Useful Tips for Successful Ablation of OTVT

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Idiopathic OTVT

- RVOT and LVOT
  - most common origin of idiopathic VT and PVCs
  - RVOT (70–80%), pulmonary artery, near the bundle of His
  - LVOT, aortic sinuses of Valsalva, coronary sinus (CS)
    - cardiac veins, mitral and tricuspid valve annuli
  - Epicardium
OTVTs

- No structural heart disease
  - MRI (subtle areas of diminished wall motion)

- Focal origin
  - triggered activity
    (burst pacing and isoproterenol administration)
Idiopathic OTVTs

- 20 ~ 50 years, women (hormonal triggers)
- Exercise- (stress-) induced

- Repetitive salvos of NSVT (60–92%) or incessant or paroxysmal sustained VT

- Exercise test; during exercise or in the recovery phase
  - exercise can suppress arrhythmia
OTVTs

- **RVOT**
  - LBBB configuration with inferior (right or left) axis

- **QRS duration**
  - $\approx 140$ ms
  - $\geq 120$ ms (lead I) - RV dysplasia rather than idiopathic VT

- Usually monomorphic, may vary slightly
  - If multiple distinct VT morphologies - scar-related
OTVTs

- Benign
- Potentially malignant forms (ARVC, CPVT, Brugada syndrome, etc)

- Evaluation for organic heart diseases or genetic syndromes associated with sudden death
OT VTs

- The success of ablation; spontaneous or inducible VT or PVCs

- All antiarrhythmics; should be discontinued for at least five half-lives

- Sedation can decrease spontaneous or inducible arrhythmia
OT VTs

- Diagnostic electrode catheters; RV apex, His bundle, great cardiac vein

- Programmed stimulation and burst pacing with or without isoproterenol infusion

- Careful catheter manipulation during mapping to avoid mechanical trauma
OT VTs

- Analysis of the surface ECG; cornerstone to localize the site of origin
- ECG recordings from outside the EP lab; may not allow sufficient precision for pace mapping due to differences in patient posture and lead position during the recording
- Premature ventricular complexes with the same morphology as VT – acceptable target if VT is not inducible
- Absence of spontaneous or inducible clinical arrhythmia; Catheter ablation should be avoided
OT VTs

- Precise localization of the VT origin from its QRS morphology limited by the close anatomic relations of RVOT, LVOT, great vessels

- RVOT VT - R/S transition at lead V4
- LVOT VT - R/S transition at lead V1 or V2
- R/S transition at V3 - RV or LV origin

- Epicardial - Longer time to maximum deflection in the
- Aortic cusp - Broad R-wave in V1 or V2
Heart specimens illustrating the anatomic arrangement of RVOT and the aortic sinuses

OT VTs

- Mapping
  ; Activation, pace, combination

- RVOT (including PA) → great cardiac vein → LVOT → aortic cusps → epicardial

- Systematic point-by-point activation mapping
Right ventricular outflow tract tachycardia

- RVOT bipolar electrograms
  - normal amplitude (e.g. 1.5 mV), sharp, without fragmentation
  - high-frequency low-voltage activity preceding the main local ventricular electrogram component
  - occasionally originates from muscle bundles extending along the pulmonary artery (low-amplitude signals)

- Unipolar electrograms
  - sharp QS-morphology with a sharp intrinsic deflection 60 ms
Right ventricular outflow tract tachycardia
Right ventricular outflow tract tachycardia

- Pace mapping
  - used to identify a region of interest
  - refine position based on activation
  - major guide to the ablation site when spontaneous arrhythmia is infrequent
  - should be done at the VT rate
  - stimulus strengths only slightly greater than threshold
    (avoid capture over a large area)
12-lead ECG pace mapping within RVOT from 6 sites with characteristic ECG patterns

RVOT VAs

- Radiofrequency ablation with solid 4 mm tip electrodes; 50–70°C, 50 W

- Use of 8 mm electrodes, irrigated electrodes; careful to avoid steam pops from high-power
LVOT VAs

- Superior basal region of the left interventricular septum
- LV free wall
- aortic sinuses of Valsalva
- LV epicardium
LVOT VA

- 12%–45% of all idiopathic VAs
- Ablation is more complex
- Epicardial ablation via the GCV/AIV or subxiphoid puncture
- Greater procedural complexity as well as periprocedural risk (stroke or coronary artery injury)
Relationship between LVOT and RVOT at the level of the aortic and pulmonary arterial roots

RVOT and LVOT PVC

Aortic cusp ventricular tachycardias

- Originating from extension of ventricular myocardium above the aortic annulus
- 17 and 21% of idiopathic OT-VTs
- Ablation within the sinuses of Valsalva
  - left coronary cusp > right coronary cusp > junction between the right and left coronary cusp > non-coronary cusp.
Aortic cusp ventricular tachycardias

- Two-component electrogram
- Earliest deflection preceding the QRS complex by an average of 39~50 ms

- Pace mapping in the aortic sinus
  - Requires high output and is less likely to reproduce the VT QRS compared with pace mapping for endocardial VTs.
### Electrocardiographic morphology of OTVTs

<table>
<thead>
<tr>
<th>Site of Origin</th>
<th>Lead V1</th>
<th>Precordial Transition</th>
<th>Lead I</th>
<th>Additional</th>
</tr>
</thead>
<tbody>
<tr>
<td>RVOT free wall</td>
<td>-</td>
<td>≥V4</td>
<td>Site 1 + Site 2 +/− Site 3 −</td>
<td>Notching in inferior leads</td>
</tr>
<tr>
<td>Septal RVOT</td>
<td>-</td>
<td>V3 or V4</td>
<td>Site 1 + Site 2 +/− Site 3 −</td>
<td></td>
</tr>
<tr>
<td>Right coronary cusp</td>
<td>-</td>
<td>V2 or V3</td>
<td>+</td>
<td>Notching in downstroke of V1 suggests junction of RCC and LCC</td>
</tr>
<tr>
<td>Left ventricular summit</td>
<td>-</td>
<td>V2 or V3</td>
<td>− or +/−</td>
<td>Pattern break in V2 with more net negativity than V1 or V3</td>
</tr>
<tr>
<td>Left coronary cusp</td>
<td>+/-</td>
<td>+ throughout or V2</td>
<td>-</td>
<td>M or W configuration common in V1</td>
</tr>
<tr>
<td>Aortomitral continuity</td>
<td>qR</td>
<td>+ throughout</td>
<td>+/-</td>
<td></td>
</tr>
<tr>
<td>Superior mitral annulus</td>
<td>+</td>
<td>+ throughout</td>
<td>Septum + lateral −</td>
<td></td>
</tr>
</tbody>
</table>

Epicardial OT VTs

- Longer interval from QRS onset to earliest maximal deflection in the precordial leads
  - late access of the wavefront to the endocardial Purkinje system

- May be adjacent to the great cardiac
  - Successful ablation via this route

- Risk of coronary injury
51 Y. M

- Dyspnea, palpitation, dizziness (D: 2 years)
- Echo: LVEDD - 59 mm, Global hypokinesia, EF=32%
- CAG: No remarkable stenosis
51 Y. M – First ablation at RVOT
CRT-D despite of optimal medical therapy
51 Y. M – After CRT-D
Recurred OTVT
Slower rate but wider QRS complex
Mapping at RVOT
Mapping at RVOT
Ablation attempt at RVOT but not effective
Mapping at LVOT
Mapping at LVOT
Mapping and ablation attempts at LVOT
Epicardial mapping
Epicardial mapping
Total activation map
Ablation at epicardial site

Ablation on
Ablation at epicardium
All ablation attempts sites
Epicardial ablation, LV endocardial mapping catheter and coronary artery
Overview of approach to targeting LVOT arrhythmias

Map Endocardial LVOT/ASV
- Site of early activation?
  - Local activation time to QRS onset (V-QRS)>25 msec
  - Unipolar QS electrogram
  - Pre-potential
  - YES → ABLATE
  - NO → Map RVOT/PSV
- Unsuccessful

Map RVOT/PSV
- Site of early activation?
  - NO → Unsuccessful
  - YES → ABLATE
- Unsuccessful

Map GCW/AIV
- Site of early activation?
  - YES → Suitable for ablation?
    - Suitability criteria:
      - Distance to coronary arteries >5mm
      - Adequate power delivery
    - YES → ABLATE
    - NO → Map GCV branches
  - NO → Unsuccessful

Map GCV Branches
- Site of early activation?
  - YES → ABLATE ADJACENT SITE(S)
    - 1. Endocardial LVOT
    - 2. ASV
    - 3. RVOT
    - 4. PSV
    - 5. GCW/AIV
  - NO → Alternative Strategies
    - Simultaneous unipolar ablation
    - Bipolar ablation
    - Half-normal saline irrigation
    - Retrograde venous ethanol ablation
    - Synchronous epicardial approach
- Unsuccessful
Thank you for attention!!!

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