Retrieval of a Leadless Transcatheter Pacemaker from the Tricuspid Valve Annulus: A Case Report

Jiahui Chen[1]*, Xueying Chen[1]*, Yangang Su*
*Zhongshan Hospital Fudan University, Department of Cardiology,180 Fenglin Road, Shanghai, China, 200032
[1] Jiahui Chen, Xueying Chen contributed equally to this paper.

Corresponding author：Yangang Su, E-mail address:

yangangsu@yeah.net

Funding: None.
Disclosures: None.

Key words: Micra transcatheter pacing system, leadless pacemaker, dislocation, extraction, myocardial infarction

Abstract

This case report describes a procedure of retrieval of a leadless transcatheter pacemaker from the right ventricle after device implantation immediately. An 80-year-old man affected by ischemic cardiomyopathy, complete AV block and atrial fibrillation was implanted with a Micra transcatheter pacing system at the median septum of the right ventricle. After tether removal, the leadless pacemaker migrated to tricuspid valve annulus. The device was successfully removed using a snare loop hooked to the proximal retrieval feature of Micra.

Introduction

Permanent cardiac pacing delivered by leadless transcatheter pacing systems (TPS) has become an ideal alternative to the traditional pacemaker, concerning the advantage of minimizing potential complications associated with transvenous pacemaker system[1]. However, the experience of acute device dislocation is limited. We describe a case of success retrieval of the device after acute migration to the tricuspid valve annulus.

Case report

An 80-year-old man affected by coronary artery disease, old extensive anterior wall myocardial infarction, post coronary stent implantation, ischemic cardiomyopathy, hypertension and diabetes, suffered from complete AV block and atrial fibrillation. The echocardiography showed less thickness of the left ventricular anterior wall and septum, weakening and disappearance of systolic activities, thinning and expansion of the apex, and disappearance of systolic activities with reduced left ventricular ejection fraction (38%) and moderate to severe tricuspid regurgitation. He received a pacemaker implantation at the left side 11 years before and suffered from pocket infection for 4 years. But he refused to remove the pacing system. A decision was made to implant a new pacing system from the right side concerning the patient's will of not extracting the original pacing system at the left side when the generator required to change due to battery depletion. However, occlusion of the superior vena cava and the dilated azygos vein draining to the inferior vena cava (IVC) (Figure 1) were detected by angiography during the procedure. Finally, a leadless pacemaker (Micra TPS, Medtronic Inc, Minneapolis, MN) was chosen to implant.

A 27F Micra delivery sheath was inserted through the right femoral venous access to the right atrium. The TPS was finallyreleased at the median septum of the right ventricle prior to three attempts, accounting to unsatisfied pacing parameters. At fluoroscopy examination, three of the tines seemed to be engaged in the right ventricular septum which was confirmed with the pull and hold test.(Figure 2A). The parameters were stable after tug test: pacing threshold was 1.5 V/0.24ms, R wave amplitude was 2.5 mV, and impedance was 1200 Ohm. However, the Micra TPS migrated to the tricuspid orifice after tether removal. One tine was hooked to the tricuspid valve and the other part of the device was moving during the heart beat (Figure 2B). The pacing threshold measurement showed lost of capture at 5V/0.24ms. The patient developed a non-sustained ventricular tachycardia though he was asymptomatic.

An attempt of device retrieval was performed immediately. A 6F multifunction angiographic catheter (MPA2, Cordis) was inserted with one snare loop (QTQ-20, Shanghai medical company) via the Micra TPS delivery catheter. We attempted to successfully capture the device through the proximal retrieval feature after reshaping the MPA2 catheter (Figure 3). It was then withdrawn into the delivery catheter and extracted. The entire procedure only lasted 10 minutes.

Then a new Micra TPS was implanted at the low septum of the right ventricle after confirmation of solid fixation of the device with four tines engaged in the septum and stable pacing parameters (pacing threshold: 0.75 V/0.24ms, R wave amplitude: 8mV and impedance: 500 Ohm).

Debridement and suturing of the original pocket were performed. The generator was removed and the leads were cut and embedded.

The postoperative echocardiogramshowed no valve damage or worsening of tricuspid regurgitation (Figure 4).

Discussion

The incidence of leadless pacemaker dislodgements is significantly lower than lead dislodgement with conventional pacemakers. Small studies reported a 0.13% incidence of Micra TPS dislodgement while the reported incidence was higher with Nanostim (1.1%) [2-7]. However, research show that Micra TPS had early retrievals (< 24 h) in 50% (n = 20) of cases[8]. The device might migrate to other sites of the heart or pulmonary artery which might cause valve damage, ventricular arrhythmia and embolism.

Several experiences of early and mid-term retrieval of TPS have been published, reporting that retrieval is feasible and safe. Curnis et al. [9] reported the first-in-human retrieval of a TPS using a snare loop. Fichtner et al. [10] reported a case of Micra TPS retrieval using two steerable introducers (Agilis) and two snare catheters in an 83-year-old patient with cardiac amyloidosis implanted with a leadless pacemaker. Sterlinski et al. [11] reported a case of a Micra TPS dislodgement to the pulmonary artery in a patient with congenitally corrected transposition of the great arteries, ventricular septal defect, pulmonary stenosis and dextrocardia. Retrieval of the leadless pacemaker was easily achieved using a snare. Another case of leadless pacemaker dislocation to the right pulmonary artery 3 days after implantation described by Emanuele et al. [12] was an 80-year-old man affected by ischemic cardiomyopathy. From these cases above, a leadless pacemaker dislocation might be occurred in patients with abnormal heart structure, which probably attribute to the difficulties for device fixation.

The characteristics of the myocardium might be another factor for the fixation of TPS. Myocardial fibrosis or scars in cardiac amyloidosis, ischemic cardiomyopathy or other cardiomyopathy might influence the tines engagement in trabecular muscle. Regional left ventricular contractile dysfunction induced by ischemia is associated with less thickening of regional wall and a larger ventricular radius at end-systole. Less thickness of the left ventricular anterior wall and septum, weakening and disappearance of systolic activities were detected by echocardiogram in our case. Therefore, there was myocardial fibrosis at the right ventricular septum, which resulted in nonoptimal electrical parameters, and potential possibility of postoperative displacement.

In order to prevent TPS dislodgement, echocardiogram or cardiac magnetic resonance (CMR) assessment might be useful before the operation. During the procedure, well and stable pacing parameters could be another criteria for solid fixation. In case of detecting of device dislocation, retrieval should be performed as soon as possible to prevent further adverse events. As for retrieval, steerable introducers (Agilis) with snares were recommended [13-14]. In our case, we used a reshaped MPA2 catheter with a single snare loop via the 27F Micra sheath. This method had proved to be quick and easy when approaching the proximal retrieval feature. To the best of our knowledge, most cases tended to re-implant a new TPS after removal rather than a conventional intracardiac pacemaker just as our case. No dislodgement reoccurred after re-implantation.

Conclusion

Patients with myocardial fibrosis and abnormal heat structure need to be very careful when choosing the implant site of TPS. Using a general angiography catheter with a single snare is a feasible and safe strategy to retrieve a dislocated Micra TPS.

Acknowledgement

None.

Figure legends

Figure 1 The superior vena cava was occlusion(A) and the upper limb vein drained to the inferior vena cava via the dilated azygos vein(B).

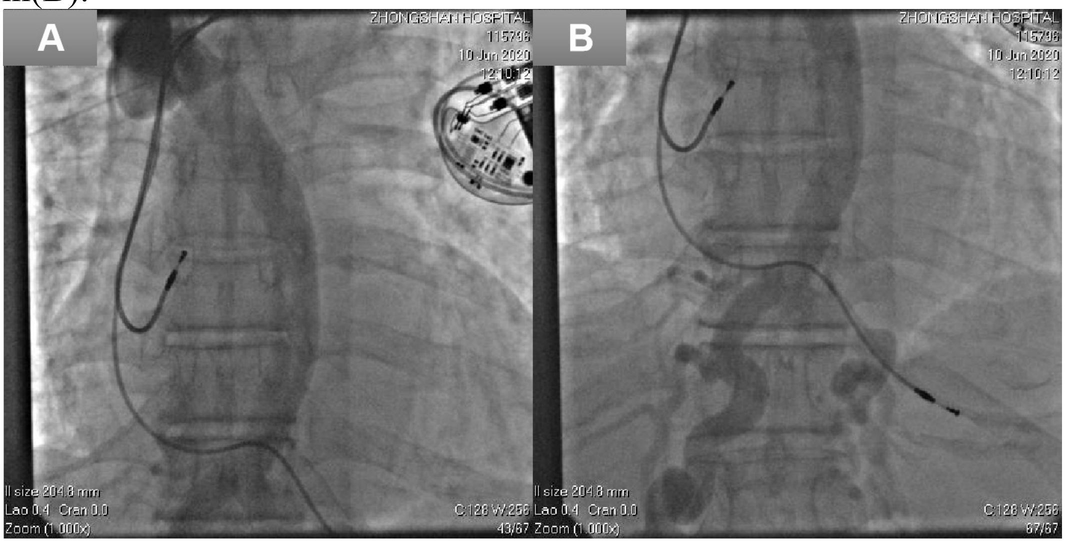


Figure 2 The first Micra TPS was successfully released at the median septum(A) and then migrated to the tricuspid orifice(B).

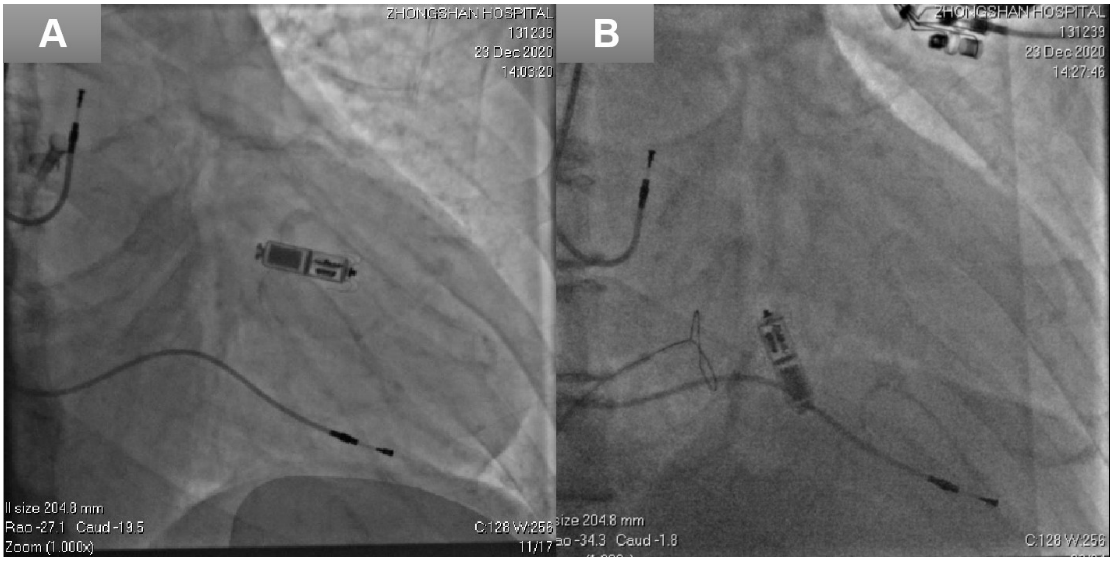


Figure 3 Exaction of Micra TPS: (A) The proximal retrieval feature was hooked enabling to move the device away from the right ventricular by a reshaped MPA2 catheter and a single snare via Micra delivery catheter. (B) The Micra TPS was extracted successfully.

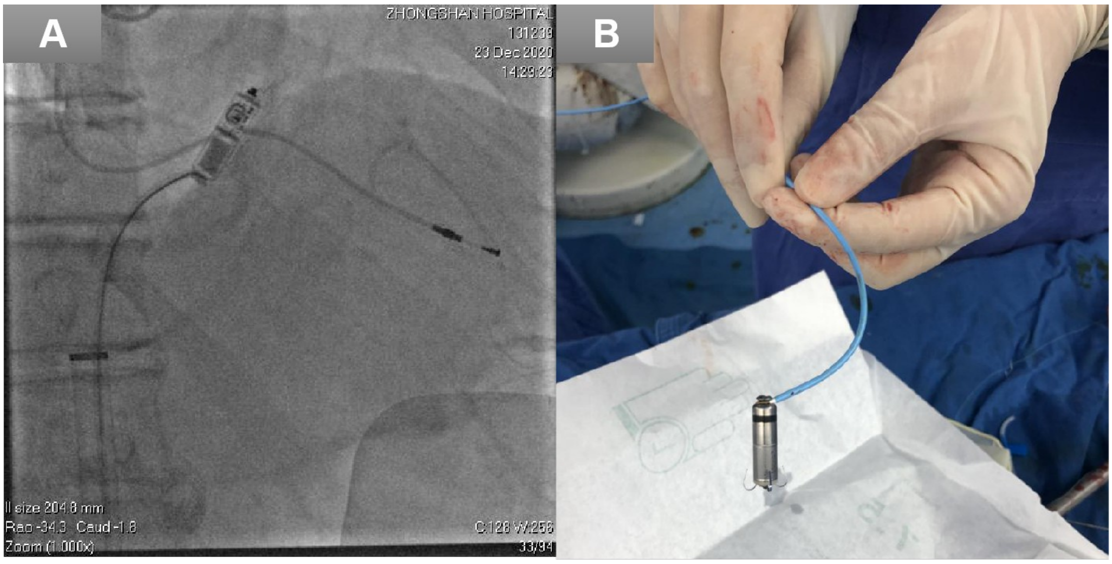
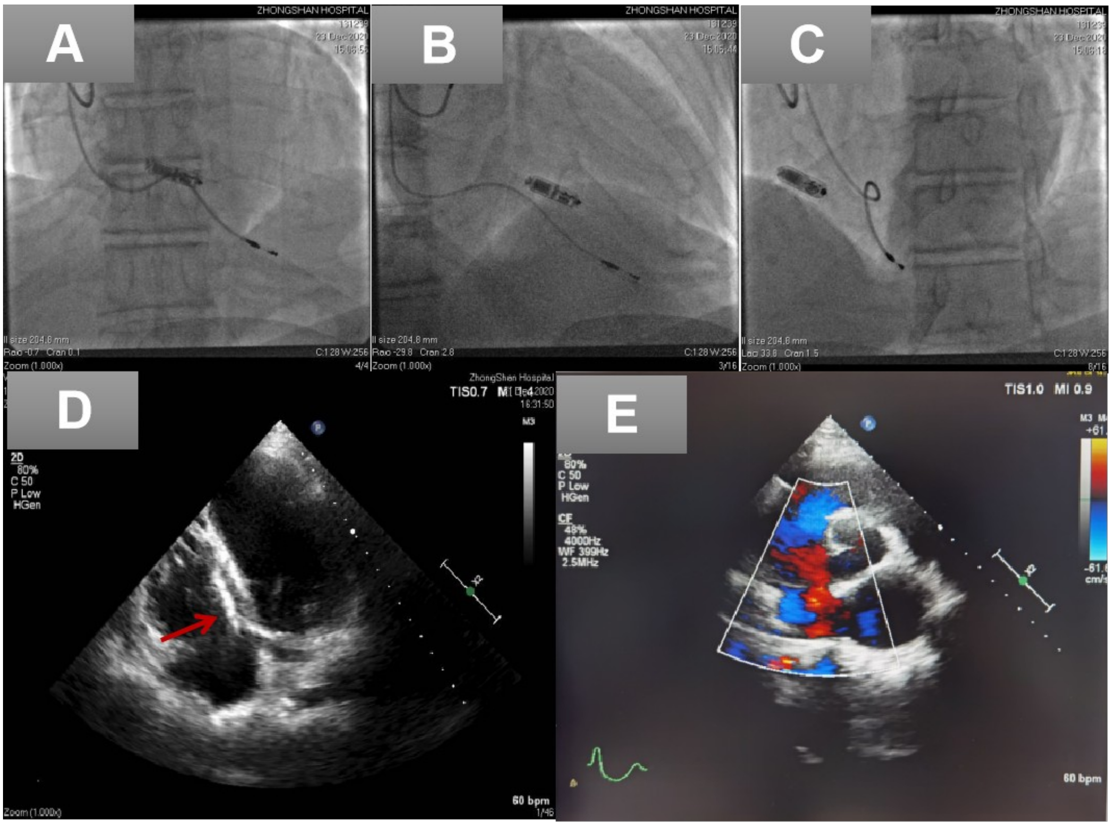


Figure 4 The images of the new Micra TPS after re-implantation: The fluoroscopic images at poster-anterior position (A), at RAO 30° (B) and at LAO 35°(C); The echocardiogram showed (D) the location of Micra TPS (red arrow) at the low septum of the right ventricle; (E) no valve damage or worsening of tricuspid regurgitation after retrieval and re-implantation.



Reference:

[1] Lee Justin Z,Mulpuru Siva K,Shen Win K,Leadless pacemaker: Performance and complications.[J] .Trends Cardiovasc Med, 2018, 28: 130-141.

[2] Cantillon Daniel J,Dukkipati Srinivas R,Ip John H et al. Comparative study of acute and mid-term complications with leadless and transvenous cardiac pacemakers.[J] .Heart Rhythm, 2018, 15: 1023-1030.

[3] Wang Yan,Hou Wenbo,Zhou Chao et al. Meta-analysis of the incidence of lead dislodgement with conventional and leadless pacemaker systems.[J] .Pacing Clin Electrophysiol, 2018, 41: 1365-1371.

[4] Garg Aatish,Koneru Jayanthi N,Fagan Dedra H et al. Morbidity and mortality in patients precluded for transvenous pacemaker implantation: Experience with a leadless pacemaker.[J] .Heart Rhythm, 2020, 17: 2056-2063.

[5] Reddy Vivek Y,Miller Marc A,Knops Reinoud E et al. Retrieval of the Leadless Cardiac Pacemaker: A Multicenter Experience.[J] .Circ Arrhythm Electrophysiol, 2016, 9: undefined.

[6] Dar Tawseef,Akella Krishna,Murtaza Ghulam et al. Comparison of the safety and efficacy of Nanostim and Micra transcatheter leadless pacemaker (LP) extractions: a multicenter experience.[J] .J Interv Card Electrophysiol, 2020, 57: 133-140.

[7] Wang Yan,Hou Wenbo,Zhou Chao et al. Meta-analysis of the incidence of lead dislodgement with conventional and leadless pacemaker systems.[J] .Pacing Clin Electrophysiol, 2018, 41: 1365-1371.

[8] Grubman Eric,Ritter Philippe,Ellis Christopher R et al. To retrieve, or not to retrieve: System revisions with the Micra transcatheter pacemaker.[J] .Heart Rhythm, 2017, 14: 1801-1806.

[9] Curnis Antonio,Cerini Manuel,Mariggiò Davide et al. First-in-human retrieval of chronically implanted Micra transcatheter pacing system.[J] .Pacing Clin Electrophysiol, 2019, 42: 1063-1065.

[10] Fichtner Stephanie,Estner Heidi L,Näbauer Michael et al. Percutaneous extraction of a leadless Micra pacemaker after dislocation: a case report.[J] .Eur Heart J Case Rep, 2019, 3: undefined.

[11] Sterliński Maciej,Demkow Marcin,Plaskota Karolina et al. Percutaneous extraction of a leadless Micra pacemaker from the pulmonary artery in a patient with complex congenital heart disease and complete heart block.[J] .EuroIntervention, 2018, 14: 236-237.

[12] Romeo Emanuele,D'Alto Michele,Cappelli Maurizio et al. Retrieval of a leadless transcatheter pacemaker from the right pulmonary artery: A case report.[J] .Pacing Clin Electrophysiol, 2020, doi: 10.1111/pace.14135.

[13] Li Jianwen,Hou Wen-Bo,Cao Ming-Kun et al. Safety and efficacy of leadless pacemaker retrieval.[J] .J Cardiovasc Electrophysiol, 2019, 30: 1671-1678.

[14] Asirvatham Roshini S,Vaidya Vaibhav R,Thome Trena M et al. Nanostim leadless pacemaker retrieval and simultaneous micra leadless pacemaker replacement: a single-center experience.[J] .J Interv Card Electrophysiol, 2020, 57: 125-131.