

Percutaneous extraction of a pulmonary artery catheter inadvertently sewn to the right atrial wall



Tyler P. Rasmussen, MD, PhD,^{*} Gary Goldsmith, RT,[†] Firas Zahr, MD,[†] Jay K. Bhamra, MD,[‡] Prashant D. Bhave, MD, FHRS[†]

From the ^{*}Department of Internal Medicine, University of Iowa Carver College of Medicine, Iowa City, Iowa, [†]Division of Cardiovascular Medicine, Department of Internal Medicine, University of Iowa Carver College of Medicine, Iowa City, Iowa, and [‡]Division of Cardiothoracic Surgery, Department of General Surgery, University of Iowa Carver College of Medicine, Iowa City, Iowa.

Introduction

Following mitral valve replacement and subsequent mediastinal exploration, a pulmonary artery catheter was inadvertently sewn to the cardiac wall near the junction of the superior vena cava and right atrium. The electrophysiology service was consulted to aid in removal of the catheter. Excimer lasers have been used for pacemaker/implantable cardiac defibrillator lead extraction,¹ but this case discusses the use of a mechanical cutting sheath coupled with a snare device for removal of an entrapped pulmonary artery catheter. This represents a novel approach to removal of catheters, leads, or other objects that may be sewn to the vascular or cardiac wall.

Case report

A 48-year-old woman underwent mitral valve repair and left atrial Cox-Maze procedure for treatment of severe mitral insufficiency and atrial fibrillation. Her postoperative course was complicated by tamponade and anterior motion of the mitral valve that caused left ventricular outflow obstruction. She subsequently underwent mediastinal exploration, mitral valve replacement, and tricuspid valve repair on postoperative day 2. The right atrium was closed with 2 polypropylene running sutures. A pulmonary artery catheter was retained at the conclusion of that procedure. The sternum remained open because of her high risk for coagulopathy and cardiac swelling. On postoperative day 4 she underwent a final mediastinal exploration and chest closure.

On postoperative day 7, the intensive care unit team encountered resistance when attempting to remove the pulmonary artery catheter, and were unable to withdraw

the catheter. Review of the chest radiograph showed an abrupt angulation to the catheter in the region of the superior vena cava–right atrial junction (Figure 1). The patient was referred to the cardiac catheterization laboratory, where traction was applied to the catheter under fluoroscopic imaging. Fluoroscopic imaging during application of traction suggested that it was sutured to the superior vena cava–right atrial junction because the catheter appeared tethered at a single point. A taper-tipped sheath was placed over the pulmonary artery catheter and advanced to the site of binding. Firm countertraction was applied, but the catheter was unable to be freed (Supplementary Video, available online). The tip of the sheath was damaged during this manipulation and the extraction attempt was aborted.

At this time, the electrophysiology service was consulted for assistance with percutaneous extraction of the retained catheter. Discussion with the cardiothoracic surgical team that had performed the case revealed that the right atrium was closed in 2 running layers, offering the opportunity to extract the pulmonary artery line without causing dehiscence of the right atrial closure.

The patient was taken to the operating room for extraction of the pulmonary artery catheter on postoperative day 11. The procedure was performed under general anesthesia. The patient's entire torso was prepped in sterile fashion and cardiopulmonary bypass support was immediately available. A baseline transesophageal echocardiogram showed no pericardial effusion. Femoral vascular access using 5F (arterial) and 16F (venous) sheaths was achieved in case the need for cardiopulmonary bypass arose.

A 94-cm-length, 13-mm loop diameter needle's-eye snare device (Cook Medical, Bloomington, IN) was deployed through the femoral venous sheath for the purpose of providing countertraction during extraction. The snare gained adequate control of the heel of the pulmonary artery catheter in the right atrium. Several centimeters proximal to the entry site into the right internal jugular vein, the pulmonary artery catheter was cut (Figure 2) and the outer sheath removed. Manual pressure was applied for hemostasis. An

KEYWORDS Catheter; Lead extraction; Pulmonary artery; Snare device; Mechanical cutting device

(Heart Rhythm Case Reports 2016;2:511–513)

Address reprint requests and correspondence: Dr Tyler P. Rasmussen, University of Iowa Carver College of Medicine, Department of Internal Medicine, 200 Hawkins Dr, E325 GH, Iowa City, IA 52242. E-mail address: tyler-rasmussen@uiowa.edu.

KEY TEACHING POINTS

- Pacemaker/implantable cardiac defibrillator lead extraction tools can be used for removal of entrapped catheters in the thoracic vasculature or cardiac wall.
- The presence of a double suture line enhanced the safety of catheter extraction in this patient. We would not have been able to use percutaneous techniques with a single running suture.
- Excimer laser ablative techniques are excellent choices for extracting catheters or leads entrapped by tissue, but they lack the ability to cut through most suture materials. However, excimer lasers should be able to cut through polypropylene.

Iron Man wire (Abbott, Abbott Park, IL) was placed in a distal lumen of the pulmonary artery catheter and advanced to the tip of the catheter. Next, a 9F TightRail Mini mechanical cutting sheath (Spectranetics, Colorado Springs, CO) was advanced over the pulmonary artery catheter. The cutting sheath was advanced without difficulty to the superior vena cava–right atrial junction where the suture was securing the pulmonary artery catheter to the cardiac wall. Firm countertraction from the snare device was applied as the mechanical cutting sheath was activated and deployed. The sheath was felt to release from the right atrium during this maneuver. The pulmonary artery catheter was released from the snare and was retracted into the TightRail sheath. Serial transesophageal echocardiogram scans showed no new pericardial effusion. Hemodynamic measurements were stable throughout the procedure. The sheath was retracted in stepwise fashion with repeat transesophageal echocardiogram imaging between each step. At this point, a purse-string suture was placed around the extraction site and was deployed upon removal of the sheath. The pulmonary artery

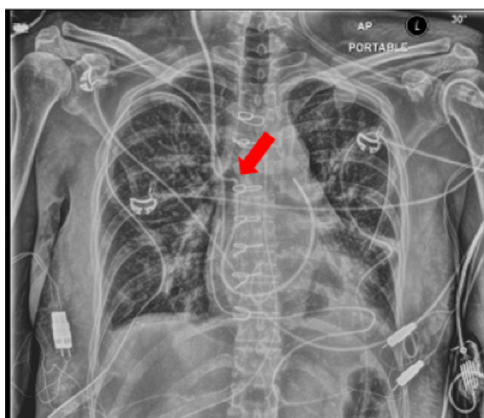


Figure 1 Pre-extraction chest radiograph. This image demonstrates an abrupt change in the pulmonary artery catheter angle near the junction of the superior vena cava and right atrium (*red arrow*), which suggested that the catheter was tethered to the cardiac wall at this site.



Figure 2 Image shows the cut and clamped pulmonary artery catheter entering the right internal jugular vein.

catheter was removed from the extraction sheath and several puncture marks from the suture needle were noted at the site formerly dwelling at the superior vena cava–right atrial junction (*Figure 3*). Hemostasis was achieved and final transesophageal echocardiogram showed no evidence of pericardial effusion.

Discussion

To our knowledge, this represents the first case in which pacemaker/implantable cardiac defibrillator lead extraction tools have been used for the purpose of percutaneous removal of a sewn-in diagnostic catheter. This represents a novel approach to removing catheters inadvertently entrapped in the body.

We were able to safely use mechanical cutting extraction tools for removal of an entrapped pulmonary artery catheter from the right atrial wall. Of note, the right atrial wall was closed with 2 separate running sutures. A single-suture closure would have prompted greater risk assessment prior to percutaneous catheter extraction and likely prompted a surgical approach for removal.

A laser-powered extraction sheath was discussed as a possible tool for this case, given that excimer lasers are able to disrupt polypropylene, but not other types of suture materials.² Excimer laser-powered sheaths are conventionally employed for transvenous pacemaker/implantable

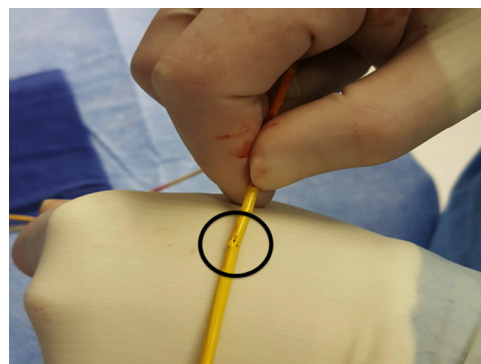


Figure 3 Pulmonary artery catheter after removal. This image, taken after removal of the catheter, demonstrates the bite marks of the suture in the pulmonary artery catheter (*black circle*).

cardiac defibrillator lead extraction¹ and have recently been reported as able to remove dialysis catheters entrapped in the right atrium,³ but they have limited ability to liberate leads encased in calcified tissue or synthetic material.⁴ Ultimately, we chose to use the mechanical cutting sheath because we felt the cutting sheath allowed superior control for disrupting the polypropylene suture adjacent to the thin right atrial wall. The TightRail mechanical cutting sheath⁵ uses a bidirectional cutting mechanism to circumferentially cut 0.5 mm beyond the sheath tip with each deployment. We felt one major advantage of the cutting sheath over the laser was to know the exact cutting depth of the sheath. Of note, standard noncutting mechanical lead extraction tools, such as tapered polypropylene or Teflon sheaths, were not employed, given that they would not be effective at cleaving suture.

Another challenge of extracting a relatively flimsy object such as a pulmonary artery catheter is generating countertraction. The risk of cutting through prolapsed or invaginated cardiac or thoracic vein tissue is greatly increased without adequate countertraction.⁶ Damaging the thoracic veins or cardiac wall tissue increases the risk of perforation and life-threatening bleeding.⁷ We attempted to mitigate these issues by placing the stiffest possible wire through the distal lumen of the catheter and snaring the heel of the catheter from the femoral approach. We affixed silk ties to the pulmonary artery catheter and used these ties to provide countertraction during the extraction process. This combination provided adequate purchase for advancing the tip of the cutting sheath to the site where the pulmonary artery catheter was sutured to the superior vena cava–right atrial junction.

Conclusion

This novel approach using a snare device and a pacemaker/implantable cardiac defibrillator lead mechanical cutting device for the purpose of catheter extraction can be considered in scenarios when catheters are difficult to remove from the body owing to entrapment at cardiac or thoracic vein sites.

Appendix

Supporting data

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.hrcr.2016.08.003>.

References

1. Parsonnet V, Roelke M, Trivedi A, Rizvi SA, Pervez A. Laser extraction of entrapped leads. *Pacing Clin Electrophysiol* 2001;24:329–332.
2. Muto Y, DuPree JJ, Duemler S, Yang Y, Koyanagi N, Cuffari WJ, Matsumoto T. Effects of argon laser on vascular materials. *J Vasc Surg* 1988;7:562–567.
3. Carrillo RG, Garisto JD, Salman L, Merrill D, Asif A. A novel technique for tethered dialysis catheter removal using the laser sheath. *Semin Dial* 2009;22:688–691.
4. Wilkoff BL, Byrd CL, Love CJ, Hayes DL, Sellers TD, Schaerf R, Parsonnet V, Epstein LM, Sorrentino RA, Reiser C. Pacemaker lead extraction with the laser sheath: results of the pacing lead extraction with the excimer sheath (PLEXES) trial. *J Am Coll Cardiol* 1999;33:1671–1676.
5. Aytemir K, Yorgun H, Canpolat U, Sahiner ML, Kaya EB, Evranos B, Ozer N. Initial experience with the TightRail Rotating Mechanical Dilator Sheath for transvenous lead extraction. *Europace* 2016;18:1043–1048.
6. Chu XM, Li XB, Zhang P, An Y, Duan JB, Wang L, Li D, Li B, Guo JH. Implantable defibrillator lead extraction with optimized standard extraction techniques. *J Geriatr Cardiol* 2013;10:3–9.
7. Scott WL. Complications associated with central venous catheters. A survey. *Chest* 1988;94:1221–1224.