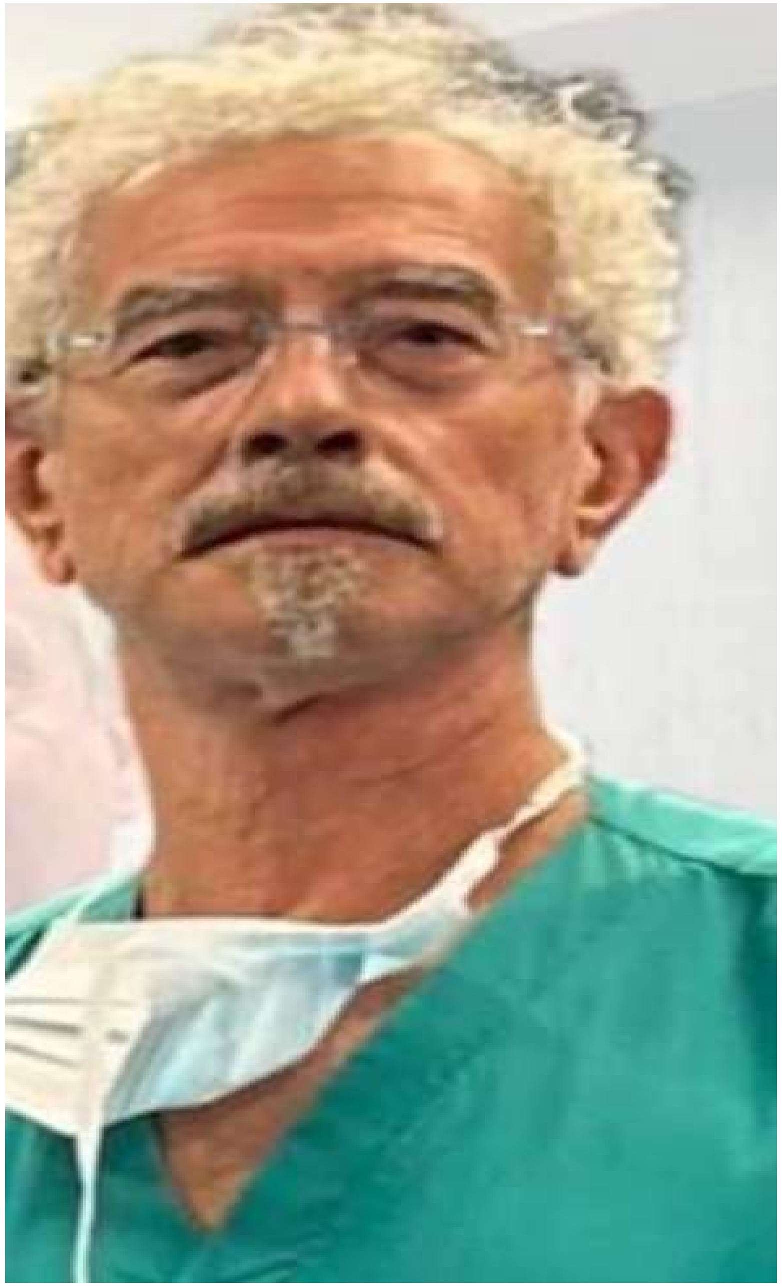

Il pacing hissiano: preziosa risorsa o inutile e dannoso?

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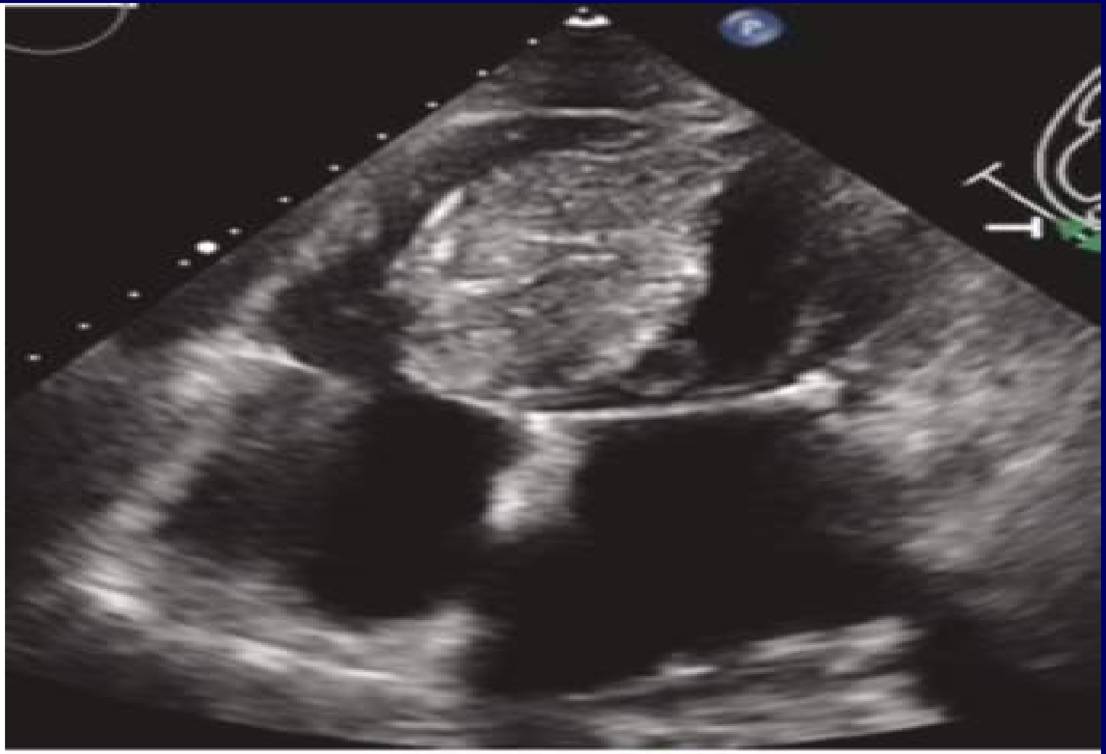
Giant Interventricular Septal Hematoma Complicating Left Bundle Branch Pacing

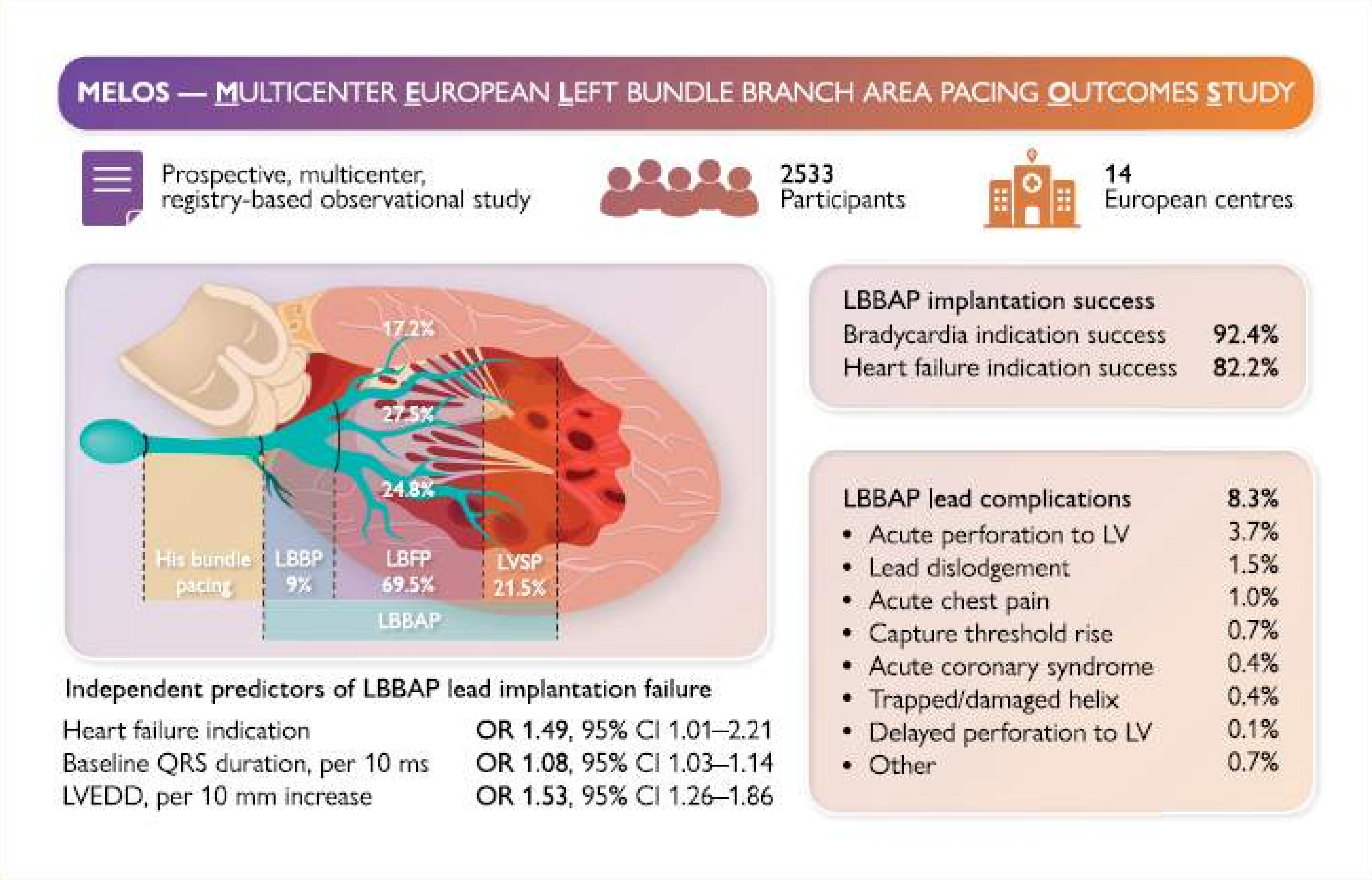
A Cautionary Tale

Rohan Trivedi, DO, Eileen Rattigan, MD, Terry D. Bauch, MD, Vernon Mascarenhas, MD, Tariq Ahmad, MD, Faiz A. Subzposh, MD, Pugazhendhi Vijayaraman, MD

ABSTRACT

An 88-year-old woman underwent atrioventricular node ablation and left bundle branch pacing for atrial fibrillation. She presented to the emergency room several hours after discharge with dyspnea. An echocardiogram revealed a giant interventricular septal hematoma. The patient was successfully treated with conservative medical therapy, with eventual complete resolution of the hematoma. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2023;16:101887)





LBBP, left bundle branch pacing; LBFP, left bundle fascicular pacing; LVSP, left ventricular septal pacing; LBBAP, left bundle branch area pacing; OR odds ratio.

ESC
European Society of Cardiology
Europace (2023) 25, 1208–1236
https://doi.org/10.1093/europace/euad043

EHRA DOCUMENT

EHRA clinical consensus statement on conduction system pacing implantation: endorsed by the Asia Pacific Heart Rhythm Society (APHRS), Canadian Heart Rhythm Society (CHRS), and Latin American Heart Rhythm Society (LAHRS)

Haran Burri [1]*, Marek Jastrzebski[2], Óscar Cano[3,4], Karol Čurila[5], Jan de Pooter[6], Weijian Huang[7], Carsten Israel[8], Jacqueline Joza[9], Jorge Romero[10], Kevin Vernooy[11], Pugazhendhi Vijayaraman[12], Zachary Whinnett[13], and Francesco Zanon[14]

Table 3 Complications with LBBAP and their incidences

Per-operative complications
Septal perforation (0.0–14.1%)[7,53,63,73,74,87,92,96,98–100]
Right bundle branch block (19.9% with 6.3% permanent)[63]
Complete heart block (9.4% acute with 2.6% permanent)[63]
Intra-operative lead dislodgment (3.0%)[53]
Acute coronary syndrome (0.4–0.7%)[7,101]
Coronary artery fistula (1.4–2.0%)[87,92]
Coronary vein fistula/injury[96,102]
Septal hematoma[103]
Helix damage/fracture (0.8–5.0%)[87,89,95]
Post-operative complications
Delayed septal perforation (0.1–0.3%)[7,87,104,105]
Worsening tricuspid regurgitation (7.3–32.6%)[53,61–63]
Lead dislodgment (0.3–1.5%)[7,63,96,98,100,104,106,107]
Rise in threshold by >1 V (0.3–1.8%)[7,63,96,98,106]
Loss of LBB capture (0.3–11.5%)[7,63,96]

His pacing: electrophysiology

- Basis
- Methods
- Data
- Perspectives

Conduction system pacing at Lavagna

- 2019-2020: 28 pts
- 2021-2024: 1031 pts
- 1059 pts: 502 His (47%), 557 LBBAP (53%)
- No dislogments
- Stability of capture threshold (2% > His capture threshold)
- LVEF (%) 25 ± 6 to 39 ± 12
- No variations in normal LVEF

His pacing at Lavagna

- 502 pts: - 151 AVB
-                 - 145 AVN RF
-                 - 106 CSS
-                 - 100 SSS
- 86% selective pacing, 14% non selective pacing
- QRS < 120 ms: mantained in 100% pts
- QRS > 120 ms: narrow in 35% pts

Effective His pacing

- Capture threshold ≤ 0.75 V x 0.4 ms
- R wave ≥ 3.5 mV
- Current of injury

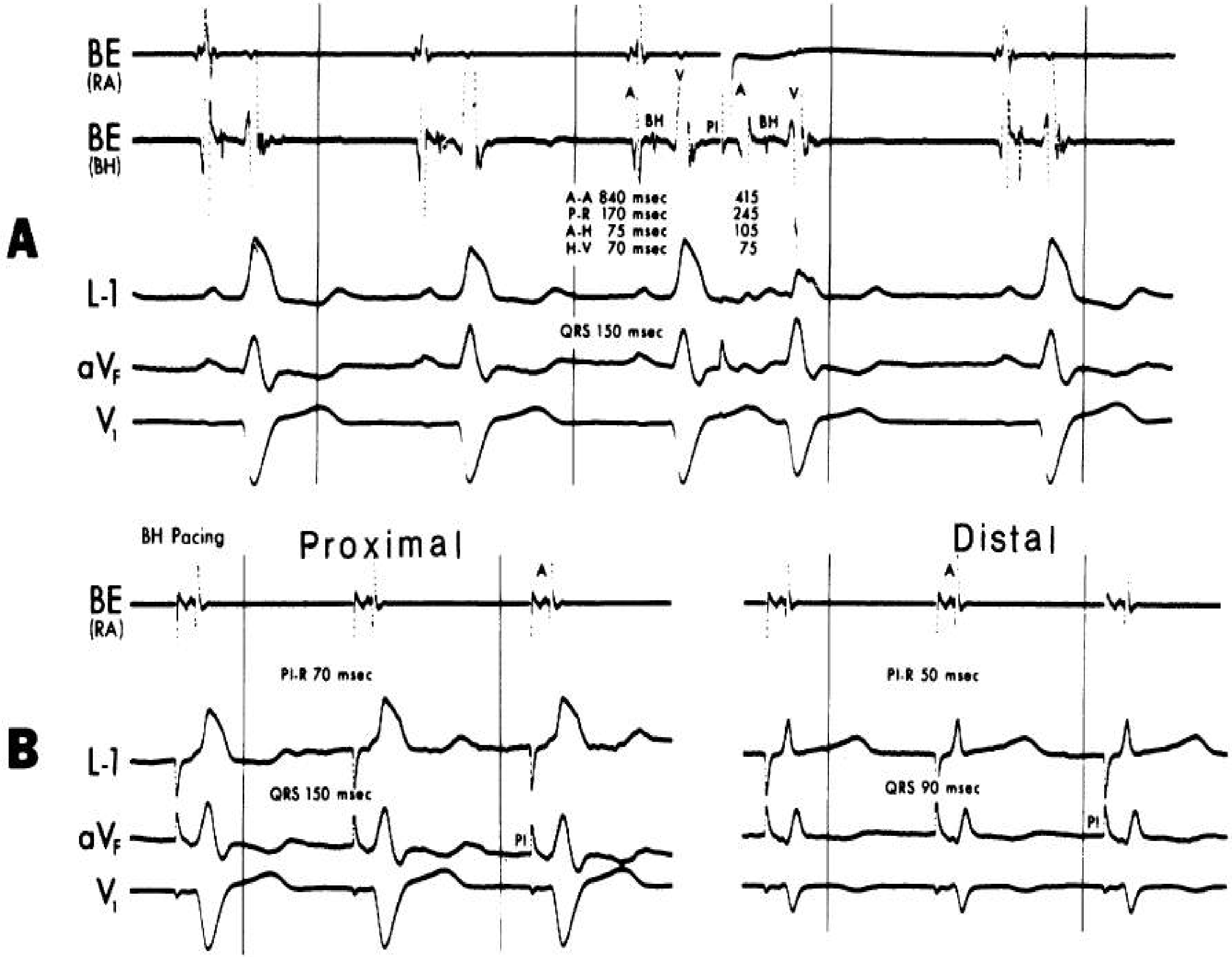
Longitudinal Dissociation in the His Bundle

Bundle Branch Block due to Asynchronous Conduction within the His Bundle in Man

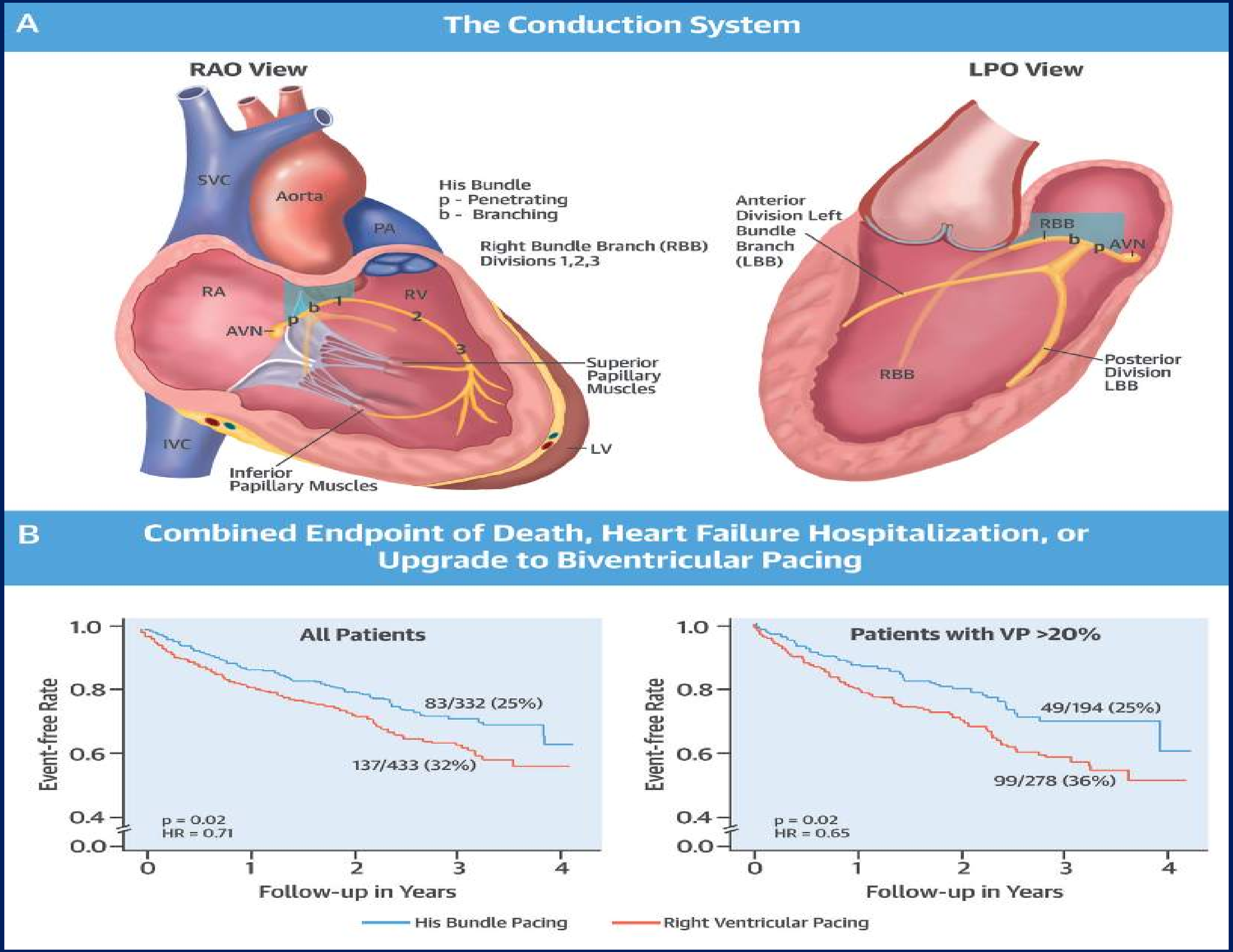
ONKAR S. NARULA, M.D.

SUMMARY This report presents electrophysiological data in 27 patients (out of a series of 110) which suggest longitudinal dissociation in the His Bundle (BH). Twenty-five patients showed left bundle branch block (LBBB) which was rate related in three and two had isolated left axis deviation (LAD) with narrow QRS complexes. BH recordings were performed via the right heart, and in each patient the same electrode catheter was used for stimulation of the BH at different sites. The H-V time was prolonged (range 50–70 msec, mean 59) in all 22 patients with constant LBBB, in one of the three of the rate related LBBB, and in one of the two with isolated LAD; and remained unchanged throughout. In all 25 patients with LBBB proximal BH stimulation exhibited QRST complexes identical to those with normal sinus rhythm with a PI-R interval equal to the H-V time. BH stimulation at a constant cycle length, but at a slightly distal site, abolished the LBBB (constant or rate related) and resulted in narrow QRS complexes ($\leq$ 95 msec) with a PI-R interval shorter than the H-V time by 5 to 20 msec. In the two patients with isolated LAD, BH stimulation abolished LAD with a PI-R interval identical to the H-V time. These findings suggest that a bundle branch block pattern and/or axis deviation may result from a focal lesion or an area of altered refractoriness within the BH. The duration of the QRS complexes and/or a shift in QRS axis was normalized by BH stimulation distal to the lesion due to synchronous impulse conduction to both the bundle branches.

Circ 1977; 56: 996-1006



James and Sherf have reported that the His bundle is partitioned into narrow cords by collagen running in its long axis and with relatively little cross connections between the compartments. The entire conduction is compartmented as various cords are insulated from each other by the collagen which provides the anatomical setting necessary for asynchronous conduction or longitudinal dissociation in the His bundle.[1] The present findings provide the electrophysiological counterpart to the detailed anatomical and histological studies on the fine structure of the His bundle.[1, 11]



P. Vijayaraman, 2018

TABLE 1 Criteria for His Bundle Pacing

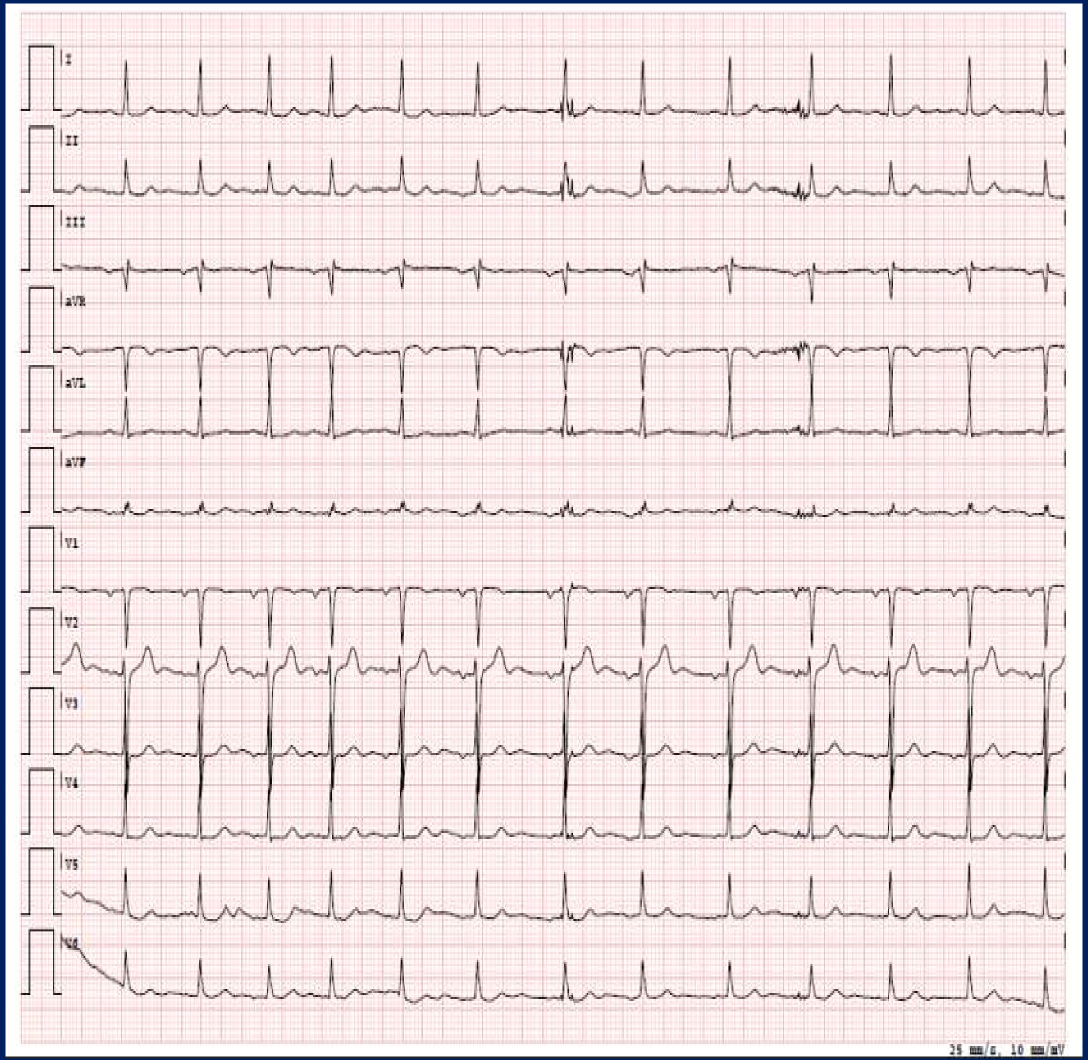
Baseline	Normal QRS	His-Purkinje Conduction Disease: With correction	His-Purkinje Conduction Disease: Without correction
Selective HBP	• S-QRS = H-QRS with isoelectric interval • Discrete local ventricular electrogram in HBP lead with S-V = H-V • Paced QRS = native QRS • Single capture threshold (His bundle)	• S-QRS ≤ H-QRS with isoelectric interval • Discrete local ventricular electrogram in HBP lead • Paced QRS < native QRS • 2 distinct capture thresholds (HBP with BBB correction, HBP without BBB correction)	• S-QRS ≤ or > H-QRS with isoelectric interval • Discrete local ventricular electrogram in HBP lead • Paced QRS = native QRS • Single capture threshold (HBP with BBB)
Nonselective HBP	• S-QRS < H-QRS (S-QRS usually 0, $S\text{-}QRS_{end}$ = $H\text{-}QRS_{end}$) with or without isoelectric interval (Pseudodelta wave +/–) • Direct capture of local ventricular electrogram in HBP lead by stimulus artifact (local myocardial capture) • Paced QRS > native QRS with normalization of precordial and limb lead axes with respect to rapid dV/dt components of the QRS • 2 distinct capture thresholds (His bundle capture, RV capture)	• S-QRS < H-QRS (S-QRS usually 0, $S\text{-}QRS_{end}$ < $H\text{-}QRS_{end}$) with or without isoelectric interval (Pseudodelta wave +/–) • Direct capture of local ventricular electrogram in HBP lead by stimulus artifact • Paced QRS ≤ native QRS • 3 distinct capture thresholds possible (HBP with BBB correction, HBP without BBB correction, RV capture)	• S-QRS < H-QRS (S-QRS usually 0) with or without isoelectric interval (Pseudodelta wave +/–) • Direct capture of local ventricular electrogram in HBP lead by stimulus artifact • Paced QRS > native QRS • 2 distinct capture thresholds (HBP with BBB, RV capture)

Reprinted with permission from Vijayaraman et al. (30).

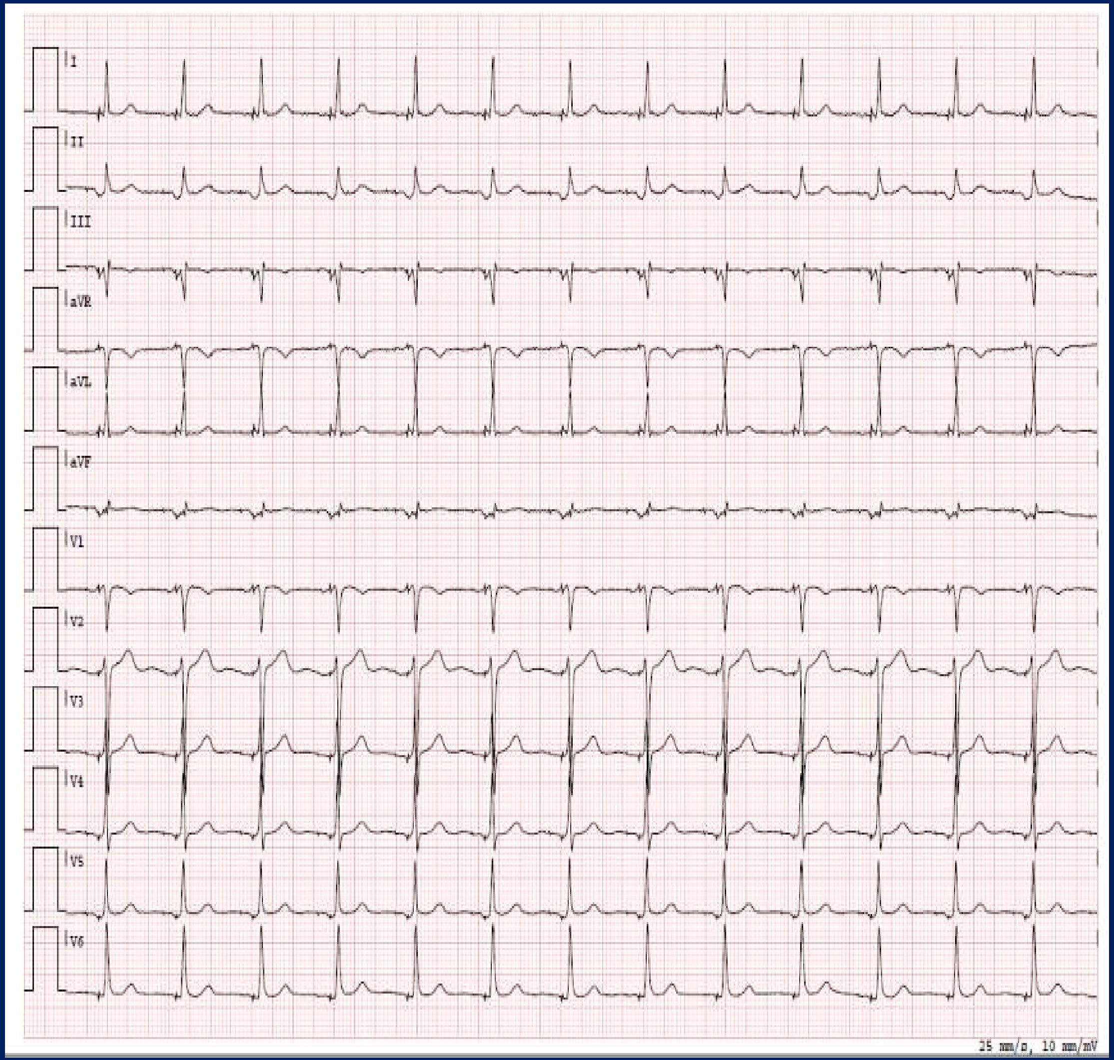
BBB = bundle branch block; dV/dt = rate of change in voltage; H-QRS = His-QRS; H-V = His-ventricular; RV = right ventricle; S-QRS = stimulus-QRS; S-V = stimulus-ventricular.

Vijayaraman, JACC 2018; 72: 927-947

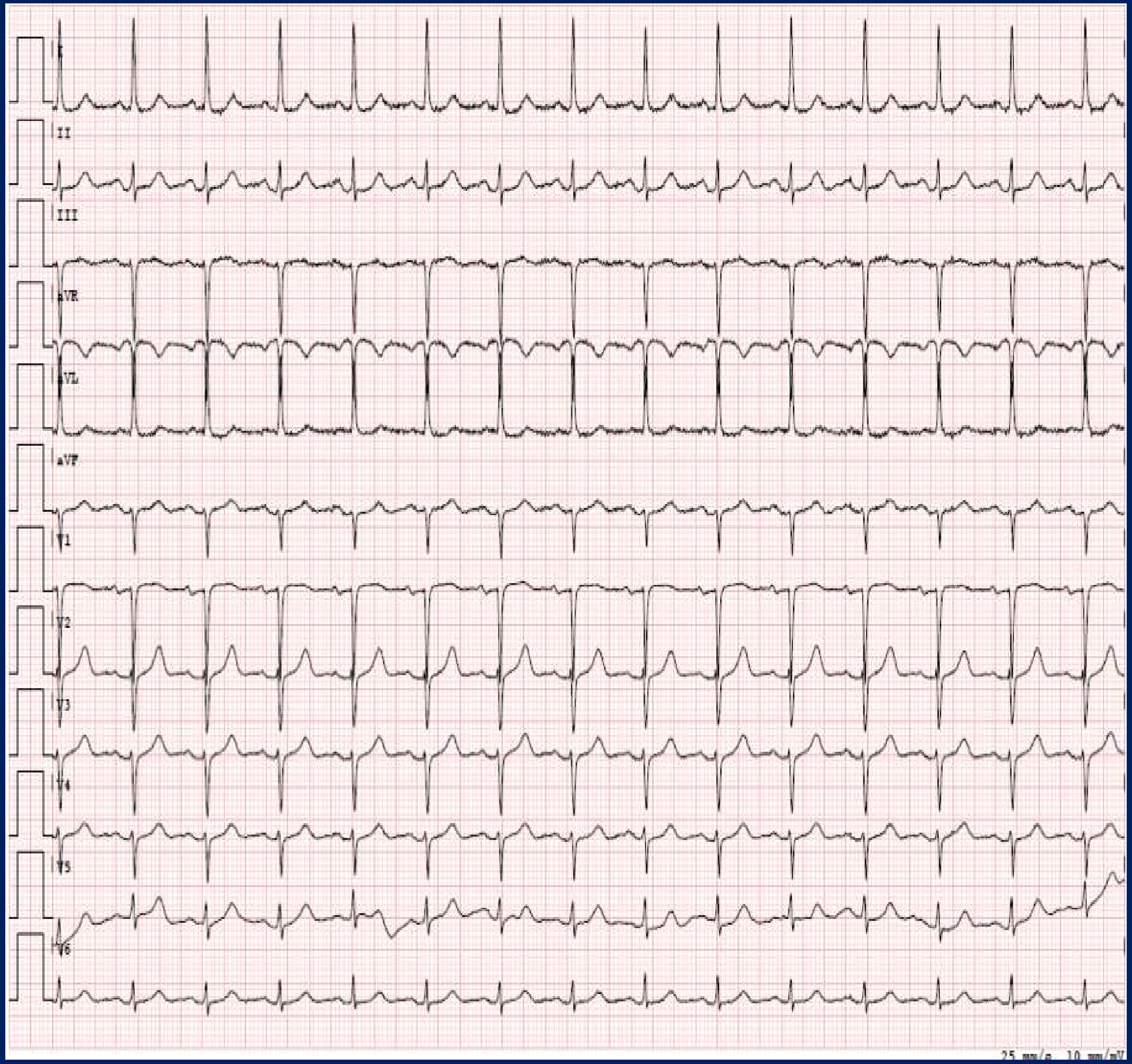
Basal



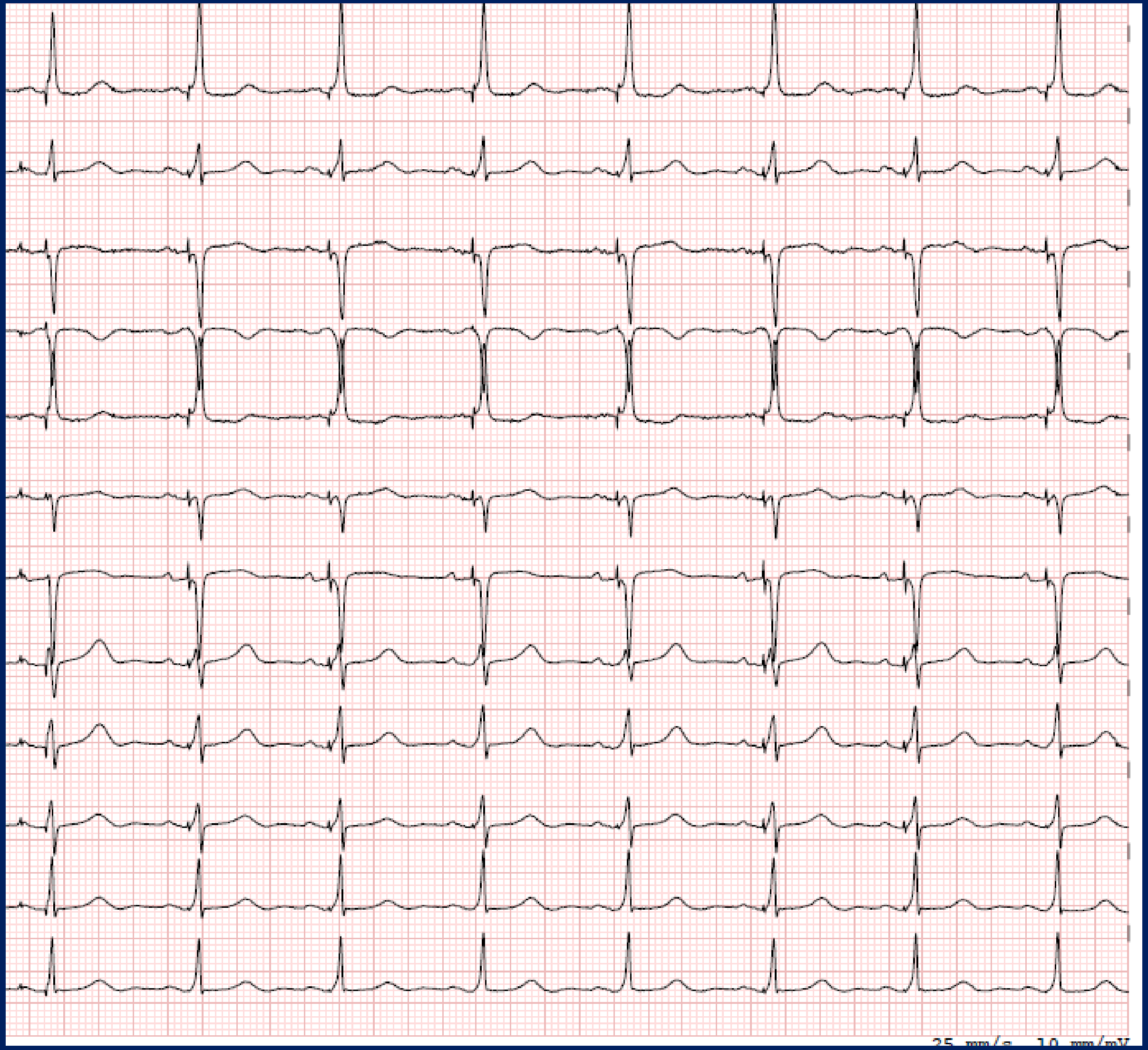
AVN ablation/His pacing



Basal ECG

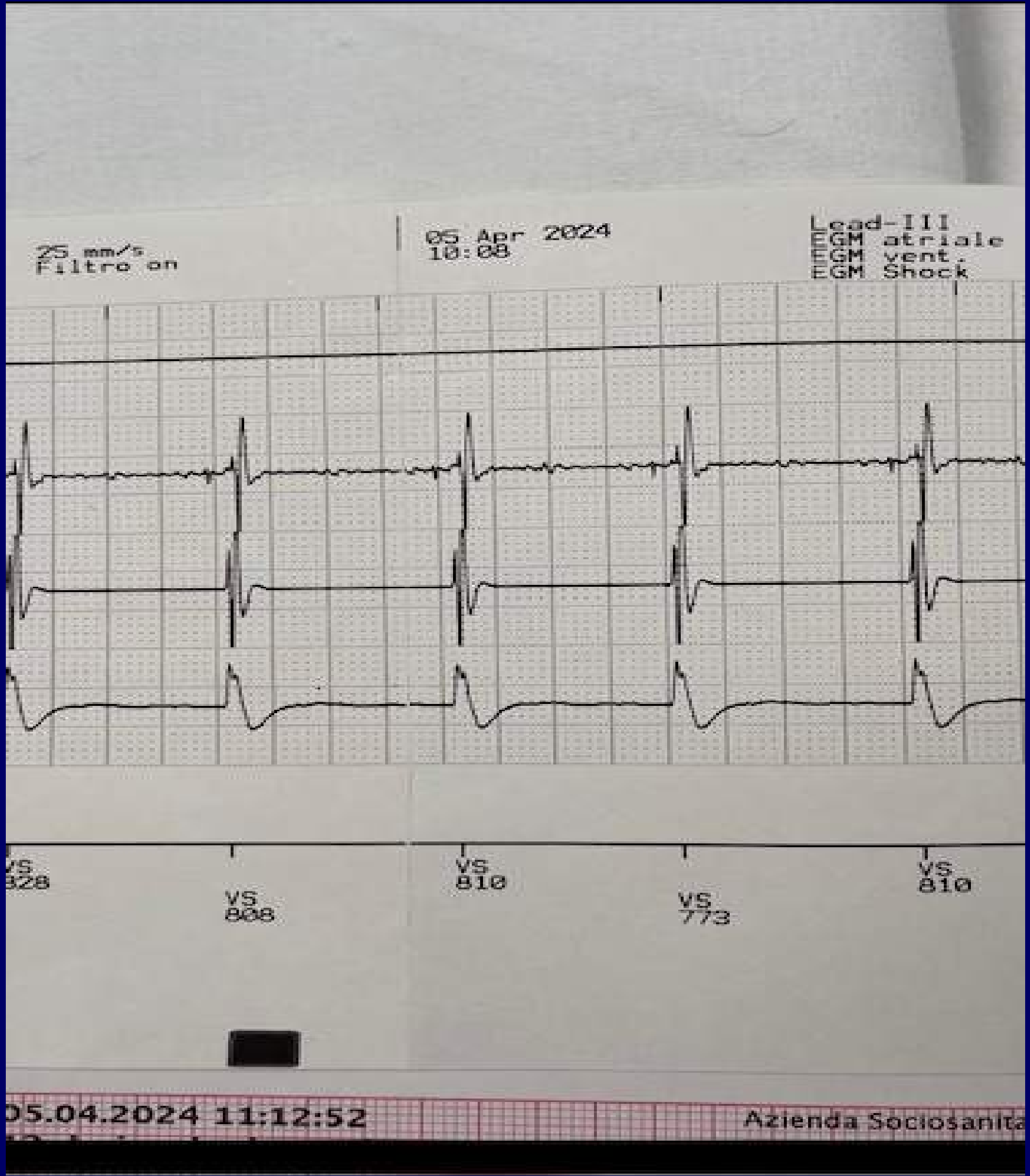


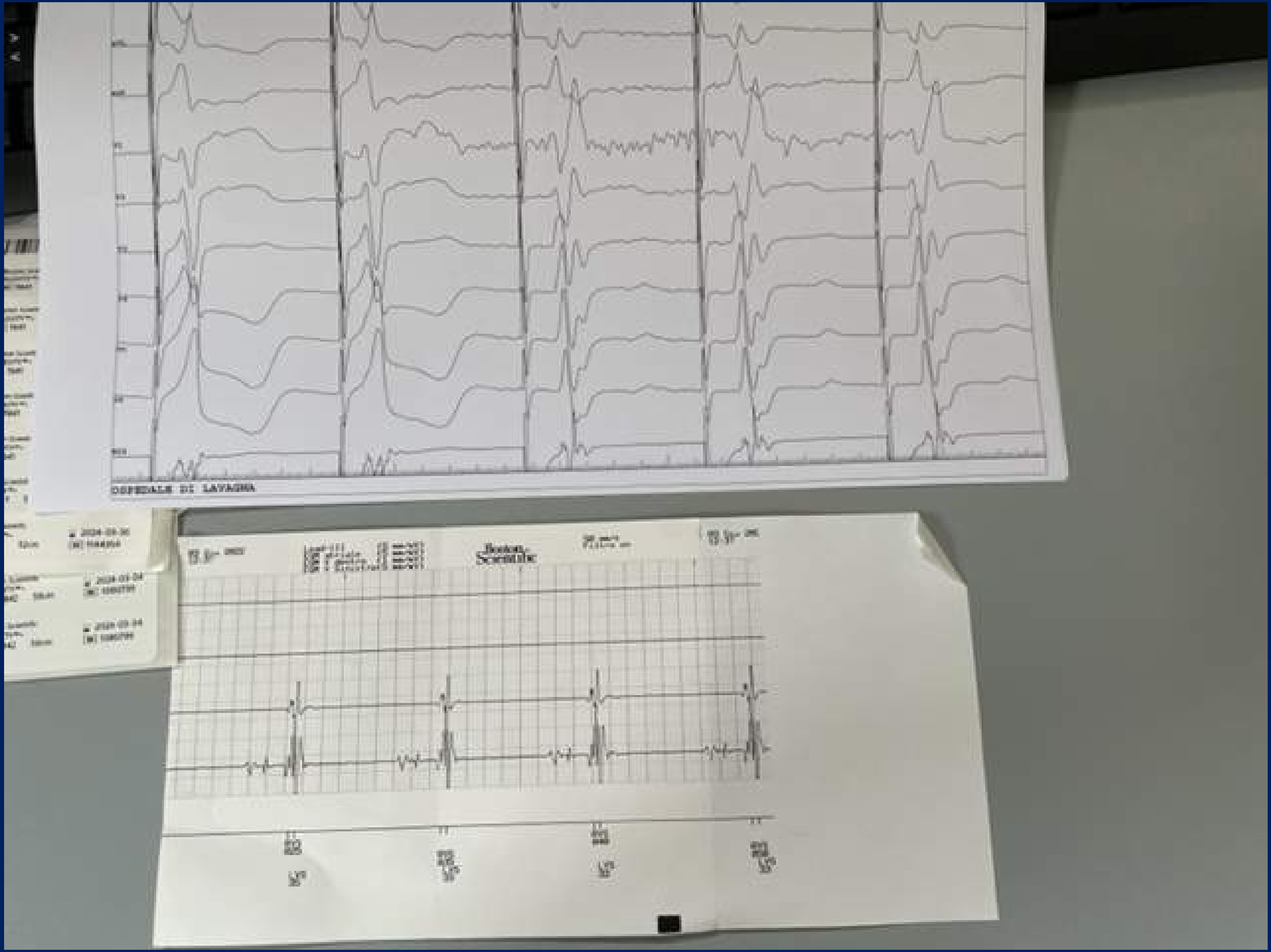
AVN ablation/His pacing



NS to selective pacing

His pace: follow-up after 60 months




OSPEDALE DI LAVAGNA
Boston Scientific

1st perspective

- His bundle pacing (HBP)
- - The ultimate physiological pacing approach to provide complete ventricular synchrony

  - Better at preventing pacing-induced cardiomyopathy

  - Significantly reduces QRS duration when baseline BBB is present

  - Improves clinical status and EF

  - Described high capture threshold/myocardial capture/premature battery depletion

2nd perspective

- Left bundle branch area pacing (LBBAP)

 - Emerged as a solution for the limitations of HBP due to favourable anatomical and histological characteristics

 - Need for a backup RV lead abolished

 - Stable and reliable lead parameters with longer battery duration

 - Complication rate: 11%!!!

 - Disadvantage of selectively engaging the LBB and delaying RV activation