Leadless pacemaker and temporary transvenous wire entanglement requiring percutaneous extraction

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Introduction

Following FDA approval of the leadless pacemaker in the first decade, there has been a steady increase in the rate of leadless pacemaker implantation.[1] While the rate of complications is generally low, there have been reported cases of percutaneous extraction of leadless pacemakers after pacemaker dislocation.[2] Here, we report the first case of leadless pacemaker suture entanglement on a knotted transvenous pacer wire that required dislodgment and percutaneous extraction.

Case report

We present the case of a 91-year-old woman with a past medical history of coronary artery disease, prior myocardial infarction status post remote stenting to the left circumflex, permanent atrial fibrillation on anticoagulation, peripheral arterial disease, chronic kidney disease stage III, and hyperlipidemia who presented to the emergency department with hypotension and bradycardia. The patient was found to be in intermittent third-degree heart block with heart rates in the 20s to 30s. A temporary pacemaker wire was placed via access through the right internal jugular (IJ) vein without fluoroscopic guidance to maintain adequate heart rate. There was some difficulty in placing the temporary wire owing to inadequate capture. Ultimately, adequate capture was obtained with the wire at the 70 cm mark. Chest radiograph post placement of the wire revealed right IJ transvenous pacer with tip projecting over the right ventricle with the wire appearing looped within the heart (Figure 1). The patient remained hemodynamically stable overnight and was taken to the electrophysiology lab the next day for leadless Micra (Medtronic, Minneapolis, MN, USA) pacemaker placement considering her age and comorbidities. A decision was made to leave the temporary wire in place without additional revision prior to leadless pacemaker insertion, as the patient was intermittently dependent.

The patient was prepped in usual fashion, including placement of pads in the anteroposterior positions in case she were to need advanced cardiac life support or back-up transcutaneous pacing. Access was obtained through ultrasound guidance and a wire was advanced into the right femoral vein into the inferior vena cava. An 8 French sheath was then guided into the superior vena cava. As per protocol patient was dilated with 12F, 18F, and 22F dilators. A 23.5F Micra introducer sheath was then advanced into the right atrium. The leadless pacemaker was then deployed successfully into the interventricular septum on the right ventricular aspect after confirming good placement in both right anterior oblique and left anterior oblique positions. After deployment, sensing thresholds and impedances were all stable. Attempt was then made to remove the temporary wire before the tether string. However, the Micra catheter had passed through a loop that had formed in the transvenous pacer wire. On pulling back of the temporary wire, a knot was formed around the tether strings of the Micra pacemaker. Several unsuccessful attempts were made to remove the knot of the temporary wire. The tether string of the Micra pacemaker was then cut and pulled in hopes to remove the string through the knot from the leadless pacemaker. Unfortunately, this led to partial dislodgment of the Micra device.

KEY TEACHING POINTS

- There is an increase in the rate of leadless pacemaker implantations.
- The rate of complications is generally low, but must not be underestimated.
- This is the first case of leadless pacemaker entanglement with a transvenous pacer.
- Steps can be taken to mitigate the chances of such a complication from occurring.

KEYWORDS Complications; Electrophysiology; Leadless pacemaker; Medtronic; Micra; Transvenous pacer
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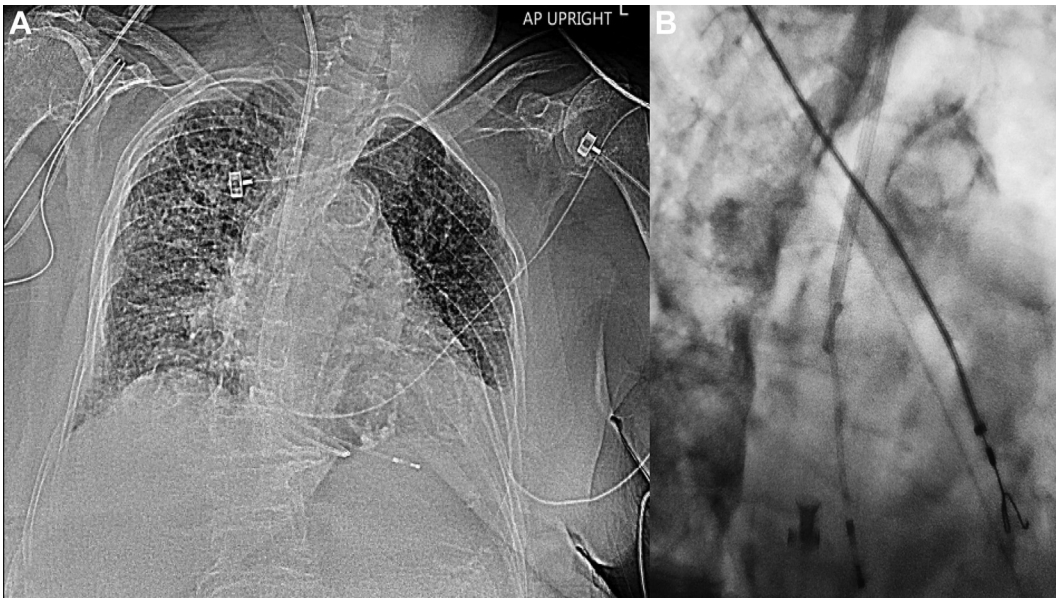

Figure 1 **A:** Portable chest radiograph revealing right internal jugular transvenous pacer with tip projecting over the right ventricle with wire appearing looped within the heart. **B:** Fluoroscopic intraprocedure image showing the knotted transvenous pacer wire.

Owing to device dislodgment and entanglement of the tether string with temporary pacemaker wire, a plan was made to snare both devices. The cardiothoracic surgery team was notified and available as standby if complications requiring emergency sternotomy were to arise. Initially, a 7F JR4 guiding catheter was placed through the Micra integrated delivery catheter in the right common femoral sheath. An 8-15 mm EN snare was used, but it could not grasp the Micra device. A different sized EN snare was then used and was also unsuccessful. Next, an attempt was made to snare the device using a 7F IMA guiding catheter using a 15 mm gooseneck snare. We were then able to snare one of the Nitinol tines of the leadless pacemaker. The snare was tightened at the tip of the guiding catheter and we pulled towards the end of the large sheath along with the transvenous pacer wire and Micra pacemaker. The temporary pacemaker wire was cut at the right IJ site. The snare was then held tightly at the end of the guiding catheter and we pulled the Micra delivery system, as well as the guiding catheter and temporary pacer wire as a unit, through the right femoral insertion site (Figure 2). After successful extraction, we could clearly visualize the knot that formed between the sutures of the leadless pacemaker and the knotted transvenous pacer wire (Figure 3). A new transvenous pacer wire was placed through the right IJ, after which a dual-chamber pacemaker was placed successfully through a standard left axillary vein approach. The patient was transfused 2 units of packed red blood cells owing to significant blood loss and monitored in the cardiac intensive care unit overnight. She was ultimately discharged on day 2 post procedure without further complications.

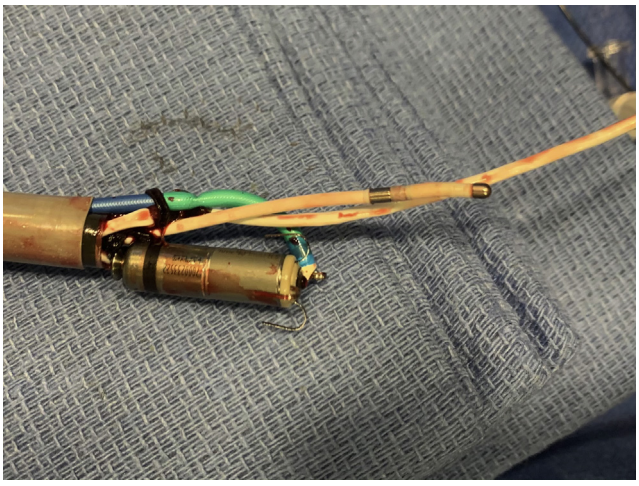

Figure 2 A 7 French guiding catheter snared onto Micra (Medtronic, Minneapolis, MN, USA) Nitinol tine via a gooseneck 15 mm snare.

Discussion

To our knowledge, this is the first of such reported complications pertaining to implantation of a Micra device. Prior studies have reported adverse events primarily related to transient dysrhythmias or femoral access complications, with the rare occurrence of pericardial effusion, cardiac tamponade, and cardiac perforations.[3,4] While previously unreported, entanglement of the Micra device deployment system with transvenous wire is a complication that physicians should be aware of as the utilization of this novel device gains ground.

Several steps can be taken to mitigate the chances of such a rare but serious complication from occurring. Suboptimal transvenous pacemaker lead placement resulting in looping in the right ventricle can result in serious complications. Using fluoroscopic guidance during placement can help avoid such loops and potential complications. Careful review of

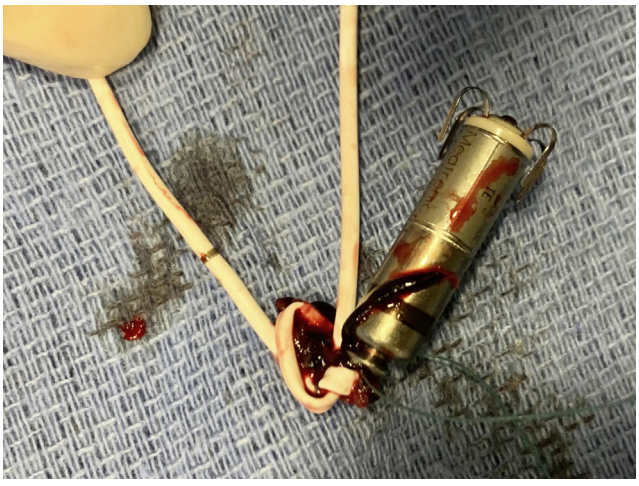

Figure 3 Knotted transvenous pacer wire with Micra (Medtronic, Minneapolis, MN, USA) sutures.

chest radiograph imaging prior to permanent pacemaker insertion should also be done to ensure removal of pacer wire with any loops or knots in the right atrium or ventricle and avoid the above complication. Attempts at reducing knotted intraventricular wires should be done using interventional radiological techniques, avoiding the need for open heart surgery. Providers should be mindful of the 3-dimensional aspects of intracardiac devices, as looped temporary wires may look innocuous on traditional fluoroscopic views but conceal complicated knots, as presented in this case. In our case, the loops in the temporary transvenous balloon catheter should have ideally been unfastened and straightened prior to advancing the Micra and tether string deployment. In hindsight, it is also possible there could have been difficulty removing the looped temporary transvenous balloon catheter through the right IJ cordis. In that case, we would recommend to pull the IJ sheath and the knotted temporary wire as a unit before implanting a permanent pacemaker. Additional temporary wire can also be implanted from the femoral vein instead, to allow pacing while the leadless pacemaker is implanted. Ideally, the temporary wire should be placed in the right ventricular apex and away from the interventricular septum to avoid untoward interaction. Even if a complication such as ours is encountered, percutaneous retrieval should always be considered before open heart surgery. We decided to use a large introducer sheath to deliver the guiding catheter and snare in order to be able to pull everything as a unit inside the large introducer sheath and avoid potential injury to cardiac or vascular structures. One could also use a separate venous access to deliver snares if so desired. Fortunately, our patient did not suffer any harm except experiencing significant bleeding requiring 2 units of packed red blood cell transfusion during the procedure. However, more serious complications such as hemodynamic compromise secondary to loss of pacing, vascular or myocardial injury, cardiogenic shock, or death can also occur as a consequence.

Conclusion

Percutaneous leadless transcatheter pacemakers in most cases can be safely implanted. However, in rare instances there is possibility that there may be device dislodgment and entanglement on a transvenous pacer. Percutaneous device extraction may be feasible, but is potentially challenging and could lead to serious complications. This case highlights the need for safe transvenous pacer wire placement under fluoroscopic guidance and extreme caution if there is any redundancy and loops are present during a leadless permanent pacemaker placement.

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