Late extraction of an embolized leadless pacemaker from the right pulmonary artery

Solomon O. Badejoko, MD, MPH,* Parampreet K. Singh, MD,* Paul Shiu, DO,* Carissa N. Chothia, BS,† Jennifer J. Williams, MD,‡ Rashaad Chothia, MD*

*From the *Department of Internal Medicine, St. Joseph's Medical Center, Stockton, California, †University of California, San Diego, San Diego, California, and ‡Division of Pulmonary, Allergy & Critical Care Medicine, Department of Medicine, Stanford University School of Medicine, Stanford, California.*

Introduction

The Medtronic Micra Transcatheter Pacing System (Medtronic PLC, Dublin, Ireland) has been a revolutionary alternative to the traditional transvenous pacing system over the past 6 years because of its lower rates of complications such as pocket infection and lead fracture.[1] Micra leadless pacemaker dislodgment is an unusual complication that may occur within 24 hours of implantation. Later dislodgments are rare, and retrieval cases are limited and not standardized.[2–4]

We report successful extraction of an embolized Micra from the right lower segmental pulmonary artery (LSPA) using the double-snare technique. This is the first known published case of a successful extraction from the pulmonary artery 12 weeks postembolization.

Case report

The patient was an 86-year-old woman with coronary artery disease, congestive heart failure, aortic stenosis (history of transaortic valve replacement), chronic kidney disease stage III, ischemic stroke, hypertension, dementia, and paroxysmal atrial fibrillation with sinus bradycardia and conversion pauses of 4 seconds seen on an implanted loop recorder. She presented with severe dyspnea and confusion. A Micra system had been placed 12 weeks earlier in a high septal location, confirmed using a tug test, and unchanged device interrogation on postoperative day 1. Before discharge, there was no evidence of pacing failure. The Micra was left programmed at VVI 60.

KEYWORDS Atrial fibrillation; Bradycardia; Double-snare technique; Heart failure exacerbation; Leadless Pacemaker; Micra transcatheter pacing system; Prolonged Micra dislodgment; Pulmonary artery embolization; Right ventricular outflow obstruction

(Heart Rhythm Case Reports 2022;8:793–795)

Funding Sources: None. Disclosures: All authors report no conflicts of interest. **Address reprint requests and correspondence:** Dr Rashaad Chothia, Division of Electrophysiology, Department of Cardiology, St. Joseph's Medical Center, 1800 N California St, Stockton, CA 95204. E-mail address: rashaadchothia@me.com.

KEY TEACHING POINTS

- Extraction of a leadless pacemaker from the pulmonary artery can be performed safely as late as 12 weeks postimplantation.
- The double-snare technique provides the ability to orient and navigate a leadless pacemaker safely through multiple cardiac structures.
- The double-snare technique prevented re-embolization of the leadless pacemaker when 1 snare slipped off the tine.

The patient's vital signs were heart rate 42 bpm and respiratory rate 24 breaths per minute, and she was afebrile. She had jugular venous distension, pitting pedal edema, and lung rales. An S3 was heard. Initial laboratory test results revealed mild macrocytic anemia, prerenal azotemia, and brain natriuretic peptide level of 840 pg/mL. She initially had undergone medical management for acute hypoxic respiratory failure due to exacerbation of congestive heart failure and received furosemide and oxygen supplementation. Electrocardiogram showed sinus bradycardia.

Chest radiography revealed pulmonary edema, bilateral pleural effusions, and an extracardiac position of a displaced Micra, projecting in the right infrahilar region (Figure 1A). Its location in the right LSPA was confirmed by noncontrast computed tomography of the chest. No sensing or pacing activity was seen on pacemaker interrogation. Ongoing episodes of bradycardia with heart rates <50 bpm were seen on loop recorder starting on postoperative day 2. Heparin drip was started for suspected device-related thrombus. Because of the patient's worsening dyspnea, the embolized device was extracted using the double-snare technique.

With the patient under general anesthesia and under transesophageal echocardiographic (TEE) guidance, 6F and 8F sheaths were inserted in the femoral veins. A

https://doi.org/10.1016/j.hrcr.2022.08.013

temporary transvenous pacer was placed into the right ventricular (RV) apex pre-emptively. Pulmonary angiogram confirmed a partial occlusion of the right LSPA (using a J-tip, Swan-Ganz catheter, Edwards Lifesciences LLC, Irvine, CA) (Figure 1B). A pigtail catheter over a J-wire was advanced into the right subclavian vein and exchanged for an Amplatz extrastiff J-tip wire (Boston Scientific, Marlborough, MA). Serial dilation of the femoral vein and routine sheath upsizing were performed. A prepared Micra 23F introducer sheath (Medtronic PLC) was inserted (Figure 2). This sheath could traumatize the right ventricular outflow tract (RVOT) if advanced further than the inferior vena cava/right atrial junction because of its large size and rigidness. Instead, an Agilis small-curve deflectable catheter (Abbott Vascular, Santa Clara, CA) was passed through this sheath and placed into the RVOT. The first snare (20-mm single loop, Covidien Ireland Limited, Tullamore, Ireland) was directed through the RVOT and into the right pulmonary artery. The snare secured a proximal tine and locked with the snare catheter (Figure 1C). With gentle sustained traction, the snare pulled the Micra from the LSPA into the main pulmonary artery. The second snare (15-mm single loop, Covidien Ireland Limited) was placed through the Micra sheath and securely looped around the body of the Micra. With simultaneous traction, the Micra was oriented vertically, and removal from the pulmonary artery was started. The snare over the tine slipped off and the device reoriented horizontally, causing brief occlusion of the pulmonic valve with acute hypotension and RV dilation (seen on TEE). The Micra was advanced into the artery, allowing flow to return. The first snare was repositioned over the Micra's proximal button (Figure 1D). Using both snares, the Micra was extracted through the pulmonic and tricuspid valves into the right atrium using TEE to confirm no damage to the valves or subvalvular apparatus.

After the second snare was released, the Micra was safely pulled into the Micra sheath and the entire system was removed. The venotomy site was closed with the previously placed Perclose devices (Abbott Vascular). Complications included a brief RVOT obstruction and backbleeding from the Micra sheath due to nonclosure of the hemostatic valve with 2 smaller sheaths inserted (500 mL).

Postextraction TEE revealed an unchanged small inferolateral pericardial effusion and estimated ejection fraction of 55%. RV function had normalized, and the patient was safely discharged 1 day after the retrieval without a replacement pacemaker, based on the patient's preference for ongoing monitoring.

Discussion

The Micra is the smallest leadless pacemaker, approved by the Food and Drug Administration in 2016.[1] Indications for use of the Micra include bradycardia associated with persistent or permanent atrial tachyarrhythmia, sinus nodal dysfunction, atrioventricular block, contraindications to transvenous pacemaker (eg, history of endocarditis), and compromised venous access.[1] A recent real-world study revealed Micra implantation has a 38% lower adjusted rate of reinterventions and a 31% lower rate of chronic complications compared with transvenous pacing.[2] In a meta-analysis, the incidence of early complications was 0.46% at 3 months.[3] Although device dislodgment usually is postprocedural, it may occur within hours to days but rarely occurs later.[4–7] Micra embolization to the branches of the pulmonary artery can be severe, resulting in pulmonary

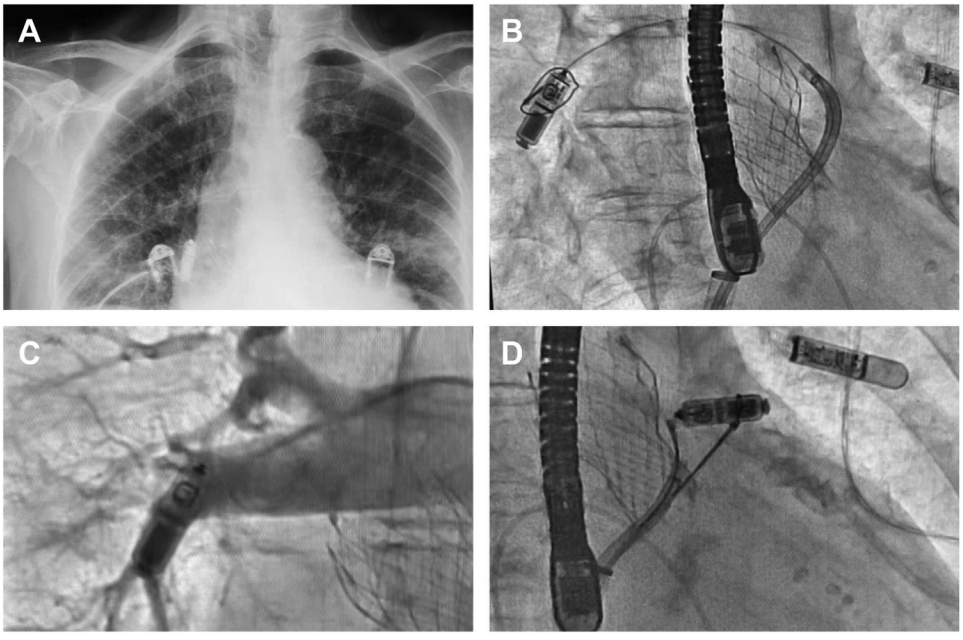

Figure 1 **A:** Embolized Micra on chest radiograph. **B:** Pulmonary angiography confirmed a right lower segmental pulmonary artery partial occlusion. **C:** A 20-mm, single-loop snare over the Micra device. **D:** Second snare securing the device within the pulmonary artery.

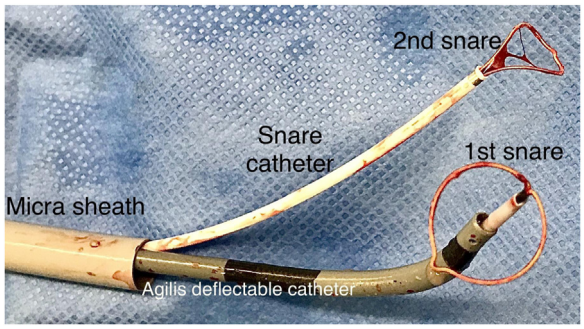

Figure 2 Micra 23F introducer sheath, Agilis small-curve deflectable catheter, snare catheter, and the 2 snares (6F, 120-cm length, 20-mm and 15-mm diameters).

artery obstruction, acute respiratory failure, cardiac tamponade, cardiac perforation, and, sometimes, death; therefore, it warrants immediate extraction.[4] As presented in this case, an attempt at late extraction from the pulmonary artery can be achieved successfully to prevent erosion of the pulmonary artery and relieve flow obstruction.

The lack of support and need for vertical positioning during retrieval is the bane of extraction for the Micra. Other hindering factors include its small-sized design, lack of a dedicated Micra retrieval system, vigorous motion, and intracardiac structures such as the papillary muscles.[5,7] The double-snare, catch-hold-pull technique has been used for intracardiac dislodgment[4,5] and to maneuver and safely extract the Micra from the pulmonary artery.[6,7] This technique reduced the risk of collateral damage to the cardiac valves and subvalvular structures. Although some have advocated for 2-operator–dependent, 2-directional snare dislodgment via the inferior vena cava and superior vena cava,[5] we successfully utilized single-site access with the double-snare technique. Given the increased use of leadless pacemakers, cases of Micra dislodgment are expected to continue to rise, creating an urgent need for a universally acceptable, standardized, structured retrieval system.

Conclusion

Complications of leadless pacing systems are occurring more frequently with their increasing popularity and implantation. Different methods of retrieval have been explored with varying success rates, especially for prolonged dislodgment. Our case demonstrated that a dislodged and embolized leadless pacemaker such as the Micra, in the right LSPA, can be successfully retrieved using the double-snare technique as late as 12 weeks postimplantation.

References

1. Reynolds D, Duray G, Omar R, et al. A leadless intracardiac transcatheter pacing system. N Engl J Med 2016;374:533–541.
2. El-Chami MF, Bockstedt L, Longacre C, et al. Leadless vs. transvenous single-chamber ventricular pacing in the Micra CED study: 2-year follow-up. Eur Heart J 2022;43:1207–1215.
3. Ngo L, Nour D, Denman R, et al. Safety and efficacy of leadless pacemakers: a systematic review and meta-analysis. J Am Heart Assoc 2021;10:e019212.
4. Kawasaki M, Yamada T, Watanabe T, et al. Extraction of a "floating leadless pacemaker": a case report. HeartRhythm Case Rep 2020;6:457–459.
5. Hasegawa-Tamba S, Ikeda Y, Tsutsui K, et al. Two-directional snare technique to rescue detaching leadless pacemaker. HeartRhythm Case Rep 2020;6:711–714.
6. Terricabras M, Khaykin Y. Successful leadless pacemaker retrieval from the left pulmonary artery: a case report. HeartRhythm Case Rep 2020;6:798–799.
7. Gupta S, Cho K, Papagiannis J, et al. A novel technique for extraction of a leadless pacemaker that embolized to the pulmonary artery in a young patient: a case report. HeartRhythm Case Rep 2020;6:724–728.