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Prospective evaluation of a novel catheter equipped with mini electrodes on a 10-mm tip for cavotricuspid isthmus ablation - The efficacy of a mini electrode guided ablation

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ABSTRACT

Background: Clinical utility of large-tip ablation catheters for cavo-tricuspid isthmus (CTI) ablation has been reported, however, it is limited by the impaired near-field electrogram resolution. This study evaluated the efficiency of a novel mini-electrode (ME) equipped 10-mm tip CTI ablation catheter.
Methods: Thirty-four patients were prospectively enrolled (Group-A). Initially, radiofrequency energy was applied point-by-point guided by ME signals. If it failed, RF applications were applied conventionally guided by tip-ring signals. The data were compared with 32 and 32 patients undergoing CTI ablation using 8-mm tip (Group-B) and 3.5-mm irrigation-tip (Group-C) catheters, respectively.
Results: The successful CTI block creation rate was significantly higher in Group-A and Group-B than Group-C (32/34[94.1%], 31/32[96.8%], and 25/32[78.1%], $p = 0.027$). In Group-A, ME guided ablation was successful in 30 patients and subsequent conventional ablation in 2. There was no significant difference between the 3 groups for the total procedure and fluoroscopic times using the initial catheters. However, the total radiofrequency applications (6.9 ± 3.6, 9.9 ± 4.3, and 12.0 ± 7.1, $p = 0.001$), total radiofrequency time (358 ± 197, 558 ± 248, and 566 ± 265 s, $p = 0.001$), and radiofrequency time to achieve initial block (222 ± 159, 471 ± 242, and 396 ± 211 s, $p < 0.001$) were significantly shorter in Group-A than Group-B and Group-C. In Group-A, a maximal ME amplitude attenuation ($86 \pm 13\%$, from 0.84 ± 0.53 to 0.08 ± 0.04 mV) was obtained by 19.0 ± 6.5 s mean applications. Maximal tip-ring amplitude attenuation ($76 \pm 17\%$, from 0.58 ± 0.29 to 0.12 ± 0.09 mV) was obtained by 22.1 ± 6.2 s mean applications.
Conclusions: ME guided ablation using a novel ME equipped 10-mm tip ablation catheter was feasible for human CTI ablation, and might reduce inadvertent radiofrequency applications.

1. Introduction

Creating linear conduction block between the tricuspid valve and inferior vena cava isthmus is an established therapy for atrial flutter [1–3], and is an important technique in catheter ablation. However, in some cases, creating cavo-tricuspid isthmus (CTI) block is challenging, and multiple energy applications and prolonged procedure and fluoroscopic times are required. Previous studies have evaluated the efficacy of several types of ablation catheters, and reported that the irrigation-tip catheters and conventional 8-mm tip catheters are similarly effective in creating CTI block [4,5].

The clinical utility of a 10-mm tip ablation catheter for CTI ablation has been reported in some studies [5,6], however, an impaired near-field electrogram resolution is an important limitation of large tip catheters. That is, the span of the distal electrode pair extends beyond the ablated lesion and introduces greater susceptibility to monitoring tissue that is not in the ablation zone as well as far field electrical activity. To overcome this issue, a novel ablation catheter equipped with 3 radially distributed mini electrodes (MEs) on a 10-mm tip has been introduced into clinical use. The addition of the ME at the circumference of the catheter tip focuses on recording the tissue in contact with the ablation catheter. This prospective study aimed to evaluate the efficiency and

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feasibility of this novel 10-mm tip ME catheter for CTI ablation by comparing it with 8-mm tip and 3.5-mm irrigated tip catheters.

2. Methods

2.1. Study population

This prospective study consisted of 34 consecutive patients undergoing CTI ablation using a novel 10-mm tip catheter equipped with MEs (IntellaTip MiFi XP, Boston Scientific, Boston, MA) (Group A). The pin electrodes were 1 mm in diameter, radially distributed at 2.5-mm intervals around the tip of the ablation catheter at 120° orientations, and embedded 2-mm from the catheter tip in addition to the 3 standard ring electrodes (Fig. 1A). The study data were compared with the data of the CTI ablation using a dumbbell shaped 8-mm tip catheter (Ablaze, Japan-Life-Line, Tokyo) in 32 consecutive patients (Group B) and a 3.5-mm tip irrigation catheter (Thermocool or Surround Flow SF, Biosense-Webster, Diamond Bar, CA) in 32 consecutive patients (Group C). All patients gave their written informed consent. The study protocol was approved by the hospital's institutional review board. The study complied with the Declaration of Helsinki.

2.2. Ablation protocol

All anti-arrhythmic drugs were discontinued more than five half-lives prior to the procedure. A 7 Fr 20-pole three-site mapping catheter was inserted through the right

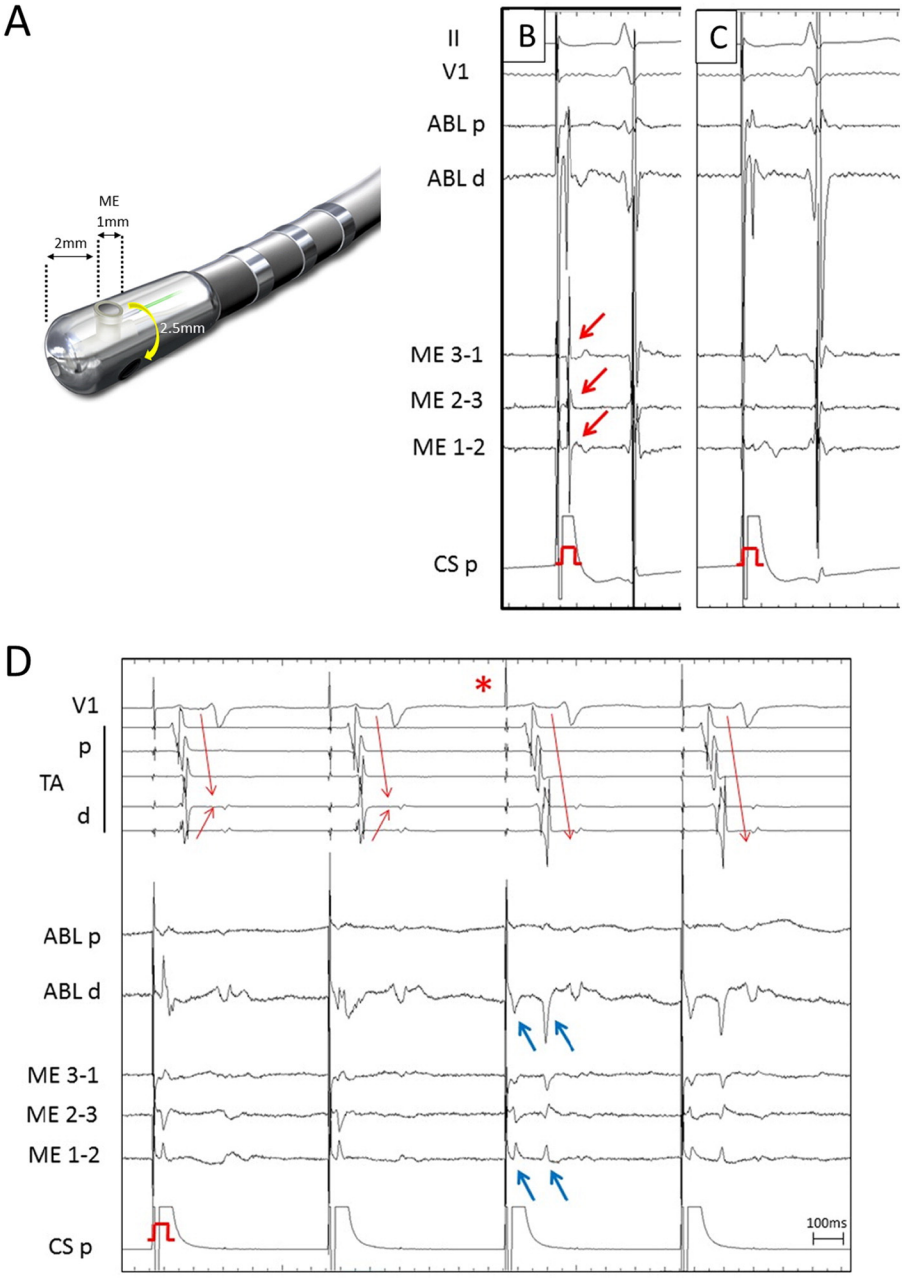

Fig. 1. A. A novel 10-mm tip catheter equipped with MEs. The pin electrodes were 1 mm in diameter, radially distributed at 2.5-mm intervals around the tip of the ablation catheter at 120° orientations, and embedded 2-mm from the catheter tip in addition to the 3 standard ring electrodes. B, C. Discrepancy of the amplitude of the atrial electrograms recorded by the MEs and conventional bipolar configurations of an ablation catheter during pacing from the proximal CS at the ventricular edge of the CTI. The conventional electrodes recorded high-amplitude ventricular and low-amplitude atrial electrograms (C), suggesting an optimal site to initiate the deployment of the linear lesion. However, the mini-electrodes display only ventricular electrograms, suggesting that the tip of the ablation catheter is situated in the right ventricle. Sharp atrial electrograms could be recorded by dragging the catheter towards the atrium (B, red arrows), suggesting an optimal ablation site to initiate CTI ablation. Please also note that the atrial and ventricular electrograms recorded on the MEs are sharper than those recorded on the conventional electrodes. D. The activation sequence changed (red arrows) during pacing from the proximal CS when CTI linear block was created (asterisk). Double potentials were also observed at the same timing on both the conventional electrodes and MEs (blue arrows). ABL: ablation catheter, ME: mini-electrode, CS: coronary sinus, p: proximal, d: distal, TA: tricuspid annulus. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

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