TITLE: Preferential Conduction through Cavotricuspid Isthmus Revealed by Ultra High Resolution Mapping in Typical Flutter

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BACKGROUND Linear ablation of the cavotricuspid isthmus (CTI) has been recognized as a highly successful and safe technique in the treatment of typical atrial flutter. However, it could be extremely difficult in some patients. The possible explanation would be complex and individual anatomy of the CTI. And the anatomic property could be translated into different activation patterns through the CTI.

OBJECTIVE The purpose of this study was to test the hypothesis that CTI conduction is not in step and preferential conduction could be revealed by ultra high-resolution mapping.

METHODS A total of 28 patients with typical flutter were included between September 2016 to August 2018 (average age: 52 ±16 years, right atrium: 39 ± 5 mm, left ventricular ejection fraction: 60 ± 9 %). High-resolution 3D mapping (Rhythmia mapping system, Boston Scientific, Natick, Massachusetts) was performed. Maps were analyzed retrospectively to characterize wave front propagation patterns in CTI.
region. The length of CTI, the width of preferential conduction area and their ratio were measured. The relationships between the ratio and termination or cycle length prolongation were also evaluated.

**RESULTS** 16(57%) patients underwent previous cardiac surgery. 1 (3%) patient has received previous ablation in CTI. There are five different activation patterns through CTI (Figure 1). Type I in 4 patients (14%) was homogenous conduction without preferential wave front though CTI. Type II in 15 patients (53%) was with preferential wave font close to tricuspid annulus. Type III in 1 patients (3%) was with preferential wave front in the middle of CTI. Type IV in 7 patients (25%) was with preferential wave front close to inferior vena cava (IVC). Type V in 1 patients (3%) was with double preferential wave fronts. We found that the termination sites were exactly located at preferential wavefront in 18 of 28 patients (64%). The width of preferential wave front in termination group was shorter than those in non-termination group (16.6±1.0 mm vs. 23.3±3.4 mm, P=0.025). The cycle length (CL) prolongation (20ms longer than baseline) before termination was noted in 16 of 28 patients (57%). However the width of preferential wave front in CL prolongation group was similar with those in non-prolongation group (18.4±1.5 mm vs. 19.8±3.0 mm, P=0.655). the relationship between the ablation reaction and the ratio ( the width of preferential wave front and CTI ) were showed in table 1.

**CONCLUSION** Activation conduction through CTI is heterogeneous.
The preferential conduction was common and the majority was close to tricuspid annulus. If the preferential conduction is more apparent, it is more likely to terminate atrial flutter during ablation exactly at the preferential wave front site.

KEYWORDS Ablation; Cavotricuspid isthmus; preferential conduction; Typical atrial flutter
Figure 1 Different Patterns of Preferential Wavefront through CTI

A: Type I
B: Type II
C: Type III
D: Type IV
E: Type V
Table 1: The relationship between ablation reaction at preferential wave front and the ratio of width of preferential wave front to CTI. (PW: preferential wave front)

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Termination @ PW</th>
<th>Cycle length prolongation</th>
<th>Width of PW (mm)</th>
<th>Width of CTI (mm)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(n=6)</td>
<td>YES</td>
<td>NO</td>
<td>15.4 ± 4.8</td>
<td>38.4 ± 10.4</td>
<td>0.41 ± 0.13</td>
</tr>
<tr>
<td>2(n=12)</td>
<td>YES</td>
<td>YES</td>
<td>17.2 ± 4.0</td>
<td>35.9 ± 6.7</td>
<td>0.50 ± 0.18</td>
</tr>
<tr>
<td>3(n=4)</td>
<td>NO</td>
<td>YES</td>
<td>22.1 ± 9.5</td>
<td>39.4 ± 7.5</td>
<td>0.57 ± 0.29</td>
</tr>
<tr>
<td>4(n=6)</td>
<td>NO</td>
<td>NO</td>
<td>24.2 ± 12.3</td>
<td>29.9 ± 8.8</td>
<td>0.79 ± 0.24</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td>0.153</td>
<td>0.242</td>
<td>0.020</td>
</tr>
</tbody>
</table>