His Bundle Pacing: Where is it going?

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Conflicts

Medtronic: Research, Honoraria, Consulting
Boston Scientific: Research, Honoraria, Consulting
St. Jude Medical: Honoraria, Consulting
Biotronik: Honoraria, Consulting
Medtronic and Boston Scientific: Institutional Support
CASE PRESENTATION

83 year-old female with history of diabetes presents with high degree AV block with RBBB. EF is 35-40% from an echo taken two years ago. Patient has had symptoms of dizziness in the past. Repeat echo shows unchanged EF. No CAD. A decision was made to place a permanent dual-chamber His Bundle pacemaker.
Repositioning His Lead
Note that in this case, the 3830 lead was initially positioned in an acceptable location with adequate thresholds prior to atrial lead placement. This deployment is captured on fluoroscopy in the image on the left.

His lead repositioned. Threshold rose from 1.6V @ 0.5ms to 2V @ 1.0ms after atrial lead placement.
MAPPING THE HIS

First mapping, pre-fixation

First mapping, post-fixation

His Injury

“V” Signal

HIS
MAPPING THE HIS

Second mapping, pre-fixation (some His injury still present)

Second mapping, post-fixation

“V” Signal

Large Ventricular Current of Injury
Final Atrial and His Bundle Pacing Thresholds

<table>
<thead>
<tr>
<th>Lead</th>
<th>Polarity</th>
<th>Time</th>
<th>P/R (mV)</th>
<th>Slew (V/s)</th>
<th>Impedance (ohms at V)</th>
<th>Threshold (V at ms)</th>
<th>Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial</td>
<td></td>
<td>1:07 PM</td>
<td>2.8</td>
<td>1.7</td>
<td>749 at 5.0</td>
<td>1.5 at 0.50</td>
<td>&lt; 0.1</td>
</tr>
<tr>
<td>LV</td>
<td>(His Bundle)</td>
<td>1:35 PM</td>
<td>10.6</td>
<td>3.0</td>
<td>418 at 5.0</td>
<td>0.4 at 1.00</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Right Bundle Branch Block (RBBB)
Note that this patient received a new RBBB during second fixation of His Bundle Lead. The block resolved when pacing the His Bundle.
12-LEAD ECG

Paced Morphology

Underlying Morphology
12-LEAD ECG

Paced Morphology

Underlying Morphology

V1

V2

V3
Case Presentation

• 72 year old man, long h/o HTN
• LBBB x 13 years
• Normal LV function
• Presents with weakness, dizziness and near syncope
• EKG with Complete heart block and slow ventricular escape rhythm
Electrogram from HBP lead

130 ms
His bundle pacing

1.5 V @ 1 ms

1.2 V @ 1 ms

110 ms

130 ms
EKGs in Follow-Up

15 months
2:1 HV block
## His Bundle Pacing in Advanced AV block

<table>
<thead>
<tr>
<th></th>
<th>Narrow QRS (AV nodal) (Success %)</th>
<th>Wide QRS (His-P block) (Success %)</th>
<th>BiV pacer / Backup RV</th>
<th>Lead Dislodgement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kronborg 2010 (38)</td>
<td>32 of 38 (84%)</td>
<td>0</td>
<td>All</td>
<td>0 (RBBB 6) 12 months</td>
</tr>
<tr>
<td>Barba-Pichardo 2006 (37)</td>
<td>6 of 10 of 16 (38%)</td>
<td>5 of 10 of 21 (23%)</td>
<td>Intra-his only</td>
<td>--</td>
</tr>
<tr>
<td>Barba-Pichardo 2010 (182)</td>
<td>44 of 65 of 84 (54%)</td>
<td>15 of 26 of 98 (16%)</td>
<td>Intra-his only</td>
<td>3/59 (5%) 3 months</td>
</tr>
<tr>
<td>Vijayaraman P 2015 (100)</td>
<td>43 of 46 (93%)</td>
<td>41 of 54 (76%)</td>
<td>5 %</td>
<td>5/100 (5%) 19 ± 11 m</td>
</tr>
</tbody>
</table>

Sunao Tawara: July 5, 1873 – January 19, 1952

“I intend, for the first time in medical history, to propose an integral and consistent explanation concerning the atrioventricular bundle and the Purkinje fibers”

Functional Transverse Interconnections within the His Bundle and the Bundle Branches

By Ralph Lazzara, Billy K. Yeh, and Philip Samet

Normalization of Bundle Branch Block Patterns by Distal His Bundle Pacing

Clinical and Experimental Evidence of Longitudinal Dissociation in the Pathologic His Bundle

Nabil El-Sherif, M.D., Fernando Amat-Y-Leon, M.D., Clyde Schonfield, M.D.,
Benjamin J. Scherlag, Ph.D., Kenneth Rosen, M.D., Ralph Lazzara, M.D.,
and Christopher Wyndham, M.D.

Circulation, Vol 57, No 3, March 1978
His or PH pacing preserves LV function in AVB

12 months PHP and RVA pacing in a randomized double blinded crossover trial
AV Optimized Direct HBP Improves Acute Hemodynamic Function in Patients With HF and PR Interval Prolongation Without LBBB

Sohaib et al., JACC EP 2015; Vol. 1, No. 6

17 pts in sinus rhythm, PR > 200 ms, systolic heart failure and either QRS < 140 ms or typical RBBB
<table>
<thead>
<tr>
<th>Reference</th>
<th>Baseline</th>
<th>Follow-Up</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample Size</td>
<td>Mean ± SD</td>
<td>Sample Size</td>
</tr>
<tr>
<td>Deshmukh et al 2004</td>
<td>29</td>
<td>23.0 ± 11.0</td>
<td>29</td>
</tr>
<tr>
<td>Ajijola et al 2017</td>
<td>11</td>
<td>26.9 ± 9.0</td>
<td>11</td>
</tr>
<tr>
<td>BarbaPichardo et al 2013</td>
<td>16</td>
<td>29.0 ± 5.0</td>
<td>16</td>
</tr>
<tr>
<td>Huang et al 2017</td>
<td>42</td>
<td>44.9 ± 14.6</td>
<td>42</td>
</tr>
<tr>
<td>Barba-Pichardo et al 2010</td>
<td>59</td>
<td>50.0 ± 6.0</td>
<td>59</td>
</tr>
<tr>
<td>Occhetta et al 2007</td>
<td>68</td>
<td>51.3 ± 11.2</td>
<td>57</td>
</tr>
<tr>
<td>Catanzariti et al 2013</td>
<td>26</td>
<td>57.2 ± 7.4</td>
<td>26</td>
</tr>
<tr>
<td>Zanon et al 2008</td>
<td>12</td>
<td>59.8 ± 7.0</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>263</td>
<td>42.8 ± 4.5</td>
<td>252</td>
</tr>
</tbody>
</table>

95% CI (34.1, 51.6) 95% CI (43.4, 55.6) 95% CI (2.6, 9.3)
The graphs show the changes in QRS duration and ejection fraction between baseline and HBP conditions. The QRS duration decreases from 180 ± 23 ms to 129 ± 13 ms, with a significant p-value of <0.0001. The ejection fraction increases from 27 ± 10% to 41 ± 13%, also with a significant p-value of <0.0001.
F. Zanon et al. (submitted)
Permanent His-Bundle Pacing: A systematic literature review and meta-analysis
LIMITATIONS

• Failure to implant (10-20% of patients, infra-His block)
• High thresholds (10-15% of patients)
• Lead revisions (~3%)
• Ventricular undersensing
• Far-field atrial oversensing
• Atrial capture
• Acute injury to the His bundle
• Transient HV block (1%) and up to 50% during LBBB implant
• Persistent RBBB (2-3%)
PACED EKG: WHICH IS BETTER THIS OR CRT ONE?

Post-case EKG shows selective His Bundle pacing
CONCLUSIONS

• If it looks like a duck, and quacks like a duck….it is a duck
• Routine permanent HBP is feasible in a majority of patients
• HBP can correct chronic left and right bundle branch block and pacing induced LBBB
• HBP can have significant impact in patients with heart failure
• HBP leads can be placed in roughly 80+% of patients
• New technology will be needed to make HBP lead easier