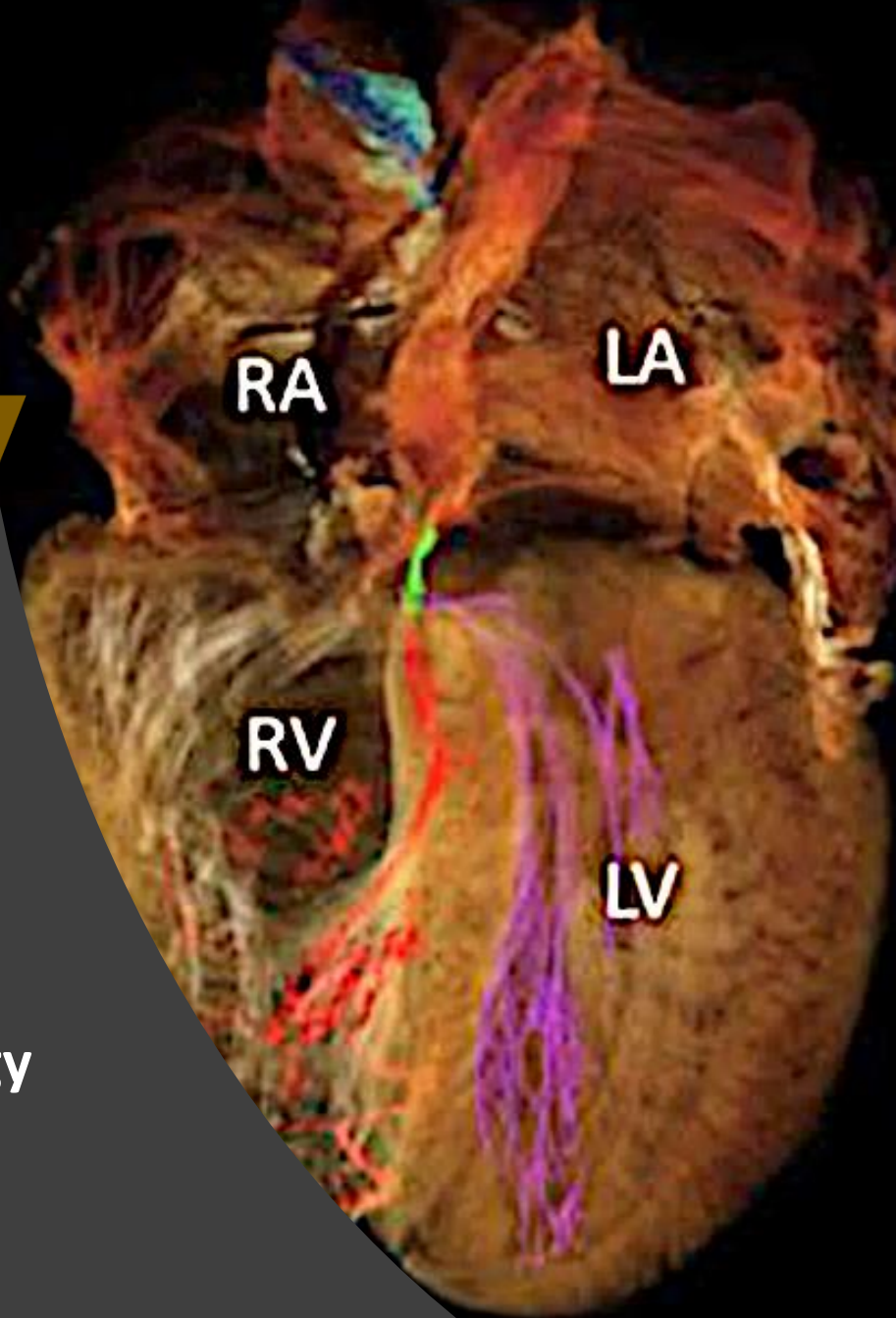


*Update on
Conduction System
Pacing:
VCU Experience*

Kenneth A. Ellenbogen, MD
Kimmerling Professor of Cardiology
VCU School of Medicine



DISCLOSURES

- Consultant, Research, DSMB, Honoraria: Medtronic, Boston Scientific
- Honoraria: Biotronik
- Honoraria and Consulting: Abbott

AGENDA

- VCU Left Bundle Branch Area (LBBA) Pacing Experience
- Tips and Tricks for Successful Implant
- Case Studies

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

Francesco Zanon^{1*}, Kenneth A. Ellenbogen², Gopi Dandamudi³, Parikshit S. Sharma⁴, Weijian Huang⁵, Daniel L. Lustgarten⁶, Roderick Tung⁷, Hiroshi Tada⁸, Jayanthi N. Koneru², Tracy Bergemann⁹, Dedra H. Fagan⁹, John Harrison Hudnall⁹, and Pugazhendhi Vijayaraman¹⁰

Table 1 Manuscripts included in the systematic review

Publication	Study type	Total number of points*	Implant success (%)	Follow-up (months)	Type pacing	Indication	3830 used
Ajijola et al. ²	Single-arm	21	76.2	12	S, NS HBP	CRT	Yes
Huang et al. ⁵	Single-arm	52	80.8	21.2 ± 8.3	DHBP, PHP	AF with AVN ablation	Yes
(HBP vs. RVA vs. RV5)							
Barba-Pichardo et al. ²³	Single-arm	91	64.8	3	Pure, fused	AVB	No
Pastore et al. ²⁴	Comparative	44	93.6	None	DHBP, PHP	AVB, SSS	Yes
(RVA vs. RV5 vs. HA)							
Barba-Pichardo et al. ²⁵	Single-arm	31	35.4	None	Pure, fused	AVB	No
Zanon et al. ²⁶	Comparative	12	100	NR	DHBP	AVB, AF	Yes
(DHBP vs. RV5)							
Occhetta et al. ²⁷	Single-arm	9	93.3	12	DHBP, PHP	AVB, AF	Yes
Catanzariti et al. ²⁸	Single-arm	5	58	7.5 ± 5.9	HBP	AF, AVB, SSS	Yes
Cantu et al. ²⁹	Single-arm	1	100	NR	HBP	AVB, AF, SSS	Yes
Zanon et al. ³⁰	Single-arm	26	92	NR	DHBP	AF, AVB, SSS	Yes
Deshmukh and Romanystyn ³¹	Single-arm	54	72.2	42	DHBP, PHP	AF with HF	No
Deshmukh et al. ³	Single-arm	14	85.7	23.4 ± 8.3	DHBP	AF with HF	No

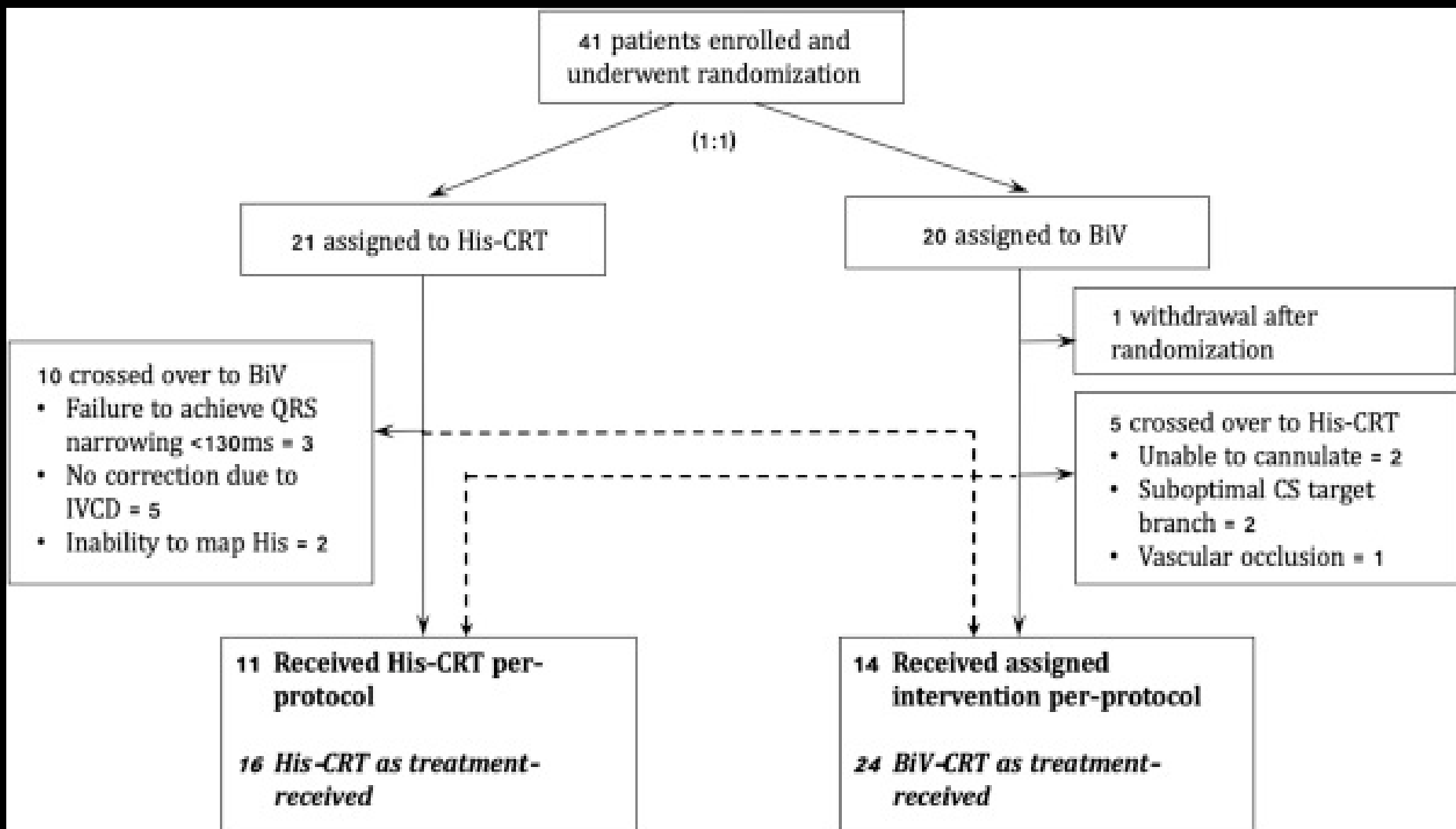
These data shed some light on whom the target patient may be for HBP. The majority of patients undergoing HBP were treated for AV block (62% of patients from 16 papers), and patient age, sex, and comorbidities reflect that of a typical pacemaker population.

The literature

Table 2 Baseline characteristics

Baseline characteristics	Papers reported number	Sample size of data reported (n)	Value (95% CI)
Total	25	1453	
Age (years)	20	1148	73.0 (71.5–74.4)
Male sex (%)	22	1206	65.1% (62.5–67.8%)
AF	17	983	41.5% (27.4–55.6%)
Indication			
AV block	16	1177	62.1% (49.2–75.1%)
SND	8	645	34.2% (21.4–47.1%)
AV nodal ablation	8	329	30.9% (4.9–56.9%)
Infranodal block	3	158	33.6% (1.2–66.0%)
CRT	14	665	29.1% (7.1–51.1%)
ICD	11	597	20.3% (0–43.1%)
QRS			
Native duration	17	960	118 (108–128)
LBBB	7	254	53.4% (24.1–82.7%)
RBBB	6	229	18.8% (6.7–30.9%)
AVCD	1	30	3.30%
Heart failure			
NYHA class			
I	7	231	10.9% (0–27.3%)
II	7	231	11.0% (0–24.1%)
III	7	231	44.4% (13.2–75.6%)
IV	7	231	1% (0–2.5%)
Any (unspecified class)	10	634	69.4% (42.7–96.2%)
None/not reported	15	637	NA
Cardiac function			
LVEF	17	1204	47.3 (42.1–52.5)
Hypertension	13	695	67.8% (55.6–80.0%)
Coronary artery disease	11	614	28.3% (19.0–37.6%)
Valvular disease	6	175	23.9% (0–53.8%)

On-treatment comparison between corrective His bundle pacing and biventricular pacing for CRT: His-SYNC

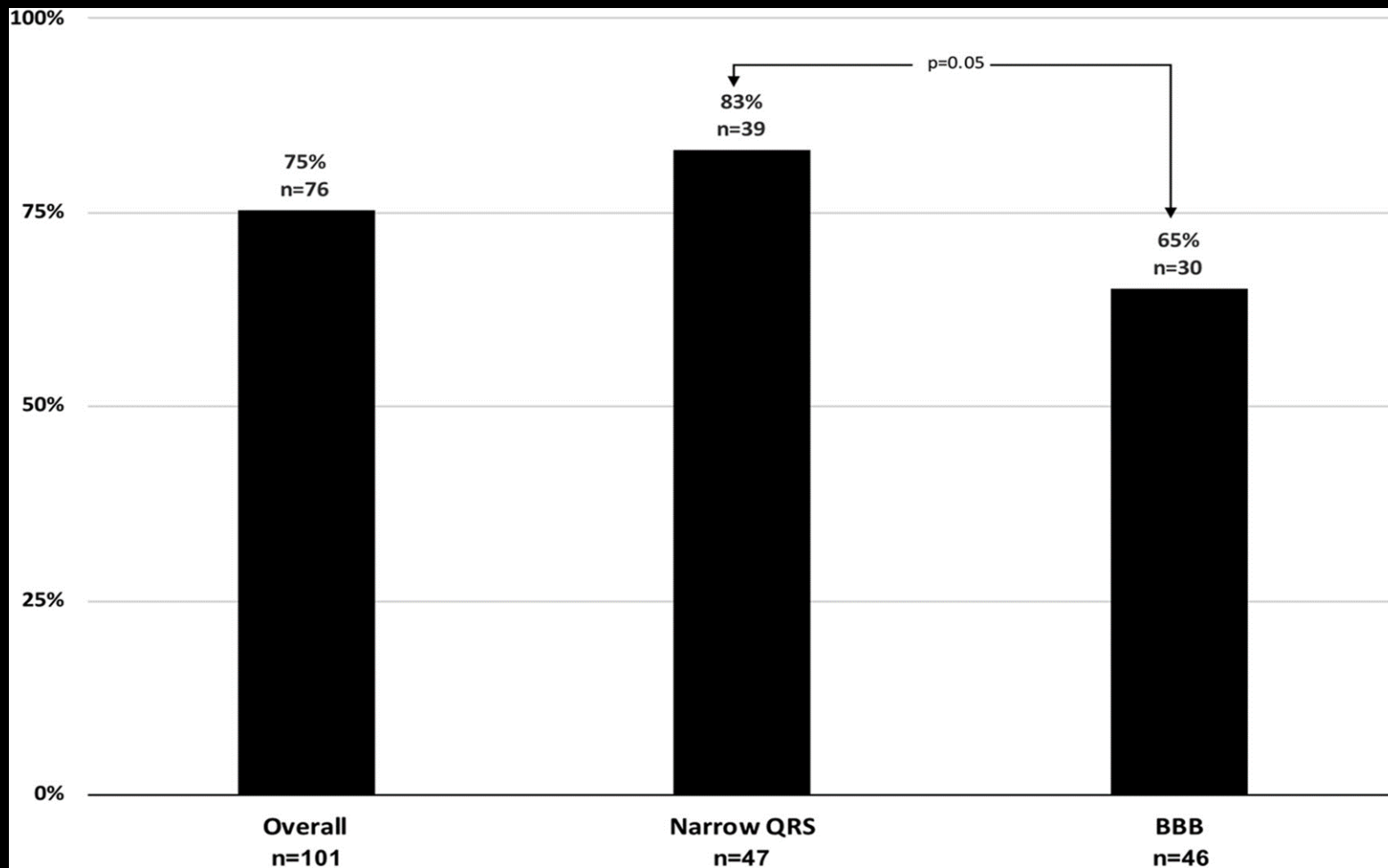


The Efficacy of His Bundle Pacing: Lessons Learned From Implementation for the First Time at an Experienced Electrophysiology Center



Advay G. Bhatt, MD, Dan L. Musat, MD, Nicolle Milstein, MS, Jacqueline Pimienta, BA, Laura Flynn, NP, Tina Sichrovsky, MD, Mark W. Preminger, MD, Suneet Mittal, MD

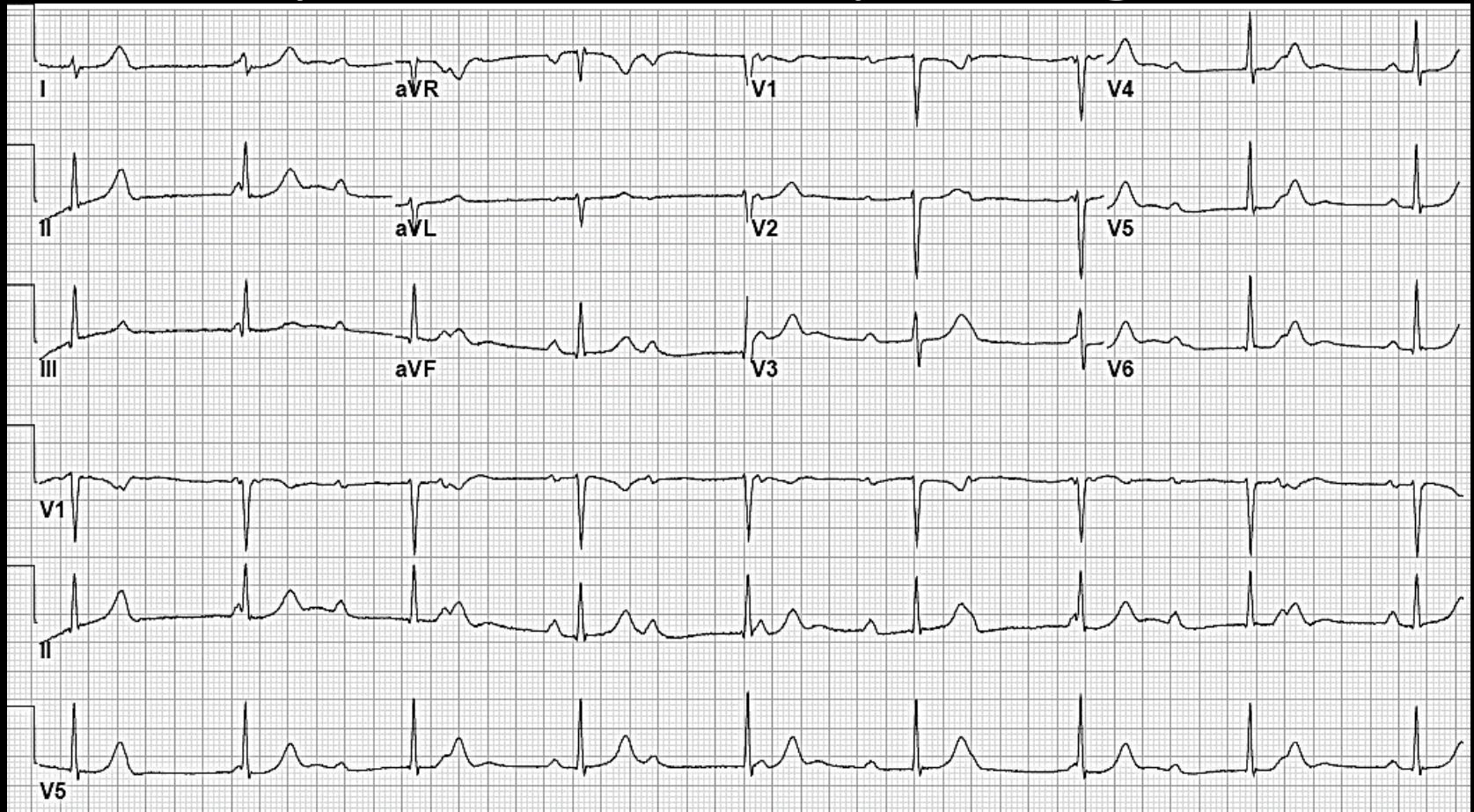
CONCLUSIONS HBP was feasible and readily learned with a high implant success in the hands of experienced electrophysiologists without prior exposure to the technique. BBB and atrioventricular block pattern appears to affect success. The technique is limited by a high rate of rising thresholds and lead intervention. These data have important implications for patient selection. (J Am Coll Cardiol EP 2018;4:1397-406) © 2018 by the American College of Cardiology Foundation.



Case History

- 32 year old F with past medical history of congenital complete heart block who underwent His bundle pacemaker implantation 1 year ago.
- She presented to the ER with complaints of dizziness and presyncope while driving
- She is currently 28 weeks pregnant at presentation

Pre implant ECG : 1 year ago



Post pacemaker implantation : 1 year ago

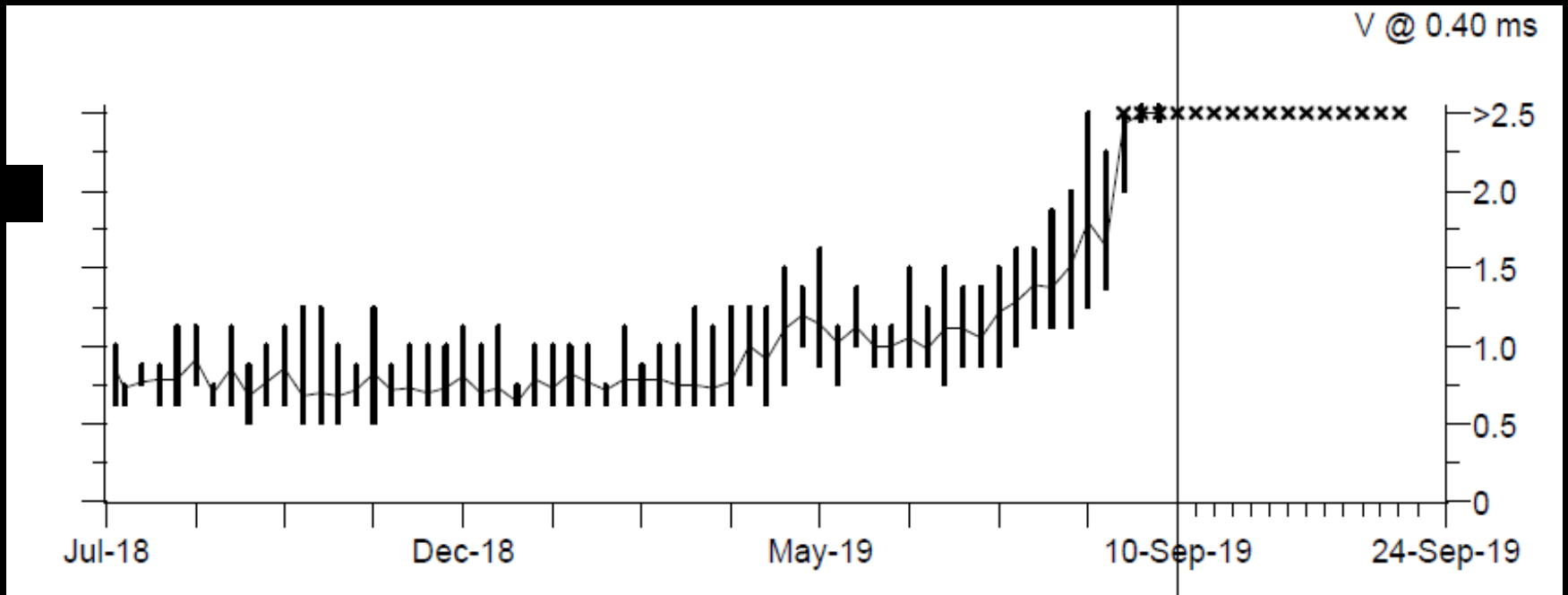


Device interrogation on presentation

His bundle lead

- Capture threshold (bipolar) 3.25V at 0.5ms
- Programmed output (bipolar) 3V at 0.5 ms
- Impedance 304 ohms
- Measured R waves 3.1 mV
- Programmed sensitivity 0.6 mV

His bundle capture threshold trends



VCU LBBA Pacing Experience

- February 2019-October 2019
- All consecutive patients referred for standard indications for PPM implantation
- LBBA pacing was attempted in 110 patients
- Indications:
 - Sinus node dysfunction : 33%
 - AV block : 45%
 - Cardiac resynchronization therapy : 7%
 - Refractory AF prior to AVJ ablation : 15%

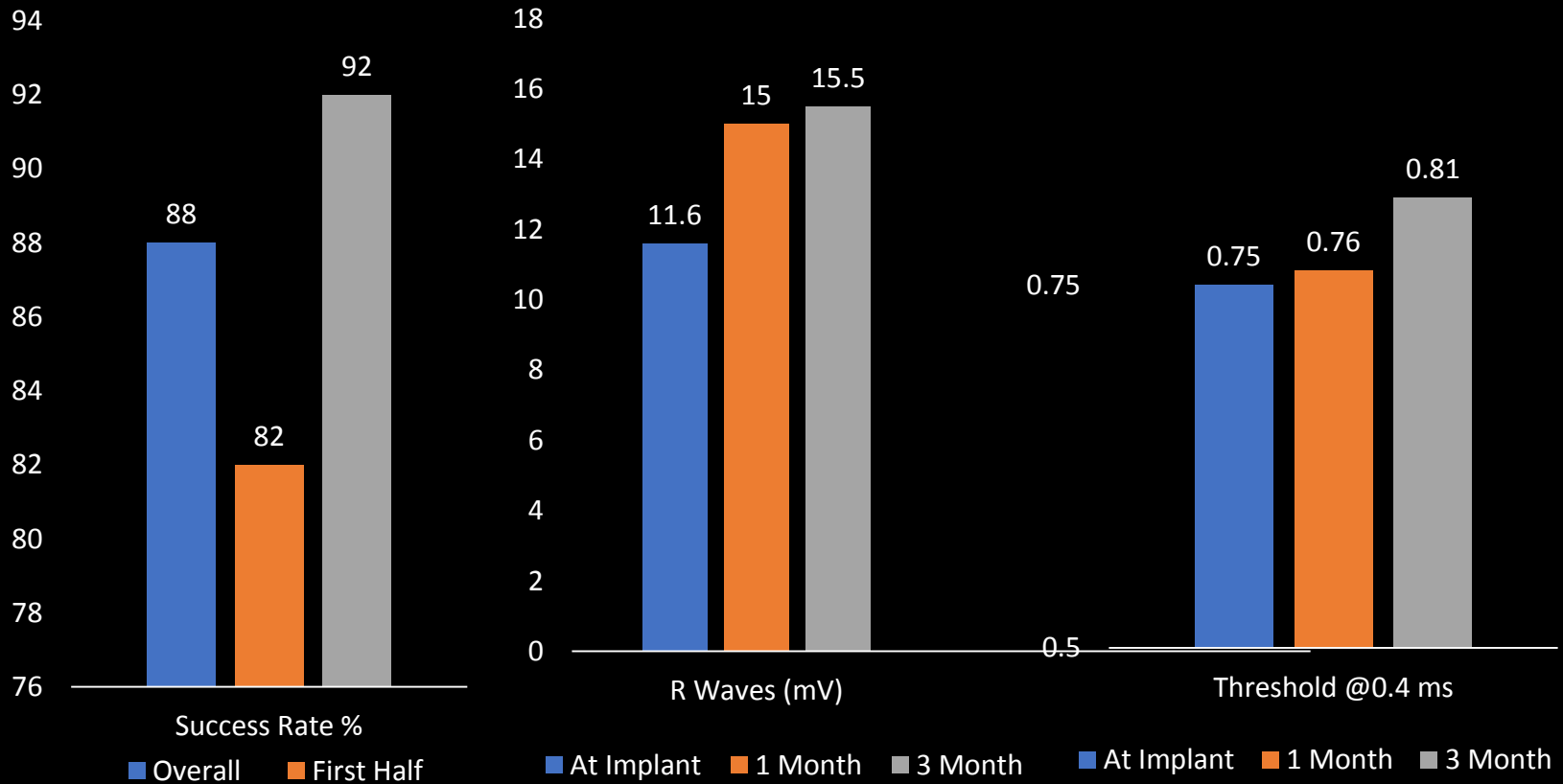
Variable	N (%)
LBBA Pacing Attempted	110
LBAA Pacing Successful	88%
Age (years); Mean \pm SD	72 \pm 12
Females (%)	54%
Hypertension	54%
Diabetes Mellitus	28%
Coronary Artery Disease	32%
Valvular Heart Surgery	11%
Left Ventricular Dysfunction (EF<50%)	23%
Atrial Fibrillation	42%
Baseline ECG Characteristics	
QRS Duration (ms); Mean \pm SD	116 \pm 29
QRS Duration >130 ms	37 %
Right Bundle Branch Block	27%
Left Bundle Branch Block	14%
Intra Ventricular Conduction Delay	5 %

Procedural Characteristics	
Procedural Duration (mins)	107 ± 32
Notch or 'W' pattern in V1	54%
Paced QRSD (ms)	116 ± 11
Left Bundle Branch Potential (LBB)	51%
LBB Potential-QRS Duration (ms)	21 ± 5
LVAT at 5V	70 ± 10
LVAT at 1V	73 ± 11
C315 His Fixed Curve Sheath	85%
C304 His Deflectable Sheath	15%

Preliminary data

Success Rates and Electrophysiological Parameters with Left Bundle Branch Area Pacing

1



Preliminary data

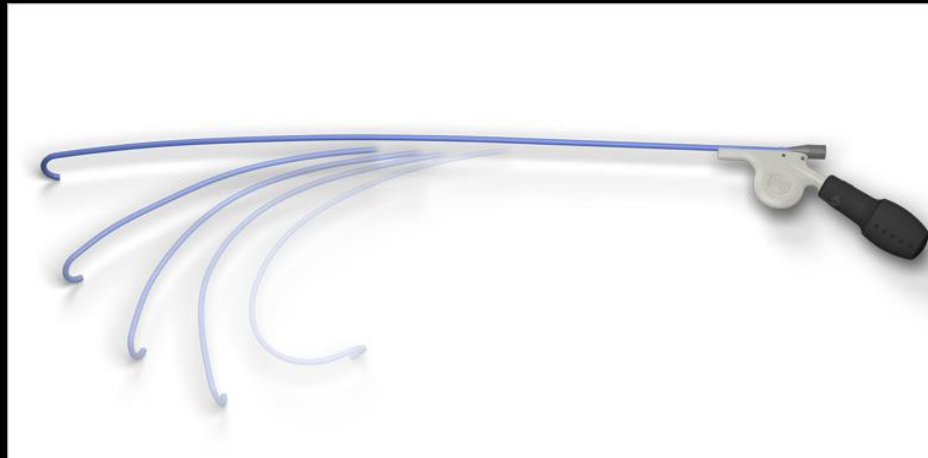
Conduction System Pacemaker Implantation



C315 HIS Sheath
Outer diameter 7F
Inner Diameter 5.4F

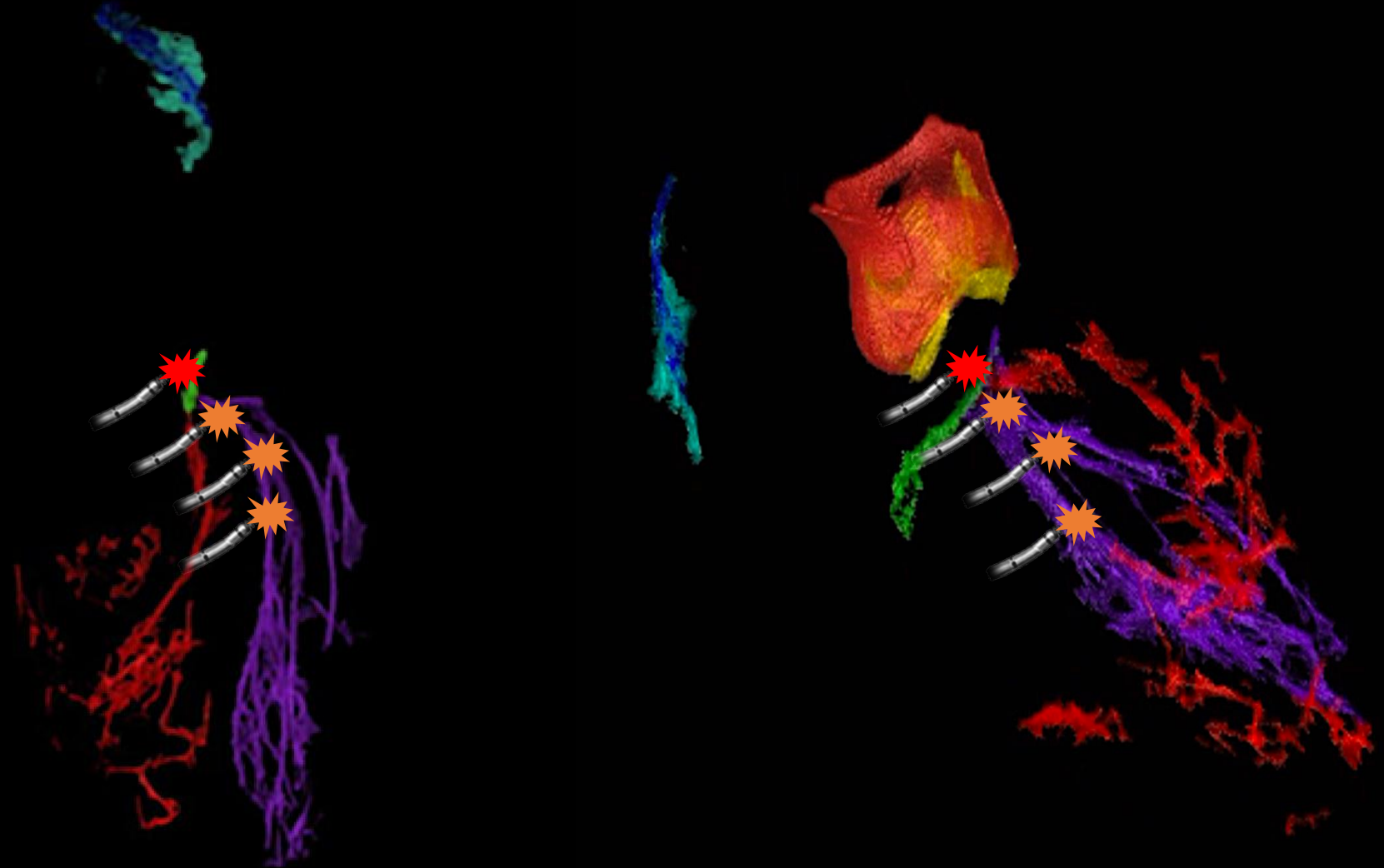


SelectSecure® 3830 Pacing Lead
4.1 F, exposed helix
Isodiametric lead body
Lumenless design



New C304 His Deflectable Sheath
Outer diameter 8.4F
Inner diameter 5.7F

Conduction System Pacing



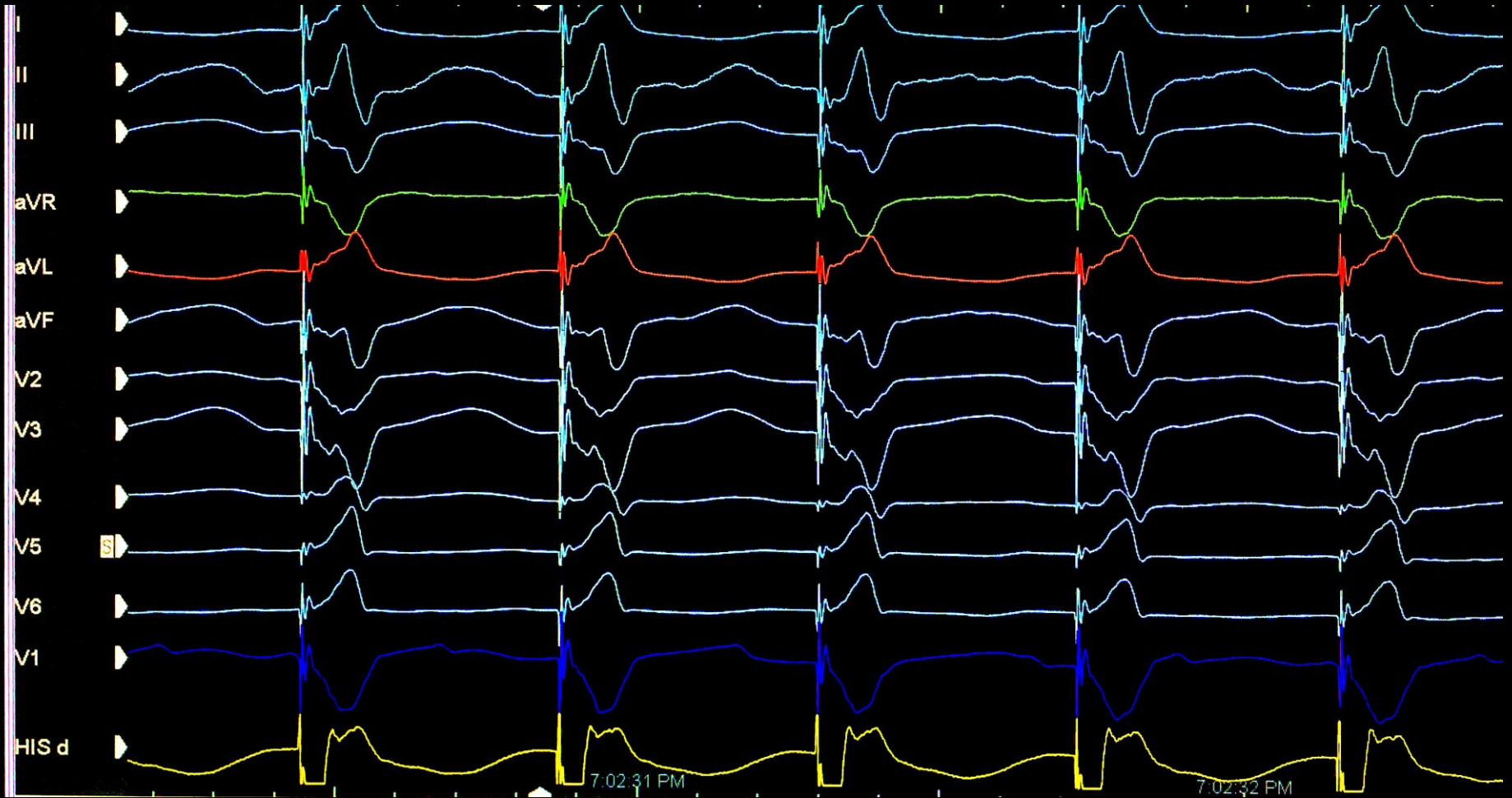
LBAP: Technically easier and higher success rates

Criteria for LBB Capture

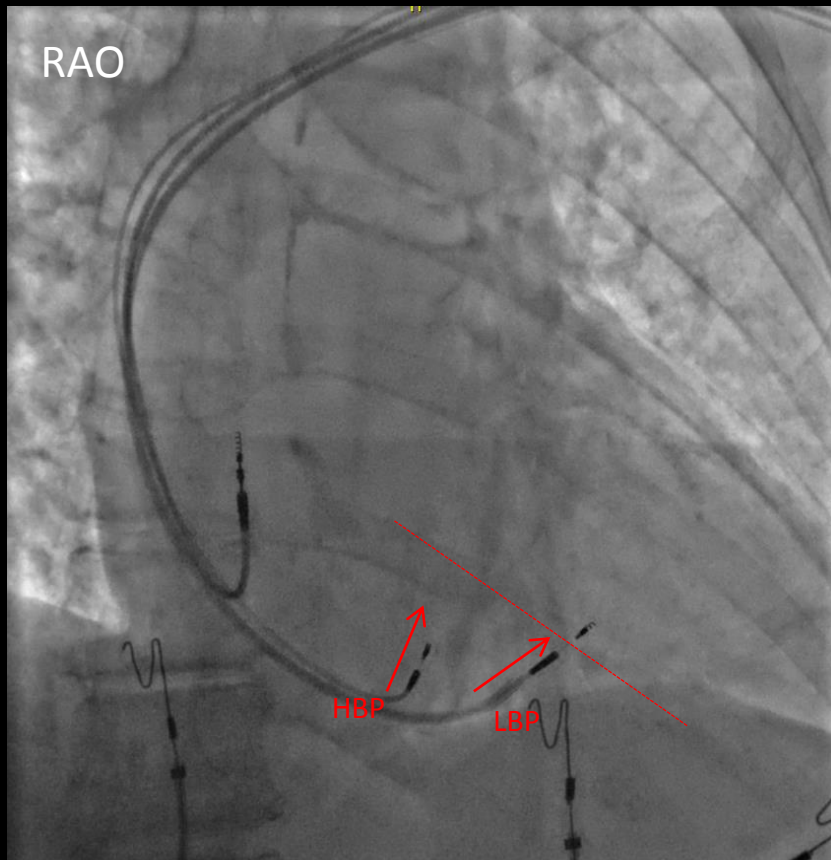
- 1. Paced morphology of RBBB pattern: Qr or rSr'
- 2. Identification of the LBB potential
- 3. Pacing stimulus to left ventricular activation time (Stim-LVAT)
- 4. Determination of Selective (S) and nonselective (NS) LBBP
- 5. Evidence for direct LBB capture

Tips and Tricks

#1: Ideal site for lead fixation



#2: Sheath position: difference between HBP and LBBAP

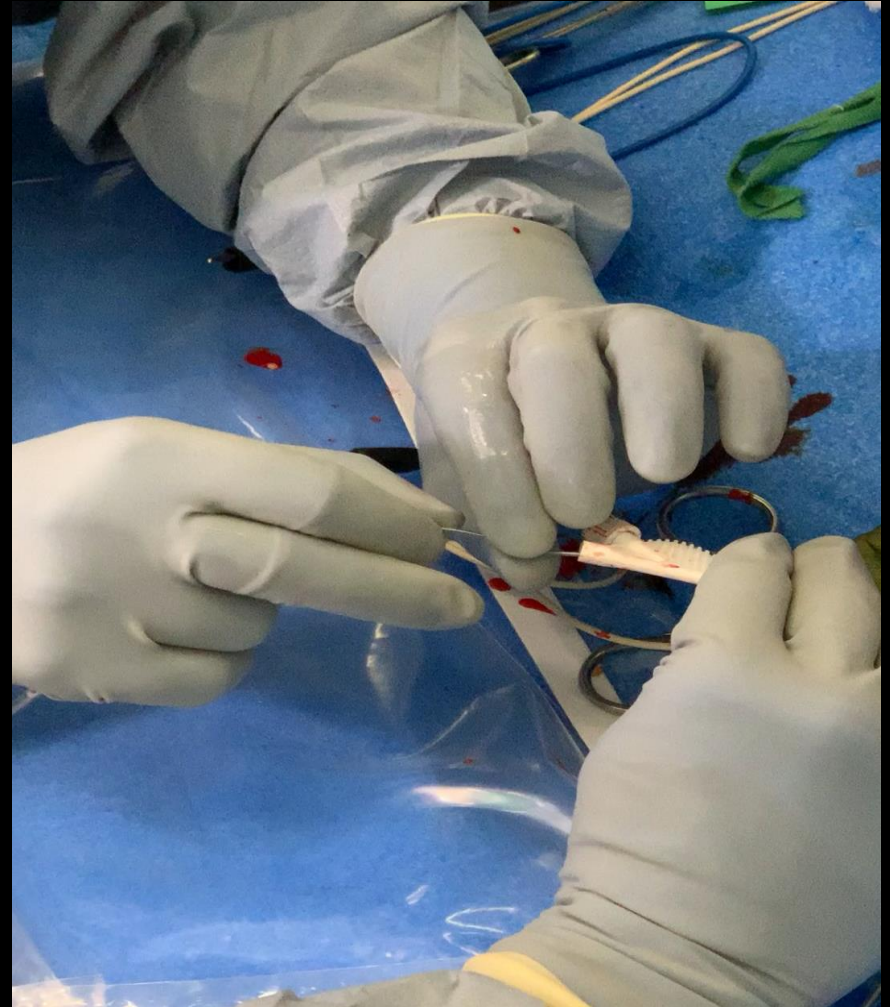


Apply at least 45 deg counter clockwise torque (so that the lead tip faces 1-2 O' clock position in RAO)

#3 Lead fixation technique

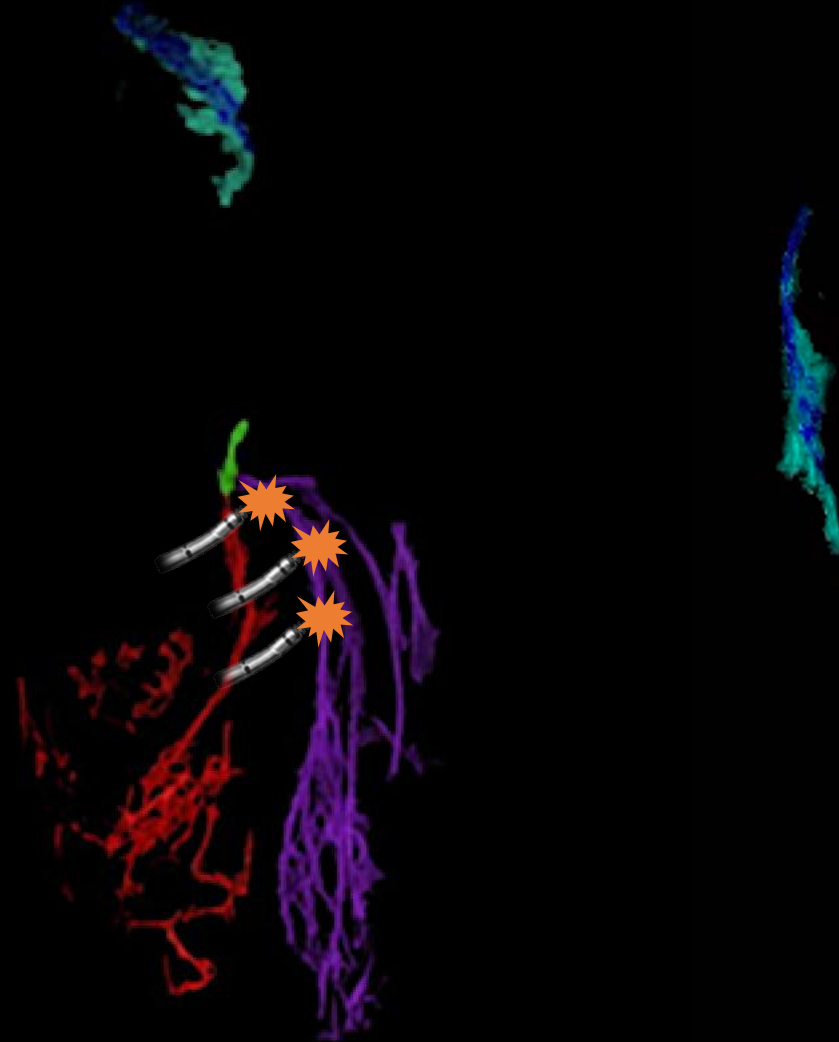


Avoid bloody/sticky gloves
Clean or get a new pair



Two hands, Rapid 4-5 turns

#4 What to do if lead buckles or back spins?



Before repositioning lead, take it out and clean the helix

#5. Recognize interventricular trans-septal perforation

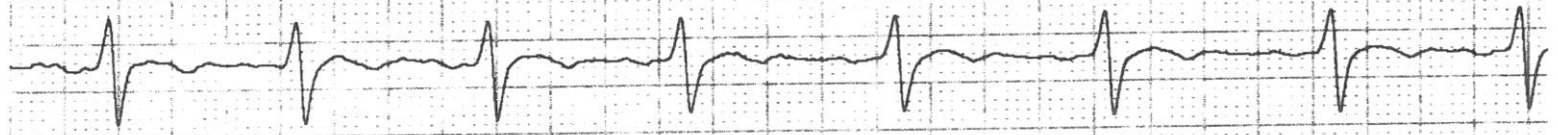
2290 Analyzer

09/03/19 8:46:37 AM

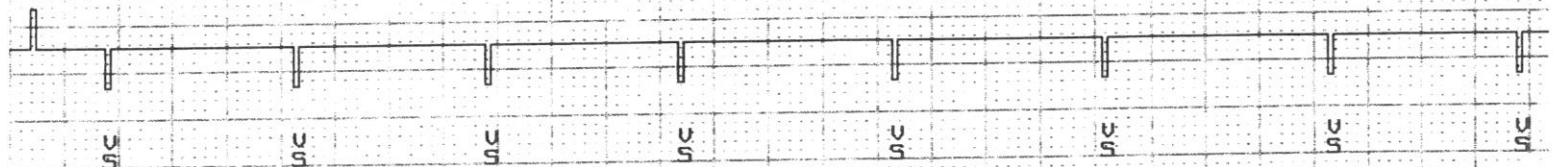
CHART SPEED 25.0 mm/s

IMPEDANCE Δ FROM 710 Ω TO 329 Ω WITH HEX TURN

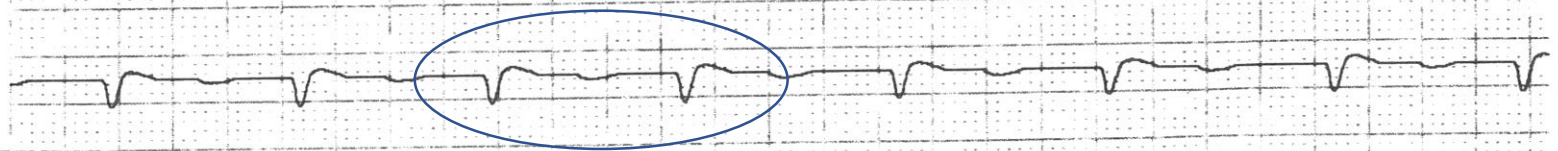
ECG LEAD II 0.2 mV/mm



MARKER CHANNEL



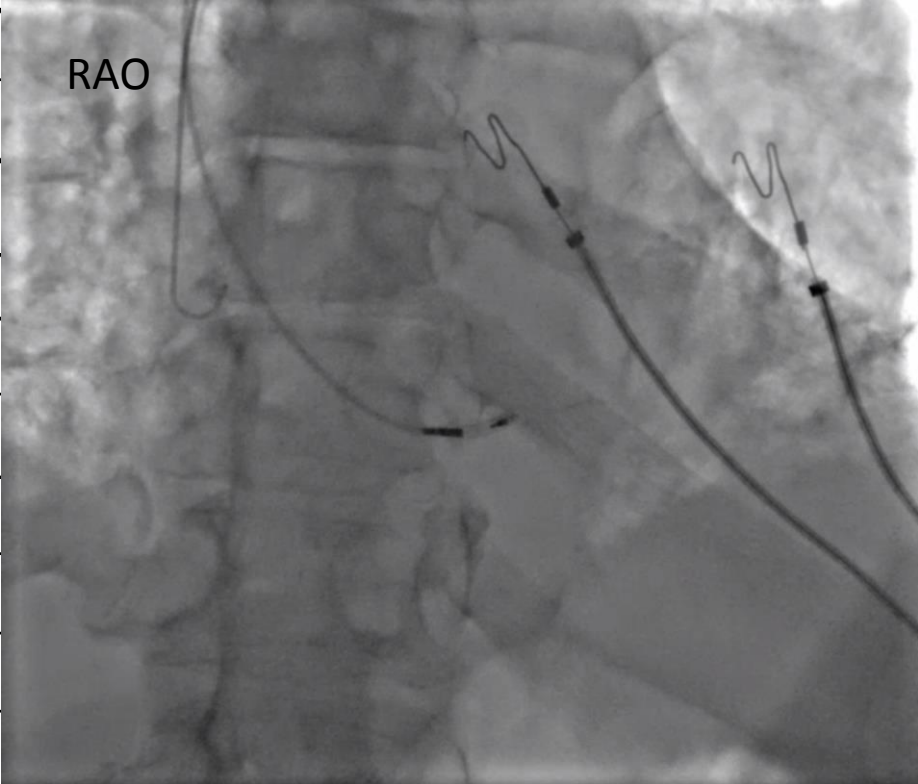
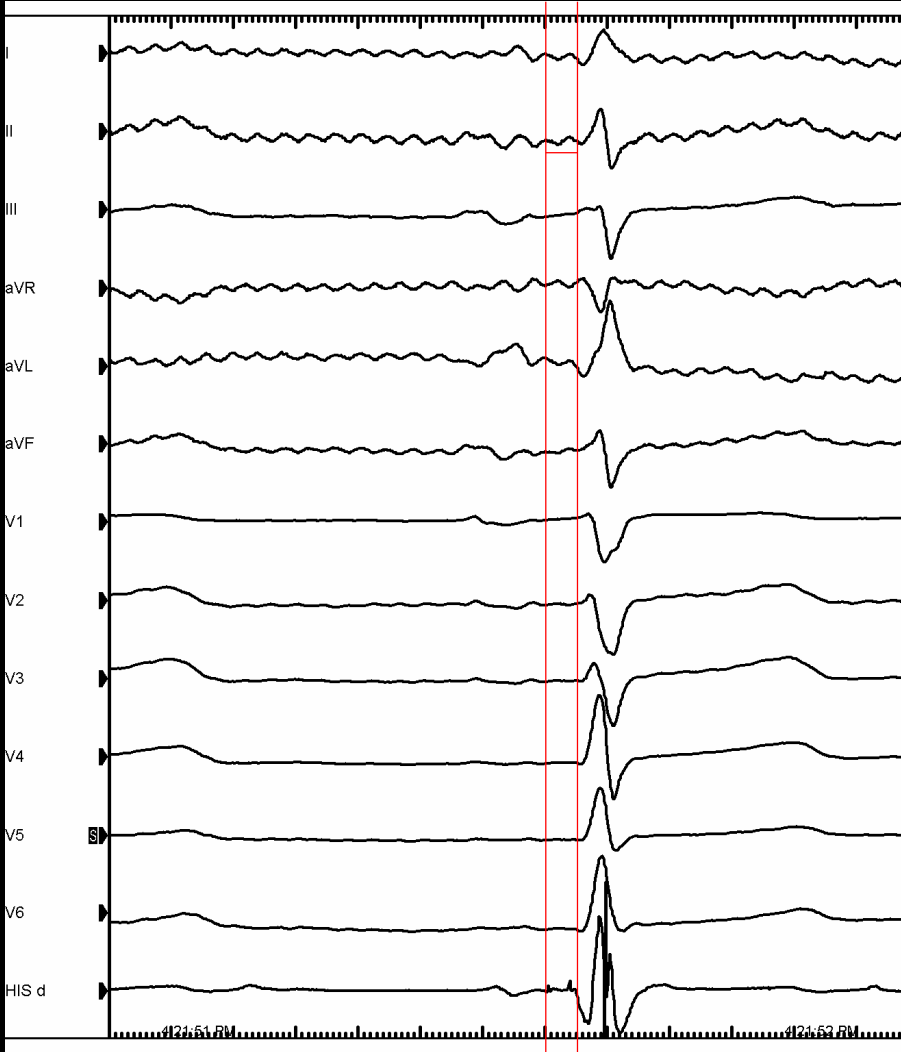
V EGM 5 mV/mm



LBBA Pacing Cases

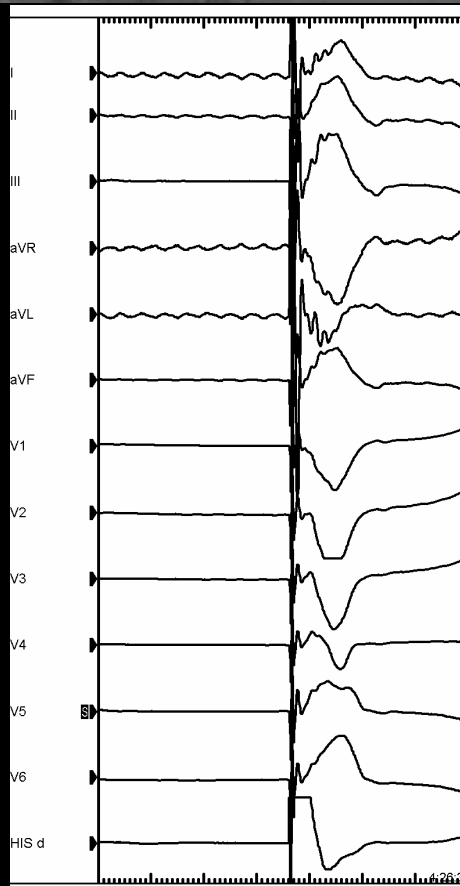
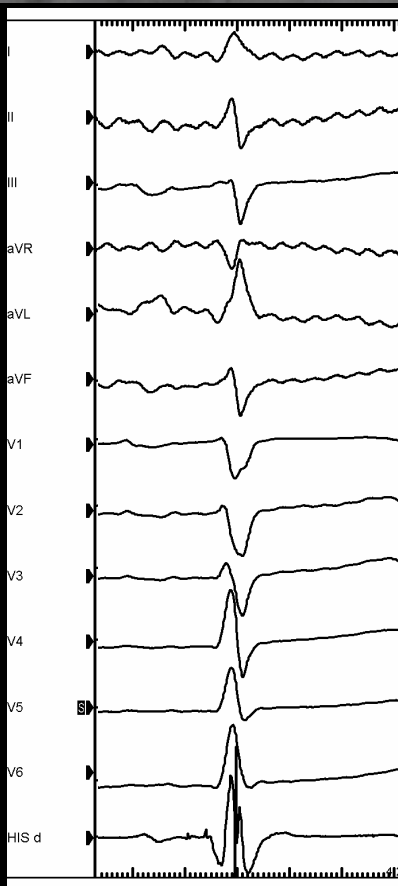
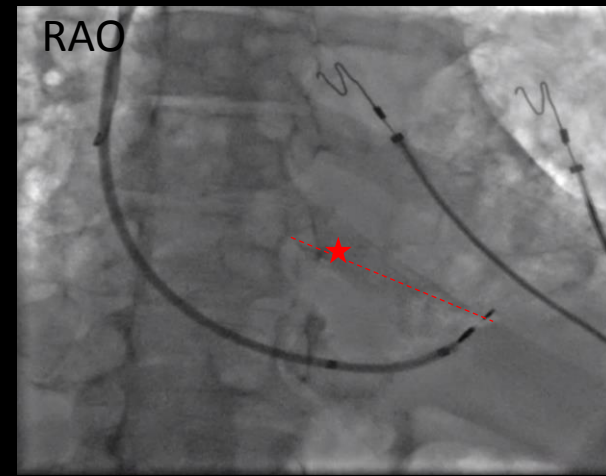
Case 1: Difficult to reach basal septum with C315 His sheath.

HV 54 ms



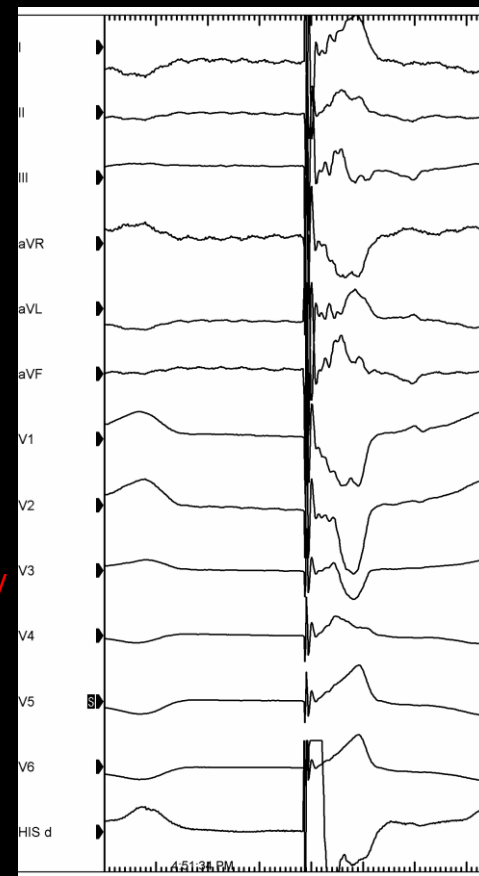
MDT C315 Fixed Curve Sheath

MDT C304 Deflectable His Sheath

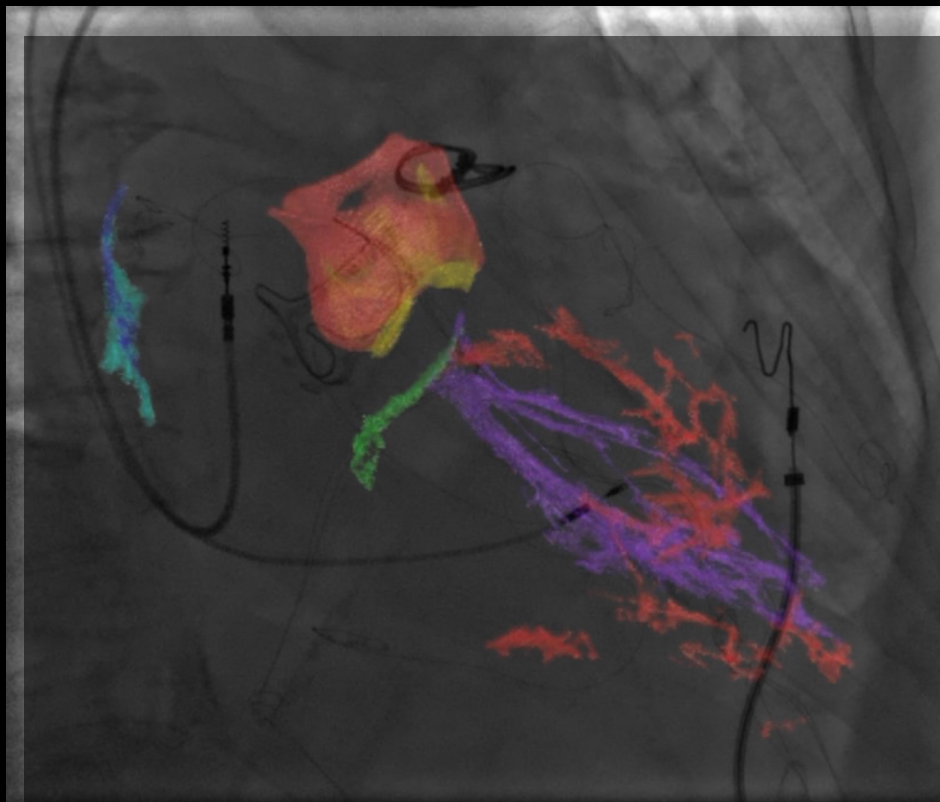


Outflow
Tract
Morphology

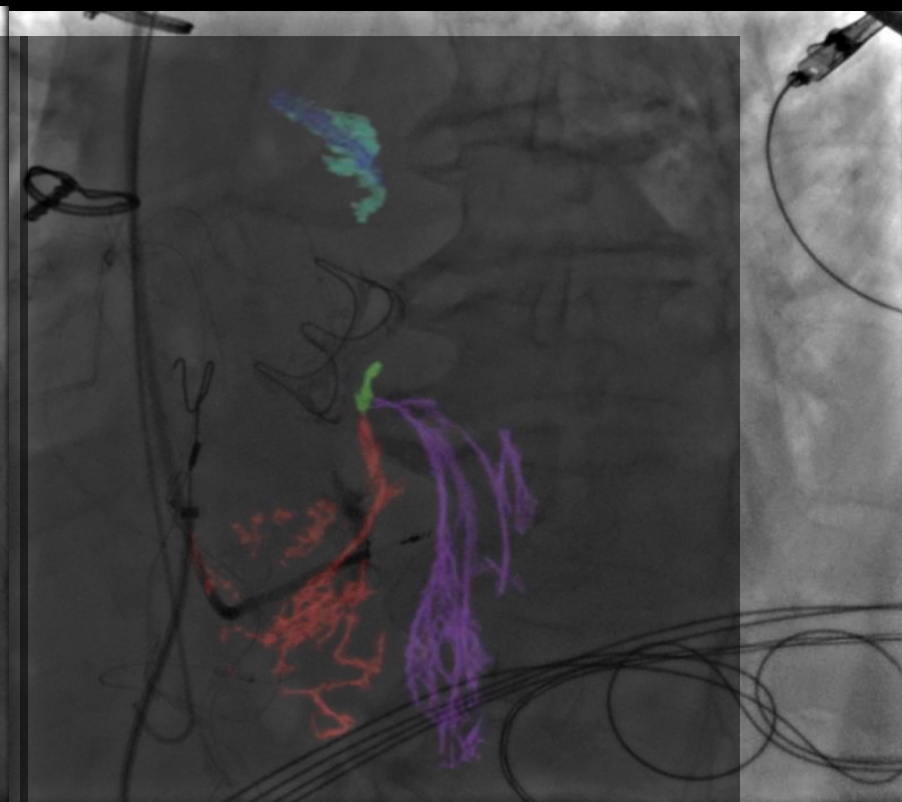
Para-Hisian
Morphology



Case 2: CHB post AVR. Mid-septal LBP lead fixation
Final QRS 110 ms with rSr' pattern in V1



RAO view



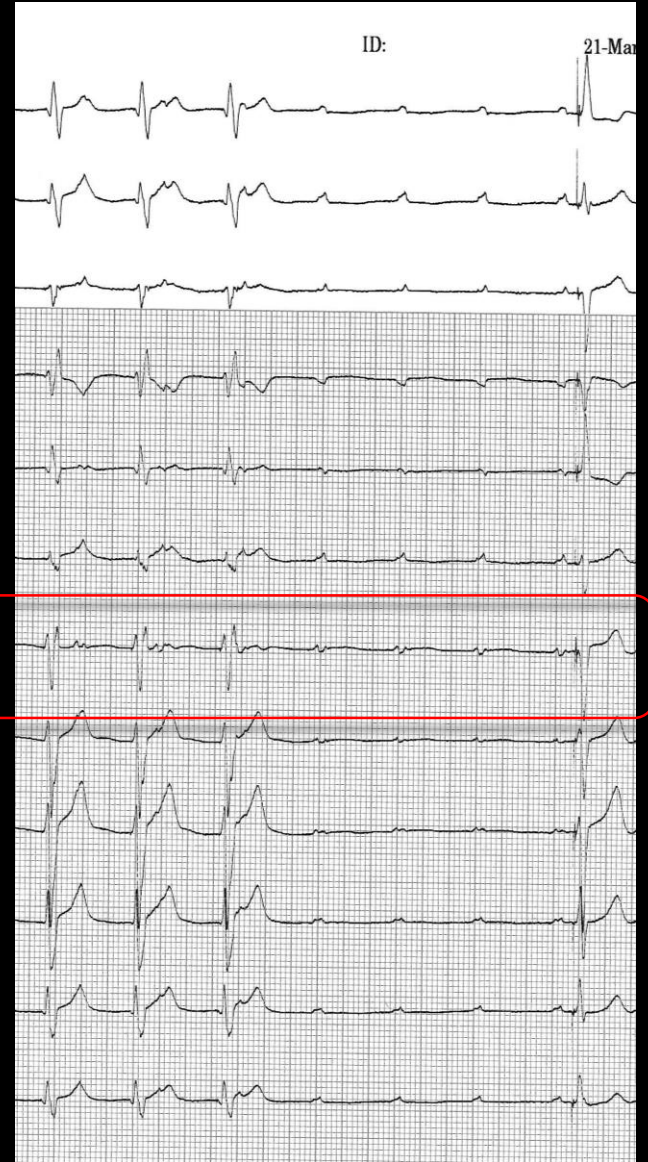
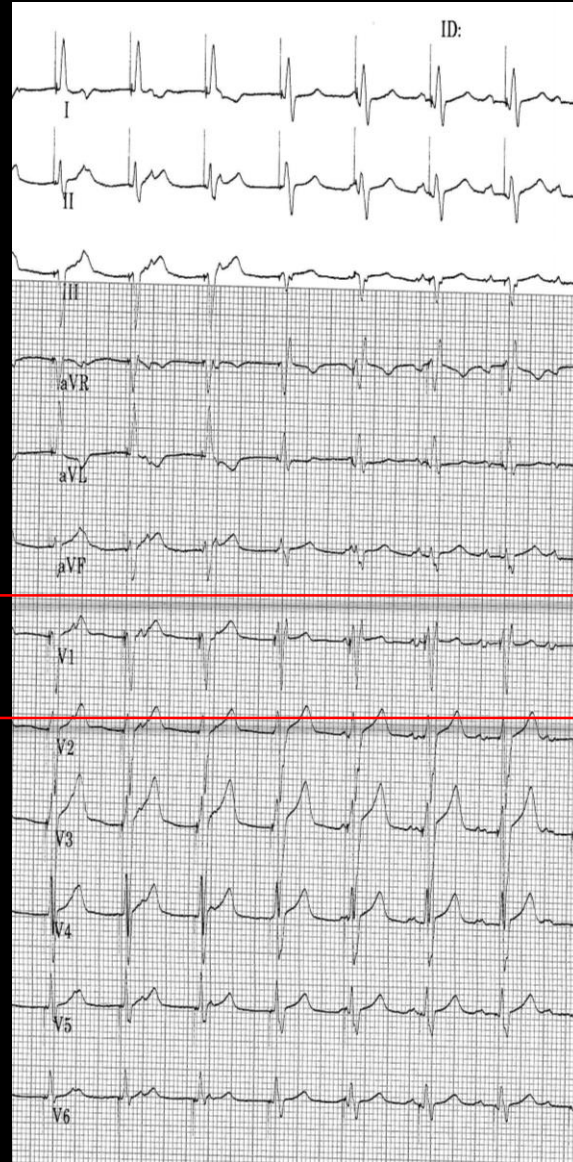
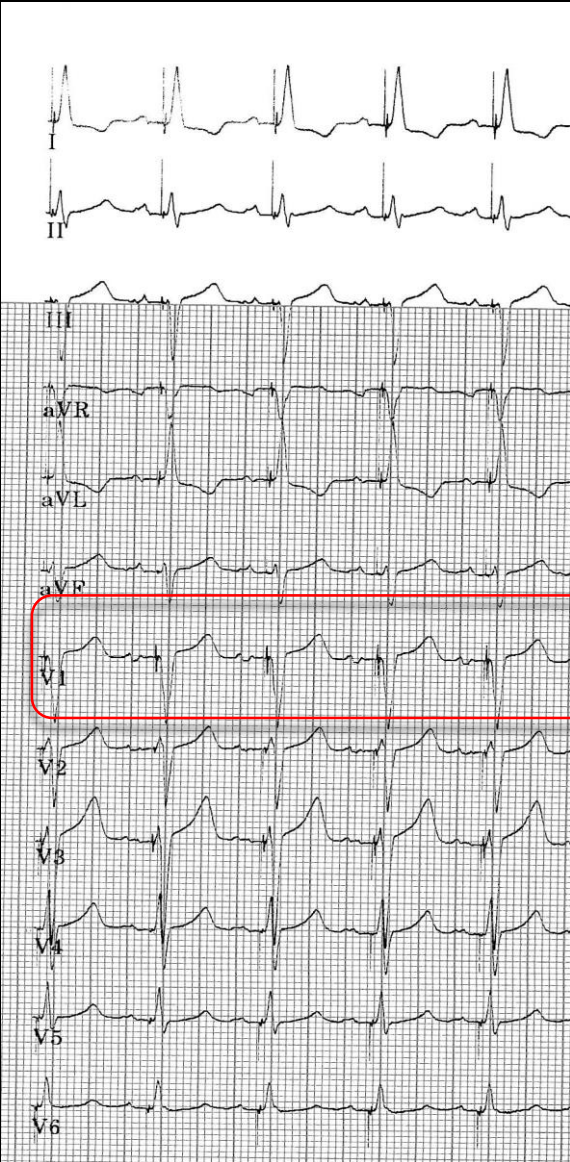
LAO view

ECG Rhythm Strip: VVI Bipolar Pacing. Threshold Testing

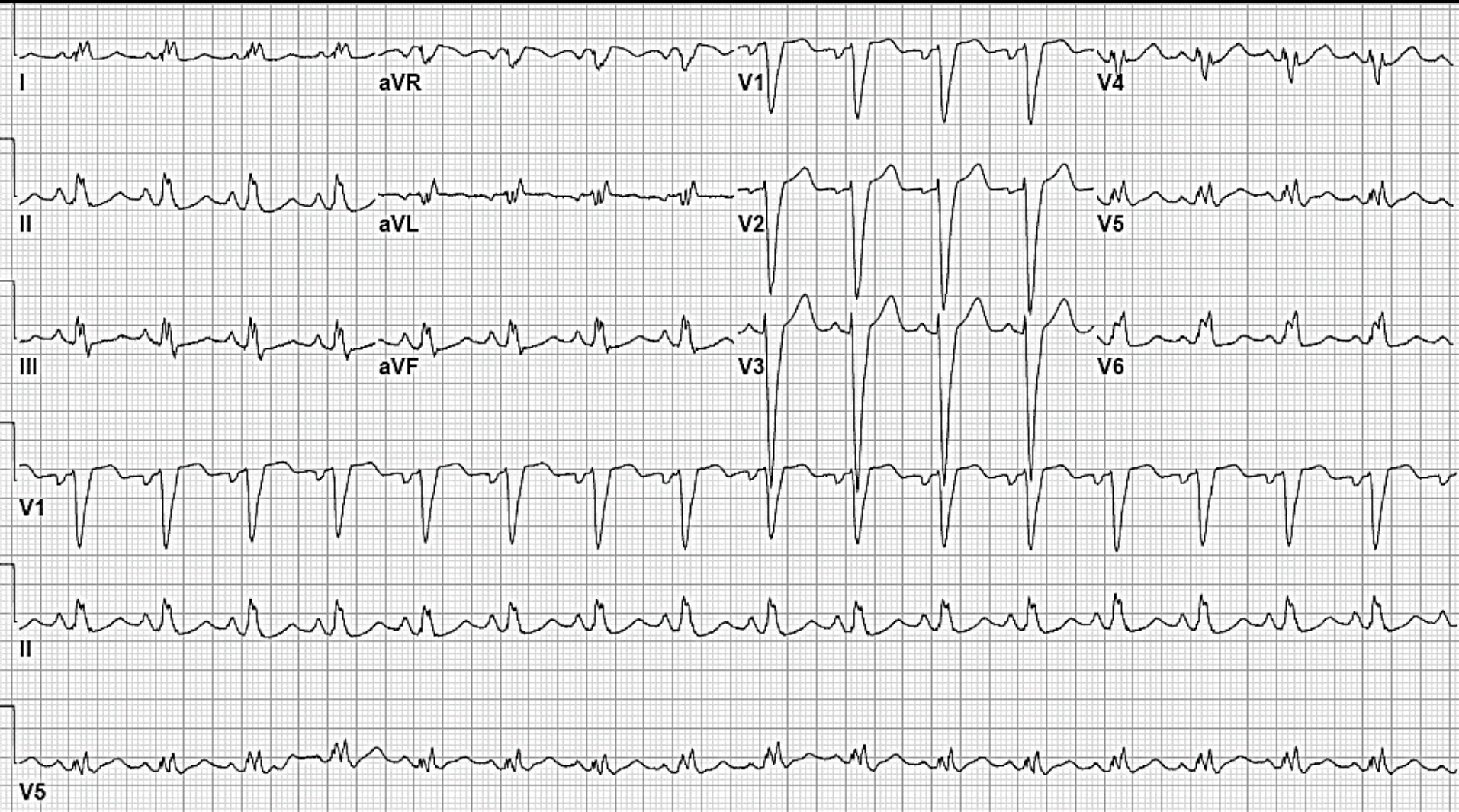
3V

1.75V

0.5V

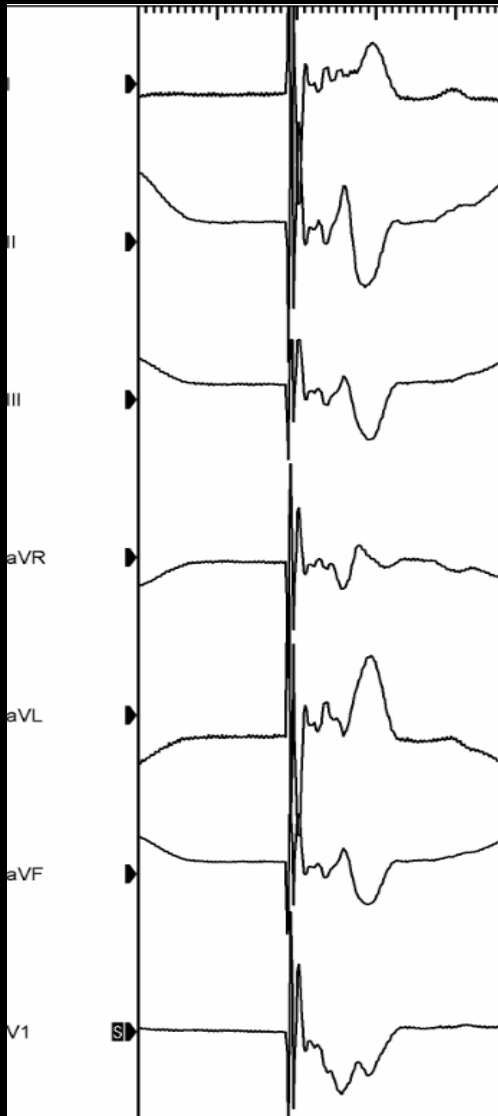


Case 3: 64 yo F w. ICMP EF 20%, on home milrinone, LBBB w. QRSd 160 ms, ambulatory NYHA class IV symps referred for CRT-D implant

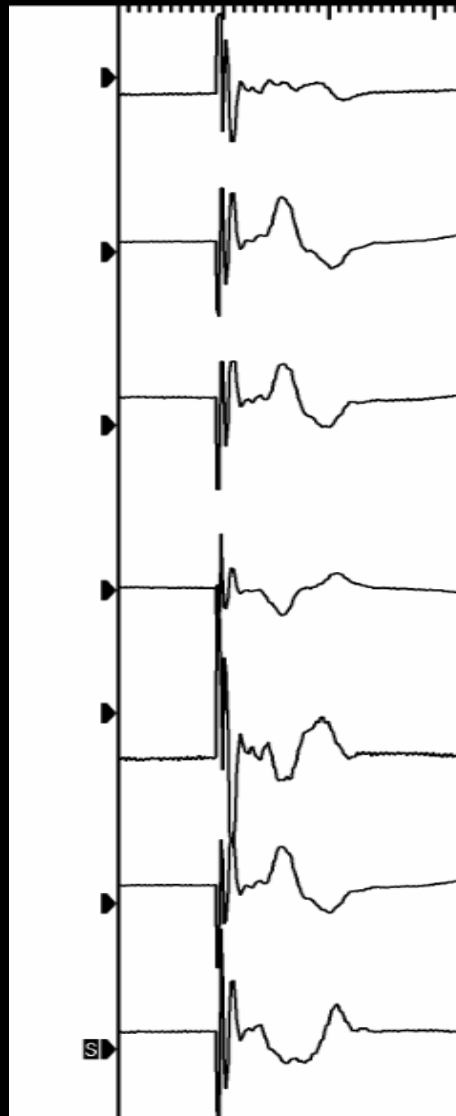


Bail out LBBA pacing lead

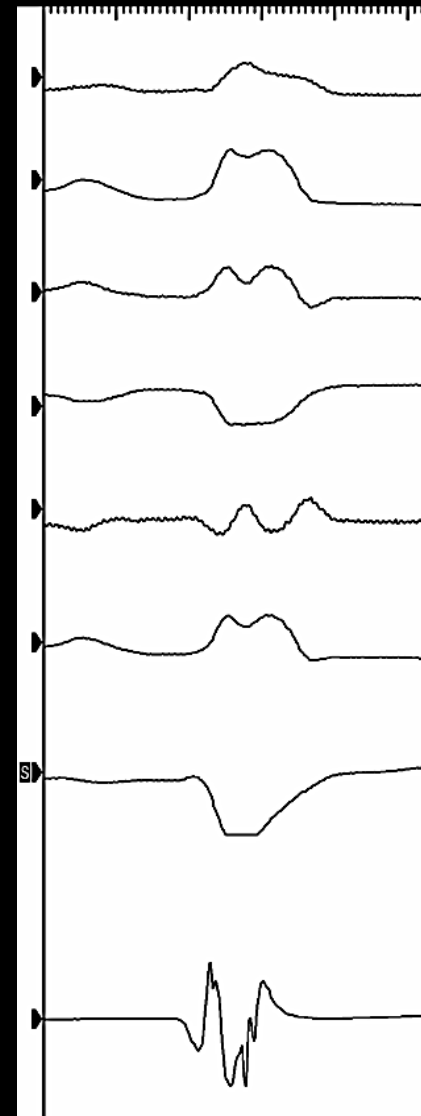
Initial Site



After 6 turns



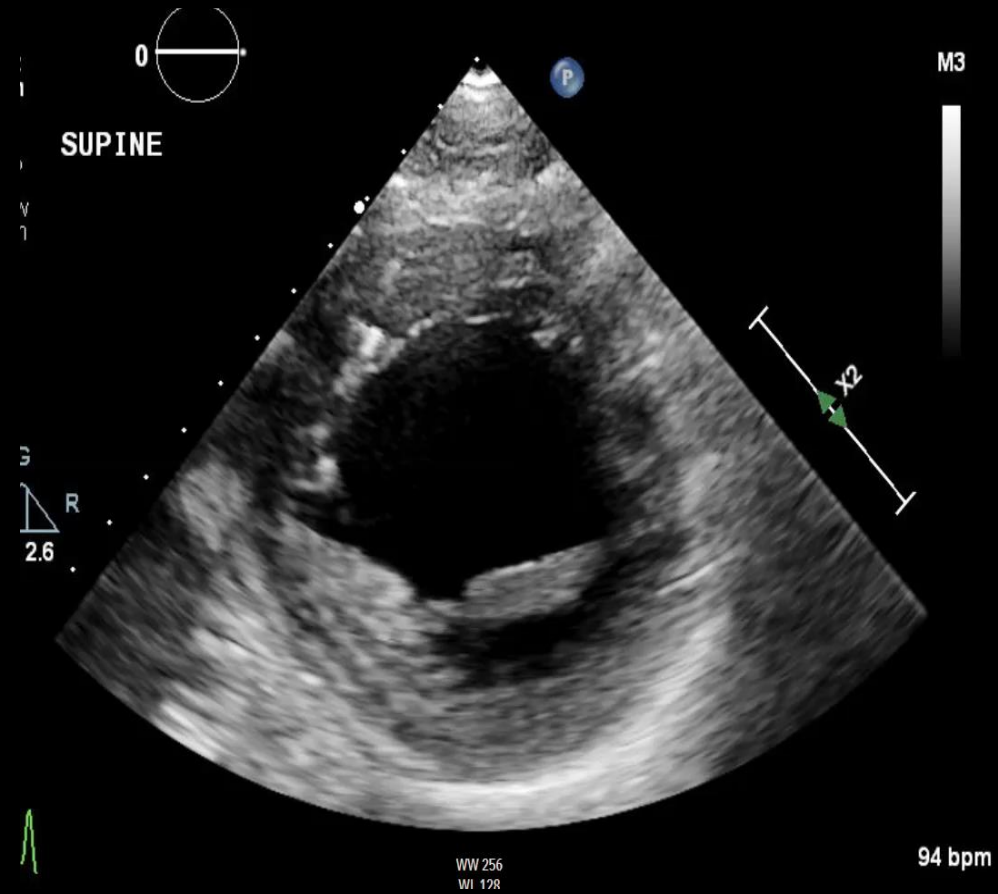
Retro LB potential

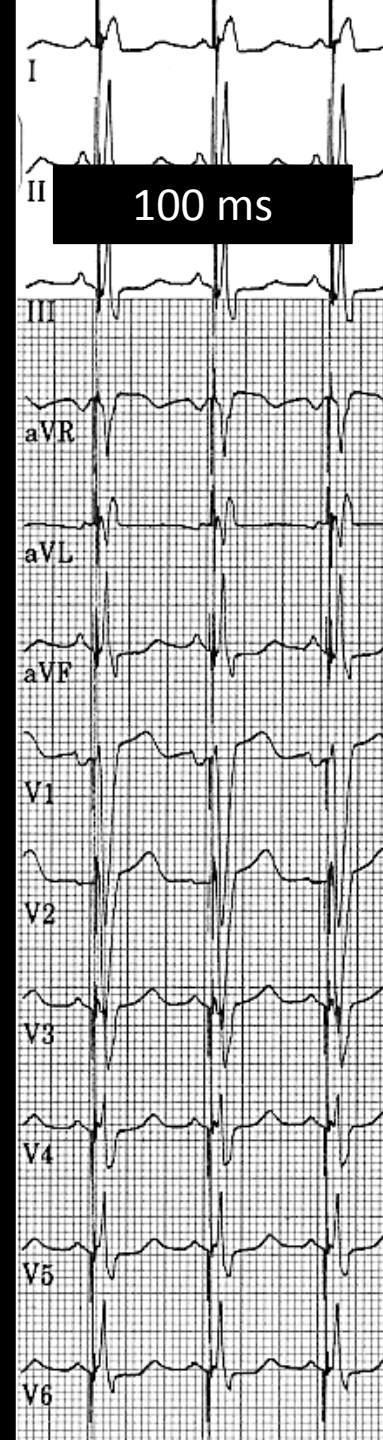
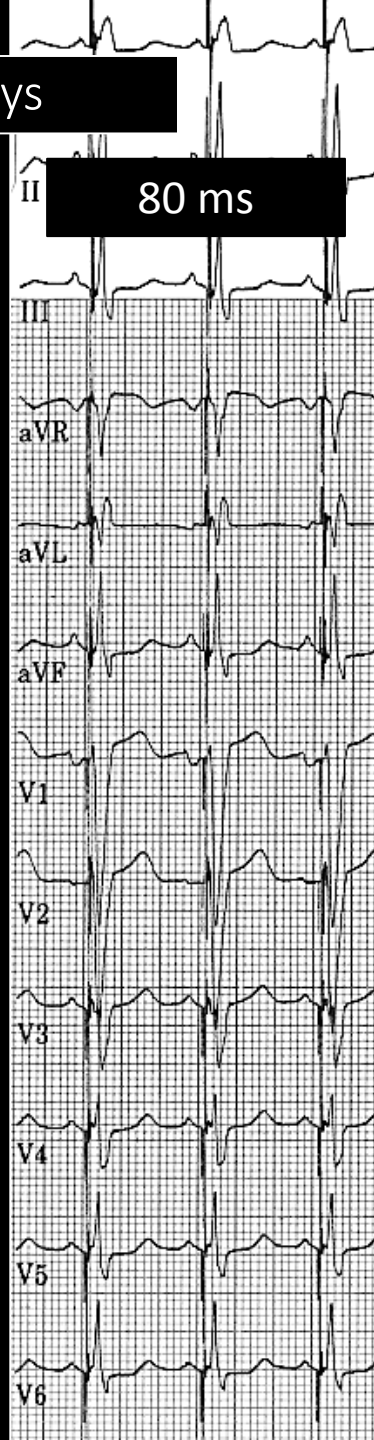
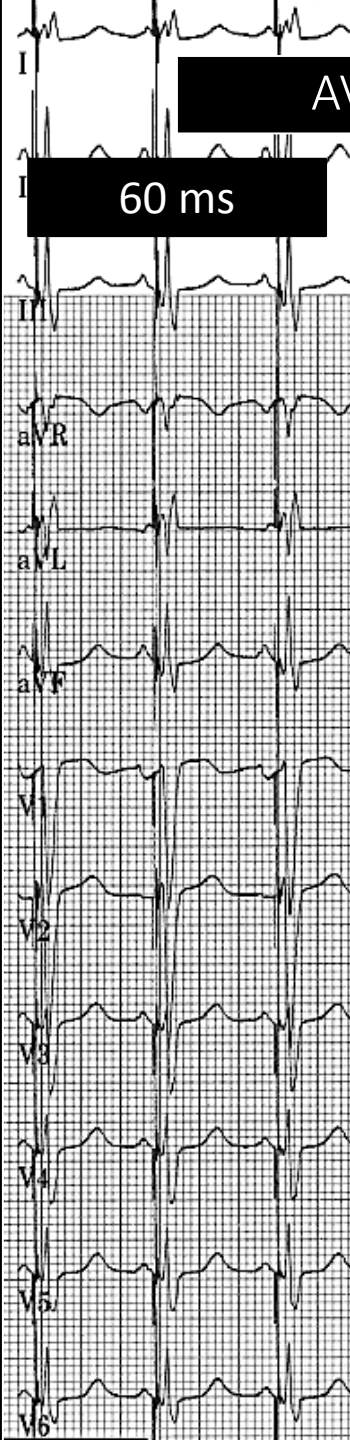
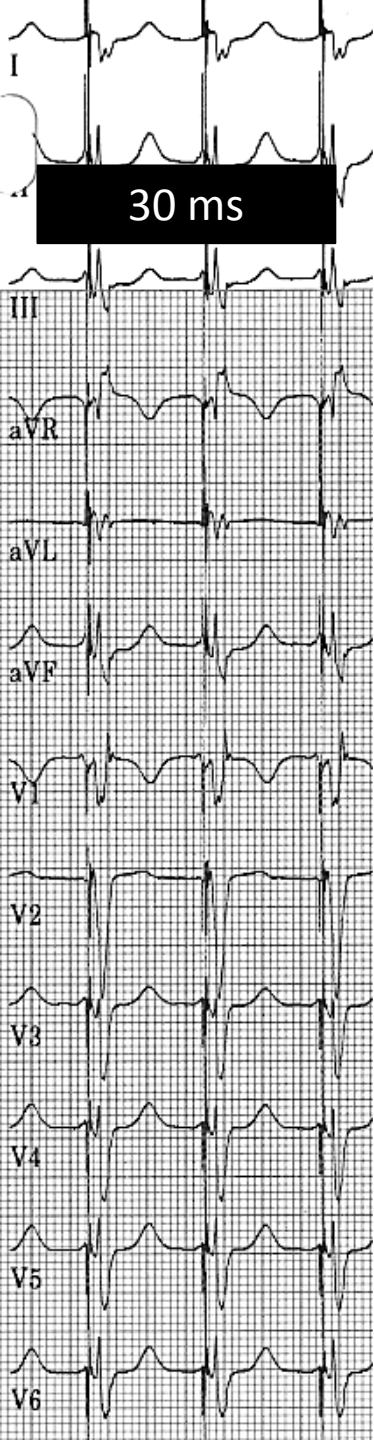


LAO: Septogram



TTE





AV delays

30 ms

60 ms

80 ms

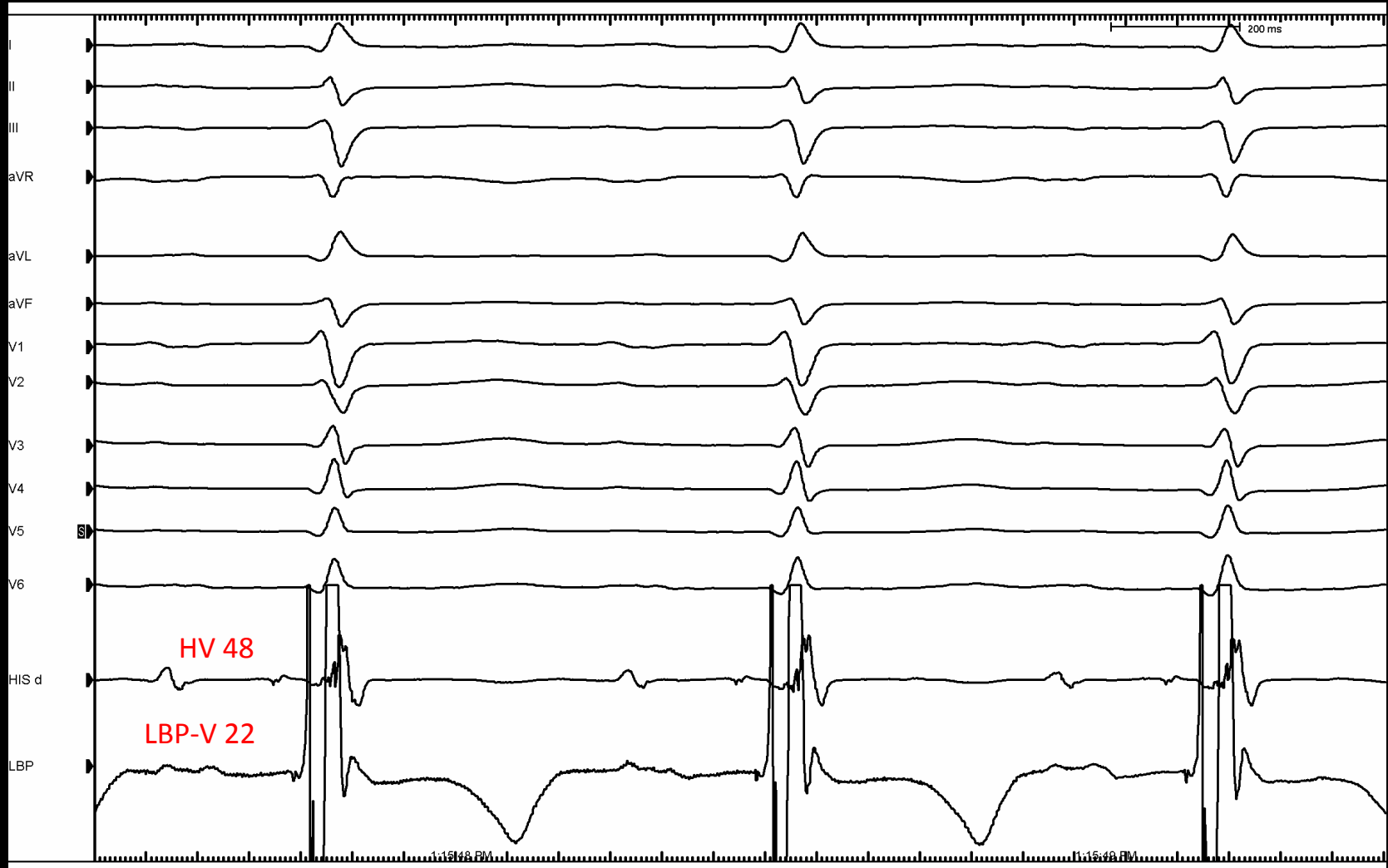
100 ms

Final ECG

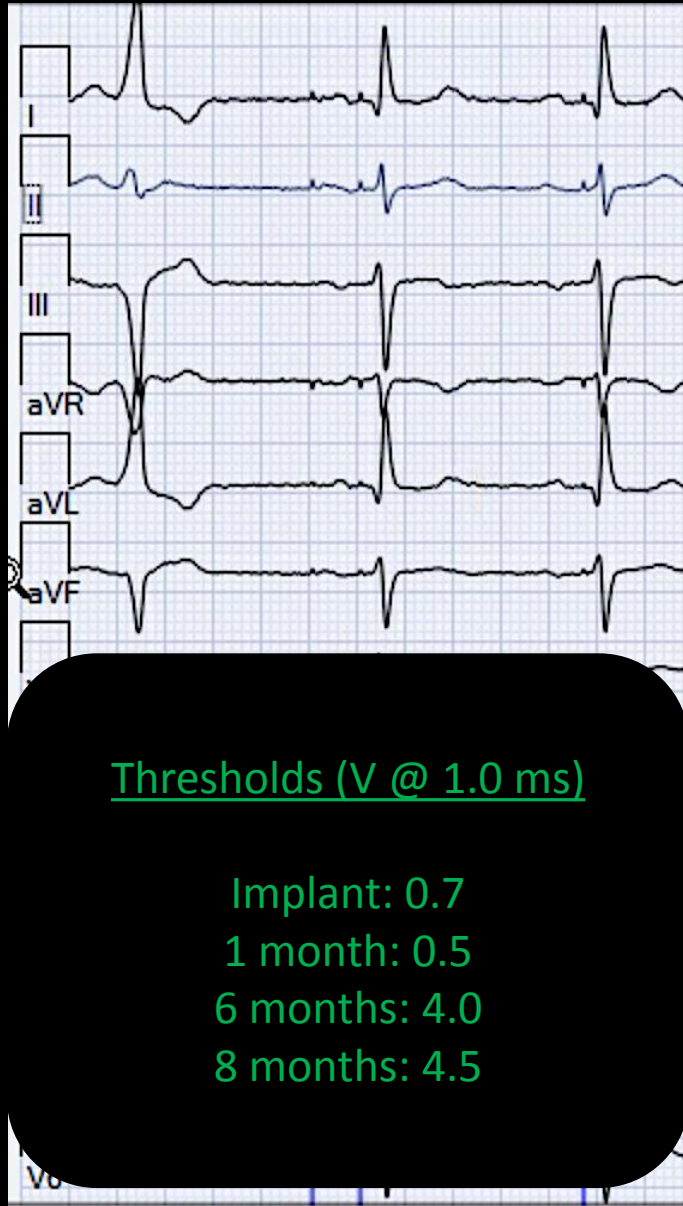


Discharged home off Milrinone next day

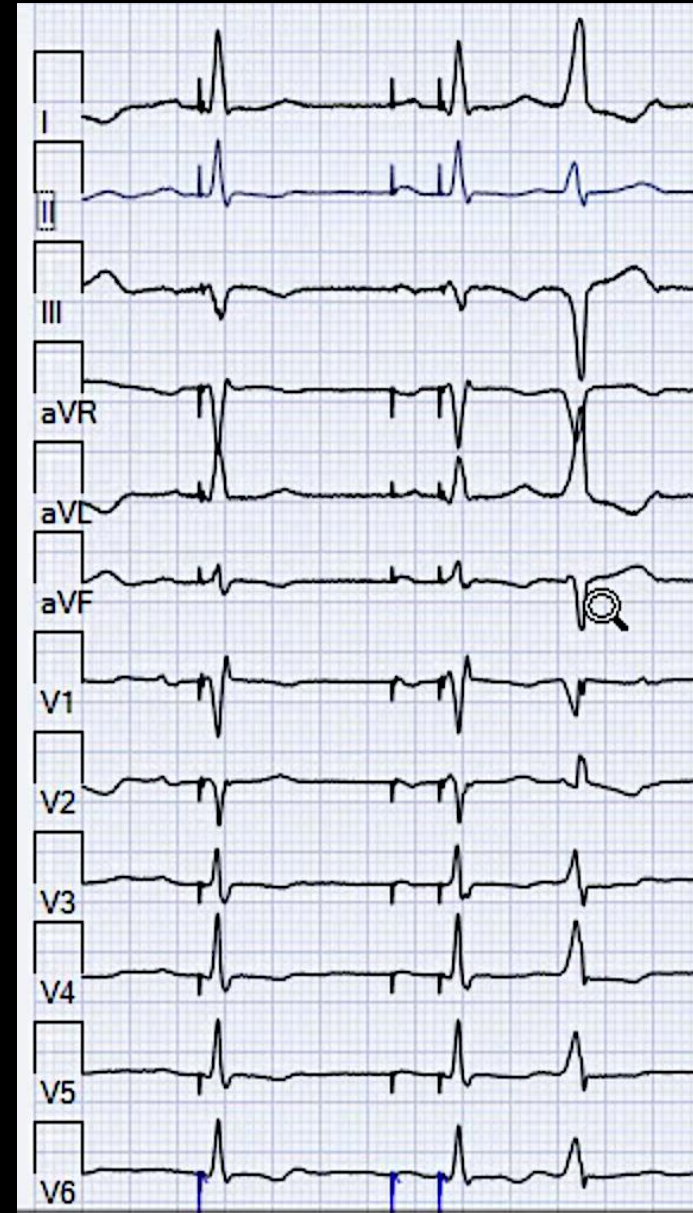
Case 4: HBP lead exit block 6 months after implant. Referred for LBBA pacemaker. Note HIS and LB signals on respective leads



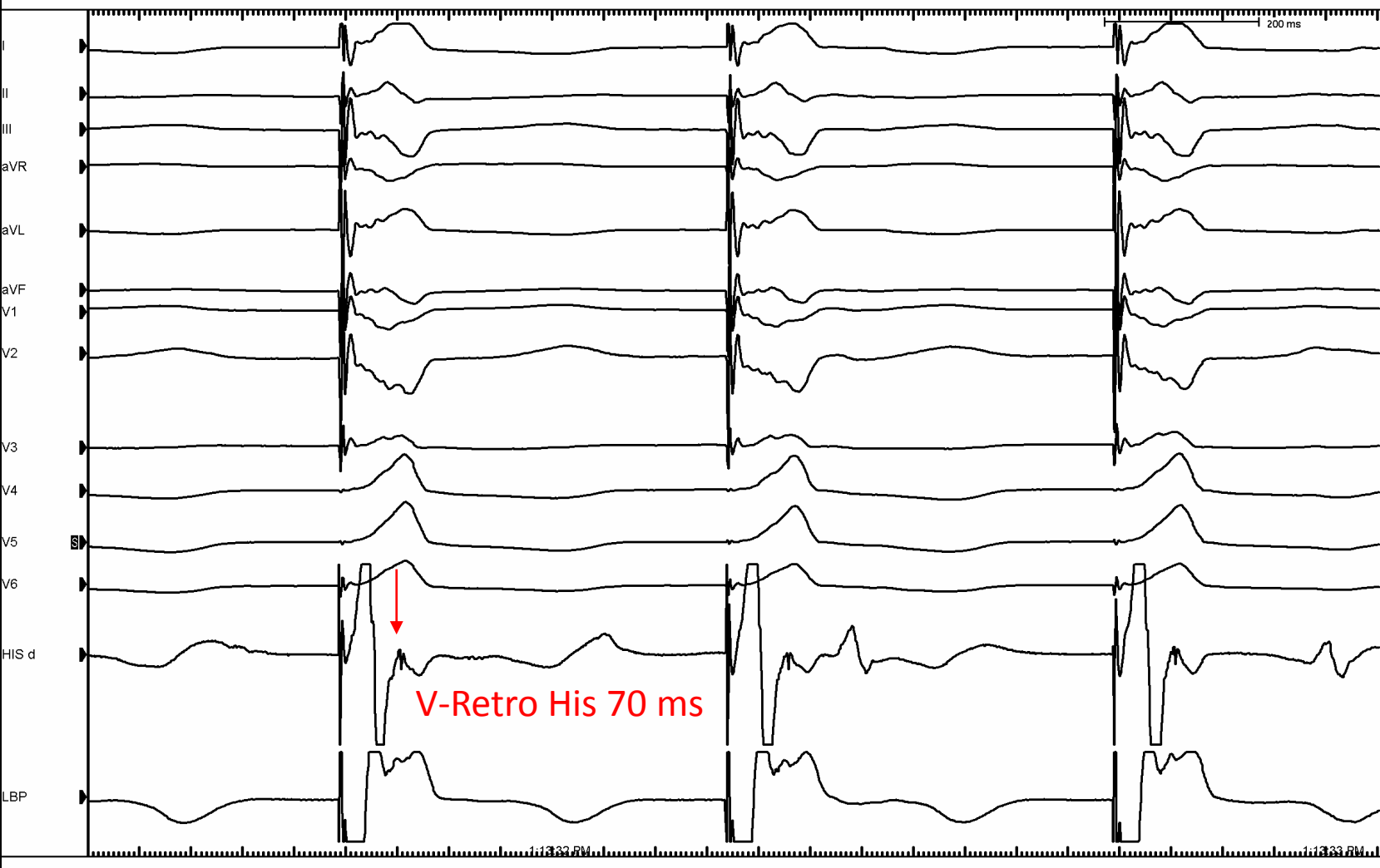
HBP



LBBAP



Evidence for direct LBB capture: V-His_R time
Unipolar ring



Evidence for direct LBB capture: V-His_R time
Unipolar tip

