A case of an ablation catheter entrapped in the pulmonary vein during atrial fibrillation ablation requiring open heart surgery for removal

Ryudo Fujiwara, MD, PhD, Mitsuru Takami, MD, PhD, Yoichi Kijima, MD, Tomoya Masano, MD, PhD, Ryoji Nagoshi, MD, PhD, Amane Kozuki, MD, PhD, Hiroyuki Shibata, MD, Shinsuke Nakano, MD, Yusuke Fukuyama, MD, Syunsuke Kakizaki, MD, Daichi Fujimoto, MD, Junya Shite, MD, PhD

From the Department of Cardiology, Saiseikai Nakatsu Hospital, Osaka, Japan.

Introduction

A catheter entrapment in the heart is a very rare complication. Most case reports on entrapment have described ring catheters becoming entrapped. An ablation catheter becoming entrapped has rarely been reported.

Case Report

A 64-year-old woman with a 3-year history of drug refractory paroxysmal atrial fibrillation was referred to our hospital for catheter ablation. Preprocedual echocardiography and enhanced computed tomography (CT) revealed no structural heart disease or anatomic anomalies (Figure 1A). Catheter ablation of the atrial fibrillation was performed under conscious sedation. Two 8.5-F long sheaths, an 8-F long sheath, and a 6-F short sheath were introduced percutaneously via the right femoral vein. A 6-F venous sheath was introduced via the right internal jugular vein. A decapolar electrode catheter was positioned in the right ventricular apex. A duodecapolar electrode catheter was advanced into the coronary sinus. A transseptal puncture was performed with the assistance of intracardiac echocardiography using a radiofrequency needle (Japan Lifeline, Tokyo, Japan). Three long sheaths were advanced into the left atrium through the same puncture site. Pulmonary vein (PV) and left atrial angiogram revealed no anatomic anomalies, and the sheaths were placed into the superior PVs. Two circular mapping catheters were positioned in the PVs. An ablation catheter (Thermocool Smart Touch, Biosense Webster, Diamond Bar, CA) was inserted into the 8.5-F sheath placed in the right superior PV. The ablation catheter was pulled back and moved to start the ablation. The operator intended to place the ablation catheter into the left PV and pushed the catheter rightward (patient's left side) in the left anterior oblique view. At that point, the catheter became entrapped. Intracardiac echocardiography showed that the ablation catheter shaft was in the left atrium; however, the location of the catheter tip was unclear. Gentle traction only produced a shift in the atrial wall. When the sheath was advanced, the ablation catheter could be inserted into the sheath. However, the catheter tip would not come free from the PV (Figure 2A–C). Rotational traction also was not effective. Then, the patient was transferred for a CT scan. The CT results showed that the catheter tip was positioned in a small branch of the PV or extracardiac area (Figure 1B). Strong traction could injure the cardiac tissue; therefore, a surgical removal and Maze procedure were performed after informed consent was received from the patient. According to the intraoperative findings, the catheter was entrapped in a small branch of the right inferior PV (RIPV) (Figure 3). It could not be removed even by traction during direct observation. A microincision in the branch released the catheter, and the small branch was sutured. A Maze procedure and left atrial appendage closure were performed. Subsequent analysis of CT results revealed that the root of the small branch separated from the right inferior PV ostium could be recognized; however, the tip of the branch was not visualized (Figure 1A). The diameter of the small branch was 2.5 mm. The patient was discharged 19 days after the operation. She has had no recurrences of atrial fibrillation.

Discussion

Our case involved a rare complication with an ablation catheter getting entrapped in the RIPV and requiring open heart surgery. The complication rate for catheter ablation of atrial fibrillation is 4-6%.[1–3] A catheter becoming entrapped in heart is a very rare complication, and that of an ablation catheter becoming entrapped has rarely been reported. Most case reports of entrapment have described ring catheters becoming entrapped. Of the total of 8 case reports on a ring catheter becoming entrapped in the mitral apparatus, open heart surgery was required in all cases.[4–6] The Chiari

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KEY TEACHING POINTS

- The complication rate for catheter ablation of atrial fibrillation is 4%–6%. A catheter becoming entrapped in the heart is a very rare complication.
- The main sites of catheter entrapment in a heart are the mitral valve and the Chiari apparatus. An ablation catheter could be entrapped by the small branch of the pulmonary vein when the diameter of the ostium of the small branch coincidentally equals the size of the catheter tip.
- Starting to monitor the contact force immediately after insertion of the catheter into the intracardiac chamber and confirming the catheter location by the biplane image might prevent this complication.

apparatus is also an important structure that requires careful attention. There was 1 case report about a duodecapolar catheter entrapment in the Chiari apparatus that required vascular surgery for its removal.[7] Rarely are PVs anatomic structures that cause catheter entrapment. There has been only 1 previous case report about an ablation catheter becoming entrapped in a PV. Stronger traction and rotation with unusual resistance could release the ablation catheter. However, the catheter tip was covered with the translucent membrane of the venous branch.[8] This maneuver has the risk of a major hemorrhage. Open heart surgery may be safer when normal traction is not effective. The PVs have a tapered shape and therefore are associated with the potential risk for catheter entrapment. However, the diameter of the PV branch becomes the same as the diameter of the catheter tip only in the distal portion. The ablation catheter is not usually inserted into the terminal portion of the branch. It was confirmed during the open heart surgery that the diameter of the ostium of the small branch coincidentally equaled the size of the ablation catheter tip. The diameter of the small branch was 2.5 mm. The RIPV has a tendency to branch early near its root.[9] In such a case, it is difficult for the operator to recognize whether the catheter is positioned in the left atrium or PV branch. In this case, a small branch separated from the right inferior PV ostium. However, the 3-dimensional constructed CT could visualize only the root of the small branch (Figure 1A). Therefore, the operator could not recognize the small branch before the procedure, and as a result, the catheter was forcefully inserted into the PV branch unintentionally. The PV branch was stretchier than the left atrial wall even after the catheter entrapment. The catheter was still mobile within about 20 mm (Figure 2A–C). This retractility prevented the operator from recognizing the catheter insertion into the small branch. The ablation catheter used in this case had a contact force sensor. However, the catheter was entrapped before we began to monitor the contact force. We should have started to monitor the contact

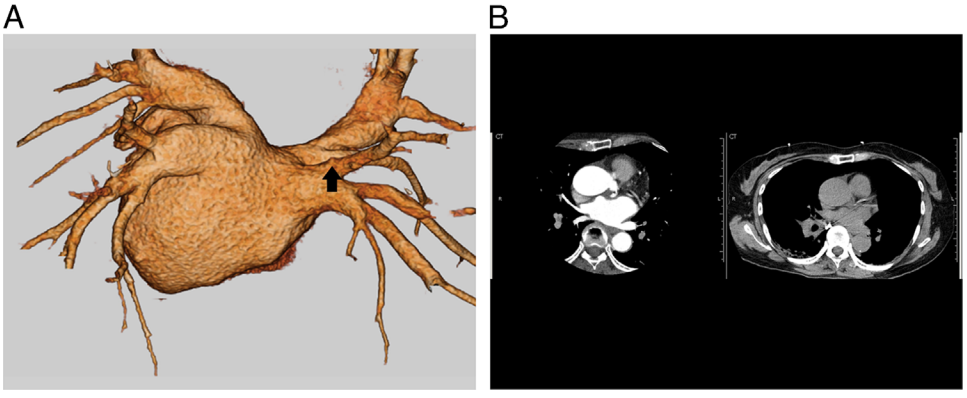

Figure 1 **A:** Preoperative 3-dimensional constructed enhanced computed tomography image. Seemingly no anatomic abnormality could be pointed out. On an in-depth look, the root of the small branch separated from the right inferior pulmonary vein (PV) ostium could be recognized (arrow);however, the tip of the branch was not visualized. The diameter of the small branch was 2.5 mm. **B:** Transverse computed tomography images before (left) and after (right) the ablation catheter entrapment. The catheter was positioned in the right inferior PV. However, it was unclear whether the catheter tip was positioned in a small branch of the PV or extracardiac area.

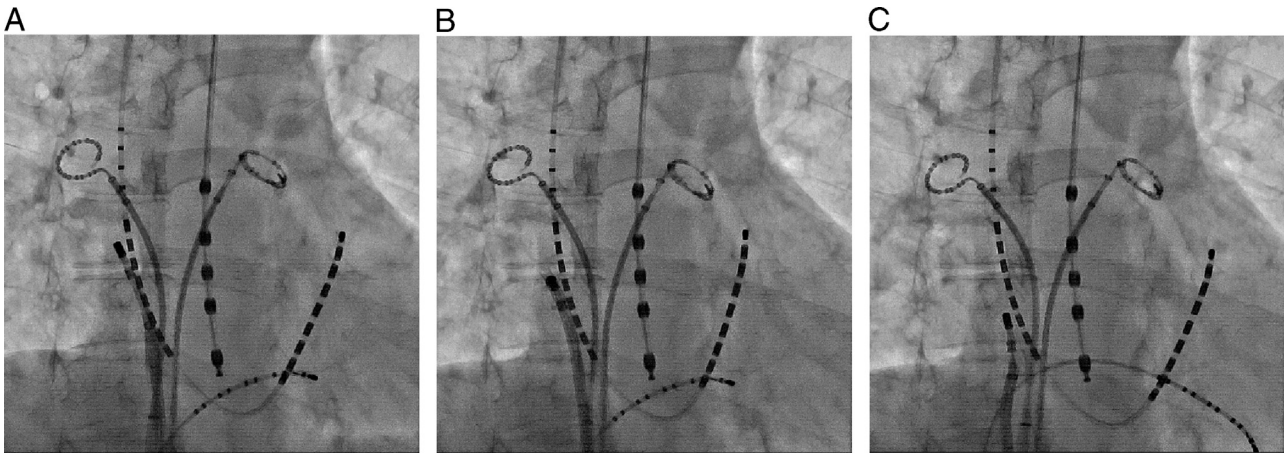

Figure 2 Fluoroscopic image of the catheters. **A:** The ablation catheter entrapment site. **B:** The ablation catheter was pulled and inserted into the sheath. **C:** The ablation catheter and sheath were pulled to the maximum. These figures indicate the catheter had mobility of about 20 mm even after the catheter became entrapped.

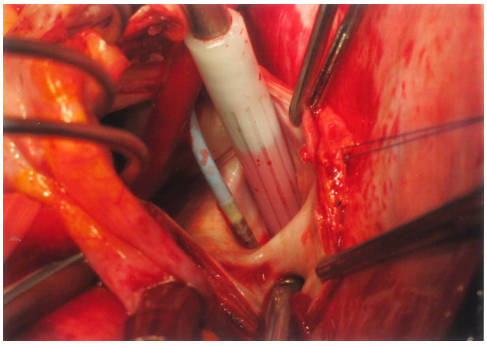

Figure 3 A photograph taken during the surgery, from the head of the patient. The lower side is cranial and the upper side is caudal. Two suction tubes were in the right superior pulmonary vein (PV) and right inferior PV, respectively. The ablation catheter was entrapped in a small branch of the right inferior PV. The catheter tip was placed 15 mm distal to the RIPV ostium.

force immediately after the catheter was inserted into the intracardiac chamber. The operator saw only the left anterior oblique view in fluoroscopy. Confirming the catheter location by the biplane image might prevent this complication.

Conclusion

Our case involved a very rare complication with an ablation catheter getting entrapped in the RIPV and requiring open heart surgery. Gentle catheter manipulation is required at all times.

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