

# Leadless pacemaker twins in an achondroplastic dwarf



Giovanni Morani, MD, Bruna Bolzan, MD, Emma Zimelli, MD, Luca Tomasi, MD, Ruggero Tomei, MD, Flavio Luciano Ribichini, MD

From the Division of Cardiology, Department of Medicine, University of Verona, Verona, Italy.

## Introduction

The Micra Transcatheter Pacing System (MTPS, Medtronic, Minneapolis, MN) is a novel expanding technology with some potential advantages over traditional transvenous pacing systems, especially in regard to lead- and pocket-related complications. Accumulating scientific evidence supports the safety and effectiveness of MTPS technology.

A relevant open question is end-of-life (EOL) management of the MTPS.<sup>1</sup> To date, given the absence of a specific extraction tool and the procedural risks of approaching a fully encapsulated device, the current opinion and recommendation of the manufacturer is to abandon and turn off the old device and implant a new one. However, there is very little data to support the feasibility and safety of multiple Micra implantation in humans.

The management of a unique, challenging case of an achondroplastic dwarf is described, previously implanted with an MTPS that prematurely reached EOL, owing to progressive threshold elevation and 100% right ventricular (RV) pacing.

## Case report

A 73-year-old patient affected by diabetes mellitus and achondroplastic dwarfism with the pathognomonic phenotypical features, characterized by small size (height of 120 cm, weight of 39 kg), disproportionately short upper limbs, and an abnormal limb-to-trunk ratio, underwent pacemaker implantation in 1970 for complete atrioventricular block. Over the years, the patient experienced multiple system revisions owing to recurrent RV lead failures and pocket infections. In 2011, owing to a pocket infection that evolved into sepsis with endocarditis of the tricuspid valve, the patient underwent complete system extraction by means of open heart surgery followed by tricuspid plasty and an epicardial dual-chamber pacemaker placement with leads tunneling to an abdominal pocket. The cardiac surgery was complicated by pneumomediastinum, respiratory failure, and permanent

## KEY TEACHING POINTS

- The management of Micra Transcatheter Pacing System (MTPS, Medtronic, Minneapolis, MN) end of life is still an unsolved issue; a possible and feasible solution is multiple MTPS implantation.
- In case of multiple MTPS implantation the abandoned Micra device does not affect the proper functioning of the new device.
- Multiple MTPS may affect the proper functioning of the remote monitor.

tracheostomy. In 2015, an untreatable abdominal pocket infection occurred and the patient was referred to our center in 2016. Given the absolute dependency of the patient from pacing and the extremely high infection risk, it was decided firstly to implant MTPS, successfully accomplished by the standard technique,<sup>2</sup> and secondly to partially remove the epicardial pacing system, performed via minithoracotomy 1 month later without complications.

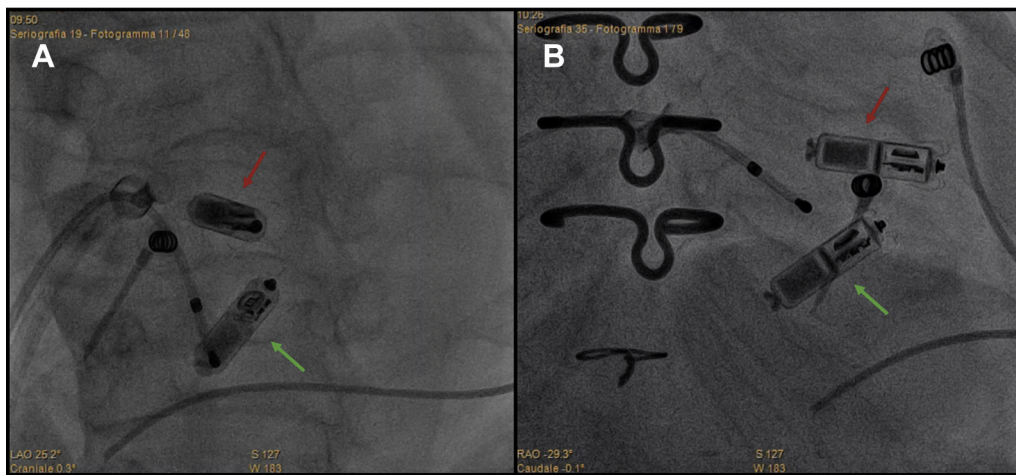
During the follow-up, a slow progressive capture threshold increase was observed from 0.8 V at 0.24 ms up to 2.25 V at 0.40 ms, making the device prematurely reach EOL in October 2018. The patient was on atrial fibrillation with a pacing rate of 100%. Impedance was stable and no radiological dislodgment of the MTPS was recognized. An echocardiogram showed preserved biventricular function and the presence of MTPS inside the RV.

The MTPS needed to be replaced. A multidisciplinary approach, involving an anesthesiologist and a cardiac surgeon in addition to cardiologists, carefully balanced the risk/benefit ratio of each option and shifted towards a new MTPS implantation, without extraction of the chronically implanted one.

The procedure was performed under local anesthesia by the standard technique. A temporary pacemaker was positioned for pacing backup in case of MTPS pacing inhibition owing to possible electrical interference with the previous device. The delivery catheter greatly exceeded in length the inferior limbs of the patient and required careful

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**Address reprint requests and correspondence:** Dr Giovanni Morani, Azienda Ospedaliera Universitaria Integrata Verona, Piazzale Stefani 1, Verona 37126. E-mail address: [giovanni.morani@aovr.veneto.it](mailto:giovanni.morani@aovr.veneto.it).



**Figure 1** **A:** Left anterior oblique view of the twin Micra devices (Medtronic, Minneapolis, MN) implanted. **B:** Right anterior oblique view of the twin Micra devices implanted. In both panels the red arrow points to the new Micra and the green arrow points to the previously implanted Micra.

manipulation. A step-by-step mapping of the interventricular septum, by repeated injection of a small quantity of contrast media through the delivery system, was used to select the best position for MTPS deployment, avoiding any contact with the previously implanted one. The MTPS was successfully deployed in the interventricular septum at the first attempt (Figure 1A, Supplemental video), with optimal electrical parameters (capture threshold 0.38 V at 0.24 ms, impedance 630 ohms). No periprocedural complications occurred (Figure 1B). The old MTPS was turned off (OOO mode) and the temporary pacemaker was removed. The procedural time, skin to skin, lasted 45 minutes.

The patient was given a remote monitor before discharge to be followed by remote control (CareLink, Medtronic, Minneapolis, MN). The 6-month follow-up showed the electrical parameters were stable and optimal (capture threshold 0.38 V at 0.24 ms, impedance 620 ohms, estimated longevity >9 years), the echocardiogram showed no deterioration of biventricular function, and tricuspid regurgitation was unmodified. The patient was free from infections.

Notably, a difficulty in the MTPS interrogation was encountered both in the ambulatory follow-up and during remote transmission via remote monitoring. The automatic recognition of the device through the programmer's magnet did not work properly and MTPS interrogation was allowed only by manual selection of the functioning device. The CareLink monitor's reader did not work at all, as it was unable to recognize the device.

## Discussion

While the EOL management of traditional pacemakers is a simple box exchange procedure, the best strategy to manage MTPS EOL is still an unsolved issue. Given an MTPS average longevity of 10 years, the necessity of device replacement could occur 1 or more times during a patient's lifetime. The inability to retrieve the device could be a major limitation for its applicability, especially in young patients.

As a Hamletic dilemma, the dichotomous options “to extract or not to extract” begin to appear in the clinical scenario.

### “To extract”

The leadless pacemaker extraction generally seems to be a more appealing option that allows to avoid the accumulation of exhausted intracardiac hardware. However, the lack of specific extraction tools for the MTPS raises a relevant issue about the feasibility and safety of the extraction procedure of a chronically implanted device.

Early encapsulation of the device contributes to making the outcome of an extraction attempt challenging and unpredictable. The available literature is limited, and the time interval from implantation to extraction is often relatively short so that most of the reported procedures could be considered “late retrieval” rather than “extraction.” In any case, the reported experience seems to be mostly frustrating owing to the difficulties and prohibitive risks encountered in the removal of a device progressively encapsulated by fibrous tissue.<sup>1</sup>

### “Not to extract”

Given the aforementioned issues, current opinion, and the manufacturer's recommendation, it seems more reasonable to avoid MTPS extraction and to add a new device.

Some studies in cadaver and swine models seem to support the capability of the RV to accommodate up to 3 MTPS.<sup>3,4</sup> In these studies, however, no pacing therapy was delivered, no electrical parameters were collected, and the possibility of unexpected electrical interference among multiple MTPS was not explored. Moreover, mechanical and electrical interactions among MTPS in contracting human hearts might be quite different from cadaver or swine models and remains an unexplored field.

To our knowledge there is very little research about 2 MTPS implantations in a normally grown adult with limited follow-up.<sup>5,6</sup>

It could be argued that even though MTPS multiple implantation seems an easy and reassuring solution to the MTPS EOL management issue, the lack of data in humans does not allow to draw any firm conclusion about its safety, with particular regard to the possibility of detrimental effect on RV physiology and the risk of unfavorable electrical interactions among MTPS devices.

Considering all the aforementioned issues, the decision “to extract or not to extract” could benefit from a careful risk/benefit analysis that should take into account, case by case, the clinical condition of the patient.

In this case report, some specific clinical features such as advanced age, the frail nature of the patient, diabetes, the dependency from pacing, and, most of all, the history of previous major cardiac surgery, complicated by respiratory failure and permanent tracheostomy, markedly raised the anesthesiologic and procedural risk of extraction. Moreover, in case of abrupt major complications, an urgent reoperation could be a challenging and less feasible solution, since the postsurgical intrapericardial and intrathoracic adhesions might complicate the technical aspect of an emergent redo sternotomy, requiring a time-consuming dissection of fibrous tissue.

Finally, from a purely technical point of view, the position of the prior device with a downward orientation of the tail could have made the snaring of the docking button very challenging.

On the other hand, if considering the addition of a new MTPS, the small body size and the unique anatomical feature could carry an intrinsic additional procedural risk, with the great uncertainty of adaptability of 2 MTPS to such a particular anatomy.

A multidisciplinary approach helped to weigh the risk/benefit ratio of the choices and pointed towards a new MTPS implantation without extraction. At 6-month follow-up, the biventricular function and tricuspid regurgitation showed no deterioration. It could be argued that the careful

mapping of the interventricular septum played a key role for selection of the best site for deployment to avoid any physical and electrical interference with the chronically implanted MTPS and the tricuspid valve. Notably, according to Class 2 Device Recall MyCareLink Patient Monitor n. Z-0399-2018 ID 77964, the CareLink remote monitoring system did not work properly; namely the new implanted MTPS was not automatically recognized by the MyCareLink patient monitor, which was unable to distinguish the functioning device from the abandoned one, so that it was impossible to remotely monitor the device.

More in vivo cases and longer follow-up periods are required to investigate feasibility and safety of multiple MTPS implantation and, more generally, to identify the best strategy of MTPS EOL management.

## Appendix Supplementary data

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.hrcr.2020.04.006>.

## References

1. Grubman E, Ritter P, Ellis CR, et al. To retrieve, or not to retrieve: system revisions with the Micra transcatheter pacemaker. *Heart Rhythm* 2017;14:1801–1806.
2. Morani G, Bolzan B, Borio G, Tomasi L, Ribichini FL. Leadless pacemaker implantation in achondroplastic dwarfism and recurrent cardiac implantable electronic device infections: a case report. *Europace* 2018;1:1160. 20.
3. Omdahl P, Eggen MD, Bonner MD, Iazzo PA, Wika K. Right ventricular anatomy can accommodate multiple Micra Transcatheter Pacemakers. *Pacing Clin Electrophysiol* 2016;39:393–397.
4. Chen K, Zheng X, Dai Y, Wang H, Tang Y, Lan T. Multiple leadless pacemakers implanted in the right ventricle of swine. *Europace* 2016;18:1748–1752.
5. Boldt LH, Lacour P, Pieske B, Haverkamp W, Blaschke F. First-in-human: leadless Micra transcatheter pacing system meets the Nanostim leadless cardiac pacing system. *Europace* 2018;20:391.
6. 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;15:841–846.