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EDITORIAL COMMENT

Micra Extraction

Macro Considerations*

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Development of the self-contained Micra (Medtronic, Minneapolis, Minnesota) transcatheter pacing system (TPS) was a seminal event in cardiac electrophysiology. Although it is still a niche product, owing to its ability to pace only the right ventricle, its mere existence has given us a glimpse into the future of cardiac pacing. The WiSE (EBR Systems, Sunnyvale, California) cardiac resynchronization (CRT) system, although still investigational in the United States and not fully self-contained, has added to the vision of a completely leadless system, in this case, for the purposes of CRT. While leadless technology is elegant and appealing in its own right, avoidance of transvenous leads holds the promise of decreasing infection rates and obligatory transvenous lead extraction (TLE) procedures, which carry risk and cause angst. As with any new technology, however, one must anticipate potential problems prior to full adoption.

When transvenous leads were first routinely implanted in the 1960s, both the indications and the techniques for TLE were uncertain. Since then, multiple tools and techniques have been developed with various degrees of success and safety. Tools and techniques have included sustained traction with adhesive tape or a weighted pulley system; internal traction with intravascular snares via the vena cavae; and surgical approaches, either limited or via open sternotomy (1). Not surprisingly, there were many complications during this evolution, until novel tools and concepts ultimately ushered in the sheath-based counter-traction era, the standard method used today. As indications are directly related to the risk of the procedure, these indications too have evolved commensurate with the safety and efficacy of the TLE techniques in vogue at the time. Historically, only patients with life-threatening conditions such as infection underwent TLE, whereas recent data suggest approximately one-half of these procedures are now performed for indications other than infection (2).

In this issue of *JACC: Case Reports*, Minami et al. (3) present a 79-year-old patient with a history of complex valvular surgeries who received a Micra TPS to manage permanent atrial fibrillation with a slow ventricular response. The system was ultimately upgraded to CRT by way of a wireless left ventricular endocardial pacing system (WiSE-CRT) after the technical failure of transvenous lead placement. Four years after initial implantation, the patient was admitted for elective Micra TPS retrieval and reimplantation due to battery depletion using fluoroscopic and intracardiac echocardiographic (ICE) visualization. A 7-mm snare was placed through the 23-F Micra TPS delivery catheter and traction on the snare along with countertraction from the distal cone, resulted in the release of the tines from the myocardium. The patient had a replacement Micra TPS implanted through the same sheath and was doing well at 1 year. The authors concluded that Micra TPS retrieval could be safely performed with currently available tools, facilitating the possibility of elective reimplantation of a new Micra TPS, with reductions in the risk of potential device-to-device interactions and long-term risks of multiple devices implanted in the right ventricle.

Several aspects of this paper warrant comment. The patient's relatively advanced age of 79 years and history of extensive cardiac surgery potentially made removal easier with less risk of myocardial injury (4). Although the authors did not state as such, the Micra TPS removed at 4 years likely had a high pacing threshold as devices placed

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within the Micra Transcatheter Pacing Study had an estimated battery longevity of 12.5 years; with 94% lasting more than 10 years (5). Because dwell time is correlated with extraction difficulty (6), successful removal in this case does not necessarily imply comparable results with older devices in younger patients, where the degree of endothelialization may be more pronounced (7). This degree of endothelialization, and our ability to accurately identify it, represents an important variable for future consideration. Indeed, even a thin layer of tissue on the proximal retrieval feature will make percutaneous removal challenging if not impossible. Fortunately, indications for removal of a fully endothelialized device are few if any, as this may render it more resistant to infection than it already is (8,9). Although ICE suggested a lack of complete endothelialization in this case, this application has not been validated, and future studies are needed to improve our ability to assess this phenomenon, whether it be with an ultrasonography-based method, computerized tomography, cardiac magnetic resonance, endoscopic visualization, or evaluation of genetic predisposition.

When a device can be snared, controlled counter-traction, a basic tenet of TLE, is essential for the safe removal of devices within the heart. With a replacement device planned, the authors had the benefit of using the implantation sheath for counter-traction, although this sheath was not designed as an extraction tool and might have been insufficient in more challenging cases. As this sheath is not commercially available without a new Micra TPS included, the authors appropriately describe another method of removal, namely, the use of a large snare through a deflectable sheath. This method provides flexibility and ease of movement but, due to its small size, does not provide direct counter-traction. Simple traction may prove to be inadequate and potentially dangerous in more challenging cases, and it is incumbent upon the cardiac pacing community to develop safe and effective extraction tools that allow for the same principles of TLE counter-traction to be used in this scenario. Considering the variety of future leadless devices in various chambers of the heart, this may be easier said than done.

Whether empirical removal of a Micra TPS is beneficial is unknown. Arguments for abandonment include its small caliber (10); inevitable decrease in size with future iterations; risk of TLE with older devices; resistance to infection; expected heightened battery longevity; and in its application in older patients. Arguments for empirical removal include a more challenging extraction in the future if a compelling indication emerges, the potential for increased tricuspid regurgitation with additional devices (11), potentially fewer infections in the future with an extraction strategy (12), and lack of device-to-device interactions, although there are few data to support this final notion. Individual patient decisions will depend on additional patient characteristics and preferences, operator experience, technical innovations, and emerging data. The authors should be commended for calling for a worldwide Micra TPS registry to accumulate such information.

The emergence of the leadless pacing era will undoubtedly result in both known and unknown challenges, with the onus on the electrophysiology community to use and manage these new devices responsibly. As it relates to qualitative decision analysis, we would be wise to keep in mind historical lessons learned throughout the evolution of TLE, such as the Accufix experience (13) in order to avoid potentially making the solution worse than the problem. Although the sizes of the devices are shrinking, the implications of managing them are certainly not.

AUTHOR DISCLOSURES

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