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CASE REPORT

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Case report of the successful treatment of a rare complication of pulmonary vein stenting: atrial rupture and stent detachment

Yu wei[1†], Qin wei[1†], Zhu ziyang[1] and Li fajiu[1*]

Abstract

Pulmonary vein stenosis (PVS) is a relatively rare pulmonary vascular disease in clinical practice, and radiofrequency ablation (RFA) is a common cause of pulmonary vein stenosis. Owing to its nonspecific symptoms and irregular follow-up, PVS is often misdiagnosed. In severe cases, intervention is needed, with the main treatment options being pulmonary vein stenting and/or balloon dilation, both of which carry risks of serious complications. We report a patient with severe pulmonary vein stenosis who experienced right atrial wall rupture and stent detachment during an interventional procedure. Through active intraoperative intervention, we successfully avoided serious complications.

Keywords Pulmonary vein stenosis, Atrial septal puncture, Right atrial rupture, Stent detachment

Introduction

Pulmonary vein stenting is considered the most effective intervention for treating PVS, but the potential complications of this procedure must not be disregarded. This article reports a case of an elderly patient who experienced severe complications during pulmonary vein stenting. We successfully treated the rupture of the right atrial wall using a ventricular septal occluder and transferred the detached stent to the outside left atrium by establishing a track.

Case presentation

A 61-year-old male patient was transferred to our hospital for haemoptysis. One week prior, he visited a local hospital due to intermittent haemoptysis that lasted for more than four months. Computed tomography angiography (CTA) revealed occlusion of the left pulmonary vein (Fig. 1A). The patient had a coronary stent implantation and cardiac pacemaker insertion 4 years ago and underwent RFA for atrial flutter six months ago. On the third day of admission, the patient underwent pulmonary vein stent implantation therapy. The procedure was performed under local analgesia guided, Via the right femoral vein approach, a 0.035-260 cm stiff wire (Terumo, Japan) was used to introduce a SWARTZ (Braided 8.5F Transseptal Guiding Introducer, Abbott, USA). The front end of the SWARTZ was left in the superior vena cava. The direction of the SWARTZ sheath and dilator was rotated to point towards the 4–5 o'clock position, and then it was slowly retracted downward. When the "bounce sign" appeared with the dilator, indicating that the dilator was in the area of the foramen ovale, the atrial septal puncture needle was then pushed through the septum at a left anterior oblique 45°position. Due to excessive force applied while advancing the SWARTZ sheath, the puncture needle and dilator entered the pulmonary artery and the pericardial cavity, respectively (Fig. 1B, C,

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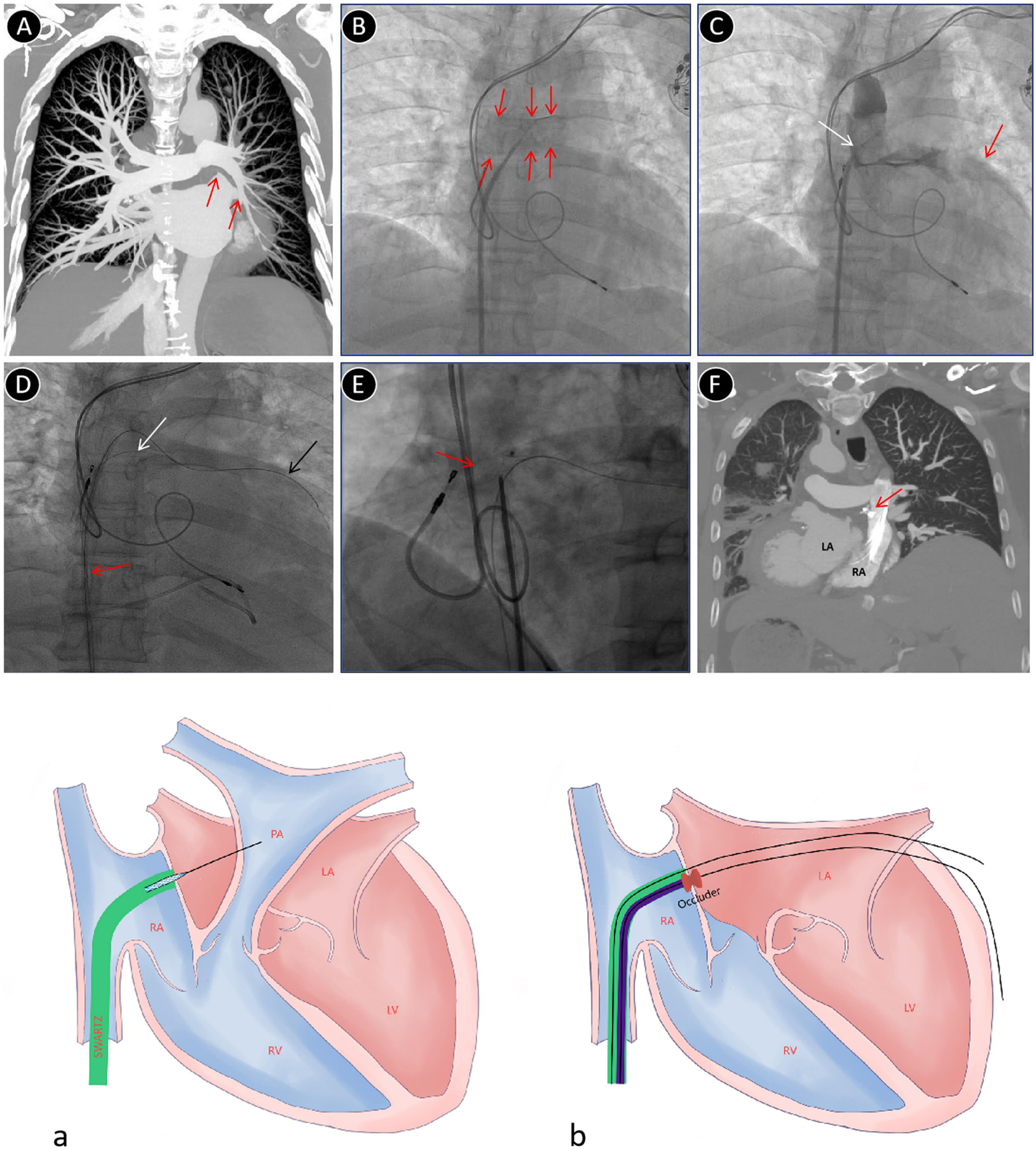

Fig. 1 **A** Left pulmonary vein occlusion (red arrow). **B** Main pulmonary artery outline development (red arrow). **C** The SWARTZ outer sheath penetrates the left atrial wall (white arrow), and the contrast agent remains in the pericardium (red arrow). **D** The 0.035–260 cm guide wire exchange and introduction of the occluder interventional delivery device (black arrow); the 0.018–300 cm guide wire remains on the outside (white arrow). **E** Release of the shape memory ventricular septal occluder (red arrow). **F** Postoperative review via CTA revealed that the shape of the memory ventricular septal occluder was in a good position (red arrow). **a** Schematic diagram of the interatrial septum puncture needle entering the pulmonary artery. **b** Schematic diagram of the interventricular septal occluder used for atrial septal defect occlusion

a). The patient presented with pericardial effusion and chest tightness symptoms at this time. We immediately performed a pericardiocentesis on the patient, draining approximately 200 ml of bloody pericardial fluid, while maintaining the dilator within the pericardial cavity throughout the process.Then the atrial septal puncture needle was withdrawn, and a pulmonary artery angiography was performed via the left femoral vein approach to confirm that the pulmonary artery was intact and not ruptured. Finally, to address the atrial wall rupture, we introduced a 0.035-260 cm stiff guide wire along the dilator and advanced it to the far end of the pericardial cavity. We secured the stiff guide wire, withdrew the dilator, and simultaneously pushed the SWARTZ sheath forward to seal off the atrial wall rupture. We then introduced a ventricular septal occluder delivery system (SHSMA, China) along the stiff guide wire, leaving a 0.018-300 cm wire (Terumo, Japan) outside the delivery system, with its distal end also placed in the pericardial cavity to prevent loss of the atrial wall rupture site in case of occluder release failure (Fig. 1D,b). Subsequently, a shape-memory ventricular septal occluder (SQFDQ-II i06, SHSMA, CHINA) was successfully deployed to seal the right atrial wall rupture (Fig. 1E). A follow-up chest CTA was performed on the first day after the interventional procedure, showing the atrial wall rupture located at the upper edge of the interatrial septum, with the ventricular septal occluder well positioned (Fig. 1F).

The second interventional surgery was performed on the 5th day of hospital admission. The atrial septal puncture was successful, and selective angiography revealed severe stenosis at the proximal ends of the left upper and left lower pulmonary veins. We used a balloon dilation catheter to dilate the stenotic areas and then deployed the stents (Abbott Vascular, Omnilink Elite). The deployment of the left upper pulmonary vein stent (10*19 mm) went smoothly. However, during the deployment of the left lower pulmonary vein stent (10*19 mm), it detached and migrated to the left atrium (Fig. 2A). At this point, we opted to deploy a smaller stent (9*19 mm) (Fig. 2B, c). To retrieve the dislodged stent from the atrium, We put 0.035-260 cm stiffened wire through the detached stent and the heart along the left atrial—left ventricular—aorta direction. A retrieval device was introduced through the femoral artery to establish a track by capturing the reinforced guide wire (Fig. 2C). We introduced a JR4.0 catheter (Cordis, USA) at both ends along the stiffened wire, secured the stiffened wire at the femoral artery end with a hemostat, and then used the JR4.0 catheter from the femoral vein side to push the detached stent(Fig. 2D, E, d). It was successfully advanced along the established track to the common iliac artery (Fig. 2F). Postoperative transthoracic echocardiography showed no abnormalities in the heart valves, and the patient was discharged on the 7th day (Table 1).

Discussion

RFA is the most common cause of pulmonary vein stenosis, with an overall incidence rate ranging from 1 to 3% [1]. Owing to the lack of specific manifestations, the disease may be misdiagnosed. The current main treatment methods are pulmonary vein stenting for pulmonary vein stenosis and/or balloon dilation [2]. These treatment methods are associated with potential complications such as balloon rupture, pulmonary oedema, pericardial tamponade, haemoptysis, stent thrombosis, stroke, and stent embolization [3]. Timely detection and effective management of complications are essential to prevent serious consequences. We report a case in which, during the first surgery, it was found that the dilator had penetrated the right atrial wall. Given that the size of the right atrial rupture was comparable to the outer diameter of the dilator, withdrawing the dilator from the pericardium would have led to delayed cardiac tamponade and pericardial effusion [4]. Therefore, we first performed pericardiocentesis to relieve the cardiac compression and then proceeded to address the atrial rupture. Since the thickness of the damaged atrial wall could not be determined, we chose a ventricular septal occluder with a longer waist to close the breach in the right atrium. During the second surgery, the stent dislodged from the pulmonary vein. Keeping the dislodged stent telescoped onto the guide wire is crucial for determining whether the stent can be removed from the heart [5]. We exchanged a reinforced guide wire through the dislodged stent, established a track through the femoral artery and femoral vein, and then successfully pushed the stent out of the heart using a JR4.0 catheter introduced from the femoral vein, leaving it in the iliac artery. However, this method may cause damage to the heart valves. There have been reports of capturing dislodged stents from the left atrium and removing them from the body by cutting the femoral vein [6], but this method requires dilation of the interatrial septum and an incision in the femoral vein, which is more invasive than our approach is.

In summary, complications from interventional treatment of pulmonary vein stenosis are often urgent, and timely detection and intervention are crucial for patient survival.

Statement of clinical significance

During the process of pulmonary vein stenting, atrial wall rupture and stent detachment may occur. Although such situations are not common, they are urgent and dangerous. This article introduces a successful treatment method different from the past for these complications,

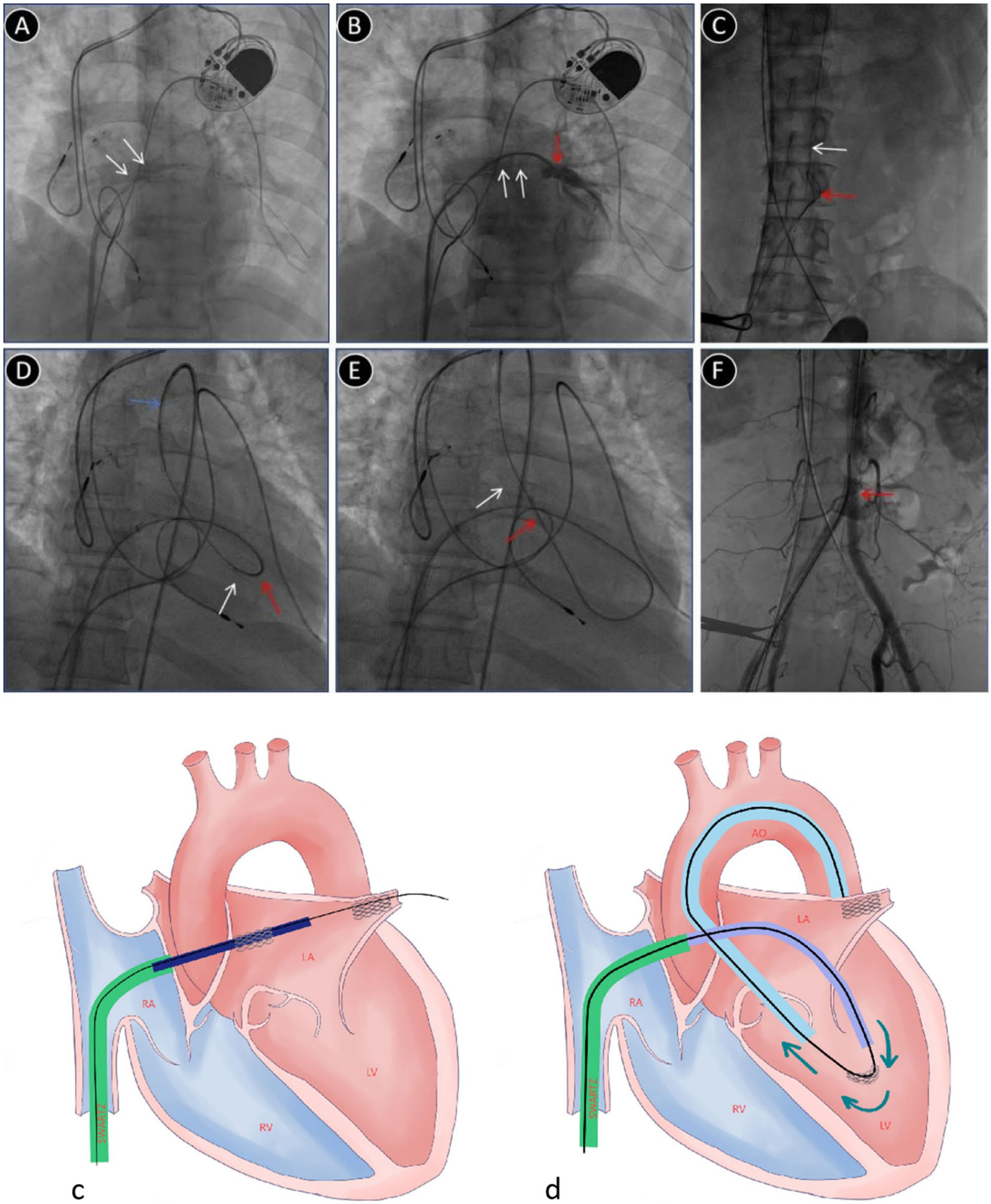

Fig. 2 **A** The stent falls off (white arrow). **B** The second stent is released successfully (red arrow), and the first stent is invaginated on the guide catheter (white arrow). **C** The catcher captures the hardened guide wire. **D** The left intraventricular detached stent (white arrow) and the JR4.0 catheter (red arrow). **E** The detached stent (white arrow) in the left ventricle and the JR4.0 catheter (red arrow). **F** The detached stent remains at the intersection of the iliac artery (red arrow). **c** Schematic diagram of stent detachment. **d** Schematic diagram of the retrieval of the detached stent

Table 1 Timeline

Timeline	Event
February 2023	RFA for atrial flutter
August 2023	Recurrent haemoptysis
December 2023	The patient was diagnosed with pulmonary vein occlusion by CTA
Day 3	During the atrial septal puncture process, a cardiac rupture occurred, and we used a ventricular septal occluder to close the breach
Day 4	The follow-up CTA revealed a perforation located at the upper edge of the interatrial septum
Day 5	During the deployment of the left lower pulmonary vein stent, the stent detached and migrated to the left atrium. A track was established using a guide wire, and the separated stent was pushed into the iliac artery
Day 7	Echocardiography showed no abnormalities in all cardiac valves, and the patient was discharged

providing a new therapeutic strategy for clinical practice. For atrial rupture, previous reports may have required surgical repair. In this case, the patient's atrial wall rupture was successfully repaired using a ventricular septal occluder via an interventional approach. Previous reports have been of retrieving a dislodged stent from the left atrium by dilating the interatrial septum and making an incision in the femoral vein. However, we established a track through the femoral artery and femoral vein and pushed the dislodged stent into the common iliac artery, which was almost non-traumatic for the patient.

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Authors' contributions
Yu wei:wrote the main manuscript text Qin wei: prepared figures Li fajiu: Provide writing guidance Zhu ziyang: Providing surgical information.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Written informed consent was obtained from the patient for publication of this case report, including accompanying images.

Competing interests
The authors declare no competing interests.

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