

Anesthetic Consideration for Patients with Micra Leadless Pacemaker

Abstract

MICRA, miniaturized leadless single chamber pacemaker, is inserted directly into the right ventricular myocardium via transcatheter approach. We present a case of a 66-year-old patient with a Micra pacemaker scheduled for kidney-pancreas transplant. The patient is pacemaker dependent. The preoperative cardiology consult did not comment on the need of reprogramming. One hour prior to the surgery, the anesthesia team was unable to locate the pacemaker on the chest wall. The Medtronic hotline was called, and the caregivers learned that the particular pacemaker is buried within the ventricular wall and is not responsive to an external magnet. Thus, the case was delayed and a cardiac electrophysiology team was contacted to reprogram the pacemaker to VOO (fixed ventricular pacing) mode. We suggest that the pacemaker can pose perioperative challenges due to its novelty, paucity of report, and guidelines.

Keywords: EMI, MAGNET, MICRA

Introduction

Anesthesia personnel are challenged with ever more common and complex implanted medical devices (“black boxes”). Lack of familiarity and experience can lead to device mismanagement or failure resulting in patient complications.^[1] Approximately, 200,000 cardiac pacemakers are implanted every year in the United States alone.^[2] Since the first pacemaker implantation in 1950s, the technology, sophistication, and complexity of these devices continue to advance. Leadless pacemakers have been approved for use in Europe since 2013 but the first leadless cardiac pacing system was approved for use in the United States in 2016.^[3] Currently, two leadless pacing systems are available: The Micra transcatheter Pacing system (Micra TPS; Medtronic, Minneapolis, MN) and the Nano stim Leadless Cardiac Pacemaker (St. Jude Medical, Sylmar, California USA).^[4] Both systems utilize advanced battery technology that facilitates leadless implantation, with the goal to reduce the significant potential morbidity associated with catheter-based delivery systems. However, these new pacemakers are not widely used and therefore anesthesiologists are less likely to be familiar with this technology. Supporting this hypothesis, we report a patient with

a Micra TPS pacemaker undergoing a kidney transplant surgery, but the unique perioperative requirements associated with this pacemaker were recognized only minutes prior to the scheduled start of the case.

Case Report

A 66-year-old man with a leadless Micra Transcatheter Pacemaker System was scheduled for kidney-pancreas transplant for end-stage renal disease secondary to long-term diabetes and hypertension. His significant past medical history included atrial fibrillation, diastolic heart dysfunction, and obstructive sleep apnea that required nightly continuous positive airway pressure. He previously underwent nephrolithotomy, vitrectomy of the left eye, atrioventricular nodal ablation and Micra pacemaker implantation for refractory atrial fibrillation with rapid ventricular rate response without complications.

The patient’s preoperative workup included normal values for his laboratory tests of a complete blood count, comprehensive metabolic panel, and liver function test with the exception of an elevated creatinine, BUN, and urea. His electrocardiogram and echocardiogram prior to the surgery showed complete heart block with ventricular pacing, normal bi-ventricular

**Sathappan Karuppiah,
Richard Prielipp,
Ratan K. Banik,**

*Department of Anesthesiology,
University of Minnesota,
Minneapolis, MN, USA*

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Address for correspondence:

*Ratan K. Banik, MD, PhD,
Department of Anesthesiology,
University of Minnesota,
Twin Cities Campus, B515
Mayo Memorial Building,
420 Delaware Street S.E., MMC
294, Minneapolis - 55455, MN,
USA.*

E-mail: rkbanik@umn.edu

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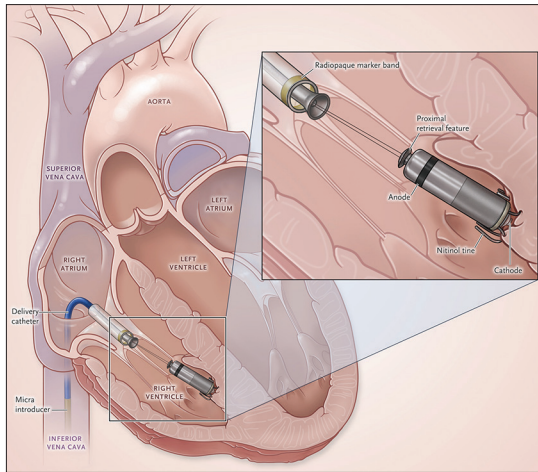


Figure 1: Leadless pacemaker (MICRA) located in the right ventricle

function, grade II diastolic dysfunction, and no valvular abnormalities. Preoperative cardiac stress testing did not reveal any inducible ischemia.

As a routine preparation for transplant surgery, he was evaluated by the inpatient cardiology team several hours before the surgery. The cardiologist recommended no further evaluation or tests necessary for the planned transplant surgery. Moreover, there were no recommendations for any special precautions regarding the Micra pacemaker.

One hour prior to the surgery during preoperative evaluation, the anesthesia team was unable to locate the pacemaker on the chest wall. The Medtronic hotline (1-800-633-8766, toll-free within the United States) was called for insights of this pacemaker, and caregivers learned this particular pacemaker is buried within the ventricular wall. Moreover, this type of pacemaker is not responsive to an external magnet. Since the patient is pacemaker dependent, the case was delayed to allow cardiac electrophysiology team reprogram the pacemaker (to VOO mode). His transplant surgery was then completed without complications.

Discussion

The Micra TPS pacemaker is 93% smaller than a conventional pacemaker and is directly implanted into the right ventricular myocardium.^[5,6] The pacemaker measures 2.6×0.7 cm and requires a 23-French introducer sheath which is placed via the transfemoral approach, but in selective patients, it has been successfully implanted via a transjugular approach.^[7,8] It has an estimated longevity of about 12 years.^[8] Micra pacemaker is recommended for patients with symptomatic high-grade atrioventricular nodal block with or without atrial fibrillation, symptomatic bradycardia-tachycardia syndrome, and sick sinus syndrome. It has pacing modes such as VVIR, VVI, VOO, and OVO.^[7,8] It has 63% fewer complications than conventional pacemakers, including problems that are related to either the lead wires themselves, or the

pacemaker pocket in the chest wall. Moreover, patient experiences no scar or deformity of the chest wall.^[9] The most common device-related complications include device dislodgement (1.7%), cardiac perforation (1.3%), and elevated pacing thresholds requiring device repositioning (1.3%).^[7,9,10]

Use of electrocautery in the intraoperative period can cause significant interference with these pacemakers as well as automated implantable cardiac defibrillators (AICD). Common problems include unintended pacemaker inhibition, inappropriate tracking or interpretation of electrical noise, damage at the lead-tissue interface, pulse generator damage, delivering inappropriate pacing or shocks, and the induction of an electrical reset mode.^[11,12] Sources of electromagnetic interference (EMI) in the perioperative period are the use of electrocautery, use of transcutaneous electrical nerve stimulation for postoperative pain, electroconvulsive therapy, radiation therapy, magnetic resonance imaging, and extracorporeal shockwave lithotripsy.^[13,14] The consensus statement from American society of anesthesiologist (ASA) and Heart rhythm society (HRS) recommends that focused preoperative evaluation should be done in patients with cardiovascular implantable electronic device, which includes defining the type and location of device, details of last device interrogation, manufacturer, model of the device, and dependency of the patient for antibradycardia pacing function and defibrillation.^[15,16]

ASA/HRS recommendations for pacemaker-dependent patients also include the use of the shortest feasible electrosurgical bursts. In addition, anesthesia professionals should have a magnet immediately available for procedures below the umbilicus and in nondependent patients, whereas they should actually place the magnet over device for procedures above the umbilicus or those that require extensive electrocautery.^[15,16] In AICD patients, recommendations are to use short electrosurgical burst and place magnet over the device to suspend tachyarrhythmia detection.^[16] However, there is no mention of newer devices such as leadless pacemakers like Micra.

Medtronic Leadless Micra pacemaker technology is a promising long-term permanent cardiac pacing option for patients requiring only RV pacing [Figure 1].^[17] However, because of its intracardiac location and absence of hall sensor, reprogramming cannot be achieved by clinicians at the bedside with placement of a magnet prior to or during surgery.^[18] In the absence of guidelines from ASA and HRS, it is important for anesthesiologists to determine the risk of EMI prior to surgical procedures. If there is a concern for EMI, Medtronic recommends to consider a preoperative asynchronous programming and restore device parameters after the surgery. In urgent cases where preoperative reprogramming is not be possible, general procedures should be followed as outlined in Table 1.^[19]

Table 1: Emergency pacemaker management absent reprogramming

Prepare:

1. Temporary pacing and defibrillation equipment in the operating room.
2. Brief surgeon about unique pacemaker and advice to use a bipolar electrocautery system or harmonic scalpel.^[18]
3. If a bipolar electrocautery system is not available, position the return electrode patch such that the electrical current pathway does not pass within 15 cm (6 in) of the device. Use short, intermittent, and irregular bursts at the lowest clinically appropriate energy levels.

Intraoperative Monitoring:

Consider manually monitor the patient's rhythm (take pulse); Consider monitoring the patient by some other means such as ear or finger pulse oximetry, Doppler pulse detection, or arterial pressure display.

Postoperative:

Consider postoperative interrogation if a) monopolar electrocautery was used, b) patient is hemodynamically unstable, and c) after cardiothoracic surgery, radiofrequency ablation or external cardioversion

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Conflicts of interest

There are no conflicts of interest.

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