Simultaneous atrioventricular node ablation and leadless pacemaker implantation

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Introduction

The ablate-and-pace technique is a well-established method to treat patients with persistent and paroxysmal atrial fibrillation with poor rate control on medical therapy.[1] The technique represents a class IIa indication to control heart rates when pharmacologic therapy is insufficient or intolerable.[2] As many of these patients are in permanent atrial fibrillation, they frequently require only single-chamber ventricular pacing after an atrioventricular (AV) node ablation. With the advent of transcatheter pacing systems, single-chamber pacemakers can now be implanted percutaneously without the need for leads or creation of a pocket or transvenous leads. Leadless pacemakers have a lower complication rate compared with that of traditional pacemakers in a historical control population.[3]

CaseReport

We present a case series of 2 patients with drug- or ablation-refractory atypical atrial flutter who underwent AV node ablation and implantation of a leadless Micra transcatheter pacemaker (Medtronic, Minneapolis, MN) through a single vascular access site.

The first patient was a 59-year-old male with a history of nonischemic cardiomyopathy with both systolic and diastolic dysfunction, atrial fibrillation, and atypical atrial flutter. He had been hospitalized multiple times for flash pulmonary edema in the setting of atrial flutter with rapid ventricular rate. Coronary artery disease had been excluded as an etiology for his cardiomyopathy, and tachycardia-mediated cardiomyopathy was thought to be the etiology. He also had severe ataxia, experienced frequent falls, and received infrequent medical care, which excluded him from being a candidate for thromboembolic prophylaxis with anticoagulation. A strategy of ablation or direct-current cardioversion that would convert him to normal sinus rhythm was contraindicated in this patient in the absence of anticoagulation for 4 weeks afterward. Because of his low ejection fraction of 37%, he was offered biventricular pacing with either a prepectoral or subpectoral implant, but he declined in favor of implantation of the Micra, as he refused a device that would leave a scar or that he could feel under his skin.

The second patient was an 84-year-old female with a history of atrial fibrillation with 2 prior ablations for atrial fibrillation and a third ablation for atypical atrial flutter. She developed recurrent atypical atrial flutter that was unresponsive to sotalol and direct-current cardioversions and was difficult to manage via rate control. She chose not to pursue a fourth left atrial ablation and desired an AV node ablation and pacemaker.

In both patients, access was obtained with ultrasound guidance in the right femoral vein, and the vein was serially dilated with 8F, 14F, and 20F dilators to accommodate the Medtronic 27F hydrophilic sheath. The dilator and wire were removed. The patient was given 3000 units of heparin intravenously. The Micra deployment catheter was advanced into the right atrium. The sheath was positioned across the tricuspid valve toward the right ventricular septum, and the Micra was deployed where appropriate sensing and thresholds were obtained. A tug test was performed, which revealed >2 of 4 tines secured to the myocardium. The final suture was cut and removed. The Micra catheter was then withdrawn from the outer sheath.

Initially, a 4-mm nonirrigated ablation catheter was advanced through the 27F sheath, but there was significant leakage of blood through the hemostatic plug. A 14F sheath was inserted into the 27F sheath, which achieved hemostasis, but there was persistent leakage when the ablation catheter was advanced through the 14F sheath. The previously used 8F sheath was inserted into the 14F sheath, and the hemostatic plug stayed intact (Figure 1). The ablation catheter was advanced just proximal to the His bundle location, and AV block was achieved with ablation (Figure 2). All catheter manipulation was performed under fluoroscopy to prevent dislodgement of the Micra (Figure 3). The ablation catheter and all sheaths were removed without incident, and the access site was sutured closed with a 2–0

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KEY TEACHING POINTS

- Implantation of a leadless pacemaker and atrioventricular node ablation for medically refractory atrial fibrillation can be performed safely during the same procedure and with a single access site.
- The ablate-and-pace technique remains an effective way to treat poorly controlled atrial fibrillation. Implantation of a leadless pacemaker with this procedure eliminates the long-term lead-related complications seen with traditional pacemakers.
- The Micra pacemaker (Medtronic, Minneapolis, MN) should be implanted in the mid to apical septum to prevent mechanical, electrical, or thermal complications from a subsequent atrioventricular node ablation.

silk figure-of-8 suture. Interrogation of the Micra after the ablation revealed stable sensing and pacing thresholds that were essentially unchanged from initial implantation.

Discussion

Although pulmonary vein isolation has become a mainstay therapy for medication-refractory atrial fibrillation, there still remains a role for AV node ablation in patients in whom pulmonary vein isolation has failed or who are not candidates for ablation. This procedure necessitates the implantation of a concomitant pacemaker. Traditional transvenous pacemakers have been associated with a complication rate of 9% -12%, including lead- and pocket-related complications.[3]

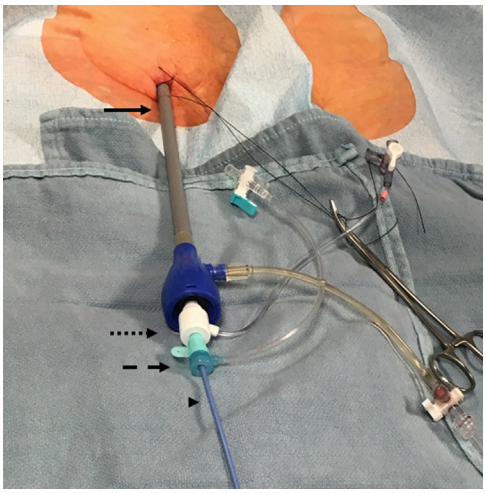

Figure 1 Multiple sheath assembly with the 27F Medtronic sheath (Minneapolis, MN; solid arrow),14F short sheath (dotted arrow), 8F sheath (hashed arrow), and 4.0-mm nonirrigated ablation catheter (arrowhead). The access site has been preclosed with a figure-of-8 suture and with a hemostat securing the ends of the suture.

These complications may include lead dislodgement, tricuspid regurgitation, subclavian vein thrombosis, pneumothorax, pocket infection or pocket hematoma, among others. Leadless pacemakers have been shown to have a significant reduction in complication rates compared with those of traditional pacemakers, likely because of the lack of leads or pocket creation.[4] Long-term follow-up of leadless pacemakers, though, is still underway. With the approval of a leadless pacemaker, AV node ablation patients can now benefit from the reduced complication profile associated with leadless pacemakers.

We have also demonstrated in our 2 cases that AV node ablation can safely be performed immediately after implantation of the Micra pacemaker. Potential risks with performing an ablation immediately after implantation include mechanical dislodgement, electrical damage to the device, electromagnetic interference if not programmed asynchronously, or conductive heating of tissue near the device. Prior studies have demonstrated the safety of radiofrequency ablation in the presence of pacemakers and implantable cardiac defibrillators, with low complication rates.[5] In both of our cases, there was no sign of detrimental electrical or mechanical effects on the Micra pacemaker and care was taken not to touch or dislodge the pacemaker using fluoroscopy. In addition, the pacing mode was programmed VVI, and there was no electromagnetic interference or pacing inhibition seen.

Another concern with AV node ablation after Micra implantation is the phenomenon of remote heating of the device from the ablation catheter. Nguyen et al demonstrated in an ex vivo animal model that remote heating of the metallic elements of a device occurred if placed within 5 mm of the electric field of the ablation catheter.[6] With this simultaneous technique, implantation of the Micra should be directed toward the mid to apical septum. This will avoid a situation in which the Micra is near the ablation catheter during AV node ablation.

An additional technical concern with performing a Micra implantation followed by AV node ablation from a single access site is the significant mismatch between the hemostatic valve in the 27F Medtronic sheath and the ablation catheter. We therefore inserted a 14F sheath into the introducer sheath and then an 8F sheath into the 14F sheath. The ablation catheter was finally inserted through the 8F as demonstrated in Figure 1, which allowed for a hemostatic seal during the ablation procedure. A similar technique through the 27F Medtronic sheath was described during snaring of a Micra.[7]

Conclusion

To our knowledge, these are the first documented cases of simultaneous leadless pacemaker implantation and AV node ablation with a single vascular access site. We demonstrate that AV nodal ablation can safely be performed immediately after implantation of a leadless pacemaker without the need for any additional vascular access and without dislodgement of the Micra pacemaker.

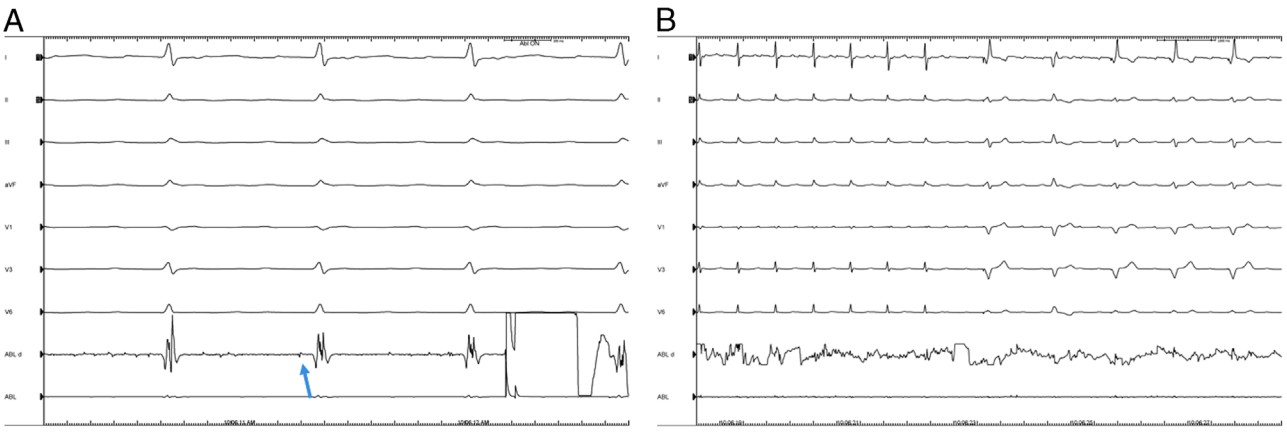

Figure 2 **A:** Signal on the ablation catheter prior to starting ablation, with arrow pointing to His electrogram (100 mm/s). **B:** Radiofrequency ablation and development of complete heart block with ventricular pacing at VVI 60 beats per minute (25 mm/s speed).

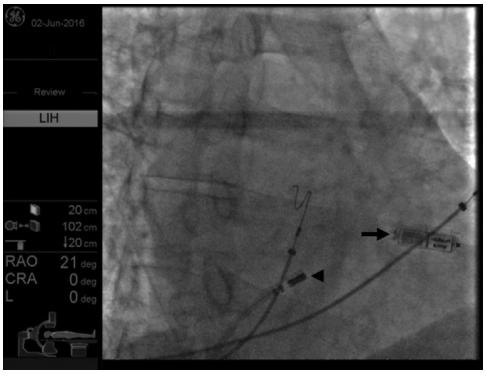

Figure 3 Right anterior oblique (RAO) fluoroscopic image of the ablation catheter in the His position (arrowhead) and Micra (Medtronic, Minneapolis, MN) deployed in the mid right ventricular septum (solid arrow).

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