The Mini Electrode-equipped Catheter: Utility for Paroxysmal Supraventricular Tachycardia Ablation

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The Mini Electrode-equipped Catheter: Utility for Paroxysmal Supraventricular Tachycardia Ablation

Short title: **Mini Electrode Recordings for Paroxysmal Supraventricular Tachycardia**

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Abbreviation list

AP = accessory pathway

AVNRT = atrioventricular nodal reentrant tachycardia

AVRT = atrioventricular reentrant tachycardia

CTI = cavo-tricuspid ishmus

ME = mini electrodes

PSVT = paroxysmal supraventricular arrhythmias

RF = radiofrequency

WPW = Wolff-Parkinson-White

The role of catheter ablation for paroxysmal supraventricular arrhythmias (PSVT) is well established given that it is often a simple, safe, and successful procedure.[1] However, in some instances, identifying a suitable ablation target can be challenging, and can lead to multiple energy applications, prolonged fluoroscopy and procedural times. The IntellaTip MiFi OI (Boston Scientific) catheter offers increased mapping resolution due to the 3 mini electrodes (ME) located at the distal tip of the catheter that allows for high-resolution electrograms. It has been shown that the use of this catheter may help to avoid unnecessary radiofrequency (RF) ablation at the cavotricuspid ishmus[2] (CTI) [3]. While this may be the case, ME facilitated high resolution electrogram capability may not provide sufficient advantages in the setting of CTI ablation when compared to current irrigated force sensing catheters. This is likely related to CTI ablation being an anatomical approach that is not dependent on the identification of minute potentials. Therefore, it may be most meaningful to evaluate this particular catheters advantages, as it relates to identifying small potentials such as slow pathway and accessory pathway (AP) potentials during PSVT ablation. The manuscript by Choi et al in the current issue of the journal aims to address this.

In this prospective, randomized, controlled trial, the authors investigated clinical records of 136 patients with AVNRT or atrioventricular reentrant tachycardia (AVRT) or Wolff-Parkinson-White (WPW) syndrome in two medical centers between 2020 to 2021. They found a two-fold higher incidence of the slow pathway or accessory pathway potential detection in the ME group. This group also had a lower mean number of ablation attempts (2 vs. 3) and a reduced ablation time to achieve the primary ablation endpoint: the emergence of junctional rhythm in AVNRT and conduction block of AP potential (23.5 vs. 64.5 sec). In fact, 15/27 patients (55%) had a discrete pathway potential identified by the ME catheter. There was no significant difference between the two groups in terms of total ablation time and procedure time. Applied RF power and temperature during ablation in the ME group were significantly higher and lower, respectively because of saline irrigation (although ablation was performed with minimal irrigation rates). The acute reinduction rate was similar in both groups and there were 4 patients with recurrence during follow-up, but the relationship between recurrence and the presence of pathway potential on the ME catheter is not clear.

When considering cases of AVNRT and AVRT/WPW syndrome separately, only the mean ablation time to the emergence of junctional rhythm in the patients with AVNRT was significantly shorter in the ME group. Other measures were not significantly different. From these observations, the authors concluded that the ME catheter was advantageous for identifying pathway potentials and reducing initial ablation attempts and ablation time to reach the acute endpoint.

How best should we interpret the data the authors provide? Patients with AVNRT and AVRT/WPW must be considered separately due to the differences in ablation targets which reflect the different mechanisms and anatomical locations/approaches of the targets. The authors show improved appreciation of slow pathway potentials with the study catheter which support the concept of the advantages of ME. However, this didn't impact the median RF attempts needed for junctional rhythm in both groups. On the other hand median ablation time to junctional rhythm was 16 seconds in the ME group and 48 seconds in the control group (p=0.043) which may simply reflect improved efficiency of the ME catheter or biases related to lack of blinding. Finally, there was no significant difference in total ablation time, procedure time, or acute AVNRT reinduction rates between the two groups. In one patient in the control group, AVNRT recurred three days after discharge. Thus the impact of realizing SP potentials using the ME catheter isn't immediately obvious in this group- which questions the overall utility of SP potential ablation in AVNRT or simply the lack of larger number of patients in this study.

The immediate strength of the study is the prospective and randomized fashion it was conducted but a significant limitation is the lack of blinding (would have been difficult to do, but on the other hand ablation could have been performed with the ME catheter but without the ME electrode recordings to eliminate the uncontrollable difference between catheter types). Most studies pertaining to AVNRT are retrospective and observational and thus the authors are to be congratulated for their efforts. ME catheters have been evaluated in prior reports but are limited to CTI ablation: some studies show that the ME catheter was helpful in terms of avoiding unnecessary ablation,[2,3] but others indicate that CTI ablation efficacy was inferior compared to conventional 8 mm tip non-irrigation and cryothermal catheters.[4] Iwasawa et al, explained this discordance as follows- ablation was conducted with temperature control mode. with a maximum power output of 50W and temperature limit of 58. The thermosensor being on the surface of the tip of the ME catheter allowed for the temperature to rise to limit rapidly during ablation limiting power thus potentially explaining the reduced efficacy. In this study, the target temperature was set to 60 but also saline irrigation during ablation was used. Reduction in ablation attempts and time to achieve junctional rhythm are important endpoints and of value to the clinician. More ablation attempts likely increase the risk of atrioventricular block (especially in the setting of underlying first-degree atrioventricular block.[5]) The ME catheter in this situation can provide improved identification of slow pathway potentials allowing for a more directed approach to AVNRT ablation rather than the usually anatomical approaches. Although the endpoint was achieved with a shorter time and less RF attempts, the outcome in both acute and chronic phases were not improved. This is partly because this study was conducted in an unblinded fashion and with limited number of patients. When looking at patients with AVRT/WPW, there was no significant difference in terms of both the procedural results and recurrence. Although the sample size is small, this result shows that the use of the ME catheter for identifying the accessory pathway potential was not obviously helpful. However, this doesn't necessarily mean this catheter is not helpful- in the clinical setting, there are occasionally difficult cases and such a catheter may make the difference and it is understandable these sort of situations was not have been captured in this report.

Finally, this report highlights the utility of using the study catheter in the PSVT population and suggests that it can successfully be used to rapidly map and ablate AVNRT and WPW/AVRT with meaningful reduction in ablation attempts and time.

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