ECG Localization of Site of Origin in Ischemic VT
Why ECG is important?

• What is underlying substrate?
  • Idiopathic, Non-ischemic CMP, Ischemic CMP, ARVD....

• Where to map and ablate?
  • RV, LV, epicardium ....

• What tools to use?
  • RF ablation, bipolar ablation, ICE....
ECG features
# ECG features in scar related VT

<table>
<thead>
<tr>
<th></th>
<th>Scar related VT</th>
<th>Focal VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>QRS pattern</td>
<td>Less accurate</td>
<td>More accurate</td>
</tr>
<tr>
<td>Ventricle</td>
<td>Prior infarction</td>
<td>Normal ventricle</td>
</tr>
<tr>
<td>Mechanism</td>
<td>Reentry</td>
<td>Automatic and trigger</td>
</tr>
<tr>
<td>Site of origin</td>
<td>Exit site from the isthmus to myocardium</td>
<td>Discrete site</td>
</tr>
</tbody>
</table>
Nonuniform anisotropy

- The functional nature of conduction disturbances, which influence the rapidity of propagation and the wave of propagation of impulses in the same area.
Factors influencing the QRS patterns

• The size of infarction
• The degree of fibrosis, the shape of the heart
• The site and mechanism of VT
• The effect of nonuniform anisotropy and propagation from the site of origin
• The effects of acute ischemia and/or electrolyte abnormalities
• The presence of structural abnormalities unrelated to the tachycardia mechanism
ECG clues to the underlying substrate

• Slurring of the initial forces (↔ rapid initial forces)
• Lower amplitude complexes
• Presence of notching of the QRS
• Presence of qR, QR, or Qr complexes
Localizing the origin
General principles in localizing the origin of Post-Infarction VT

- QRS duration
- QRS axis
- Bundle branch block pattern
- Concordance
- Presence of QS complexes
QRS duration

• The proximity of the VT origin to the septum
  • Septal VT narrower than free wall VT (using conduction system)

• The amount of myocardial disease
  • wider with poor overall ventricular conduction
QRS axis (Right Superior)

- Apical septal or apical lateral
- QS in leads I, II, and III / QS or rS in leads V5, V6
QRS axis (Right Inferior)

- High basal origin (high LV septum or high lateral LV)
QRS axis (Left Inferior)

- Top of the LV septum
Bundle Branch Block Pattern

• LBBB pattern: almost always arise in or adjacent to the LV septum (higher predictive accuracy)
• RBBB pattern: always arise in the LV
Bundle Branch Block Pattern

- VT with LBBB pattern: negative in V1 (QS, rS, qrS)
- VT with RBBB pattern: positive QRS in V1 (rsR`, qR, RR, R, RS)

- VT may not show features characteristic of the same BBB morphology in other leads.
Concordance

- Positive concordance: base of the heart (LVOT region)
- Negative concordance: near the apical septum, m/c with anteroseptal MI
Presence of QS complexes

- QS complex: wavefront is propagating away from that site
- QS in V2 to V4: anterior wall origin
- QS in V3 to V5: apical origin
- QS in V5 and V6: lateral wall
RBBB + Q or R (Lead I, V1, V2, V6)

- Q: near the apex
- R: posterior origin
RBBB + Q or R (Lead I, V1,V2,V6)
LBBB + Q or R (Lead I, V6)

- **Q**: apical septal
- **R**: inferobasal septal
ECG Algorithm (1)

**Precordial R-Wave Progression Patterns**

<table>
<thead>
<tr>
<th>Pattern (No.)</th>
<th>( V_1 )</th>
<th>( V_2 )</th>
<th>( V_3 )</th>
<th>( V_4 )</th>
<th>( V_5 )</th>
<th>( V_6 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing (30)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>None or Late (27)</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Regression/Growth (Not QS) (18)</td>
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<td>✓</td>
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<td>✓</td>
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</tr>
<tr>
<td>Regression/Growth (QS) (15)</td>
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<td>✓</td>
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<td>✓</td>
</tr>
<tr>
<td>Dominant (15)</td>
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<tr>
<td>Abrupt Loss (20)</td>
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<tr>
<td>Late Reverse (41)</td>
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<td>✓</td>
<td>✓</td>
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<tr>
<td>Early Reverse (16)</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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ECG Algorithm (2)

A

B

J Cardiovasc Electrophysiol, 2007;18:161-8
Different morphology from the same area
Summary

• ECG algorithm : PPV 70%
• The larger the infarct, the less predictive are ECG patterns (nonuniform anisotropy)
  • anterior infarction << inferior infarction
  • LBBB patterns (septal) >> RBBB patterns (septal or free wall)

• Localizing
  • QRS duration : narrower (septal) vs wider (free wall)
  • Axis : RS (apex) vs RI (high basal) vs LI (top of LV septum)
  • BBB : LBBB (septal) vs RBBB (LV anywhere)
  • Concordance : negative (apex) vs positive (base)
Epicardial VT
Epicardial Ventricular Tachycardia

- Pseudo delta wave: more than 34 ms
- Intrinsicoid deflection
- Shortest RS complex duration: more than 121 ms
- QRS duration more than 200 ms
IDT: 112 ms

QRS: 206 ms

Pseudo-delta: 56 ms

MDI: 103 ms / 206 ms: 0.5

Shortest RS: 157 ms
Probable Epicardial Origin (based on interval criteria)

- Presence of inferior q waves?
  - No
  - Presence of q wave in lead I?
    - No
    - MDI ≥ 0.59?
      - Yes
      - EPI VT
      - No
      - EPI VT
  - Yes
  - EPI VT

SN = 96%  SP = 93%

Nonischemic cardiomyopathy
Ischemic VT
– Endocardial vs Epicardial

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Epicardial Origin in Ischemic VT

- As most ischemic VT can be successfully targeted from the endocardium, it remains reasonable to start the first RFA approach endocardially.
Thank you for your attention