Reversed polarity of adjacent bipolar electrograms identifies successful ablation sites in idiopathic right ventricular outflow tract arrhythmias

Carine F.B. van Huls van Taxis, MD, Adrianus P. Wijnmaalen, MD, Sander F. Rodrigo, MD, Marcin Gawrysiak, MD, Martin J. Schalij, MD, PhD, K. Zeppenfeld MD, PhD

Leiden University Medical Center, Leiden, The Netherlands
Introduction - Current ablation strategy

- Radiofrequency Catheter Ablation is highly effective for the treatment of RVOT arrhythmias:
  1. Activation mapping (earliest LAT, unipolar QS)
  2. Pace-mapping

- Yamane et al reported about the use reversed polarity on bipolar electrograms as a criterion to predict successful ablation sites in pulmonary vein isolation

Yamabe et al; JACC 2002; 39:1337-1344
Reversed polarity

A rapid simultaneous deflection in opposite direction of the initial part of adjacent bipolar electrograms
Hypothesis:
Reversed polarity can be used to identify successful ablation sites for focal RVOT arrhythmias
Methods – Patient population

- 24 consecutive patients (12 male, age 42 ± 18 years)
- Highly symptomatic VT/PVC (PVC burden 23%)
- RFCA after drug failure (1.3 ± 1.4 anti-arrhythmic drugs)

- Baseline evaluation
  - Echocardiography
  - Exercise testing
  - 24h Holter monitoring

- Follow up
Methods

- 3D mapping system *(CARTO XP)*
- 3.5 mm tip catheter *(spacing 2-5-2 mm)*
- Unipolar and bipolar electrograms
  (Unipolar filter settings: 1-240Hz; Bipolar filter settings 30-400Hz)
- Prucka Cardiolab acquisition system
Methods – off line analysis

- Unipolar and bipolar electrograms of ablation sites and area points (radius of 15 mm) were evaluated:
  - Bipolar local activation time
  - Unipolar electrogram morphology
  - Presence of reversed polarity

- Successful ablation site defined as:
  Arrhythmia abolished by RF energy without recurrence of the arrhythmia with/without isoproterenol after 30 minutes

- 2 independent observers analyzed all electrograms
Results

• 25 RVOT arrhythmias (22 PVC; 3 VT)
  • All successful terminated with a mean of $2.4 \pm 1.8$ RF lesions (power settings 25-30W)

• 25 successful RF sites, 33 non-successful RF sites, 47 area points (mean distance $10.9 \pm 1.9$ mm)

• Procedure time: $46.6 \pm 24.0$ minutes (+ 30 minutes waiting period)

• Fluoroscopy time: $13.7 \pm 8.3$ minutes
Local activation time
Unipolar QS complex distribution
Reversed polarity

- Bipolar LAT -21ms
- Unipolar QS complex
- No reversed polarity

- Bipolar LAT -27ms
- Unipolar QS complex
- Reversed polarity
Reversed polarity
## Results – off line analysis

<table>
<thead>
<tr>
<th></th>
<th>Successful RF site</th>
<th>Area point</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversed Polarity (n)</td>
<td>20</td>
<td>3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean bipolar LAT (ms)</td>
<td>-28 ± 8</td>
<td>-21 ± 10</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Unipolar QS complex (n)</td>
<td>21</td>
<td>47</td>
<td>0.19</td>
</tr>
</tbody>
</table>

- Based on ROC analysis the optimal cut-off value for bipolar LAT was -25 ms
<table>
<thead>
<tr>
<th>Condition</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>NPV</th>
<th>PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversed polarity</td>
<td>80</td>
<td>96</td>
<td>0.94</td>
<td>0.87</td>
</tr>
<tr>
<td>LAT ≤ -25ms</td>
<td>72</td>
<td>72</td>
<td>0.89</td>
<td>0.44</td>
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<tr>
<td>Unipolar QS</td>
<td>84</td>
<td>32</td>
<td>0.85</td>
<td>0.31</td>
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<tr>
<td>Reversed polarity + LAT ≤ -25ms</td>
<td>64</td>
<td>100</td>
<td>0.90</td>
<td>1</td>
</tr>
<tr>
<td>Unipolar QS + LAT ≤ -25ms</td>
<td>63</td>
<td>84</td>
<td>0.87</td>
<td>0.58</td>
</tr>
<tr>
<td>Unipolar QS + Reversed polarity</td>
<td>75</td>
<td>96</td>
<td>0.92</td>
<td>0.86</td>
</tr>
<tr>
<td>RP + LAT ≤ -25ms + Unipolar QS</td>
<td>58</td>
<td>100</td>
<td>0.87</td>
<td>1</td>
</tr>
</tbody>
</table>
Conclusion

1. Reversed polarity is easy to assess

2. Presence of reversed polarity on adjacent local bipolar electrograms identifies successful ablation sites in idiopathic focal RVOT arrhythmias with high sensitivity and specificity

3. Reversed polarity in combination with earliest bipolar local activation time is highly predictive for the identification of successful ablation sites
Results – follow-up

- No procedure related complications

- No acute arrhythmia recurrence

- Mean follow-up: $7 \pm 7$ months
  - All patients were free of complaints without antiarrhythmic drugs

- 24h holter monitoring:
  - 20 patients: no PVC recurrence
  - 1 patient: 75% reduction
  - 3 patients: no 24h holter monitoring available