Hong Kong College of Cardiology
28th Annual Scientific Congress
Best Challenging / Interesting Cardiac Intervention Cases Presentation

Left Bundle Branch Pacing as a Physiological Pacing Alternative to Cardiac Resynchronization Therapy in Patients with Heart Failure and Left Bundle Branch Block

5th July 2020

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Pro-Care Heart Clinic
Case Summary

- PMH: Hypertension. Mild CAD.
- c/o: SOB for 2 years, with exacerbation for 1 week
- CXR: Cardiomegaly. Pulmonary congestion.
- Blood tests: NTproBNP 8884pg/ml. TnT 0.066ng/ml. TFT & other blood tests unremarkable.
Baseline ECG: Normal sinus rhythm. First degree AVB. Complete LBBB. QRS 150ms
Baseline Echo

- Dilated LA: 5.5cm
- Dilated LV: LVEDD 63mm
- Global hypokinesia
- LVEF 24% by Bi-plane
- Modified Simpson’s
- Severe MR
- Moderate TR.
- RVSP 36mmHg
Management

• Coronary angiogram: Mild CAD. No critical coronary artery stenosis.

• Medical treatment: Entresto 100mg bd. Aldactone 20mg daily. Cardiprin 100mg daily. Frusemide.

• Could not tolerate betablocker due to underlying SND, junctional bradycardia and alternating LBBB/ RBBB (inherent risk of CHB).
Management

• Symptomatic SND with junctional bradycardia. Alternating LBBB/RBBB.
  • Pacing Indication (Risk of RV pacing induced cardiomyopathy)

• Non-ischemic cardiomyopathy. LVEF 24%. NYHA III-IV. LBBB. QRS 150ms.
  • CRT-D Indication (Patient could not afford)

• What would you do next?
His Bundle Pacing (HBP) / Left Bundle Branch Pacing (LBBP)
LBB Pacing – Hardware Requirement
Select Secure 3830 & C315 His Catheter

- **C315 HIS sheath**
  - Outer diameter 7.0 F
  - Inner diameter 5.4 F

- **SelectSecure 3830 pacing lead**
  - 4.1 F, exposed helix
  - Isodiametric lead body
  - Lumenless design

- **SelectSite C304 HIS deflectable sheath**
  - Outer diameter 8.4 F
  - Inner diameter 5.7 F

- **EP Recording System**
- **Pacemaker Programmer**
- **Alligator Cable**

Step 1: Locating His Bundle
Fluoroscopic Confirmation

1. Advance / Clockwise Rotation → Cross tricuspid annulus → RV
2. Withdraw / Counterclockwise Rotation towards superior margin of septal TA
3. Look for His Potential
Step 2: Locating His Bundle
Electrical Confirmation –
Identify His Signal & Perform His Pacing in Unipolar Mode

Intrinsic rhythm: His Signal

His Bundle Pacing
His Signal – Baseline HV Interval 58ms
(Normal HV 35-55ms) Prolonged HV → Infra-hisian Conduction Disease
His Bundle Capture:

1. Narrow QRS (91ms) morphology & normal axis (+/- identical to intrinsic rhythm QRS)
2. Stim to V interval (SV) Interval during His Bundle Pacing (48ms)
   → Similar to HV Interval in intrinsic rhythm (58ms)

Non-selective His Capture (with no isoelectric interval between pacing spike & QRS)
Confirm His Bundle Pacing Capture Threshold
High Pacing Threshold

10V@0.4ms
QRS 91ms

5V@0.4ms
QRS 91ms

2V@0.4ms
QRS 136ms
His Bundle Pacing
Corrects the LBBB and ↓ QRS 150ms → 90ms
Step 3: Locating Left Bundle Branch
Advance Pacing Lead from His Position Towards RV Apex for 1-2cm Fluoroscopic Confirmation
Step 4: LBB Pacing
Electrical Confirmation –
Identify the “W” Potential in V1 & Perform LBB Pacing in Unipolar Mode

Before Screw-in – RV pacing “W-potential” in V1

After Screw-in: LBBB Pacing rsR pattern in V1
“W Potential” in V1 before Screw-in during pacing from RV septum (Unipolar)
Select Secure 3830 Screw-in: 3-5 clockwise turns/time

https://www.youtube.com/watch?v=0skUko9_us0
Step 5:
Determine the Depth of Lead Implant – Sheath Angiography
Avoid Implant Depth ≥ 8-10mm

IVS = Interventricular Septum
Step 5: Determine the Depth of Lead Implant – Sheath Angiography
Avoid Implant Depth >8-10mm

- Features of 3830 pacing lead
  - Tip 1.8mm
  - Ring 3.8mm
  - Tip-Ring 9.0mm

IVS = Interventricular Septum
Step 5:
Determine the Depth of Lead Implant – Electrical Confirmation
Transition of LBBB Morphology → RBBB Morphology in V1 during Lead Rotation
Pacing in Unipolar Mode at High & Low Output

Keping Chen et al. Europace 2018;0:1-8
Evolution of V1 notching, morphology, QRS width & LVAT during LBBP lead advancement

Before Screw-in: “W-potential” in V1
LBBB morphology.
Paced-QRS 196ms. LVAT 140ms

After Screw-in: “rSR pattern” in V1
RBBB morphology.
Paced-QRS 112ms. LVAT 93ms

LVAT = Left Ventricular Activation Time = Interval from pacing stimuli to peak of R wave in V5-V6
Step 5: Determine the Depth of Lead Implant with Serial Impedance Monitoring

- Measure lead impedance in unipolar mode every 3-5 turns

- Stop advancing when impedance $\leq 500 \, \Omega$ (which signifies increased risk of septal perforation)
Step 6:
Determine Lead Depth & Stability
Sheath Withdrawal into RA – Fulcrum Sign

IVS = Interventricular Septum
Step 7: Threshold Testing:
LBB Pacing at high & low output: rsR Pattern in V1.
RBBB morphology. QRS 112ms. Constant & Short LVAT 93ms

LVAT = Left Ventricular Activation Time = Interval from pacing stimuli to peak of R wave in V5-V6.
Step 8: Slitting of C315 Sheath
Slitting of C315 Sheath

https://www.youtube.com/watch?v=0skUko9_us0
Final fluoroscopic confirmation of Leads Positions in LAO & RAO views

LAO 45

RAO 30

LBBP

LBBP

LBBP

LBBP
Baseline LBBB QRS ~ 150ms
LBB Pacing. Correction of LBBB. Narrowing of QRS ~120ms
Echocardiographic Confirmation of LBBP Lead Implant Depth

Trans-septal LBB Pacing Lead

Trans-septal LBB Pacing Lead
Post LBB Pacing Echo

- LVEF Improved to ~40% by Biplane Modified Simpson’s (LVEF ~ 35-40% by Eyeballing)
- MR +++ $\rightarrow$ ++
Electrophysiological Mechanism of His Bundle Pacing (HBP) / Left Bundle Branch Pacing (LBBP)

Longitudinal Dissociation of Conduction System:
- Conduction fibers arising early from proximal His Bundle are predestined to the individual bundle branches → HBP & LBB pacing distal to the level of block → allows correction of BBB & restoration of electrical & mechanical synchrony
Prospective evaluation of feasibility and electrophysiologic and echocardiographic characteristics of left bundle branch area pacing

- N = 100.
- AVB 54%. SND 23%.
- LBBB 24% RBBB 25%
- Implant success 93%
- Paced QRS duration: 136±17 ms.
- In patients with LBBB, correction of LBBB with QRS ↓ 162 ± 21ms → 137 ± 19 ms during LBB Pacing (P <0 .001)
- Stability: Stable sensing, threshold & impedance at 12 months

LBB Pacing Corrects LBBB/RBBB
Improves LVEF, LV electrical & mechanical synchrony (strain)
Correction of LBBB / RBBB with success rate of 68.7%
(QRS 153.3 ± 27.8 → 122.2 ± 9.9 ms)
LBB Pacing → ↓ QRS , ↑ LVEF, ↓ LVEDD, ↑ LV synchrony (time to peak strain delay)

N = 33 AVB Patients. LBB Pacing success 90.9%. Safety: 1 septal lead perforation
Left bundle branch pacing
Preserves Electrical and LV Mechanical Synchrony
(Gated SPECT MPI Phase Analysis)
Indications for His Bundle Pacing

In patients with AV block at AVN level, who have an indication for permanent pacing, His Bundle Pacing may be considered to maintain physiologic ventricular activation (II b).

- LVEF 36-50%.
- Predicted Pacing Percentage ≥40%
- → His Bundle Pacing
## Comparison of His Bundle Pacing (HBP) & LBB Pacing

<table>
<thead>
<tr>
<th></th>
<th>His Bundle Pacing</th>
<th>LBB Pacing</th>
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</thead>
<tbody>
<tr>
<td><strong>Implant site</strong></td>
<td>His Bundle</td>
<td>Left Bundle Branch</td>
</tr>
<tr>
<td><strong>Implant depth</strong></td>
<td>$\leq 1.8$mm (screw length)</td>
<td>$\sim 8-10$mm (depending on orientation of lead)</td>
</tr>
<tr>
<td><strong>Sensing (Cross talk)</strong></td>
<td>Risk of atrial oversensing Cross talk</td>
<td>No cross talk with atrial signal</td>
</tr>
<tr>
<td><strong>Pacing threshold</strong></td>
<td>Higher</td>
<td>Lower (translating into longer battery longevity)</td>
</tr>
<tr>
<td><strong>Lead stability</strong></td>
<td>Lower</td>
<td>Higher (low risk of lead dislodgment)</td>
</tr>
<tr>
<td><strong>Need for RV backup pacing</strong></td>
<td>+/-</td>
<td>No (only temporary RV backup pacing during implant is suggested for patient with LBBB)</td>
</tr>
<tr>
<td><strong>Management of loss of HB/LBB capture</strong></td>
<td>Risk of simultaneous loss of His &amp; RV capture (if too close to atrial side); might need lead revision</td>
<td>Increase pacing output to capture RV</td>
</tr>
<tr>
<td><strong>AVN ablation for AF patients</strong></td>
<td>Risk of loss of His Bundle Capture after AVN ablation</td>
<td>Allows AVN ablation without affecting capture threshold</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>Lower risk of septal perforation</td>
<td>Higher risk of septal perforation (depending on depth of implant)</td>
</tr>
</tbody>
</table>
Conclusion

Left bundle branch pacing (LBBP) is a viable physiological pacing alternative to CRT & His Bundle Pacing, in patients with CHF, LV dysfunction, LBBB & high pacing dependence, in improving left ventricular function, electrical and mechanical synchrony, & minimizing pacing induced cardiomyopathy.
Acknowledgement

• Dr. Zhao Chun Ting
• Dr. Liu Min Ya
• Dr. Jojo Hai
Backup Slides
Cardiac Conduction System Anatomy – His Bundle

The Conduction System

RAO View

LPO View

HIS

AVN

Koch Triangle


Three Types of Anatomical Variation of His Bundle Anatomy

Underneath MS

Intramuscular

Beneath Endocardium
Left Bundle Branch Anatomy

His Bundle arises distal to AVN → runs underneath membranous interventricular septum (IVS) → perforates the membranous IVS beneath the junction of RCC/NCC → gives rise to left bundle branch (LBB), which bifurcates into AF, PF +/- SF

- AF = Anterior Fascicle
- SF = Septal Fascicle
- PF = Posterior Fascicle
Intra-Cardiac Recording: His Bundle Signal

This image is representative of typical catheter placement for an electrophysiology study.

His Bundle Pacing $\rightarrow$ 30% $\downarrow$ Death, CHF Hospitalization or Upgrade to CRT

Benefit primarily seen in patients with RV pacing >20%.

Clinical Outcomes of His Bundle Pacing Compared to Right Ventricular Pacing

- 765 Patients
- 332 HBP attempted
  - 304 (92%) Successful HBP
  - 28 (8%) RV septum
- 433 RV pacing
  - 176 (41%) RV apex
  - 257 (59%) Non-apical

- Mean Follow-up duration 725 ±423 days
- HBP = His Bundle Pacing

Mortality (HBP 17.2% vs RVP 21.4%. P = 0.06)

Primary endpoint reached in:
- 25% HBP patients
- 32% RVP patients

Central Illustration: His Bundle Pacing and Outcomes: Kaplan-Meier Survival Curves and Analysis of the Primary Endpoint in All Patients
His Bundle Pacing Improves Left Ventricular Ejection Fraction

His Bundle Pacing: \( \uparrow \) LVEF 5.9\% (\( p=0.001 \)) (42.8\% \rightarrow 49.5\%) @ 17 months follow-up

Permanent His-bundle pacing: a systematic literature review and meta-analysis

Records identified through database searching PubMed (Medline), EMBASE, and Cochrane Library \((n=2876)\)

Records screened \((n=2334)\)

Duplicates excluded \((n=542)\)

Records excluded for not meeting inclusion criteria \((n=2292)\)

Full-text articles excluded \((n=46)\)

- Editorial/Review (14)
- Not permanent HBP (16)
- Case report (10)
- Preclinical (3)
- Overlapping cohort (2)
- Article not in English (1)

Studies included in systematic review \((n=26)\)

LVEF%

\[\text{Baseline} \quad \text{Follow-up}\]

- EF \geq 50\% , \( P=0.13 \)
- EF < 50\% , \( P<0.001 \)

N = 26 Studies (1438 patients). Indication of HBP – 62\% for AVB. Implant success 84.8-92.1\%.

Europace 2018;0:1-8. doi:10.1093/europace/euy058
CRT or HBP $\rightarrow$ ↓ LVEDV (-2.77ml) & LVESV (-7ml). Preserved or ↑ LVEF 5.328% @ ~ 1.6y

Patients with LVEF >35% - ≤52% or AVN ablation + Pacemaker $\rightarrow$
more likely to benefit from CRT or HBP vs RV pacing.

LVEDV = Left ventricular end diastolic volume
LVESV = Left ventricular end systolic volume
A Novel Pacing Strategy With Low and Stable Output: Pacing the Left Bundle Branch Immediately Beyond the Conduction Block

Weijian Huang, MD, FHRS, Lan Su, MD, Shengjie Wu, MD, Lei Xu, MD, Fangyi Xiao, MD, Xiaohong Zhou, MD, and Kenneth A. Ellenbogen, MD, FHRS

Department of Cardiology, First Affiliated Hospital of Wenzhou Medical University, Key Lab of Cardiovascular Disease of Wenzhou, Wenzhou, China

CRHF Division, Medtronic PLC, Mounds View, Minnesota, USA

Department of Cardiology, Virginia Commonwealth University Health System, Richmond, Virginia, USA

The first case report to describe LBB pacing correcting LBBB
# Perspectives in Contrast

**Left bundle branch pacing is the best approach to physiological pacing**

Santosh K. Padala, MD, Kenneth A. Ellenbogen, MD, FHRSA

*From the Department of Cardiac Electrophysiology, Virginia Commonwealth University, Richmond, Virginia.*

Table 1. Published studies on left bundle branch area pacing

<table>
<thead>
<tr>
<th>Study (year)</th>
<th>Design</th>
<th>Sample size</th>
<th>Study population</th>
<th>Success rate</th>
<th>Mean paced QRSd (ms)</th>
<th>Mean LVAT (ms)</th>
<th>LBB potential</th>
<th>Follow-up (mo)</th>
<th>Lead complications</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen et al (2018)</td>
<td>Prospective LBBAP vs RVP</td>
<td>20</td>
<td>SND: 75% AV/Infranodal block: 20% AVB: 38%</td>
<td>NR</td>
<td>111 ± 10</td>
<td>69 ± 9</td>
<td>55%</td>
<td>3</td>
<td>A/C: None</td>
<td>Stable lead parameters</td>
</tr>
<tr>
<td>Zhang et al (2019)</td>
<td>Prospective LBBAP vs RVP</td>
<td>23</td>
<td>SND: 48% AVB: 38%</td>
<td>87%</td>
<td>112 ± 12</td>
<td>NR</td>
<td>NR</td>
<td></td>
<td>A: None C: NR</td>
<td>Acute success rate and pacing characteristics</td>
</tr>
<tr>
<td>Hou et al (2019)</td>
<td>Prospective</td>
<td>56</td>
<td>SND: 29% AVB: 37% AF with SVR: 34%</td>
<td>NR</td>
<td>118 ± 11</td>
<td>76 ± 14</td>
<td>67%</td>
<td>4.5</td>
<td>A: 1 lead dislodgment Intraoperative C: None</td>
<td>Stable lead parameters LBBAP patients with potential had LV mechanical synchrony similar to that of HBP based on phase analysis of gated SPECT MPI</td>
</tr>
<tr>
<td>Li et al (2019)</td>
<td>Retrospective</td>
<td>33</td>
<td>AVB: 100%</td>
<td>91%</td>
<td>113 ± 11</td>
<td>82 ± 15</td>
<td>26.7%</td>
<td>3</td>
<td>A: 1 LV septal perforation C: None</td>
<td>Stable LVEF Stable lead parameters</td>
</tr>
<tr>
<td>Li et al (2019)</td>
<td>Prospective</td>
<td>87</td>
<td>SND: 68% AVB: 32% SND: 23% AVB: 54% AVN ablation: 7% CRT: 11% HBF failure: 7%</td>
<td>80%</td>
<td>113 ± 10</td>
<td>79.7 ± 8.5</td>
<td>66%</td>
<td>3</td>
<td>A/C: None</td>
<td>Stable LVEF Stable lead parameters</td>
</tr>
<tr>
<td>Vijayaraman et al (2019)</td>
<td>Prospective</td>
<td>100</td>
<td>HF with reduced EF and LBBB: 100%</td>
<td>93%</td>
<td>136 ± 17</td>
<td>75 ± 16</td>
<td>63%</td>
<td>3</td>
<td></td>
<td>Stable lead parameters</td>
</tr>
<tr>
<td>Zhang et al (2019)</td>
<td>Prospective</td>
<td>11</td>
<td></td>
<td>NR</td>
<td>129 ± 16</td>
<td>80.9 ± 9.95</td>
<td>0%</td>
<td>6.7</td>
<td>A/C: None</td>
<td>Improvement in LVEF by ≥5% from baseline in all &gt;20% from baseline in 7 patients Improvement in LV synchrony by pulsed-wave Doppler and tissue synchronization imaging</td>
</tr>
</tbody>
</table>
# Perspectives in Contrast

## Left bundle branch pacing is the best approach to physiological pacing

Santosh K. Padala, MD, Kenneth A. Ellenbogen, MD, FHRSA

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<tr>
<th>Study</th>
<th>Year</th>
<th>Type</th>
<th>Number</th>
<th>Criteria</th>
<th>Efficacy</th>
<th>Complications</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hasumi et al (2019)</td>
<td>Retrospective</td>
<td>21</td>
<td>Advanced AVB: 100% Failed HBP</td>
<td>81%</td>
<td>116 ± 8.3 NR</td>
<td>6</td>
<td>A/C: None</td>
</tr>
<tr>
<td>Cal et al (2020)</td>
<td>Prospective Observational LBBAP vs RVP</td>
<td>40</td>
<td>BBB with QRS &gt; 130 ms Atypical BBB:13.6% 5 LBBB and 5 RBBB Typical BBB: 88.4% 30 LBBB and 33 RBBB</td>
<td>30%</td>
<td>133 ± 14 198 ± 14 85 ± 15</td>
<td>10%</td>
<td>NR</td>
</tr>
<tr>
<td>Jiang et al (2020)</td>
<td>Retrospective Randomized LBBAP vs RVP</td>
<td>73</td>
<td>BBB with QRS &gt; 130 ms Atypical BBB:13.6% 5 LBBB and 5 RBBB Typical BBB: 88.4% 30 LBBB and 33 RBBB</td>
<td>94%</td>
<td>121 ± 9.8 67.8 ± 6.8</td>
<td>75%</td>
<td>6</td>
</tr>
<tr>
<td>Wang et al (2020)</td>
<td>Prospective Observational LBBAP vs RVP</td>
<td>66</td>
<td>SNR: 32% AVB: 54% AF with SVR: 14%</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Total: 530

A = acute; AF with SVR = atrial fibrillation with slow ventricular rate; AV = atrioventricular; AVN = atrioventricular node; AVB = atrioventricular block; BBB = bundle branch block; C = chronic; CRT = cardiac resynchronization therapy; EF = ejection fraction; HBP = His-bundle pacing; HF = heart failure; LBB = left bundle branch; LBBAP = left bundle branch area pacing; LBBB = left bundle branch block; LV = left ventricle; LVAT = left ventricular activation time; LVEF = left ventricular ejection fraction; NR = not reported; QTc = corrected QT interval; QTD = QT dispersion; QTCO = corrected QT dispersion; RBBB = right bundle branch block; RVP = right ventricular pacing; SND = sinus node dysfunction; SPECT MPI = single photon emission computed tomography myocardial perfusion imaging.
Left bundle branch pacing for symptomatic bradycardia: Implant success rate, safety, and pacing characteristics

- N = 87 patients (AVB 32.2%. SND 67.8%)
- LBB Pacing implant success 80.5%
- LBBP produced narrower QRS than RV septal pacing (113.2 ± 9.9 ms vs 144.4 ± 12.8 ms; P <0.001).
- The pacing threshold was low (0.76 ± 0.22 V at implantation and 0.71 ± 0.23 V at 3 months), with no loss of capture or lead dislodgment observed.
- No major implantation-related complications
A beginner’s guide to permanent left bundle branch pacing

Weijian Huang, MD, FHRS, Xueying Chen, MD, PhD, Lan Su, MD, Pugazhendhi Vijayaraman, MD, FHRS

Assess ventricular septal thickness by Echo and scar

Intrinsic rhythm: LBBB

Ventricular back-up pacing

Intrinsic rhythm: Non-LBBB

Vein access from left side (preferred) with C315His/C304His

initial site at right surface of VS (RAO 30°) for LBBP location

Failed to fix

Reassess

Screw perpendicular to LV septum (LAO 30-45°)

Determine the LBBP lead depth into ventricular septum

Approximately 6-8 mm or recording the RBBB paced morphology

Slow turning

Test with different output

Confirm LBB capture with acceptable pacing parameters

Location using distal HBP location: place the catheter 1-1.5cm from HBP site towards right ventricular apex

And/Or

Location using the paced morphology: “W” pattern with the notch closer to nadir in lead V1 may indicate ideal location

Observe the changes in the notch in V1 lead

Sheath angiography

Falcrum sign

Impedance monitoring

Paced morphology of RBBB pattern

Recording LBB potential

Stimulus-peak LVAT shortens abruptly with increasing output or remains shortest and constant at low and high outputs

Selective LBBP and Non-selective LBBP

Recording retrograde His potential or antegrade LBB potential during pacing (not routine in clinical practice)
LBB Pacing: Step 1 (Venous Access)

Assess ventricular septal thickness by Echo and scar

Intrinsic rhythm: LBBB
  Ventricular back-up pacing

Intrinsic rhythm: Non-LBBB
  Vein access from left side (preferred) with C315His/C304His
LBB Pacing: Step 2 (Locating the His & LBB)

- Vein access from left side (preferred) with C315His/C304His
- Initial site at right surface of VS (RAO 30°) for LBBP location

Failed to fix

- Reassess

Location using distal HBP location: place the catheter 1-1.5 cm from HBP site towards right ventricular apex

And/Or

Location using the paced morphology: “W” pattern with the notch closer to nadir in lead V1 may indicate ideal location
LBB Pacing: Step 3
(Determining the Depth of Lead Implant)

- Screw perpendicular to LV septum (LAO 30-45°)
- Determine the LBBP lead depth into ventricular septum
  - Approximately 6-8 mm or recording the RBBB paced morphology
  - Slow turning

- Observe the changes in the notch in V1 lead
- Sheath angiography
- Fulcrum sign
- Impedance monitoring
LBB Pacing: Step 4
(Threshold Testing & Confirmation of LBB Capture)

- Test with different output
  - Avoid perforation
  - Confirm LBB capture with acceptable pacing parameters
    - Paced morphology of RBBB pattern
    - Recording LBB potential
    - Stimulus-peak LVAT shortens abruptly with increasing output or remains shortest and constant at low and high outputs
    - Selective LBBP and Non-selective LBBP
    - Recording retrograde His potential or anterograde LBB potential during pacing (not routine in clinical practice)
Determining the Depth of Lead Implant
When to Stop Screwing?

• Continuously monitor the following parameters every 3-5 turns of lead rotation:

• Electrically
  • V1 morphology changed from LBBB → RBBB; with QRS narrowing
  • LVAT (Pacing stimuli to peak of R wave in V5-6) ≤ 80-90ms
  • Constant LBB capture morphology & short/constant LVAT at high & low output
  • LBBB potential detected in pacing lead
  • Unipolar impedance ≤ 500-600 ohms

• Anatomically
  • Lead depth ≥ 8-10mm
Programming: LBB Pacing in Unipolar / Bipolar mode at various output
Choose the lowest output with narrowest QRS
Programming – Choose the optimal AV delay with narrowest QRS
LBB Pacing at various AV interval at constant output