What’s Old is New Again

HIS Bundle Pacing

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Objectives

- Define limitations of non-physiologic pacing
- Describe HIS bundle anatomy
- Describe feasibility of HIS bundle pacing
Is the cure worse than the disease?

- At its core pacing is intended to support the ventricular rate.
- Traditional dual chamber pacemakers have significant drawbacks regardless of the pacing indication.
  - Sinus node disease
  - Complete heart block
Pacing Mode Does Not Alter Outcome

**Primary End Point**

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**Hospitalization for Heart Failure, Stroke, or Death**

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**NO. AT RISK**

- **Ventricular pacing**
  - Primary End Point: 996 897 813 678 557 431 320 218 125 39
  - Hospitalization for Heart Failure, Stroke, or Death: 996 880 839 752 624 504 388 287 193 110 35

- **Dual-chamber pacing**
  - Primary End Point: 1014 963 930 833 693 555 431 328 214 120 28
  - Hospitalization for Heart Failure, Stroke, or Death: 1014 926 889 793 649 518 394 297 188 105 26

**Adjusted P-values**

- **Primary End Point**: P=0.48 (Adjusted P=0.32)
- **Hospitalization for Heart Failure, Stroke, or Death**: P=0.23 (Adjusted P=0.05)
There is no such thing as low burden pacing.

Figure 2  Kaplan-Meier curves depicting 15-year survival without LVEF decrease to $\leq 40\%$ (PICM) for (A) the entire cohort, (B) cohort stratified by $< 40\%$ or $\geq 40\%$ RV pacing, and (C) cohort stratified by $< 20\%$ or $\geq 20\%$ RV pacing. LVEF = ejection fraction; PICM = pacing-induced cardiomyopathy; RV = right ventricular.
Incidence and predictors of right ventricular pacing-induced cardiomyopathy

Shaan Khurshid, MD,* Andrew E. Epstein, MD, FHRS, * Ralph J. Verdino, MD, * David Lin, MD, FHRS, * Lee R. Goldberg, MD,*† Francis E. Marchlinski, MD, FHRS, * David S. Frankel, MD, FHRS*

- 19.5% of patients with dual chamber pacemakers implanted developed a pacing mediated myopathy.
- Mean reduction in EF 62% to 36%
- Baseline QRS duration of >115 ms was 90% specific for the development of pacing mediated myopathy.
- Pacing % does not predict change in LVEF.

Figure 3 Survival free of pacing-induced cardiomyopathy. Kaplan-Meier curve is shown for 10-year survival free of right ventricular pacing-induced cardiomyopathy.

(Heart Rhythm 2014;11:1619–1625)
RV Apical v. RV Septal Positioning

Protect Pace Study
- Normal EF patient with >50%
- RV apical versus RV septal
- No difference in EF, Heart failure hospitalization, AF, or 6 minute walk.
- Longer implant and flouro times for RV septal lead placement.
- 1/3 of RV septal leads were actually not septal

Figure 2 Change in LV ejection fraction by randomization assignment.
Don’t be fooled – we are pacing!
Don’t be fooled – we are pacing!
Poor Outcomes in HF Patients

Wilkoff et al., AMA 2002; 288(24):3115-3123
That’s why we have CRT, right?

Figure 2. Freedom from a Primary-Outcome Event.

Figure 3. Freedom from the Clinical Components of the Primary Outcome.
Maybe – Biopace Trial

MORTALITY/HF HOSPITALIZATION

1810 patients / LVEF 55.4±12.2%

p (adjusted): 0.08, HR 0.871, 95%-CI: [0.75; 1.01]

Time since randomization (months)
Pacing mode does not mitigate against the detrimental effects of pacing.

RV apical and septal pacing are equal in their poor outcomes

Only patients with advanced HF and wide LBBB (>150 ms) clearly benefit from CRT

- 2013 ACC/AHA/HRS guidelines (sinus, EF <35%, GDMT)
- Strong recommendation & strong evidence
  - **NYHA class III/IV, LBBB>150 ms** (weaker evidence for class II)
  - NYHA class III/IV, non-LBBB>150 ms (weak recommendation)
  - NYHA class II/III/IV, LBBB 120-149 ms (weak recommendation with weak evidence)
A Revolution In Pacing?

- Replicates true human physiology
- Lead tip & body potentially within the right atrium
  - Could prevent lead related issues such as tricuspid regurgitation
- Ideal form of AV and VV (intraventricular and interventricular)
- Data not convincing for other forms of pacing
  - RV pacing and its detrimental effects
  - BiV pacing equivocal in EF > 35% (BLOCK-HF/BIOPACE)
HIS Bundle Pacing Physiology

**Proximal**

- BH Pacing
- BE (RA)
- L1
- aVF
- V1
- QRS 150 msec
- PI-R 70 msec

**Distal**

- PI-R 50 msec
- QRS 90 msec
- PI

**Schematic**

- M.V.
- AVN
- M.S.
- L.B.
- R.B.
- Vent. Sept.
HIS Bundle v. RV Pacing

**Abstract**

**Background:** Right ventricular pacing (RVP) is associated with heart failure and increased mortality. His bundle pacing (HBP) is a physiological alternative to RVP. The aim of the study is to evaluate clinical outcomes of HBP compared to RVP.

**Methods:** All patients (pts) requiring initial pacemaker implantation underwent attempt at permanent HBP at one hospital and RV pacing at the sister hospital. 765 patients were identified between Oct 1, 2013 and December 31, 2016. Patients' clinical course was followed from implantation. Primary outcome was the combined endpoint of death, heart failure hospitalization (HFH), or upgrade to biventricular pacing as intention to treat analysis.

**Results:** HBP was successful in 304 of 332 (92%) consecutive pts while 433 pts underwent RVP. Age (75±11 vs 76±11 yrs) and LVEF (55±8 vs 54±10%) were similar in HBP and RVP respectively. There were more men (60% vs 53%, p<0.05) and more pts with AF (57 vs 44%, p<0.05) in the HBP group. There was no significant difference in the prevalence of HTN, DM, heart failure or CAD. The primary endpoint of death, HFH or upgrade to BIV pacing was significantly reduced in the HBP group (77 of 332, 23%) compared to RVP (125 of 433, 29%) (HR 1.4, p=0.02). This difference in primary endpoint was mainly in pts with ventricular pacing > 20% (24% in HBP vs 32% in RVP) (HR 1.7, p <0.02).

**Conclusion:** Permanent HBP is associated with reduction in the combined endpoint of death, HFH or upgrade to biventricular pacing compared to RVP.
Post - TAVR

RBBB – CHB following TAVR
Post - TAVR
HIS Bundle v. CRT Pacing

**Figure 1**

- **QRS duration (ms)**
  - Overall: Baseline QRSd 118, HBP QRSd 163, p-value = 0.0001177
  - BBB: Baseline QRSd 116, HBP QRSd 125, p = 0.04
  - Ventricular paced: Baseline QRSd 103, HBP QRSd 108

- **LV Function (%)**
  - Overall: Baseline 30, Follow-up 44, p-value = 0.0001
  - Baseline LVEF < 35%: Baseline 25, Follow-up 40
  - Baseline LVEF 35-50%: Baseline 44, Follow-up 55

(Hart Rhythm 2018;15:413–420)
HIS Bundle v. CRT Pacing (Crossover)

**A** Ejection Fraction

- Baseline
- His
- BiV

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<th>Ejection Fraction (%)</th>
<th>Baseline</th>
<th>His</th>
<th>BiV</th>
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<td>35</td>
<td>38</td>
<td>36</td>
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- p = 0.043 vs. Baseline
- p = 0.02 vs. Baseline

**B** NYHA Class

- Baseline
- His
- BiV

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<tr>
<th>NYHA Class</th>
<th>Baseline</th>
<th>His</th>
<th>BiV</th>
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- p < 0.003 vs. Baseline
- p < 0.001 vs. Baseline

**C** Quality of Life

- Baseline
- His
- BiV

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<th>QOL</th>
<th>Baseline</th>
<th>His</th>
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- p = 0.006 vs. Baseline
- p = 0.022 vs. Baseline

**D** Six Minute Hallwalk

- Baseline
- His
- BiV

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<th>Hallwalk (meters)</th>
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<th>His</th>
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- p = 0.009 vs. Baseline
- p = 0.069 vs. Baseline

**A** LV End Systolic Volume

- Baseline
- His
- BiV

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<th>LV End Systolic Volume (mL)</th>
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<th>His</th>
<th>BiV</th>
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- p = 0.26 vs. Baseline
- p = 0.60 vs. Baseline

**C** MR Jet Area

- Baseline
- His
- BiV

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<th>MR Jet Area (cm²)</th>
<th>Baseline</th>
<th>His</th>
<th>BiV</th>
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- p = 0.18 vs. Baseline
- p = 0.97 vs. Baseline

**B** Heart Failure Questionnaire.

**Additional Information**

This work was funded by a clinical research grant from Medtronic Inc.

**References**

Long term follow-up

• Patients need to be approached much more like CRT patients.
  – Lead thresholds set to HIS capture not lowest threshold.
  – Short AV delays (Paced AV delay 140/Sensed AV delay 120)
Questions?