Rapid Ablation of Recurrent Atrial Flutter Using a Novel Ablation Catheter

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ABSTRACT. Radiofrequency ablation of atrial flutter is a very successful procedure with rare recurrences. We report the first use of a novel radiofrequency ablation catheter with mini-electrodes embedded in the tip to detect and ablate the critical site of recurrent atrial flutter. A 57-year-old male with a history of hypertension presented with symptomatic atrial flutter. After cardioversion, radiofrequency ablation of the cavotricuspid isthmus (CTI) was performed. Bidirectional block was confirmed post ablation. The patient recurred with typical atrial flutter 5 months later. A repeat ablation procedure was performed utilizing the novel ablation catheter. Entrainment confirmed the flutter was CTI dependent. A site was located at the distal CTI with a sharp atrial electrogram located only on the mini-electrodes with a low-voltage far-field atrial electrogram recorded on the distal electrode. Ablation at this site terminated the atrial flutter within 33 s. This is the first report of a novel means of identifying the critical region of recurrent typical right atrial flutter, utilizing a new ablation catheter.

KEYWORDS. atrial flutter, cavotricuspid isthmus, novel technology, radiofrequency ablation.

Case report

A 57-year-old male with a history of hypertension and tobacco abuse presented with fatigue and dyspnea on exertion and was noted to be in atrial flutter. The appearance of the 12-lead electrocardiogram was consistent with typical counterclockwise cavotricuspid isthmus (CTI)-dependent right atrial flutter. The patient was initiated on anticoagulation with dabigatran and rate control with diltiazem and underwent a transesophageal echocardiogram and direct current cardioversion. Two months later, he presented for consultation regarding treatment options and he elected to pursue electrophysiology study with radiofrequency ablation of the CTI. He presented for the index procedure in sinus rhythm. A decapolar diagnostic catheter was placed in the coronary sinus and a Boston Scientific Blazer Prime 10-mm tip radiofrequency catheter was advanced to the CTI. Prior to the onset of ablation, a baseline electrophysiology study was performed including measurement of the baseline pacing interval of 93 ms from electrode 5/6 on the coronary sinus catheter to the atrial electrogram detected by the radiofrequency ablation catheter on the CTI. Ablation was commenced using settings of 100 watts for power, 80 degrees for maximum temperature, and 120 s for maximum time. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure. During the course of ablation, typical counterclockwise right atrial flutter was induced spontaneously at a cycle length of 220 ms. Electroanatomical mapping with the St. Jude Ensite (ESI) system was used to guide ablation lesion formation and minimize fluoroscopic exposure.
This pacing sequence was repeated at a location more lateral to the CTI line that again demonstrated bidirectional block with a shorter pacing interval, consistent with complete ablation of the CTI ablation region. The procedure was completed without complications.

At 3 months post procedure, the patient had no symptomatic recurrences of atrial flutter. Anticoagulation and rate control medications were discontinued. However, at 5 months post procedure, the patient presented to the hospital with dyspnea on exertion, and fatigue and, on admission, was found to have recurrent typical right atrial flutter with a 12-lead electrocardiogram that appeared identical in appearance to the original atrial flutter electrocardiogram. After a repeat transesophageal echocardiogram verified no left atrial appendage thrombus, the patient presented to the electrophysiology laboratory for repeat electrophysiology study and radiofrequency ablation. The set-up for the repeat procedure was identical to the original procedure with the exception that the Boston Scientific Intellatip MiFi XP 10-mm tip radiofrequency ablation catheter was utilized. This catheter has three mini-electrodes that are ~1 mm in diameter and are located ~2 mm from the tip of the catheter. These mini-electrodes enable localized electrogram recording of a small region at the center of radiofrequency energy delivery. These mini-electrodes are independent of recording electrograms from the distal electrode, which record over a larger (10 mm) surface area.

Once central venous access was obtained and the coronary sinus catheter was placed, the ablation catheter was advanced to the CTI region. The patient was in persistent typical atrial flutter with a cycle length of 220 ms. Pacing at 200 ms from the tip of the ablation catheter demonstrated entrainment with a post-pacing interval minus tachycardia cycle length of 0 ms. Low-voltage electrograms were visualized on the distal and proximal ablation electrodes as well as on the mini-electrodes (Figure 1). As the catheter approached the tricuspid valve, sharp atrial electrograms were detected on the mini-electrodes that were distinct from the low-voltage electrograms visualized on the proximal and distal ablation electrodes. Radiofrequency energy was delivered to this region for 60 s with settings of 100 watts and 80 degrees. This failed to affect the tachycardia. As the catheter was advanced slightly, another area was located with sharp atrial electrograms on the mini-electrodes that were distinct from the low-voltage electrogram on the proximal and distal ablation electrodes (Figure 2). Radiofrequency energy was applied to this region with the same settings and after 33 s of ablation, the atrial flutter terminated to sinus rhythm (Figure 3). The remainder of the CTI was thoroughly investigated; however, no other localized sharp atrial electrograms could be located. Pacing was then performed from both the ablation catheter and coronary sinus electrode 5/6 with the tip of the catheter positioned immediately lateral to the cavotricuspid isthmus and then at a location at 9:00 on the tricuspid annulus. Near the line,
the stimulus to electrogram time was 141 ms and 123 ms at the more lateral region, confirming bidirectional block across the CTI. The patient had remained in sinus rhythm for greater than 20 min at this point, and the procedure was subsequently concluded. A total of four applications of radiofrequency energy were applied. At 3 months of follow up, the patient remains in sinus rhythm with no symptomatic recurrence of arrhythmia.

Discussion

Radiofrequency ablation of atrial flutter is a very successful procedure with reported acute success rates of 90–95%. Estimates of recurrence rates have varied from 4% to 20%. Possible explanations for recurrent right atrial flutter include non-isthmus-dependent atrial flutter as well as recovery of conduction from incomplete ablation. Various novel techniques have been proposed to determine the critical site of recurrent atrial flutter including use of electroanatomical mapping systems, non-contact mapping systems, and use of intraprocedural isoproterenol or adenosine to unveil incompletely ablated regions. While effective, these techniques have the disadvantage of requiring use of an expensive diagnostic catheter that requires a specialized set-up procedure or use of medication that may have side effects to a conscious patient and may need to be delivered repeatedly to assess multiple regions of suspected recurrence. The use of a 10-mm tip radiofrequency ablation catheter has been demonstrated to reduce ablation time as compared to 4-mm irrigated tip radiofrequency ablation catheters. While the larger surface area of the ablation catheter tip is helpful to allow for greater overlap between adjacent regions and more efficient radiofrequency energy delivery, the effect upon precision of localized electrogram recording is unknown. Use of the Intellatip MiFi radiofrequency ablation catheter has been suggested to improve mapping resolution and monitoring of lesion maturation in animal procedures. This has implications for detection of sharp atrial electrograms that represent incomplete ablation during both the index procedure as well as during a repeat ablation procedure for recurrent atrial flutter. The findings in this case demonstrate that electrogram signals recorded from the same tissue can differ between the mini-electrodes and the conventional proximal and distal ablation electrodes.

One potential limitation of this case is the fact that the first procedure was performed with the patient in predominant sinus rhythm, while the repeat procedure was performed with the patient in persistent atrial flutter. However, atrial flutter was induced spontaneously during the index procedure and terminated during the course of radiofrequency energy delivery, which was comparable to
the mechanism of arrhythmia termination during the repeat procedure. Furthermore, ablation of the cavitricuspid region during sinus rhythm has been validated to have equivalent outcomes to ablation in induced atrial flutter as long as complete bidirectional block is demonstrated.\(^9,10\) One additional point of interest in this case is that while bidirectional block was achieved in both the index case and the repeat case, the increase in the transisthmus conduction time was greater in the repeat case (51.6% increase) than in the index case (22.5% increase). It is known that an increase of >50% has 100% sensitivity and 80% specificity for achievement of complete bidirectional block.\(^11\)

**Conclusion**

The case is the first reported use of this catheter for recurrent typical right atrial flutter. It demonstrates an efficient and effective means of identifying the critical region of recurrent typical right atrial flutter. The advantage of this technique is that it does not require any additional equipment setup time or medication administration.

**References**


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**Figure 3:** Termination of recurrent atrial flutter with ablation. Ablation at the site demonstrated in Figure 2 resulted in termination of atrial flutter after 33 s of radiofrequency energy application. Note that even after termination to sinus rhythm, sharp atrial electrograms were still visualized on the mini-electrodes. Ablation was continued until the amplitude of these atrial electrogram voltages visualized on the mini-electrode was reduced to a low voltage.

