balloon should not be initially considered for sequential dilation of the puncture hole. In such cases, the peripheral vascular balloon should be selected. After confirming the dislodgement of the balloon, it is imperative to make every attempt to remove it. A deflectable sheath can help effectively facilitate guiding snare when capturing the detached balloon.

Lead author biography

Liu Chao, M.D., the First Affiliated Hospital of Naval Medical University (Shanghai Changhai Hospital). Member of Cardiac Electrophysiology Group of Shanghai Heart Rhythm Society. Graduated from the Naval Military Medical University, he is currently one of the surgeons in the electrophysiology team of Changhai Hospital. He has published six SCI papers, five Chinese core journals, and two authorized utility model patents. His research results have been collected and displayed on

the wall of the Oriental Congress of Cardiology and Qianjiang Congress of Cardiology

Supplementary material

Supplementary material is available at *European Heart Journal—Case Reports* online.

Consent

The authors confirm that written informed consent for the submission and publication of this case report has been obtained following the COPE guidelines.

Conflict of interest: The authors declare no competing interest.

Funding: This work was supported by the National Natural Science Foundation of China (grant number 81970278) and Special Project of Basic Medicine of the First Affiliated Hospital of Naval Medical University (grant no. 2023PY33).

Data availability: The data used for this article are available in the article and in its online supplementary material.

References

1. Mehreen F, John S, Rami D, David JB, Oliver S, Timothy JJ, et al. Trends in surgical and catheter interventions for isolated congenital shunt lesions in the UK and Ireland. *Heart* 2019;**105**:1103–1108.
2. Reinder E, Manon R, Charlotte H, Tim TC, Anthonie LD, Rypko B, et al. Atrial fibrillation in patients with an atrial septal defect in a single centre cohort during a long clinical follow-up: its association with closure and outcome of therapy. *Open Heart* 2020;**7**: e001298.
3. Shingo K, Juliane V, Steffen G, Francesco M, Bernhard M, Fabian N. Left atrial appendage closure for "primary primary" prevention during percutaneous closure of septal defects in patients with large atria but no atrial fibrillation. *Cardiol J* 2018;**25**:179–187.
4. Giulio R, Maurizio T, Francesco M. Transseptal puncture: procedural guidance, challenging situations and management of complications. *EuroIntervention* 2021;**17**:720–727.
5. Guo Q, Sang C, Bai R, Lai Y, Long D, Li S, et al. Transseptal puncture in patients with septal occluder devices during catheter ablation of atrial fibrillation. *EuroIntervention* 2022;**17**: 1112–1119.
6. Sang C, Dong J, Long D, Yu R, Bai R, Salim M, et al. Transseptal puncture and catheter ablation of atrial fibrillation in patients with atrial septal occluder: initial experience of a single centre. *Europace* 2018;**20**:1468–1474.
7. Linhart M, Werner J, Stöckigt F, Kohlmann A, Lodde P, Linneborn L, et al. High rate of persistent iatrogenic atrial septal defect after single transseptal puncture for cryoballoon pulmonary vein isolation. *J Interv Card Electrophysiol* 2018;**52**:141–148.