JACC: CASE REPORTS VOL. 2, NO. 14, 2020


MINI-FOCUS ISSUE: ELECTROPHYSIOLOGY

ADVANCED

CASE REPORT: CLINICAL CASE

# Successful Retrieval of a 4-Year-Old Micra Transcatheter Pacemaker System in a Patient With Leadless Biventricular Pacing Therapy

Kentaro Minami, MD,[a] Jürgen Shtëmbari, MD,[a] Jan Petrů, MD,[a] Milan Chovanec, MD,[a] Moritoshi Funasako, MD,[a] Pavel Hála, MD,[a] Marek Janotka, MD,[a] Jan Škoda, MD,[a] Lucie Šedivá, MD, PhD,[a] Vivek Y. Reddy, MD,[a,b] Petr Neužil, MD, PhD[a]

## ABSTRACT

This is the first report of the management of a patient with cardiac resynchronization therapy using leadless biventricular pacing. Successful retrieval of a 4-year-old Micra transcatheter pacing system (TPS) and reimplantation of a new Micra TPS prevented device-to-device interactions from multiple pacing devices in the right ventricle. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2020;2:2249–52) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

The Micra transcatheter pacing system (TPS) (Medtronic, Minneapolis, Minnesota) is a clinically effective alternative to transvenous pacemakers for single-chamber ventricular pacing (1). Although abandonment of the TPS at the end of its life is recommended, its retrievability is a critical management strategy in specific scenarios. However, there are no detailed studies of the safety and feasibility of retrieving and replacing a long-standing implanted Micra TPS.

## LEARNING OBJECTIVES

- To understand the retrieval procedure of a long-standing implanted Micra transcatheter pacing system.
- To discuss the safety and feasibility of the reimplantation of a new leadless cardiac pacing device immediately after retrieval of the old device.
- To describe the first report of the management of a patient with completely leadless CRT, combining a leadless right ventricular pacemaker and a wireless ultrasonic LV endocardial pacing system.

In this case study, we describe the retrieval of a long-standing implanted Micra TPS 4 years after initial implantation and the reimplantation of a new Micra TPS immediately after retrieval of the old device. The patient previously underwent device implantation with a leadless endocardial left ventricular (LV) pacing system (2), thereby allowing the implementation of completely leadless cardiac resynchronization therapy (CRT) combined with right ventricular pacing using the Micra TPS. To the best of our knowledge, this is the first case report of the successful management of a Micra TPS that has

From the [a]Na Homolce Hospital, Prague, Czech Republic; and the [b]Icahn School of Medicine at Mount Sinai, New York, New York.
The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Case Reports* author instructions page.

Manuscript received June 29, 2020; revised manuscript received September 8, 2020, accepted September 18, 2020.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2020.09.019

**ABBREVIATIONS AND ACRONYMS**

**CRT** = cardiac resynchronization therapy

**LV** = left ventricular

**TPS** = transcatheter pacing system

reached the end of its life in a patient with leadless CRT.

## PAST MEDICAL HISTORY

A 79-year-old patient with a history of complex cardiac surgery (mitral and tricuspid valve annuloplasty) underwent implantation of a Micra TPS to treat permanent atrial fibrillation with a slow ventricular response. After 2 years of dominant ventricle pacing, LV function deteriorated to 25%; therefore, we suggested CRT. Because of the technical failure of transvenous LV pacing, a wireless LV endocardial pacing system (WiSE-CRT System, EBR Systems, Sunnyvale, California) was implanted (2). Following the induction of the leadless biventricular pacing therapy, the LV ejection fraction improved to 60%.

## DIFFERENTIAL DIAGNOSIS

The differential diagnosis of systolic heart failure includes pacemaker syndrome caused by right ventricular pacing, coronary artery disease, and cardiomyopathy.

## INVESTIGATIONS

The electrocardiogram revealed biventricular pacing, and the QRS complex width was 120 ms.

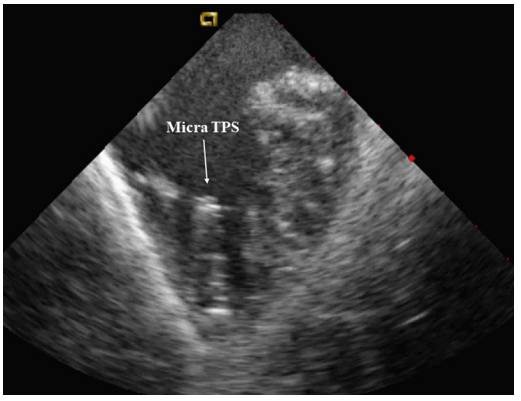
## HISTORY OF PRESENTATION

At 4 years after initial implantation of a Micra TPS, the patient was admitted for elective retrieval and reimplantation of a new Micra device as a result of battery depletion. Written informed consent was obtained from the patient after providing a clear explanation of the basic principle of the possibility of retrieval or abandonment of the Micra TPS.

## MANAGEMENT

The retrieval catheter system was inserted through the right femoral vein accessed using a 23-F Micra TPS sheath (Medtronic). Given the lack of a dedicated system for Micra TPS retrieval, we used the regular delivery catheter system for Micra TPS implantation. The device was clearly visualized using a 10-F intracardiac echocardiography catheter (AcuNav Siemens-Acuson, Inc., Mountain View, California) (**Figure 1**). A single-loop 7-mm snare wire (Amplatz Goose Neck Microsnare, ev3 Inc., Plymouth, Minnesota) was inserted through the Micra delivery catheter. By using the advanced snare, the system's distal cone was deployed around the proximal retrieval feature of the

**FIGURE 1 Intracardiac Echocardiogram Imaging of the Micra Transcatheter Pacing System**




Courtesy of Medtronic, Minneapolis, Minnesota.

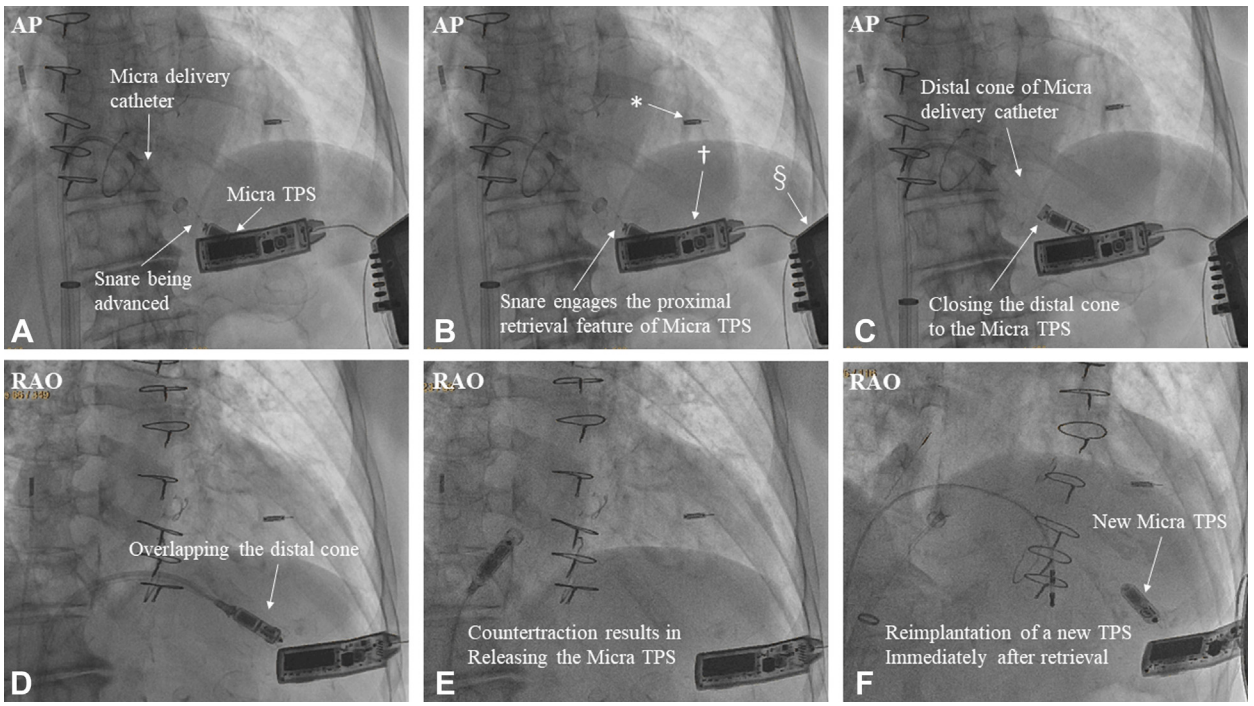
Micra TPS. After coaxial alignment between the snare and the retrieval feature was confirmed using multiplane fluoroscopy, the snare was closed and locked around the proximal retrieval feature of the Micra TPS. Once the snare was closed, the snare loop was tightened to hold the device firmly, providing tension on the snare along with a countertraction force from the distal cone that resulted in the release of the tines from the myocardium. Then, the Micra TPS and the delivery catheter were withdrawn into the introducer sheath and were removed from the body (**Figures 2A to 2F**). The patient received a new pacing device immediately after attempted device retrieval. The reimplantation of a new Micra TPS was successful, and the satisfactory electrical parameters were recorded. The fluoroscopic time during the retrieval procedure was 12 min. No procedure-related adverse device events occurred during the retrieval attempts or the reimplantation procedure.

## DISCUSSION

To the best of our knowledge, this is the first case report of the successful management of a Micra TPS at the end of its battery life in a patient with leadless CRT. We identified the following 2 crucial clinical issues: 1) the long-standing implanted Micra TPS was retrieved safely; and 2) implanting a new leadless cardiac pacing device immediately after retrieval of the old device could be a safe and feasible strategy.

First, although there is no dedicated system for the retrieval of a long-standing implanted Micra TPS, retrieval can be safely performed with currently available tools. The retrievability of an implanted

**FIGURE 2** Fluoroscopic Views of Leadless Pacemaker Retrieval




**(A)** The system's distal cone is positioned at the proximal aspect of the device. After snare advancement, the catheter is deployed around the proximal retrieval feature of the Micra transcatheter pacing system (TPS). **(B)** The snare is engaged and locked around the retrieval feature the Micra TPS. **(C and D)** After engaging the snare, the distal cone is docked and crossed over the Micra TPS. **(E)** Tension on the snare along with countertraction from the distal cone results in the release of the tines from the myocardium, and the Micra TPS is withdrawn from the patient's body. **(F)** Reimplantation of a new Micra TPS is performed immediately after retrieval. *Left ventricular electrode of WiSE (EBR Systems, Sunnyvale, California); †transmitter; §battery pack. AP = anteroposterior; RAO = right anterior oblique.

Micra TPS has several clinical implications, including the possibility for elective reimplantation of a new Micra TPS and reductions in the risk of potential device-to-device interactions and long-term risks of multiple devices implanted in the right ventricle. Notably, this patient had indications for CRT by leadless biventricular pacing. Therefore, ventricular arrhythmias caused by device-to-device interactions from multiple devices in the right ventricle could affect the CRT response and cardiac function. Because of the successful retrieval of the 4-year-old Micra TPS, we avoided the unpredictable effects caused by the presence of multiple pacing devices in the right ventricle.

Second, reimplantation of a new leadless pacing device after retrieving the Micra TPS could be a safe and feasible strategy for the management of patients with a Micra TPS whose battery life is ending or in patients requiring device replacement for other reasons. Reimplantation of a new Micra TPS after retrieval may be preferable over traditional transvenous device systems because a leadless pacemaker can prevent transvenous lead- and pocket-related complications. Furthermore, limiting the procedure to only 1 puncture at the right femoral vein for both retrieval and reimplantation procedures is advantageous.

Two approaches can be used for Micra TPS retrieval (3). Both require femoral venous access with the insertion of a Micra TPS introducer sheath. The next step involves advancing the snare and an integrated protectable sleeve using either a Micra delivery catheter or a steerable sheath. The differences between these 2 approaches are the acceptable snare size and the ability to apply a contraction force to detach the Micra TPS from the myocardium. It is easier to snare the retrieval feature using a steerable sheath because this allows the use of a 20-mm loop diameter snare. The Micra delivery catheter accommodates only a 7-mm diameter snare; however, it enables the operator to provide true contraction by using the device's distal cone. Another limitation of the steerable sheath is that because of its small diameter, the Micra TPS cannot be withdrawn into the

steerable sheath. In our case, we used the Micra delivery system and a 7-mm loop diameter snare for the retrieval procedure. Although the snare size was small, it was sufficient to catch the proximal retrieval feature of the Micra TPS.

To summarize, it is feasible to retrieve a long-standing implanted Micra TPS safely and immediately reimplant a new Micra TPS. These findings may alleviate the concern of potential interactions among multiple intracardiac devices in patients with a long life expectancy and could lead to the more widespread use of the Micra TPS. A worldwide Micra TPS registry should be implemented, and future studies addressing the retrieval of long-standing implanted Micra TPS devices should be undertaken to elucidate its safety and efficacy further.

## FOLLOW-UP

The patient has been followed up uneventfully for more than 1 year after Micra TPS retrieval and reimplantation. The LV ejection fraction has been maintained at 65%, and no symptoms of heart failure have been observed.

## CONCLUSIONS

The retrieval of a long-standing implanted Micra TPS can be safely performed, thus indicating the possibility of its safe and elective replacement with a new leadless cardiac pacing device.

## AUTHOR DISCLOSURES

This work was supported by the Ministry of Health of the Czech Republic (DRO; NNH, 00023884). Dr. Reddy has been a consultant with Abbott, Axon, Biosense Webster, Biotronik, Boston Scientific, Cardiofocus, Cardionomics, CardioNXT/AFTx, EBR, Impulse Dynamics, and Medtronic; has been a consultant for and received equity from Acutus Medical, Affera, Apama Medical, Autonomix, Backbeat, BioSig, Circa Scientific, Corvia Medical, East End Medical, EPD, Epix Therapeutics, EpiEP, Eximo, Impulse Dynamics, Farapulse, Javelin, Keystone Heart, LuxCath, Medlumics, Middlepeak, Northwind, Surecor, Valcare, and VytronUS; and has received equity from Manual Surgical Sciences, Newpace. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

**ADDRESS FOR CORRESPONDENCE:** Dr. Petr Neužil, Na Homolce Hospital, Roentgenova 37/2, 15030, Praha 5, Czech Republic. E-mail: pneuzil@seznam.cz.

## REFERENCES

**1.** Reynolds D, Duray GZ, Omar R, et al. A leadless intracardiac transcatheter pacing system. N Engl J Med 2016;374:533–41.

**2.** Reddy VY, Miller M, Neuzil P, et al. Cardiac resynchronization therapy with wireless left ventricular endocardial pacing. The SELECT-LV study. J Am Coll Cardiol 2017;69:2119–29.

**3.** Afzal MR, Daoud EG, Cunnane R, et al. Techniques for successful early retrieval of the Micra transcatheter pacing system: a worldwide experience. Heart Rhythm 2018;15:841–6.

**KEY WORDS** endocardial pacing system, leadless cardiac pacemaker, left ventricular, pacemaker retrieval