Electroanatomical Maps and Two Cautionary Tales

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NHS Foundation Trust

Heart Rhythm Congress
www.heartrhythmcongress.org
Case 1

- 73 F
- 2013:
  - PAF
  - ASD, RV impairment, TR
  - ASD repair, TV repair (ring), Cox Maze AF Ablation (2015)
- 2017:
  - Palpitations, breathlessness
  - Tachycardia 160 min⁻¹
  - Moderate LVSD
    - ? Tachycardia-induced
  - Some improvement in symptoms on beta blockers
Cox Maze IV
Atriotomy lesion extended to TVA

RAA

SVC

IVC

Cox JL: JTCVS, 2010
Rate 150
PR 91
QT 308
QTCb 487
QTCF 419

12 Lead; Standard Placement
Strategy?
Baseline entrainment

<table>
<thead>
<tr>
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<th>PPI - TCL</th>
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<tbody>
<tr>
<td>CS 7-8</td>
<td>25ms</td>
</tr>
<tr>
<td>CS 5-6</td>
<td>48ms</td>
</tr>
<tr>
<td>CS 3-4</td>
<td>100ms</td>
</tr>
<tr>
<td>CTI</td>
<td>36ms</td>
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<tr>
<td>RAA</td>
<td>56ms</td>
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Where to ablate?

- Initially ablated a putative isthmus between an area of scarring and SVC
  - No change in tachycardia
- Entrainment at areas of interest identified by voltage map
Case 2

- 52 F
- Hypertension, obesity
- No cardiac history or prior intervention
- Palpitations, breathlessness
- Holter: Predominantly an atypical AFL, some AF
- Low-normal LV function, mild atrial dilatation
REVIEW

Prediction of the atrial flutter circuit location from the surface electrocardiogram

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EPS

- TCL = 288ms
- Baseline entrainment mapping:

<table>
<thead>
<tr>
<th>Location</th>
<th>PPI - TCL</th>
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<tbody>
<tr>
<td>HRA</td>
<td>180ms</td>
</tr>
<tr>
<td>RA mid-septum</td>
<td>62ms</td>
</tr>
<tr>
<td>CS 9-10</td>
<td>52</td>
</tr>
<tr>
<td>CS 1-2</td>
<td>38ms</td>
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Entrainment example case 2
Entrainment

- Entrainment is the continual or repeated resetting of a reentrant tachycardia by each of a series of consecutive beats of a pacing train.
- Used during macroreentrant tachyarrhythmias to determine whether a pacing site is a part of the circuit.
- Entrainment mapping: Allows determination of the relation of multiple pacing sites to the re-entry circuit.
How to Entrain

- Prerequisites
  - Stable TCL
  - Stable pacing site / catheter with consistent capture
- Pace 10-30ms faster than TCL
- Ensure that the atrial rate is accelerated to pacing rate
- Measure post-pacing interval (PPI) - TCL
  - <30ms consistent with a location ‘in’ the circuit
Benefits / Downsides

**Pros (atrial tachyarrhythmias)**
- Rapid identification of chamber of interest
- Distinguishes macro-reentrant from focal atrial tachycardias
- Permits differentiation between the tachycardia circuit and passive activation elsewhere
- Can be key to ‘solving’ challenging cases

**Cons**
- Perturbs the tachycardia, could result in termination or alteration
- Needs very careful evaluation of EGMs; potentially prone to error
- Risk of atrial fibrillation, particularly at entrainment < 250ms

Conclusions

- Scar-related macro-reentrant tachycardia can occur both in patients with overt scar and, less commonly, in apparently normal hearts.
- Our second case - a dual-loop flutter in a patient without overt structural heart disease or prior intervention is particularly uncommon.
  - Jais et al Circulation 2000
- Caution when ablating the CTI in patients with previous Cox maze surgery.
Conclusions

- Mapping technology is a powerful tool to aid atrial ablation
  - Especially in complex 3D anatomy
- However, all tools have drawbacks and LAT maps, Ripple, Sparkle etc have the potential to be misleading
- Entrainment mapping a powerful tool, with risks
- By employing 3D mapping technology in conjunction with traditional pacing manoeuvres, acknowledging the limitations of both, we can successfully manage these complex patients
  - E.g. Entrainment mapping augmented by 3D visualisation