Entrapment of ablation catheter in right pulmonary veins requiring surgery to remove

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Introduction

Pulmonary vein isolation (PVI) is a safe and effective procedure for treating atrial fibrillation, but it carries a small risk of complications. The most common complications are related to vascular access; but infrequent, more severe complications, including tamponade, stroke, catheter entrapment, and mechanical disruption of pulmonary vein branches, can occur. Catheter entrapment during PVI requiring surgical removal has been reported in rare cases; however, this has predominantly involved circular mapping catheters becoming entrapped in the mitral subvalvular apparatus.[1,2] Here we report a rare case of ablation catheter entrapment within the right inferior pulmonary vein (RIPV) that required surgical removal.

KEY TEACHING POINTS

- Entrapment of an ablation catheter is a very rare complication of pulmonary vein isolation.
- Early recognition of an entrapped catheter is important, and surgical removal may be required in some cases.
- Transesophageal echocardiography can help elicit the mechanism of an entrapped catheter within the left atrium, and can aid decision-making regarding the most appropriate management strategy.

Case report

A 61-year-old male patient with symptomatic, drug-refractory persistent atrial fibrillation was referred for a redo PVI. He had a previous PVI 2 years ago where it was noted that it was challenging to isolate his right-sided pulmonary veins. Preprocedural computed tomography imaging did not reveal any anatomic anomalies. Catheter ablation was performed under a general anesthetic. Transesophageal echocardiography (TEE) was performed, and no left atrial appendage thrombus was visualized. Ultrasound-guided right femoral venous access was obtained to advance diagnostic catheters into the coronary sinus and His position. Two transseptal punctures were performed under TEE and fluoroscopy guidance. Direct current cardioversion was performed to restore sinus rhythm following the transseptal punctures. Electroanatomical mapping of the left atrium and pulmonary veins was performed using Ensite X (Abbott Medical, Abbott Park, IL) and a high-definition catheter (HD Grid; Abbott Medical). A medium curl Agilis sheath was used to introduce the ablation catheter (TactiFlex DF curve; Abbott Medical). The left pulmonary veins remained isolated; however, reconnection of the right-sided pulmonary veins had occurred. Earliest activation was seen at the posterior carina and right superior pulmonary vein. Radiofrequency ablation at 40 W was performed to the area, resulting in reisolation of the right pulmonary veins. Contact force of 10–15 g was targeted for ablation. No other obvious substrate was observed in the left atrium.

Prior to final testing for reconnection of the pulmonary veins with adenosine, there was difficulty moving the ablation catheter from the RIPV. Gentle traction and rotation was met with resistance. At this time the HD Grid catheter was positioned toward the left-sided pulmonary veins, excluding the possibility of entrapment of the ablation catheter in the HD grid (Figure 1). Subsequent imaging with TEE was performed and visualized the tip of the ablation catheter within the left atrium and a small echodense structure connecting the catheter tip to the RIPV. Further attempts at traction with TEE guidance were unsuccessful and resulted in tenting of the vein, visible on TEE (Figure 2). At this point the cardiothoracic team was consulted to discuss the next steps. The consensus was to transfer the patient to the theatre for surgical removal, as further aggressive traction could lead to tearing of the pulmonary vein, which would be difficult to access in a timely manner.

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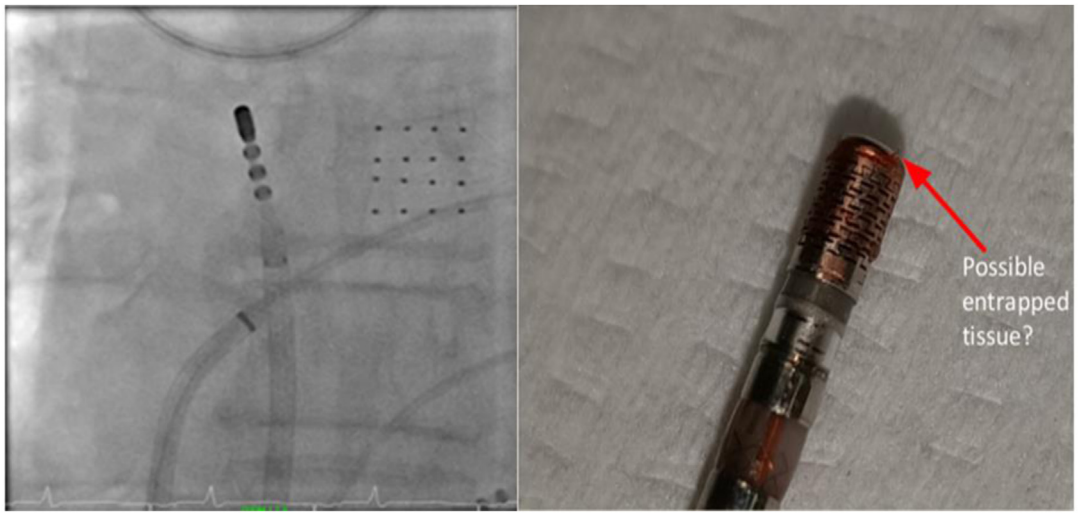

Figure 1 At left: Fluoroscopic image demonstrating entrapped catheter within the left atrium. HD Grid catheter (Abbott Medical) can also be visualized within the left atrium. At right: Ablation catheter tip post removal from the pulmonary veins demonstrating entrapped endovascular tissue at the tip of the catheter.

A median sternotomy and a pericardiotomy were performed. There was no blood in the pericardial cavity. The impacted wire could be palpated in the RIPV. The right pleura was opened to rule out any potential perforation of the RIPV in its extrapericardial course. Considering that the catheter had not yielded to a considerable force applied to retrieve it earlier, it was considered prudent to remove it under cardiopulmonary bypass support. Aorto–right atrial cannulation was done, and the cross-clamp was applied. Antegrade cardioplegia was administered to achieve good operating conditions. The left atrium was opened at the Sondergaard groove. Flooding of the field made it difficult to view the lead. A patent foramen ovale (seen on the preoperative transesophageal images) was the likely cause of the flooding of the field.

The cardiopulmonary pump was stopped for 2 minutes to visualize the catheter, which was retrieved with considerable traction under vision. The lead had a small tag of endovascular tissue attached to it (Figure 1). The left atrium was subsequently closed, the patient was weaned off cardiopulmonary bypass, decannulation was effected, and the patient was closed in layers over drainage. The patient was transferred to the intensive care unit and discharged from hospital 5 days later. The patient made a good recovery and maintained sinus rhythm at 6-month follow-up.

Analysis of contact force and impedance data during the procedure did not demonstrate any excess in force (>20 g) or abnormal impedance values during ablation. The ablation catheter was sent for analysis to the manufacturer; no defects were found.

Discussion

This is the first reported case of pulmonary vein entrapment involving the TactiFlex ablation catheter. Pulmonary vein catheter entrapment is a very rare complication in left atrial ablation, typically occurring during rotation of a curved catheter, and usually necessitates surgical intervention, although

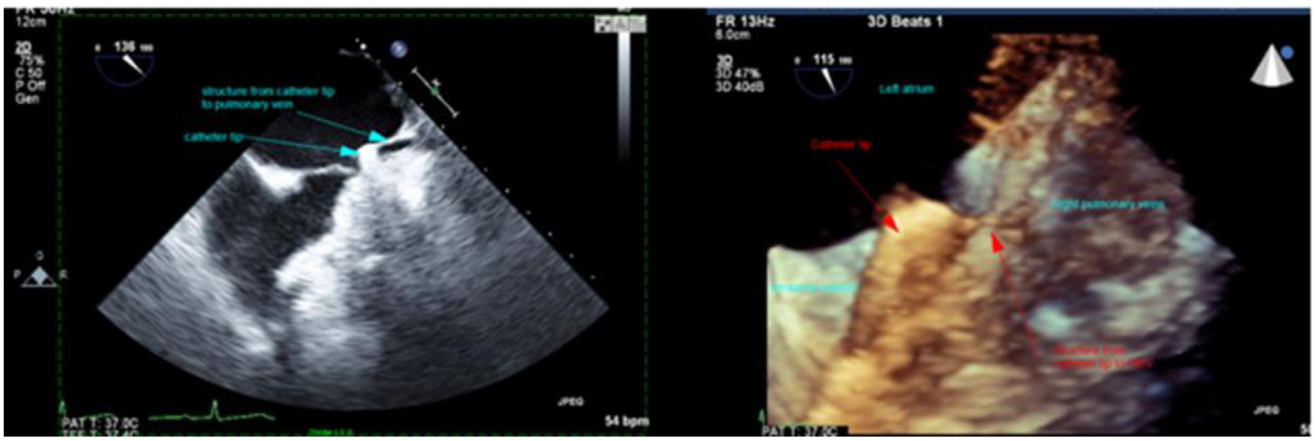

Figure 2 At left: Transesophageal view demonstrating catheter tip with an echodense structure attached that extends into the right inferior pulmonary vein. This image is taken with light traction on the ablation catheter, resulting in "tenting" of the pulmonary venous tissue seen. At right: A 3D transesophageal echocardiography image demonstrating the structure connecting the tip of the ablation catheter to the right inferior pulmonary vein.

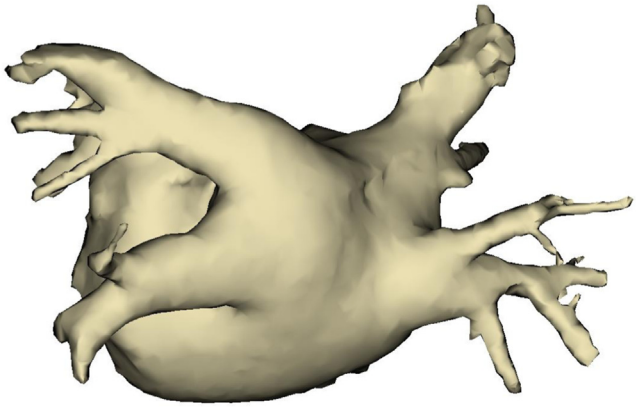

Figure 3 A 3D reconstruction of the left atrium and pulmonary veins, demonstrating normal pulmonary vein anatomy.

transvenous removal with traction and rotation has been described.[3]

Most reported cases of catheter entrapment during PVI involve circular mapping catheters,[4] though ablation catheter entrapment within the RIPV has been reported in 2 other instances. The first case described entrapment of an ablation catheter (Thermocool SmartTouch; Biosense Webster) in a distal portion branch of the RIPV. The catheter was removed surgically.[5] The second case also described entrapment of an ablation catheter (Navistar Thermocool; Biosense Webster) in the RIPV. In this instance the catheter was removed transvenously with traction and rotation. The patient made a full recovery but did experience mild hemoptysis in recovery.[3]

Forceful manipulation of entrapped catheters during PVI can lead to serious consequences for patients. The atrial tissue is delicate, and care should be taken when manipulating catheters within the left atrium. There have been reports of pulmonary vein laceration and atrial wall hematoma secondary to catheter-based ablation strategies[6] and complete stripping of pulmonary vein branches following stronger maneuvers to remove an entrapped catheter from the pulmonary vein.[3]

The RIPV can often branch more proximally, and smaller branches may not be accurately visualized by the preprocedure 3D-constructed computed tomography images.[7] Common ostia or accessory veins may also be risk factors, and catheter entrapment can occur at the point where the diameter of the catheter tip is equal to the ostium of the small branch of the pulmonary vessels.[5] The pulmonary vein anatomy in this case was not abnormal (Figure 3). If the catheter tip was entrapped within the branch, we would have expected higher impedance and visualization of the catheter tip inside the vein, without tenting.

TEE guidance can be helpful in demonstrating the anatomy involved during catheter entrapment and may help inform management strategies. The management strategies include gentle maneuvers such as applying counterpressure on opposite veins, pharmacological interventions such as vasodilators or antispasmodics, mechanical assistance such as balloon inflation or snare retrieval devices, and surgical intervention.[8,9] Given the potential for tearing of the pulmonary veins or within the left atrium and the difficulty in accessing this location surgically in a timely manner, surgical removal of an entrapped catheter, though more invasive, may be a safer approach in patients where gentle maneuvers have been unsuccessful.

Conclusion

Catheter entrapment in a PV is a rare but serious complication of PVI that requires prompt recognition and appropriate management. Surgical intervention may be necessary if less invasive measures fail to release the catheter.

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