High-Density Mapping in Adult Congenital Heart Disease

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## 3D Electroanatomical Mapping System

<table>
<thead>
<tr>
<th>Feature</th>
<th>CARTO</th>
<th>Ensite NavX</th>
<th>Rhythmia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter localization</td>
<td>Magnetic</td>
<td>Impedance</td>
<td>Magnetic/impedance</td>
</tr>
<tr>
<td>CT/MRI integration</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Ultrasound integration</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Mapping accuracy</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Mapping catheter</td>
<td>PentaRay</td>
<td>Advisor HD Grid</td>
<td>Orion</td>
</tr>
<tr>
<td>Contact force sensing</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
High-Density Mapping

- How high for high-density mapping?
  - No established criteria

- Requirements for high-density mapping
  - Stable multi-electrode mapping catheter
  - Continuous mapping
  - Automatic annotation and noise filtering
Multi-electrode Mapping Catheters

- PentaRay catheter
  - 20 electrodes

- Advisor HD Grid catheter
  - 16 electrodes

- Orion catheter
  - 64 electrodes
Challenges in EP Procedures in ACHD

- Life-long complex medical and surgical histories
- Young, but sicker compared with appearance
- Coagulopathy in patients with long-term palliative shunt
- Challenging vascular access
- Complex cardiac anatomy
- Potential sinus node dysfunction
- Elusive, fragile cardiac conduction system
- Multiple myocardial scars
- High likelihood of multiple tachyarrhythmias
Arrhythmia Mapping in ACHD

- Accuracy & speed matter!
- High-density mapping is essential.
- Unipolar voltage mapping is helpful for identification of myocardial scars.
CASE 1
CASE 1

- Patient
  - A 32-year-old man
- Chief complaint
  - Palpitation & dizziness
- Histories
  - At birth, diagnosed with transposition of the great arteries (TGA)
  - At the age of 2 years, underwent pulmonary artery banding
  - At the age of 22, underwent Mustard operation
  - At the age of 24, underwent stenting for baffle stenosis
ECG at Palpitation & Dizziness

Referred by: UHM J S
Confirmed by: KIM BYEONG-KEUK
Cardiac CT

Great arteries
Systemic venous atrium
Pulmonary venous atrium
Atriograms

Systemic venous atrium

Pulmonary venous atrium
Atrial flutter at the beginning

A-A interval = 260 ms
Double potentials on the Orion catheter
Tachycardia Mapping with Rhythmia
Propagation Map
Ablation for the Isthmus of Reentry Circuit
ECG after RFCA
Summary of the Case 1

- Intra-atrial reentrant tachycardia in a patient who underwent Mustard operation for TGA
  - Dual-loop reentry
  - Critical isthmus (slow conduction zone) at the suture lines between the baffle and atrium

- Catheter ablation
  - Ablation for critical isthmus along the double potentials
  - Bidirectional CTI block
CASE 2
CASE 2

- **Patient**
  - A 49-year-old man

- **Chief complaint**
  - Palpitation & chest discomfort

- **Histories**
  - Diagnosed with perimembranous VSD, DCRV, & severe AR
  - At the age of 36 years, underwent VSD patch repair, infundibulectomy, and aortic valve repair
ECG at Palpitation & Chest Discomfort

Heart rate = 214 /min
ECG after Cardioversion
Multifocal mesocardial, subendocardial and epicardial delayed hyperenhancement in the LV myocardium
Left Ventriculogram
Induction of VT#1 (TCL = 330 ms)
Induction of VT#2 (TCL = 225 ms)
Induction of VT#3 (TCL = 292 ms)
12-lead ECG of 3VTs
Voltage Map during Atrial Pacing
Activation Map of VT#1
Activation Map of VT#2
Double Potentials during VT#1
RFCA for VT#1
RFCA during VT#1
Termination of VT in 9 sec of RFCA
RFCA during VT#1
Summary of the Case 2

- A patient who underwent VSD patch repair, infundibulectomy, aortic valve repair for perimembranous VSD, DCRV, severe AR
- VTs with 3 different morphology were induced.
- Non-ischemic scar-related VT originating from LV mid lateral wall, that was compatible with cardiac MRI
- Rhythmia-guided high-density mapping
- Successful RFCA for VT#1
Summary

- High-density mapping is essential in ACHD because of...
  - Elusive, fragile cardiac conduction system
  - Multiple myocardial scars
  - High likelihood of multiple tachyarrhythmias
- However, conventional mapping techniques (entrainment pacing) are still indispensable.
Mindset of ‘never-give-up’ is more important than high-density mapping system.
Thank all of you!