His bundle pacing – and emerging alternative for CRT

Curila Karol, MD, PhD, MSc

Cardiocenter, 3-rd faculty of Medicine, Charles University, Prague

Heart failure and ventricular dyssynchrony

- LV dyssynchrony increases morbidity and mortality in patients with heart failure
- Resynchronization = biventricular pacing with the LV lead in the coronary sinus
- Fails to improve clinical characteristics in 20-40% of patients
- Reasons: not possible to reach the CS, no suitable CS branch, patient without ventricular dyssynchrony, …

His bundle pacing in bundle branch blockade

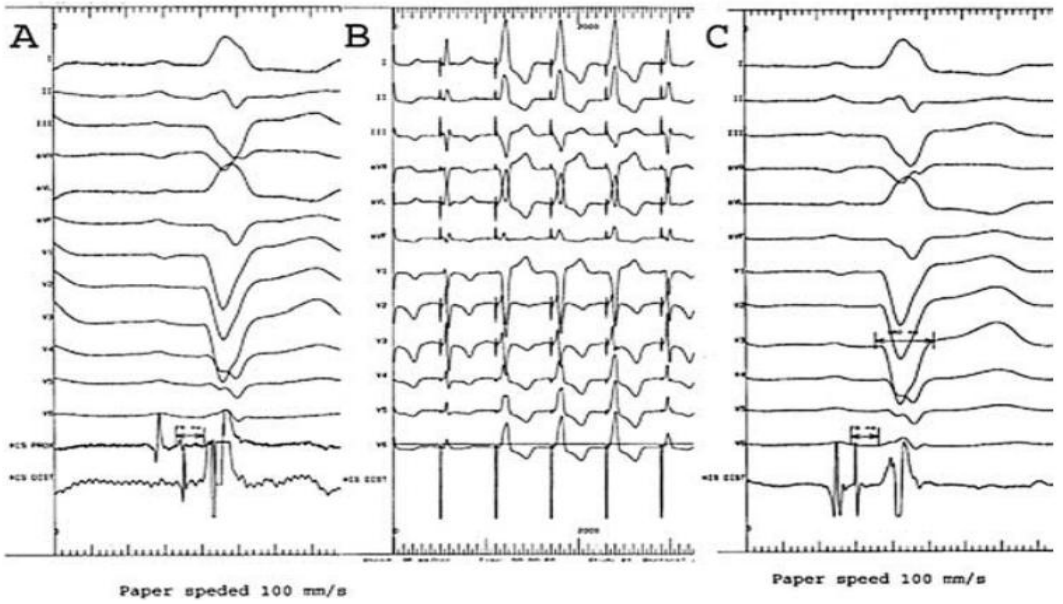
- Possible in LBBB - El Sherif, et al, 1978
- Longitudinal dissociation of the His bundle – Tawara branches being separated already inside it
- First clinical use of His bundle pacing - Deskmukh et al, 2000, Circulation

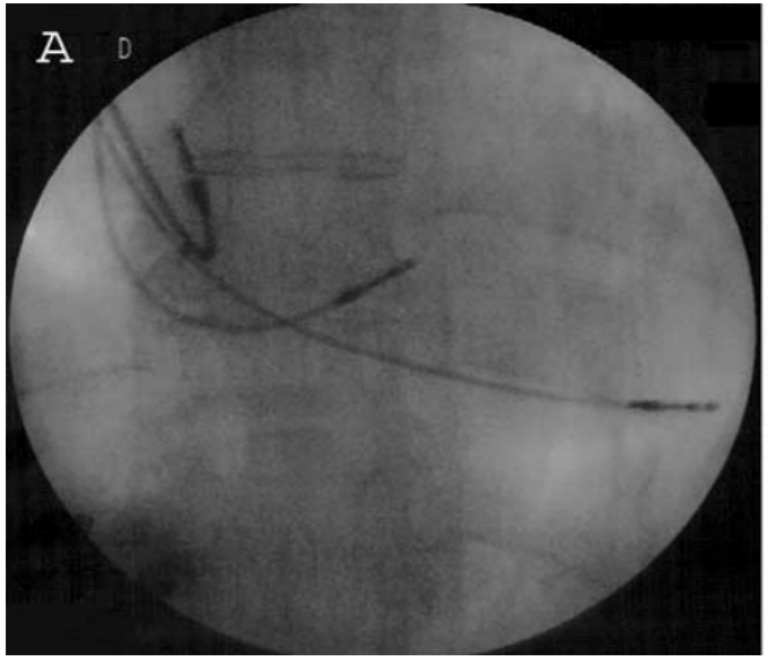
First Author, Year (Ref. #)	Patients	AV Nodal Block (Success %)	Backup RV Lead	Fluoroscopy Times (Procedure)	Pacing Threshold (Implant)	Clinical Outcomes
Deshmukh et al. 2000 (26) (N = 18)	Chronic AF, AV node ablation, DCM	12 of 18 (66%)	Yes	3.5 ± 1.5 h (P)	DHBP: 2.4 ± 0.9 V at 0.5 ms	Improved LVEF, decreased LV dimension, improved NYHA functional class

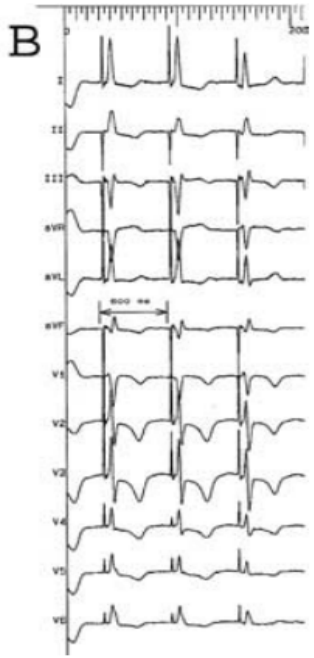
- First clinical use in a patient with LBBB – Occheta, 2005

First His bundle pacing in LBBB patient with heart failure

- Patient with AV block of 3-rd degree and EF 35%
- Recovered after 24 hours to LBBB
- CS canulation unsuccessful

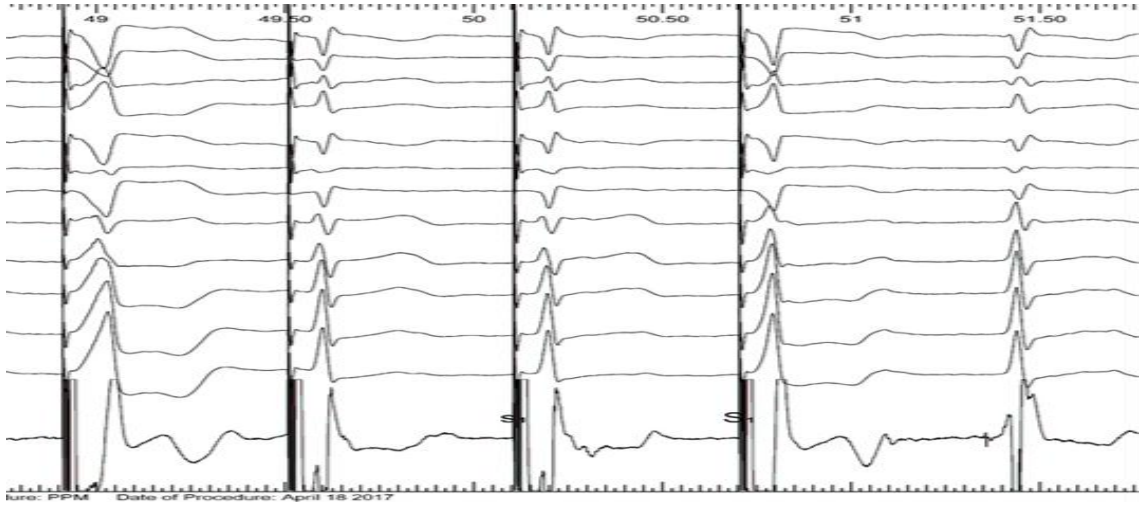


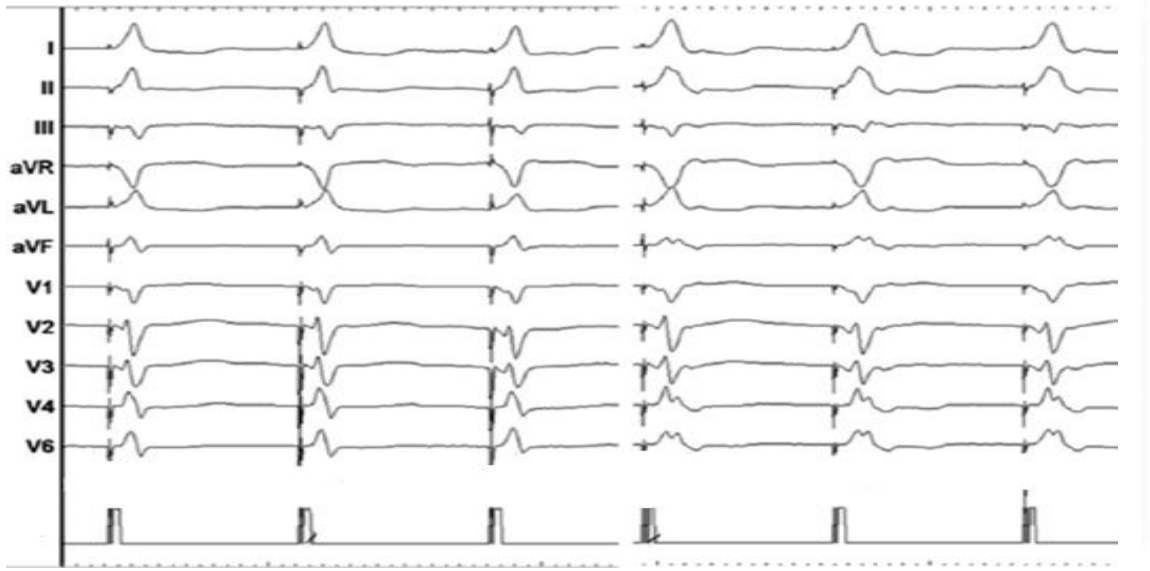


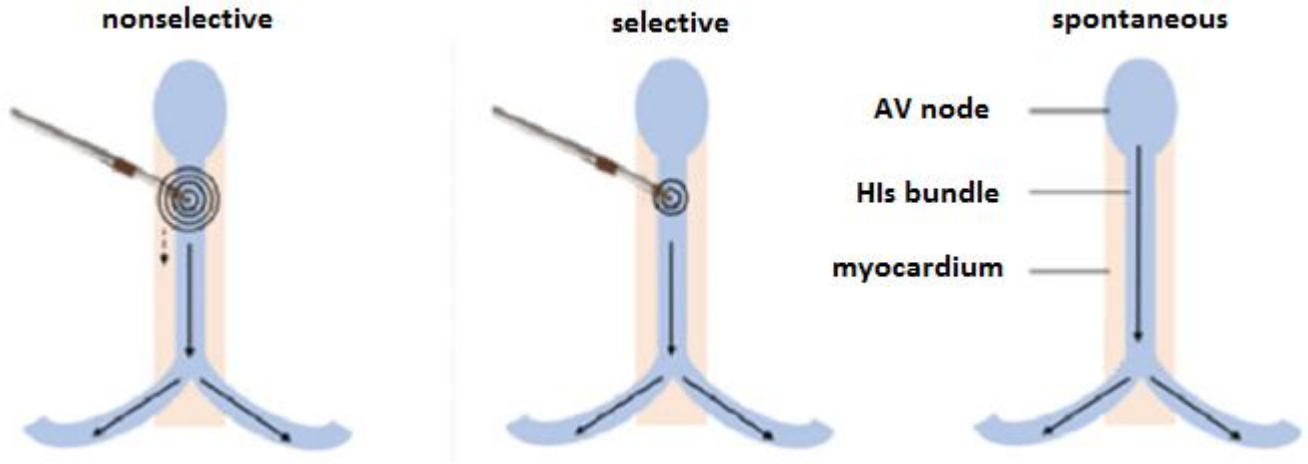


PABLO MORINA-VAZQUEZ, et al. Cardiac Resynchronization Through Selective His Bundle Pacing in a Patient with the So-Called InfraHis Atrioventricular Block, PACE, 2005

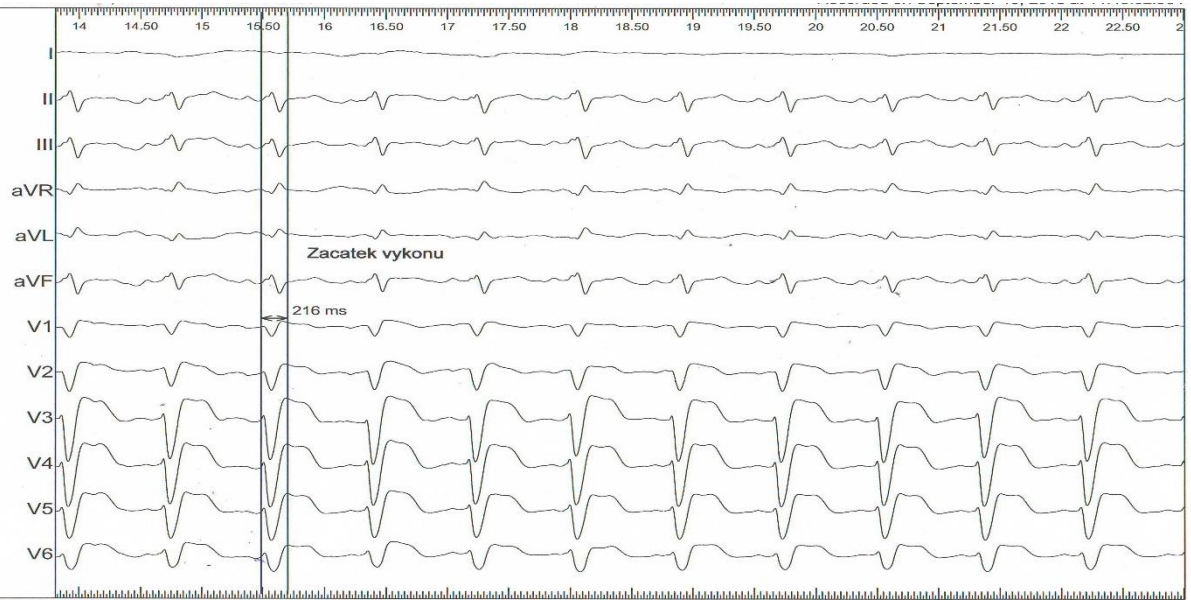
Selective and nonselective His bundle pacing (anatomical point of view)

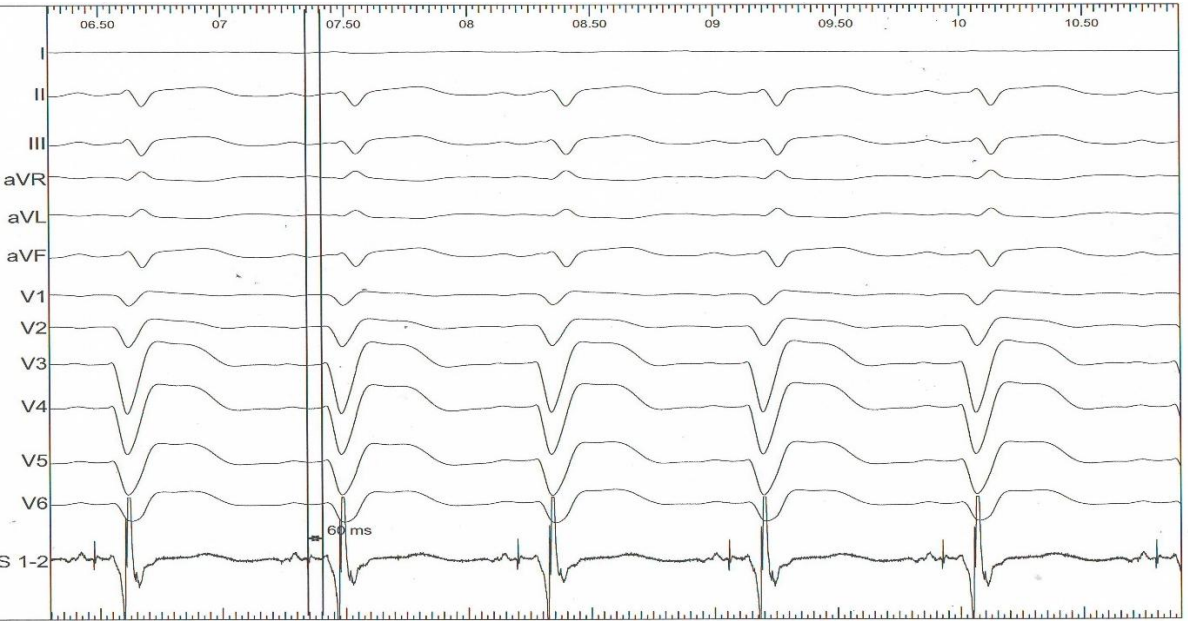


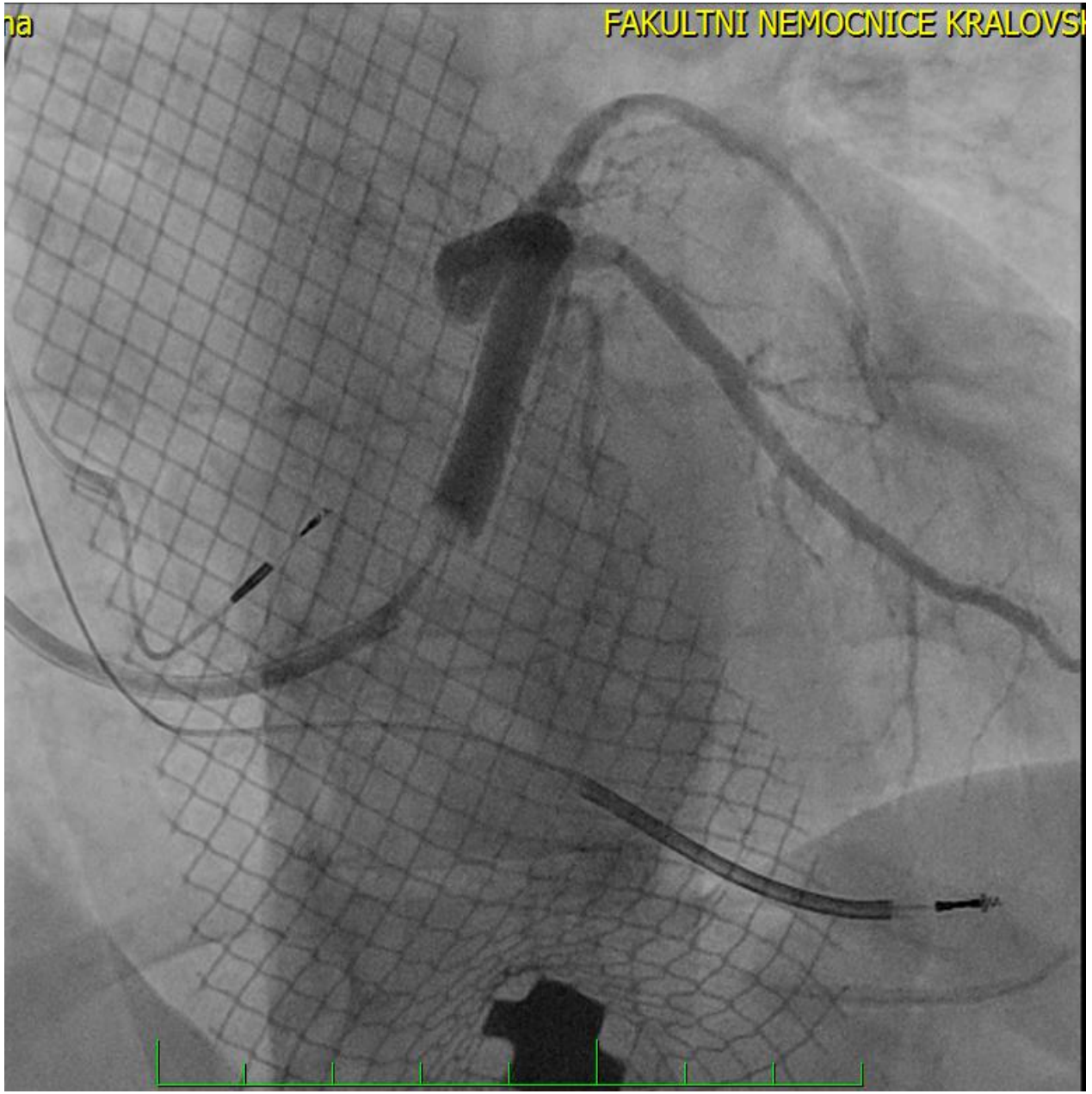


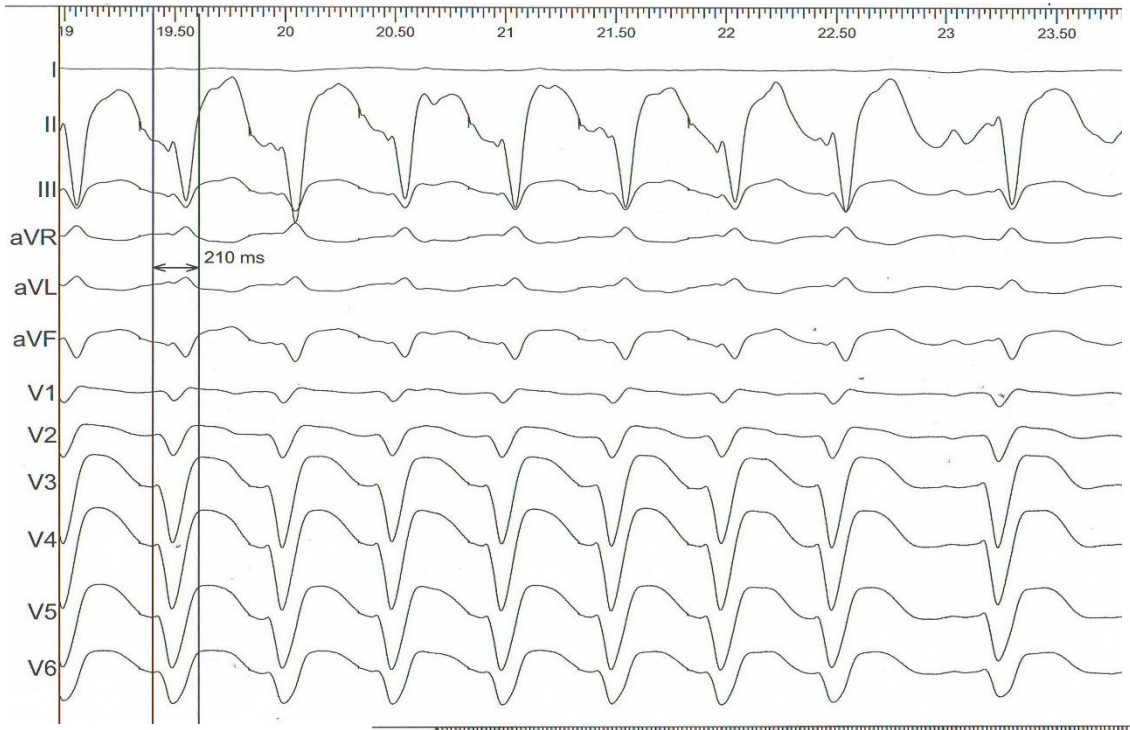


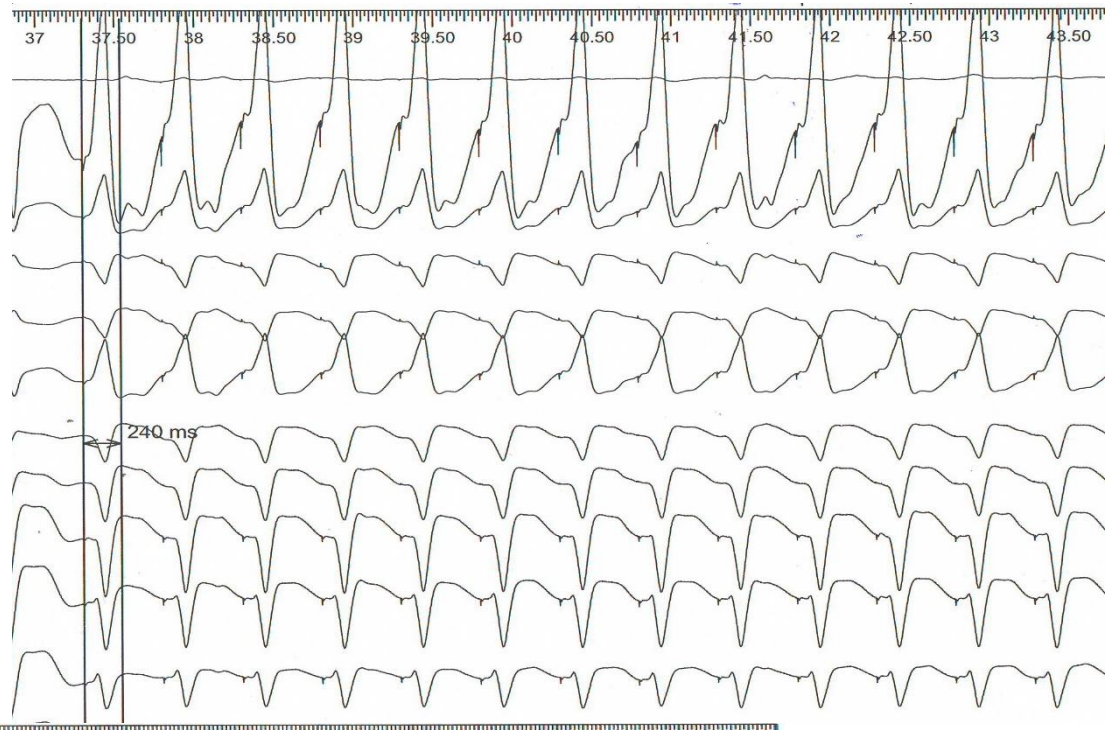
CRT patient with LBBB and His bundle pacing

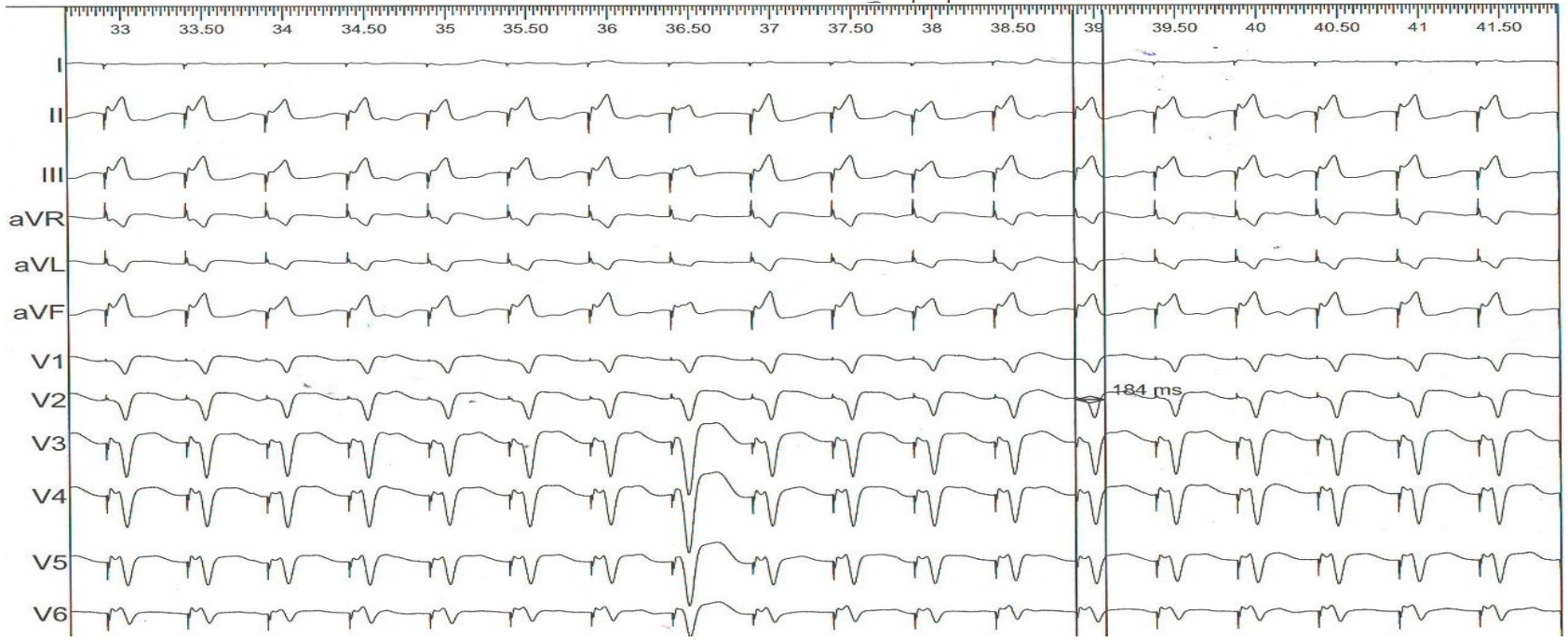




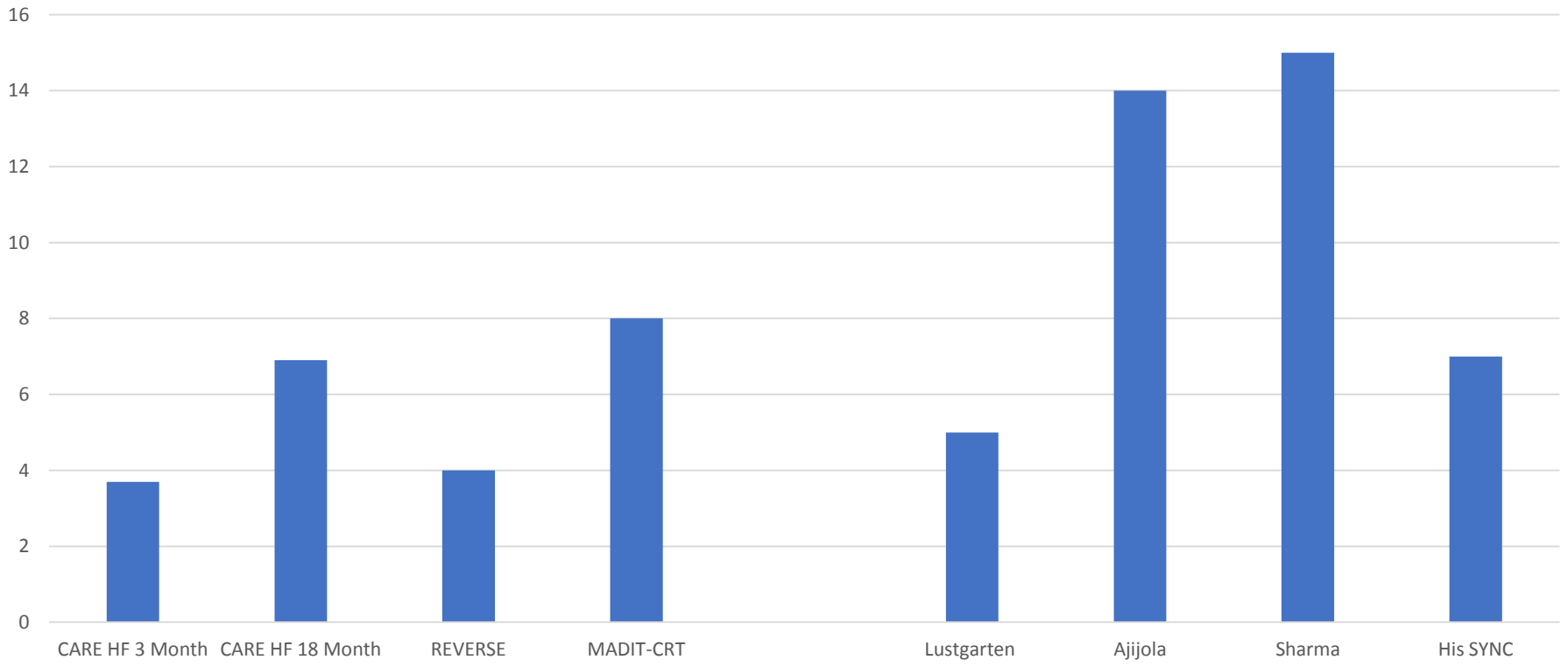



19
19.50
20
20.50
21
21.50
22
22.50
23
23.50
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
210 ms


37
37.50
38
38.50
39
39.50
40
40.50
41
41.50
42
42.50
43
43.50
240 ms

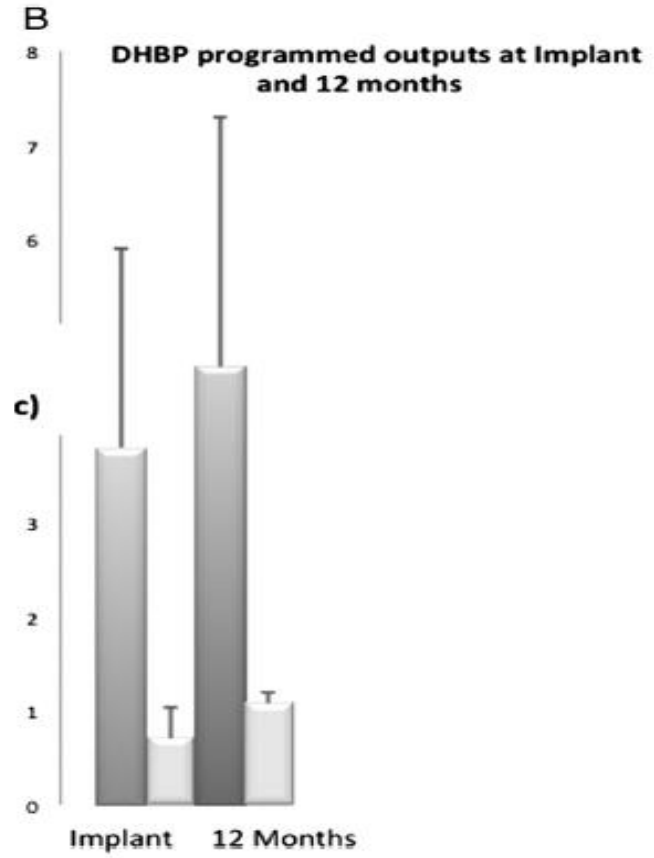

33
33.50
34
34.50
35
35.50
36
36.50
37
37.50
38
38.50
39
39.50
40
40.50
41
41.50
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
184 ms

LVEF improvement across CRT studies

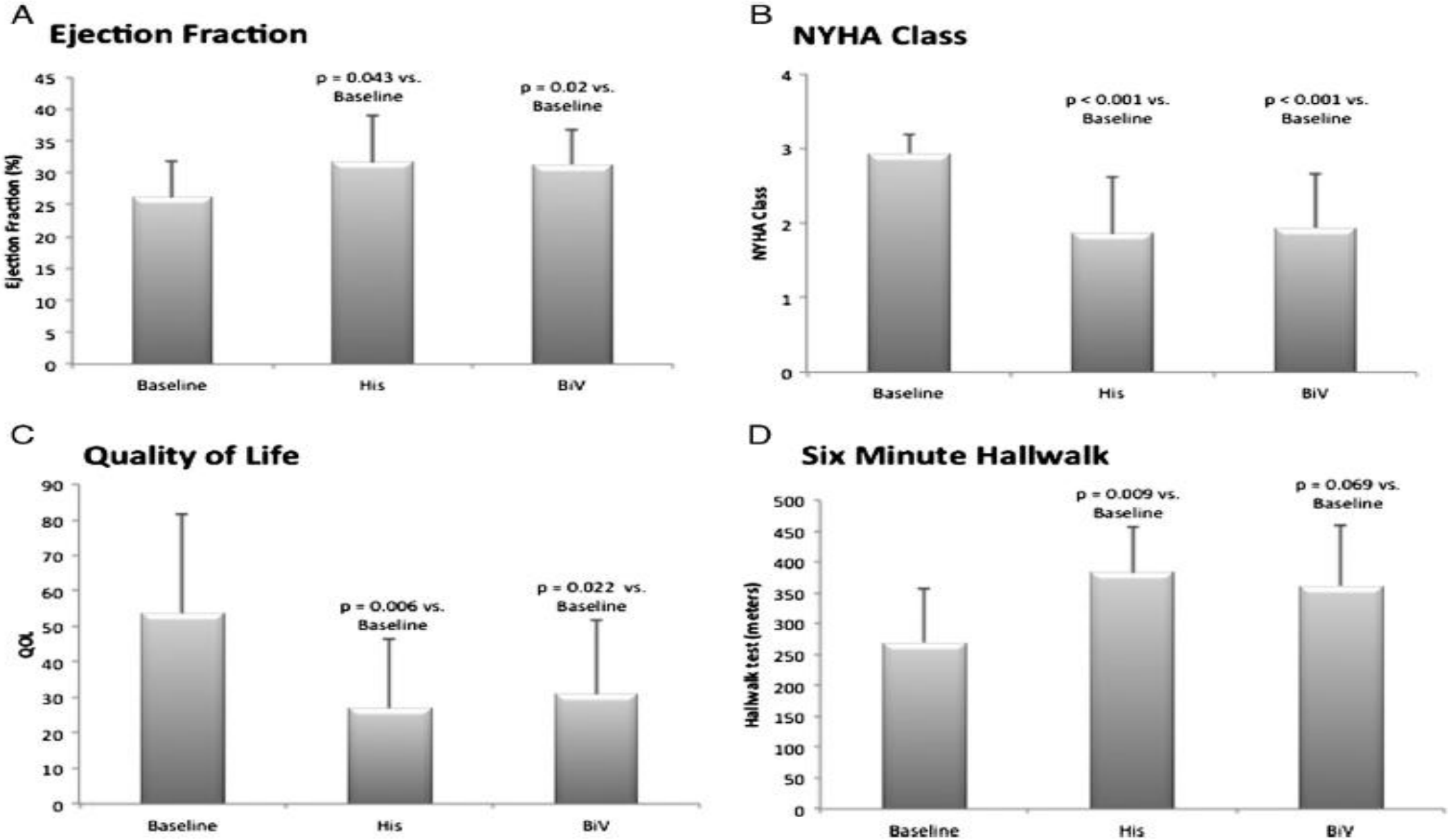


His bundle vs biventricular pacing – first clinical trial

- *Lustgarten et al, Hearth Rhythm, 2015*
- *29 patients with HF, QRSd above 130ms and mean LV EF of 26%*
- *Crossover design: 6 months His bundle and 6 months Biv pacing*
- *Acute success rate 72% (21/29 pt), a long term success rate of 52% (*15/29 pts)
- BUT - check the pacing thresholds !!!



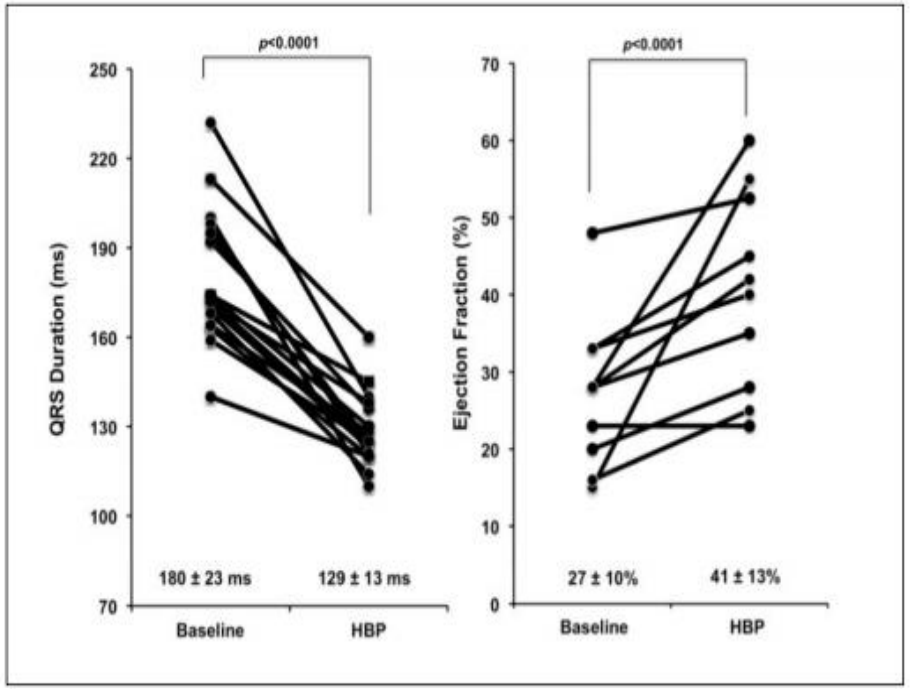
Lustgarten et al. His-bundle pacing versus biventricular pacing in cardiac resynchronization therapy patients: A crossover design comparison. Heart Rhythm, 2015.



Lustgarten et al. His-bundle pacing versus biventricular pacing in cardiac resynchronization therapy patients: A crossover design comparison. Hearth Rhythm, 2015.

His bundle pacing in lieu of Biv pacing

- 21 patients with CRT indication who chose His instead of Biv
- Success rate 76% (16/21) – more than 20% QRSd narrowing
- 12 months follow up, NYHA and ECHO
- LV EF improvement 27 ± 10 % to 41 ± 13 %
- LVEDD improved from 54 to 45 mm
- NYHA changed from III to II
- Mean implant time: 188 ±57 min.
- Pacing thresholds 1,9 ±1,2 V @ 0,6 ±0,5ms



Ajijola et al. Permanent His bundle pacing for cardiac resynchronisation therapy: Initial feasibility study in lieu of left ventricular lead. Heart Rhythm. 2017.

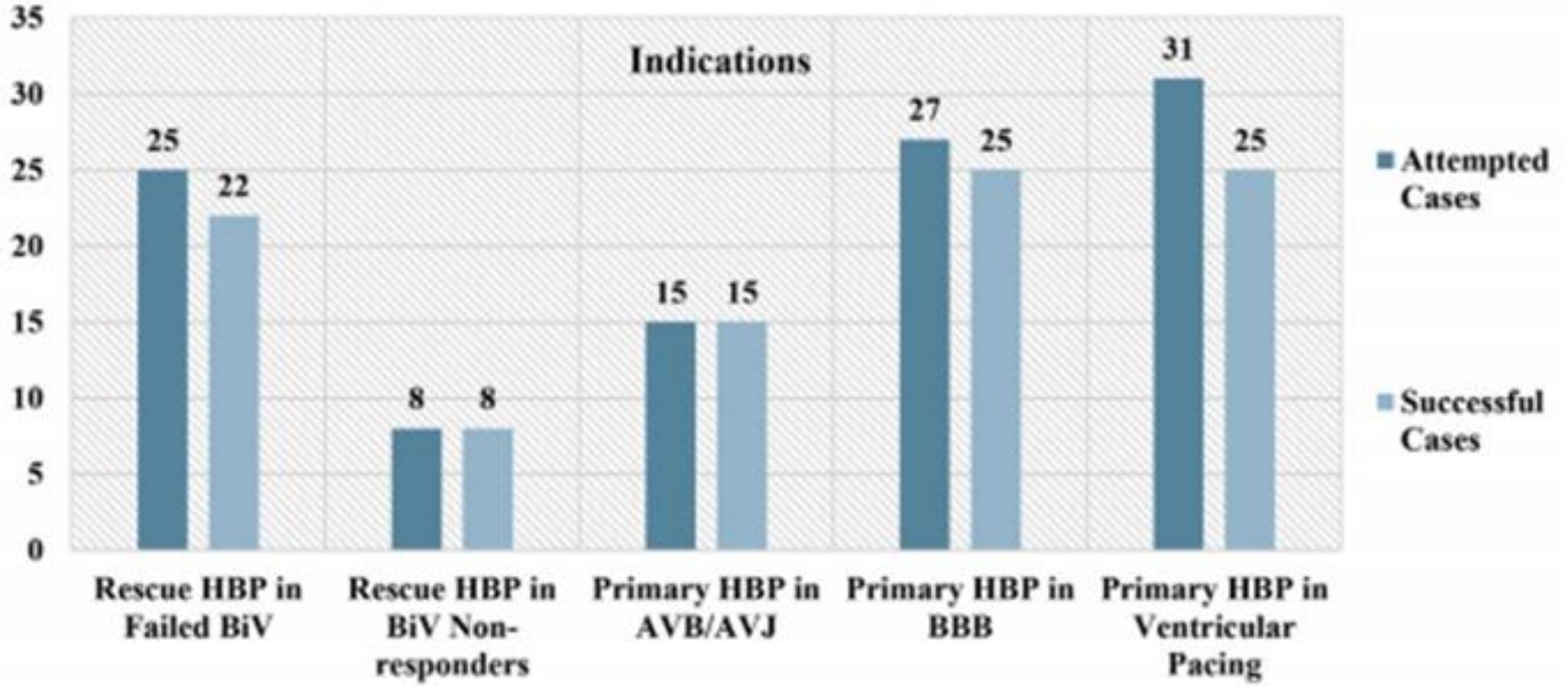
His bundle pacing – multicentric observational trial

- 2 groups of patients with heart failure and reduced LV EF
- a/ LBBB patients who failed LV lead placement or non-responders to Biv pacing

  b/ patients with a brady indication: AV block and narrow QRS, BBB, atrial fibrillation and AV node ablation or PICM
- Mean LV EF 30%±10%, 76% of patients NYHA III-IV
- QRSd 157 ± 33 ms on average
- Group A: 33 patients, B: 73 patients

Sharma SS, et al. Permanent His-bundle pacing as an alternative to biventricular pacing for cardiac resynchronization therapy: A multicenter experience. Heart Rhythm. 2017.

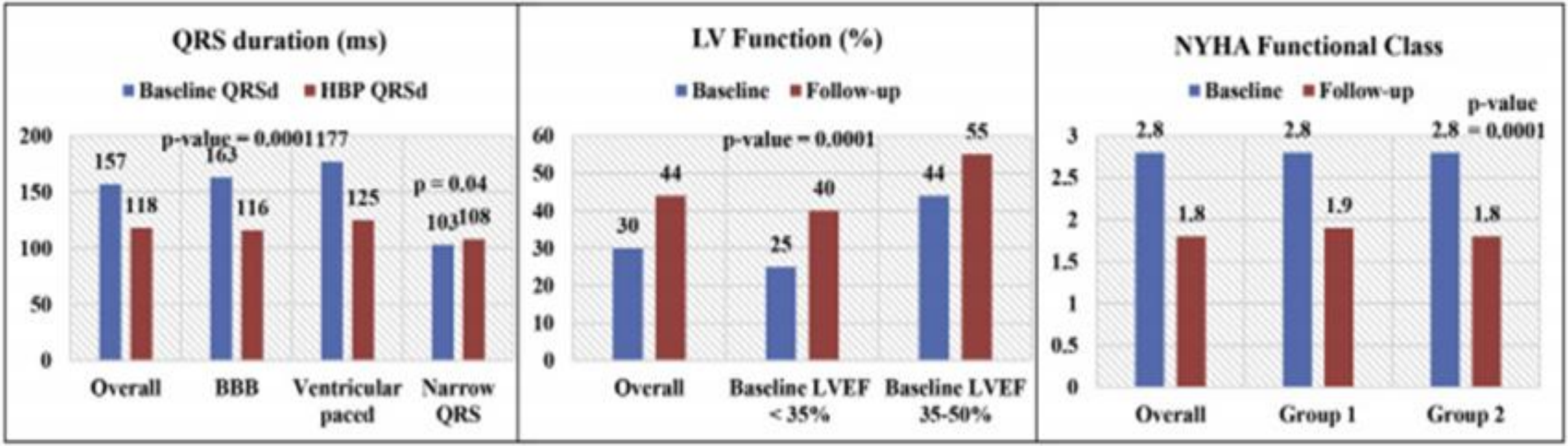
High success rates



Sharma SS, et al. Permanent His-bundle pacing as an alternative to biventricular pacing for cardiac resynchronization therapy: A multicenter experience. Heart Rhythm. 2017.

Results

- Median follow-up of 8 months

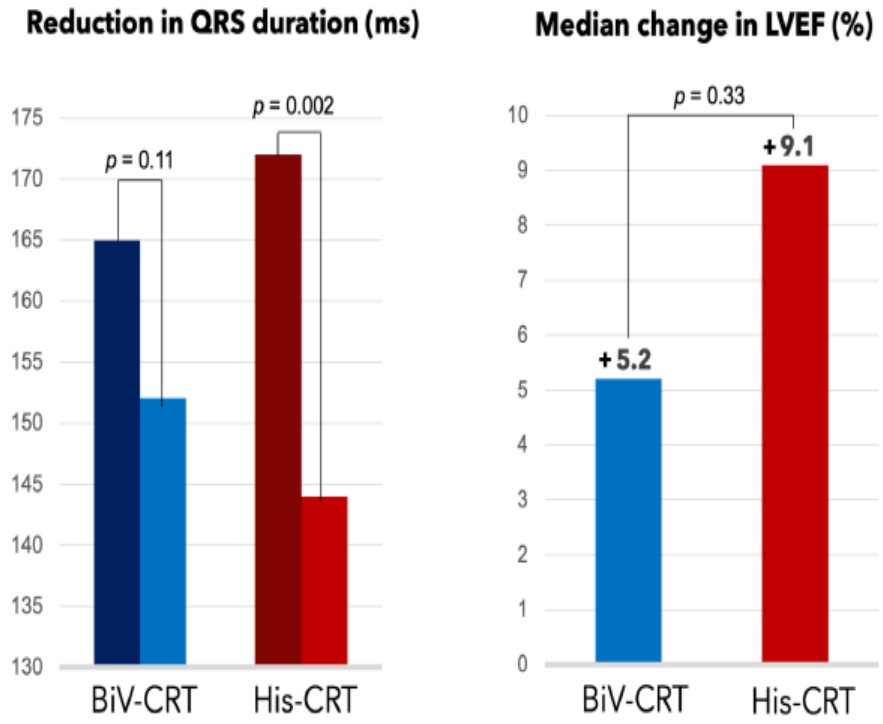


- 39 % of patients classified as super-responders (EF improvement of at least of 20%)
- 6/8 non-responders to Biv pacing improved LV EF (from 30 ± 10 % to 38 ± 13 %)

Sharma SS, et al. Permanent His-bundle pacing as an alternative to biventricular pacing for cardiac resynchronization therapy: A multicenter experience. Heart Rhythm. 2017.

His –SYNC study; pilot, multicenter, prospective, randomized Biv CRT vs HBP

- 41 patients with BBB and mean LV EF of 28 %, NYHA II-IV, QRSd above 120ms
- 1:1 randomization to His or Biv pacing
- 6 month follow up for QRSd, echo parameters
- 12 month follow up for clinical parameters
- No difference in death and HF hospitalizations - underpowered

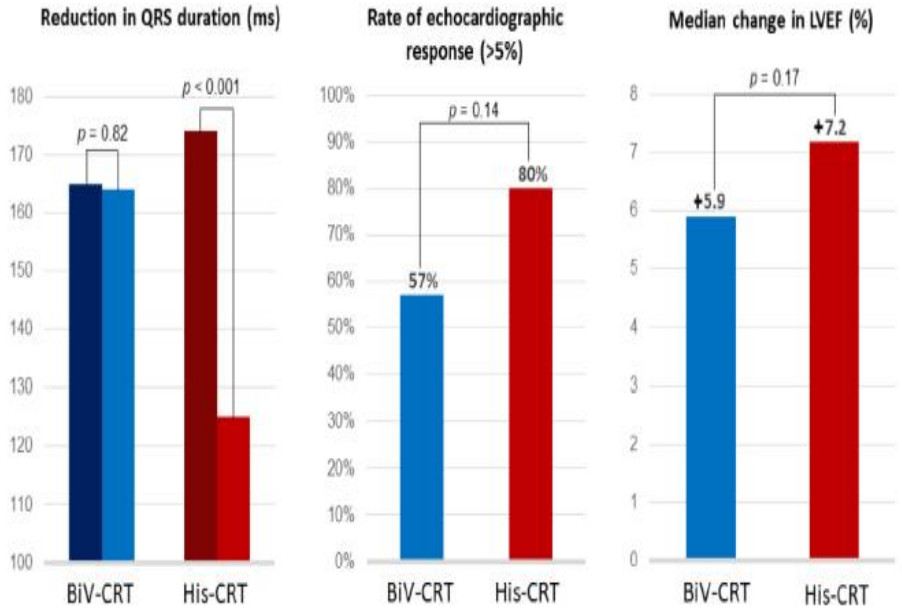


Upadhyay GA, et al. His Corrective Pacing or Biventricular Pacing for Cardiac Resynchronization in Heart Failure. J Am Coll Cardiol. 2019 May 7. pii: S0735-1097(19)34992-7.

On treatment analysis

- High crossover rates (48% in His and 26% in Biv group)
- 10 x His (impossible to correct LBBB/NIVCD in 5, His bundle not found in 2, QRS above 130 ms in 3), 5 x Biv (no CS or suboptimal venous anatomy)
- Superior for electrical resynchronization
- No difference in LV EF change,

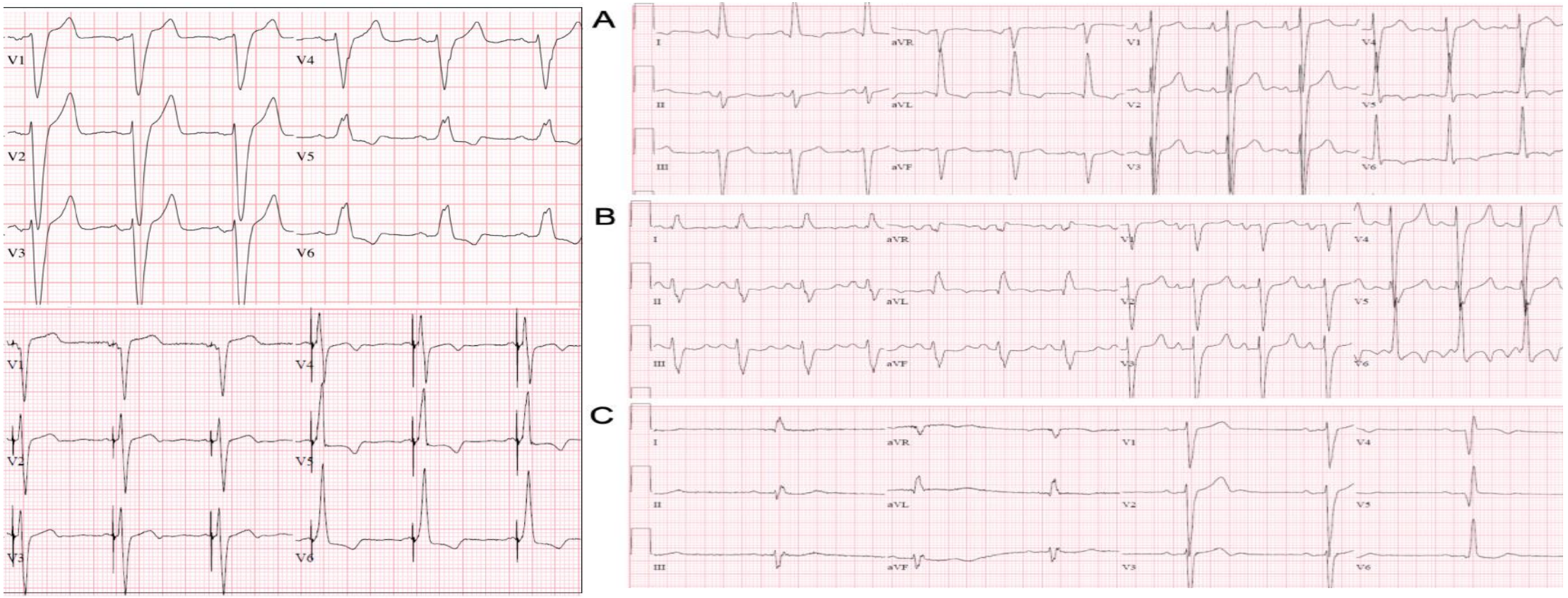
  LVESV, clinical parameters
- Thresholds 2,75 V at 1,0 ms in His group



Upadhyay GA, et al. On-treatment comparison between corrective his bundle pacing and biventricular pacing for cardiac resynchronization: A secondary analysis of his-sync. Heart Rhythm. 2019 May 13. pii: S1547-5271(19)30440-0.

Does QRS morphology matters in His bundle pacing?

- 15/16 His corrected patients had LBBB fulfilling Strauss criteria
- 5/5 His <u>not corrected</u> patients had NIVCD



Upadhyay GA, et al. On-treatment comparison between corrective his bundle pacing and biventricular pacing for cardiac resynchronization: A secondary analysis of his-sync. Heart Rhythm. 2019 May 13. pii: S1547-5271(19)30440-0.

His pacing in resynchronization - to conclude

- Most data from a few US centers (Geisinger, University of Chicago, UCLA Los Angeles)
- Retrospective studies = high success rate, perfect response
- Prospective, comparative studies = lower success rate, response similar to biventricular pacing
- Relatively high pacing thresholds to overcome the LBBB
- Can it be done differently?

LBBB pacing in Wenzhou - China

- 74 patients
- 2012 – *June/2017*
- Strict LBBB criteria
- Acute correction in 97%
- Chronic correction in 75%:

  a/ high thresholds

  b/ fixation problem

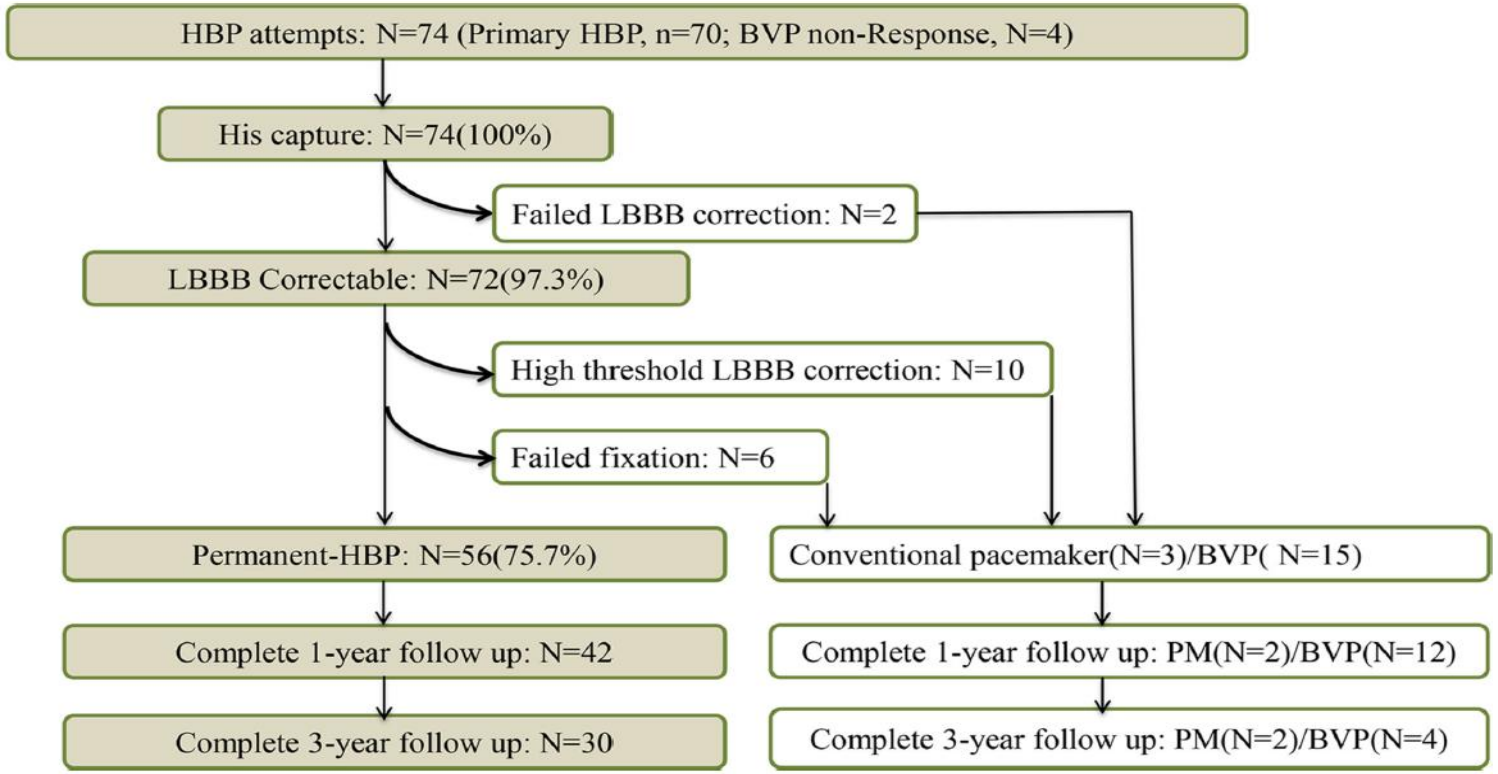


Figure 1 Flowchart of patients. HBP, His bundle pacing; LBBB, left bundle branch block; PM, pacemaker; BVP, biventricular pacing.

Huang et al. Long-term outcomes of His bundle pacing in patients with heart failure with left bundle branch block. Heart. 2019 Jan;105(2):137-143.

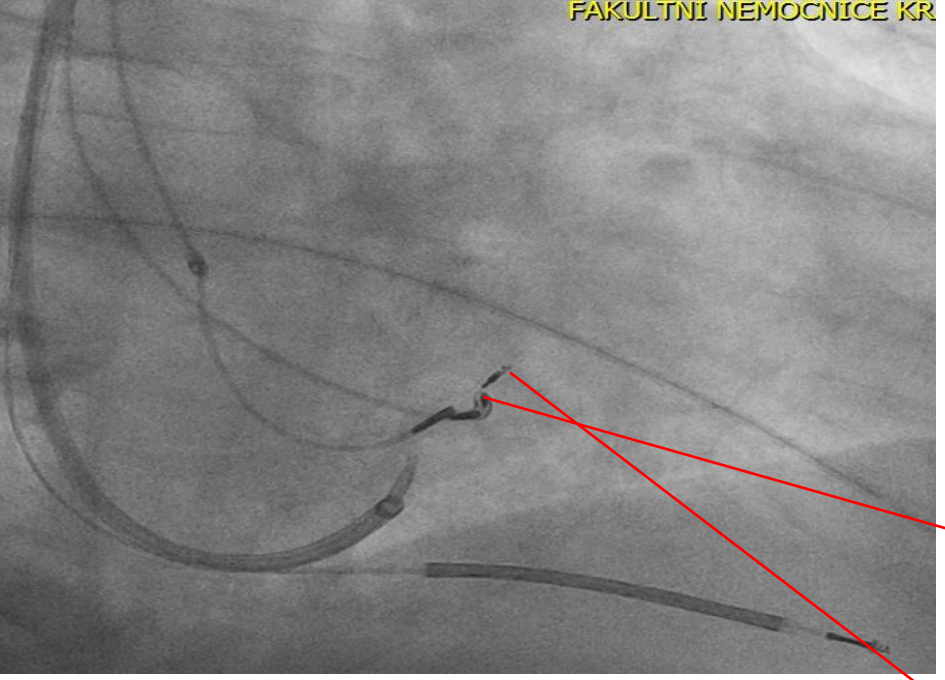
Results

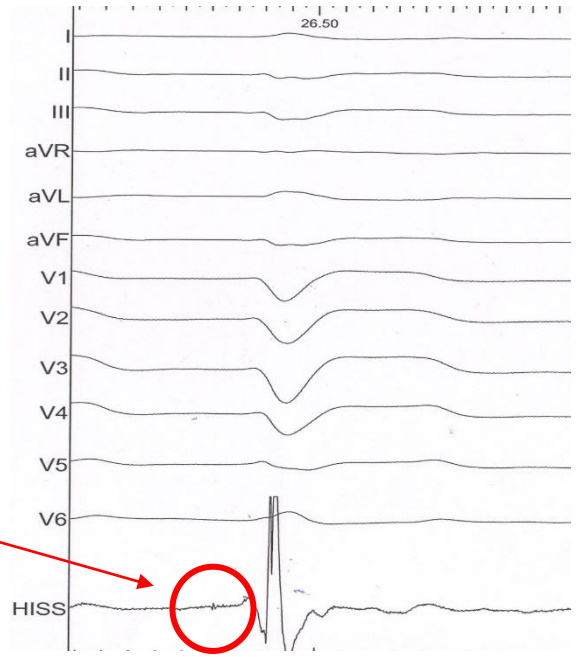
- 89% of patients with EF bellow 40% improved to more than 50%
- Mean pacing thresholds 2,1 @ 0,5 ms
- No comlications during follow up reported

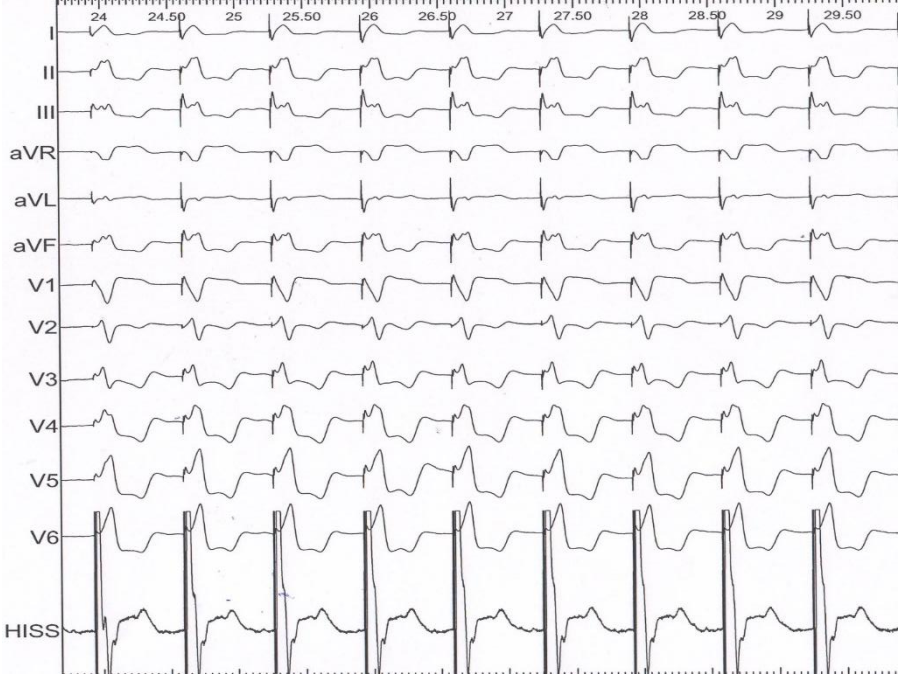
	HBP with HFrEF (n=36)		BiV pacing (n=12)		
	Baseline	1 year	Baseline	1 year	P valuest
LVEF (%)	30.5±5.1	56.5±12.4*	32.6±6.9	51.6±8.0*	0.064
LVESV (mL)	140.3±56.1	64.7±40.9*	130.7±30.3	70.8±25.4*	0.712
LA (mm)	46.8±7.1	42.7±6.4*	46.5±7.0	42.0±6.7*	0.105
MR	1.7±1.0	0.9±0.9*	1.8±0.8	0.6±0.7*	0.238
TR	1.0±0.9	0.6±0.6**	0.7±0.8	0.5±0.7	0.761
BNP (pg/L)	646.7±683.2	111.8±158.5*	614.8±469.9	106.3±85.7*	0.895
CTR	0.6±0.1	0.6±0.1*	0.6±0.1	0. 6±0.1*	0.801
NYHA Class	2.8±0.7	1.0±0.2*	2.8±0.6	1.1±0.3*	0.293

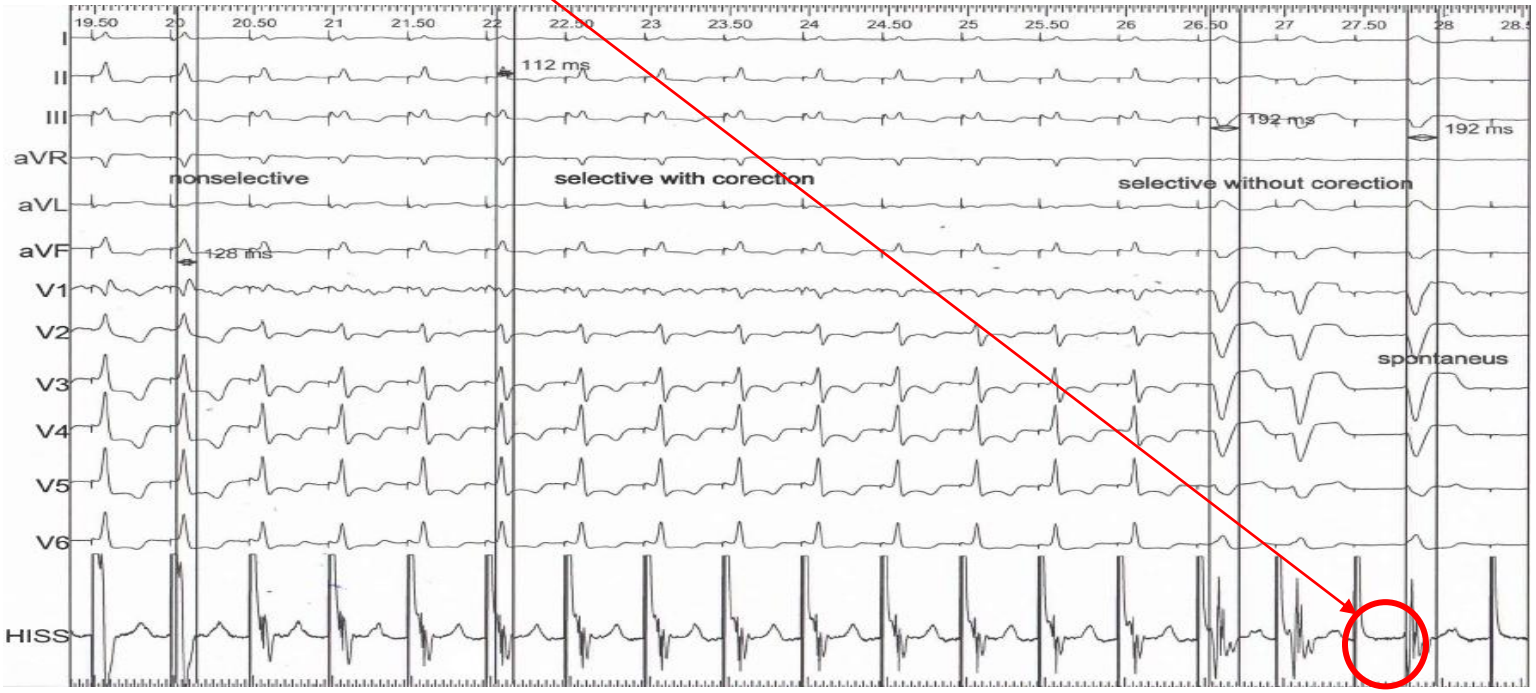
*P<0.001 and **p<0.05, when compared with baseline.

Huang et al. Long-term outcomes of His bundle pacing in patients with heart failure with left bundle branch block. Heart. 2019 Jan;105(2):137-143.


FAKULTNI NEMOCNICE KR

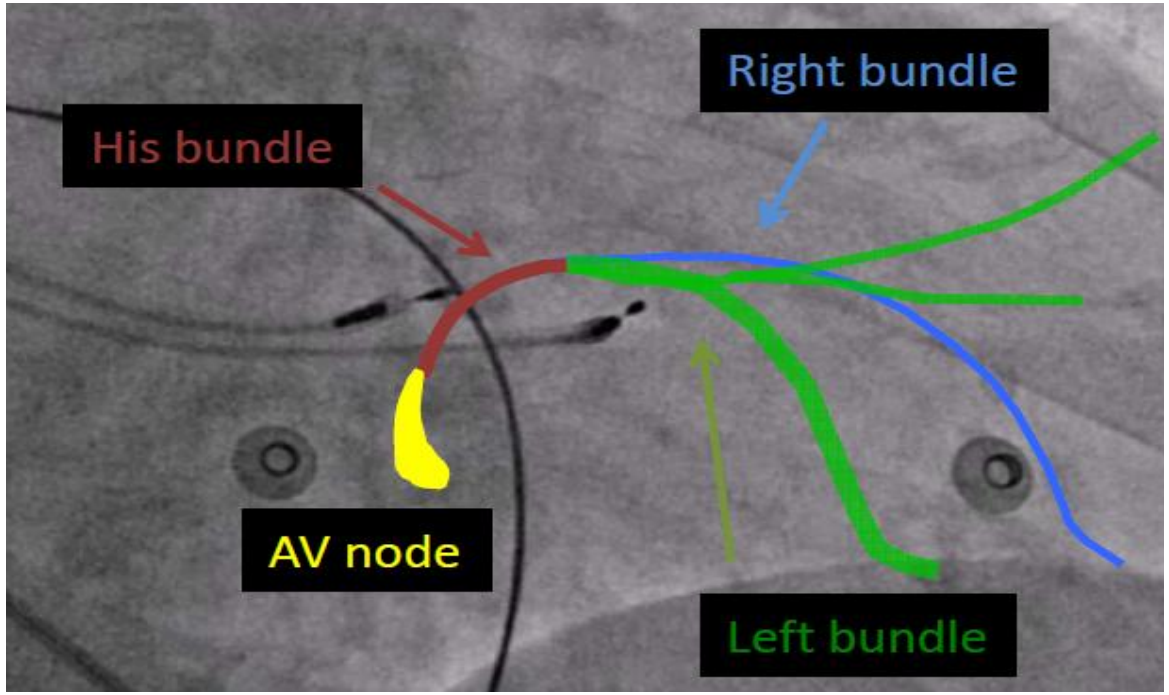

26.50
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
HISS

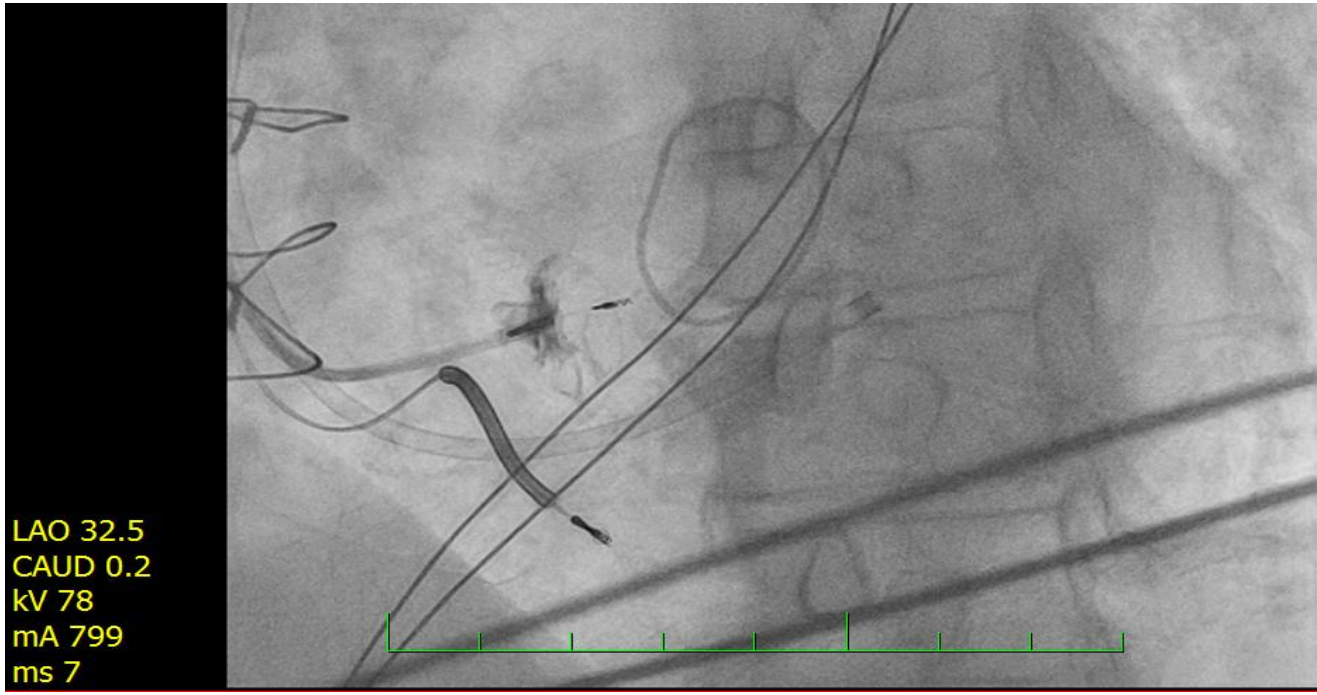

24
24.50
25
25.50
26
26.50
27
27.50
28
28.50
29
29.50
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
HISS


19.50
20
20.50
21
21.50
22
22.50
23
23.50
24
24.50
25
25.50
26
26.50
27
27.50
28
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
HISS
112 ms
128 ms
192 ms
192 ms
nonselective
selective with corection
selective without corection
spontaneus

Pacing of the LBBa

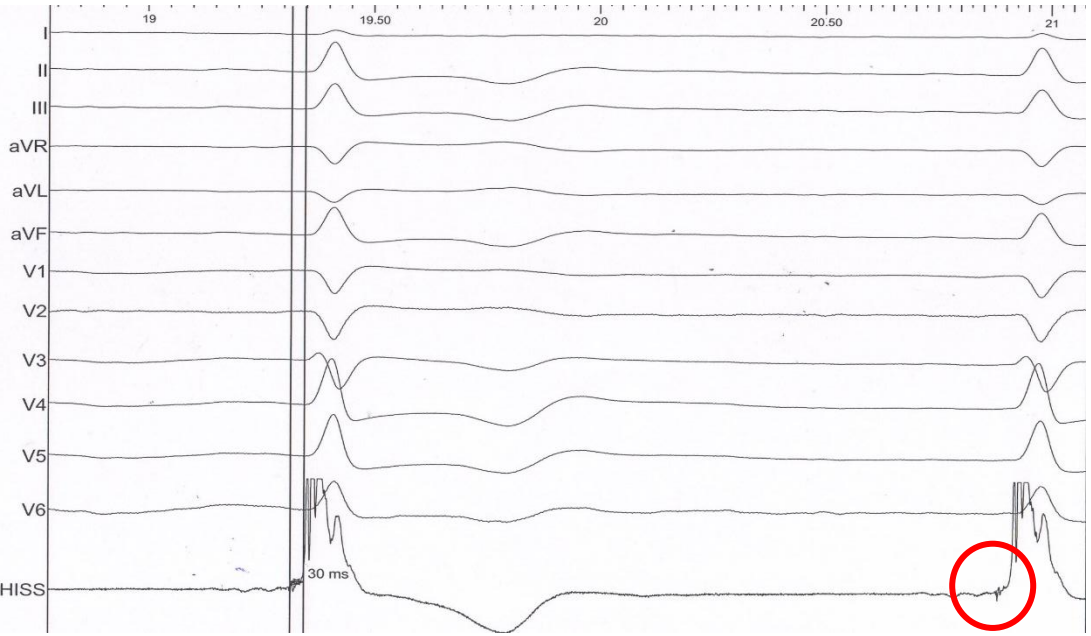
- First published 11/2017: Huang et al, Can J Cardiol
- Modified dual lead technique
- Trans-septal approach to LBB: pace beyond the block !!!
- Shorter procedure time, low pacing thresholds, high sensing values

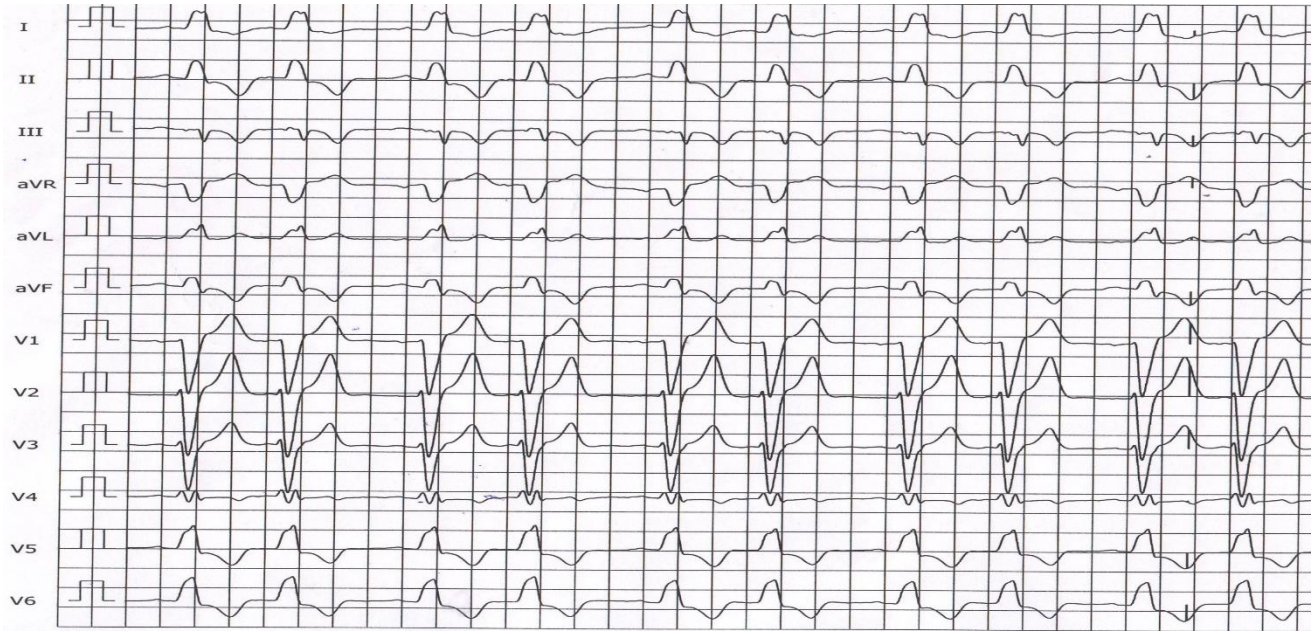


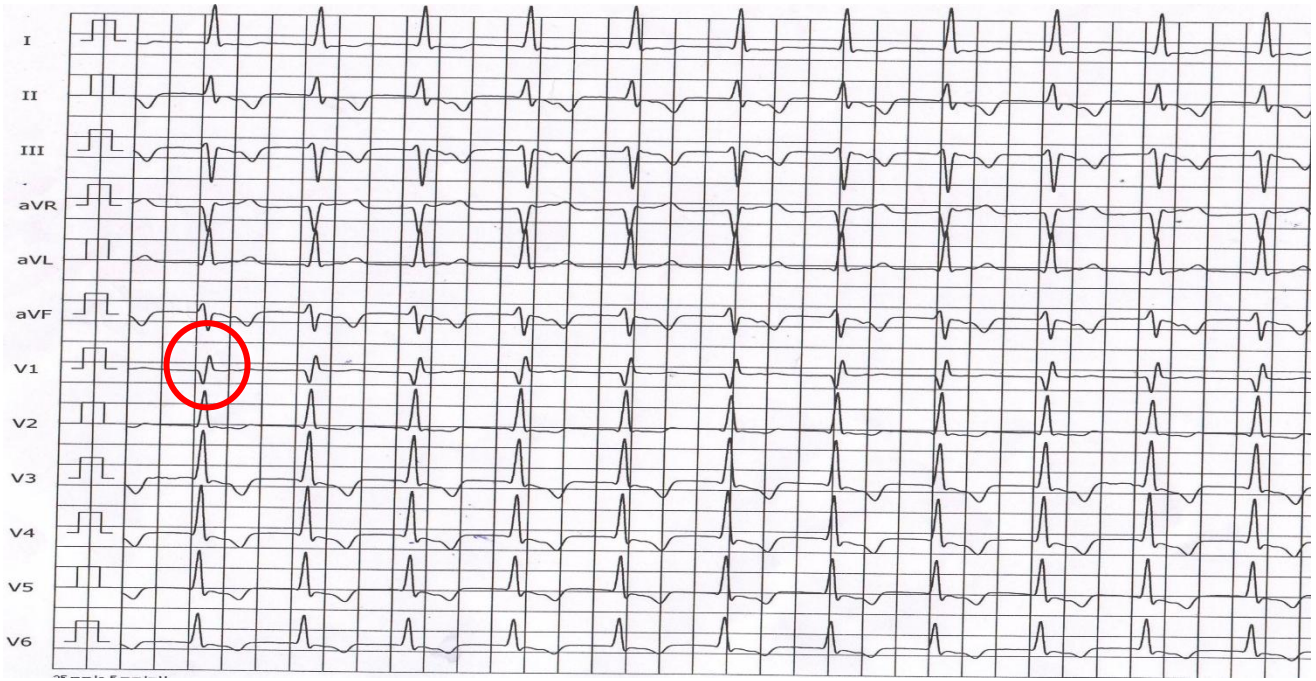


Vijayaraman, Huang W, et al. Prospective Evaluation of Feasibility, Electrophysiologic and Echocardiographic Characteristics of Left Bundle Branch Area Pacing. Heart Rhythm. May 2019

LBBB correction by LBBa pacing

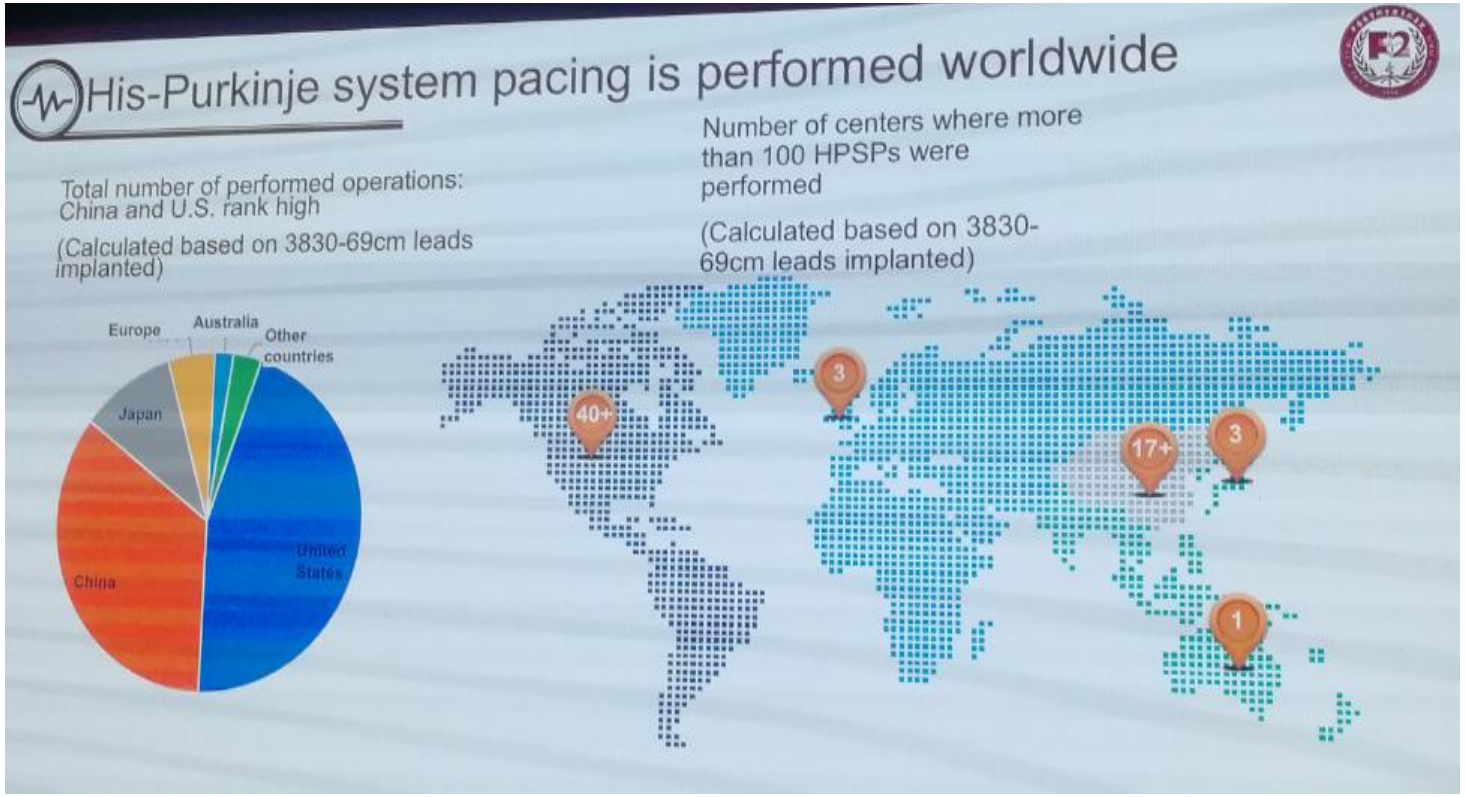






Summary

- Not His but HPCS pacing in LBBB patients
- Need for more prospective, randomized clinical trials
- In some patients the best available treatment
- Wake up Europe !!!



Thanks for your attention

Současné instrumentárium

- Standartní subklavikulární přístup

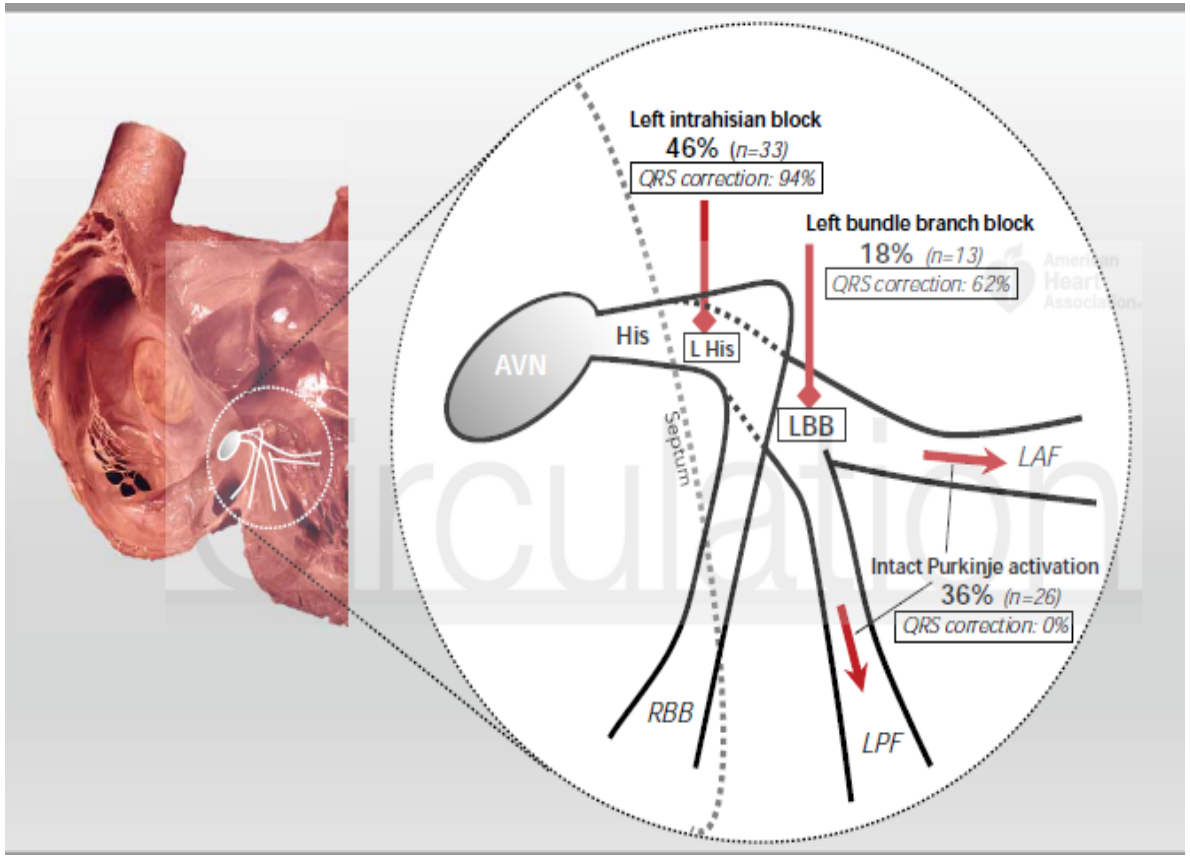
- Stimulace z oblasti Hisova svazku

- katétr Medtronic Select Site C304
  a C315HIS
- 4F elektroda Medtronic Select Secure 3830

First Author, Year	Patients	AV Nodal Block (Success %)	Backup RV Lead	Fluoroscopy Times (Procedure)	Pacing Threshold (Implant)
Zanon et al., 2011 (N = 307)	SSS: 126 AVB: 181	95% DHBP: 28%	126 of 307 41%	S: 15 ± 9 min NS: 18 ± 13 min	DHBP: 2.5 ± 2.3 V at 0.5 ms PHP: 1.3 ± 1.3 V at 0.5 ms

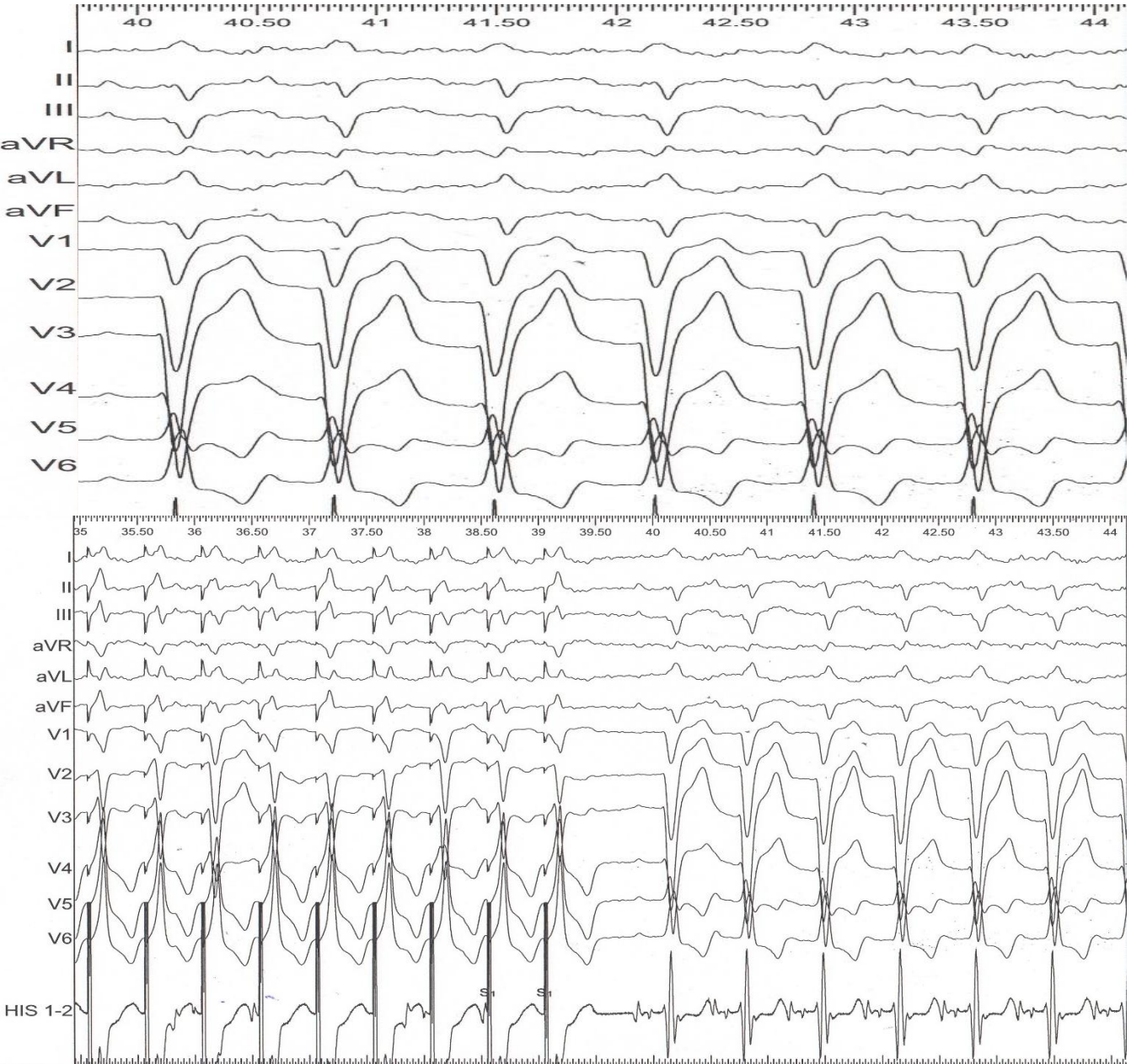
Do we know what is LBBB?

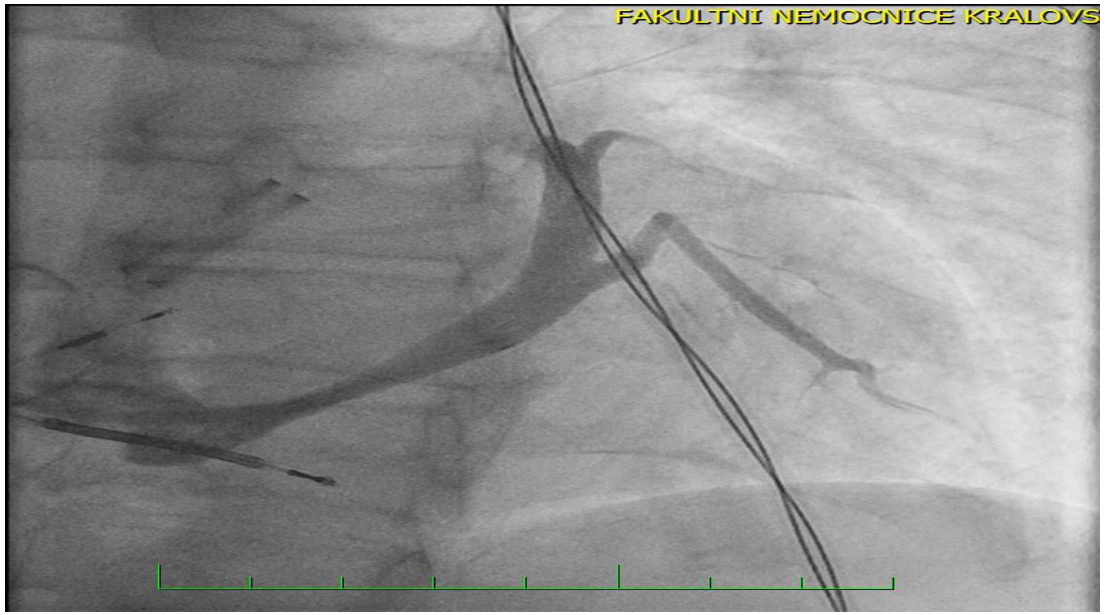
- Definitions differs per guidelines (ESC, AHA/HRS), Strauss definition
- Considerable intra - and interobserver variability of classifying LBBB (van Stipdonk et al, 2019)
- 12 – lead ECG is insufficient in describing the level of block in LBBB patients – (Upadhaya et al. Circulation, 2019)
- Mapping of the left septum in 85 pt with LBBB per AHA/HRS definition
- His pacing can´t correct IPA
- Strauss criteria had sensitivity and specificity 95 % and 55% (40% of IPA fulfilled Strauss criteria



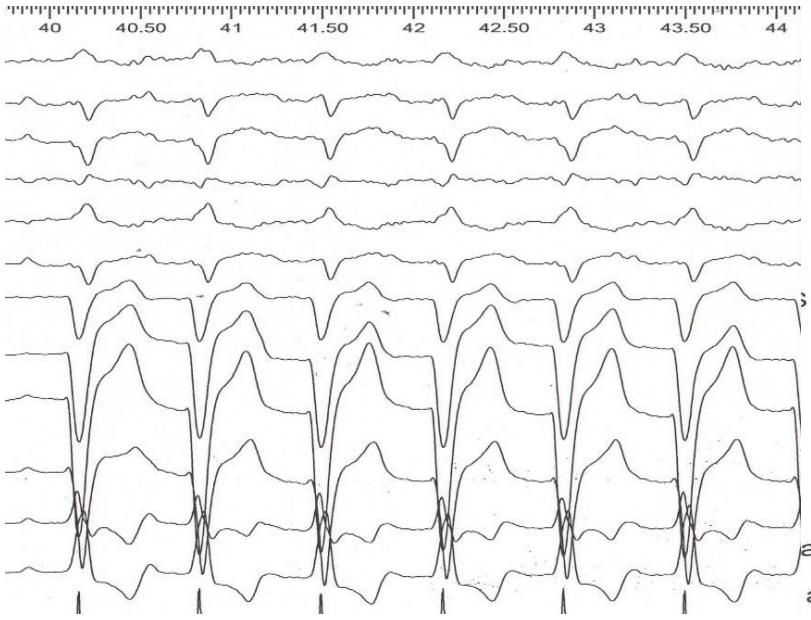
Upadhyay GA, et al. Intracardiac Delineation of Septal Conduction in Left Bundle-Branch Block Patterns. Circulation. 2019 Apr 16;139(16):1876-1888.

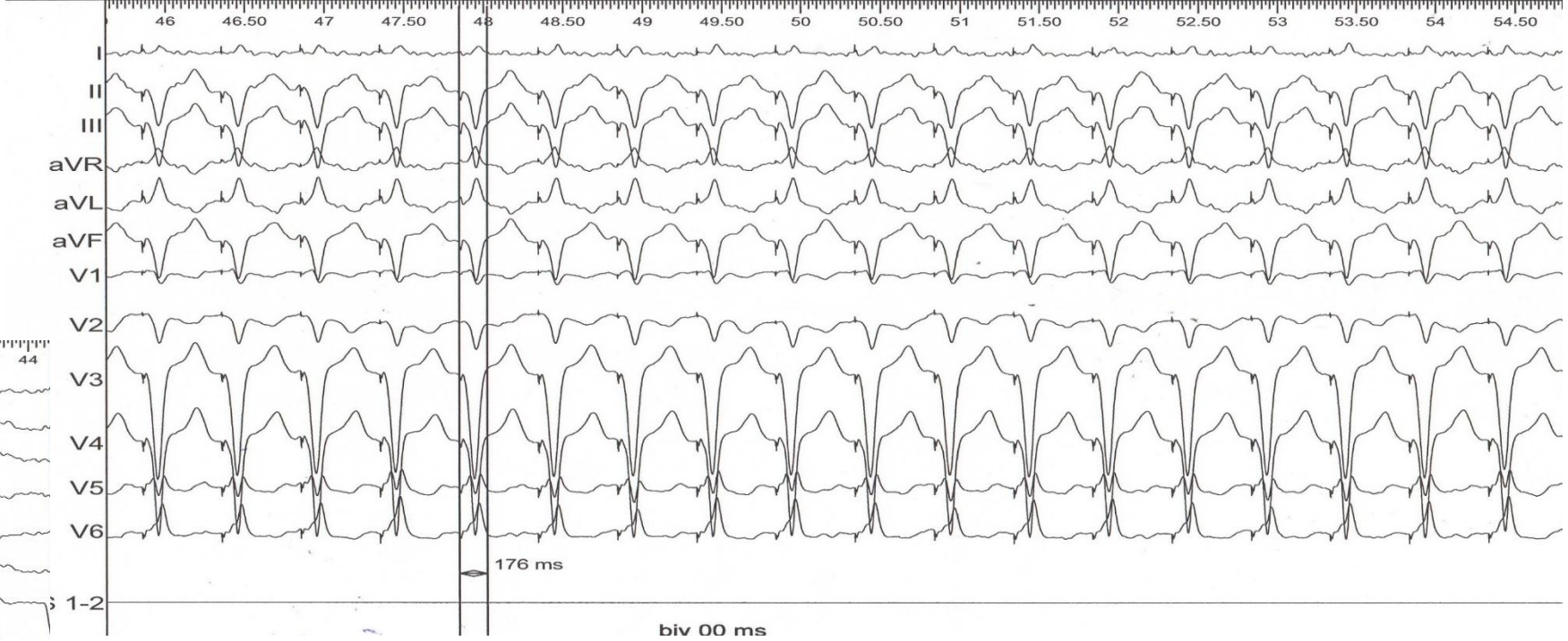
Classic CRT patient; His pacing vs Biv pacing



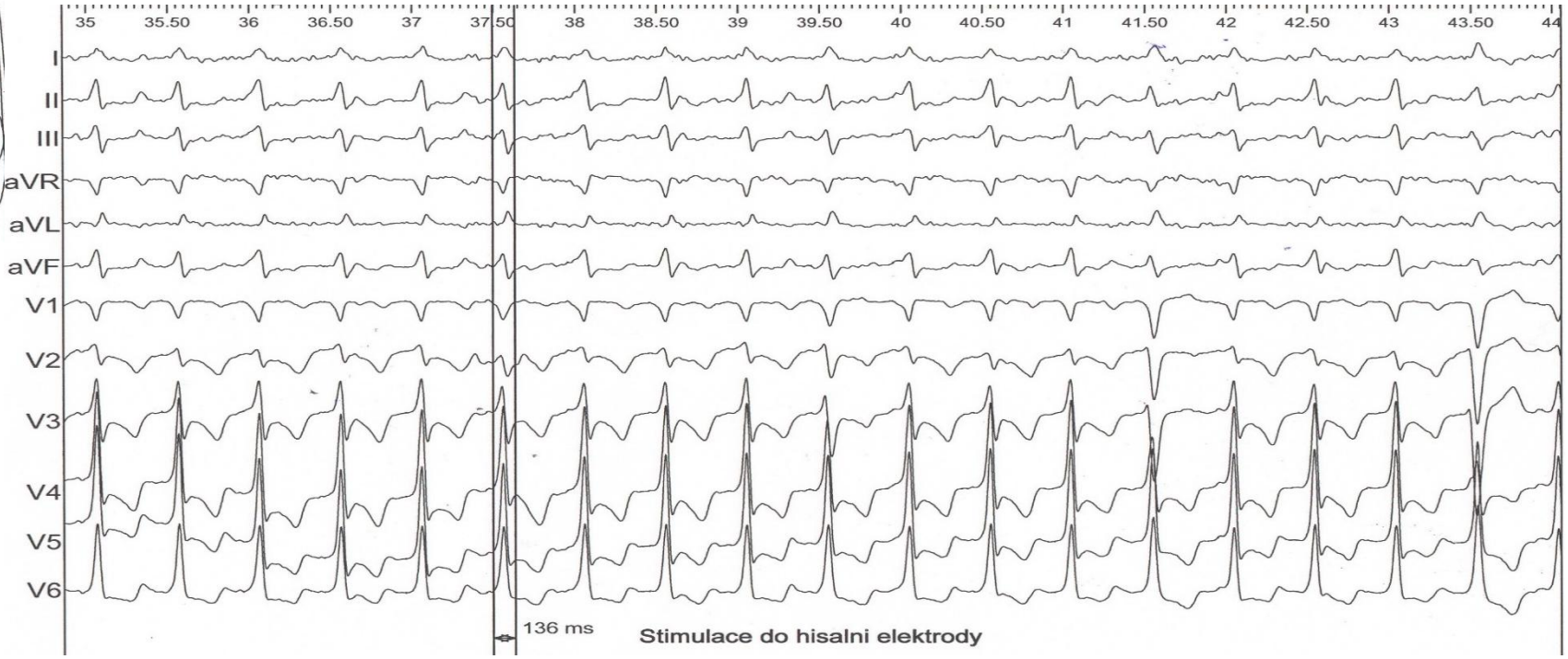


Biventricular pacing

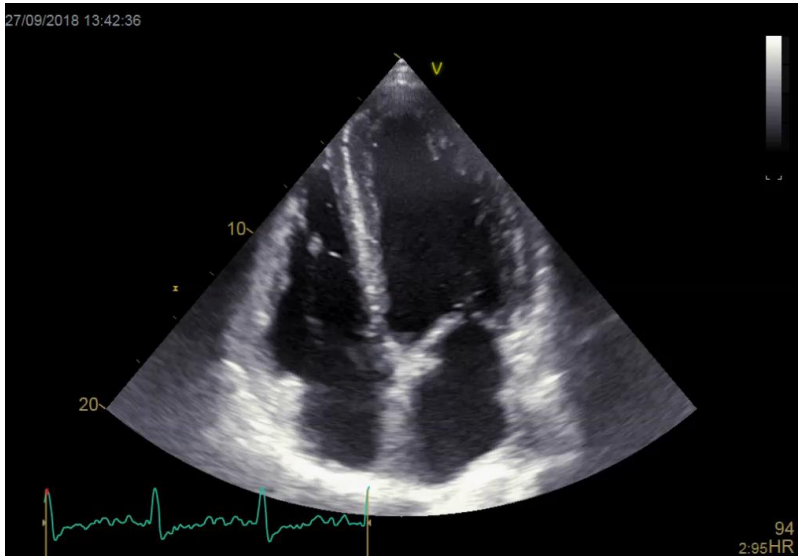


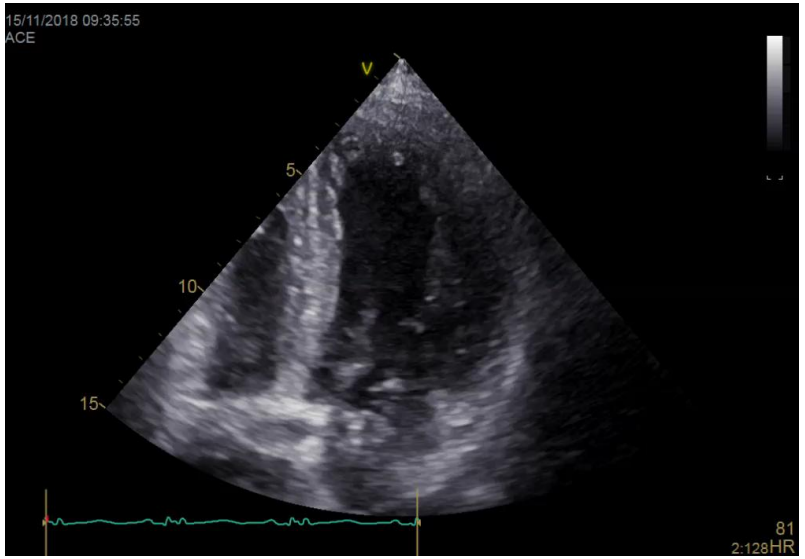


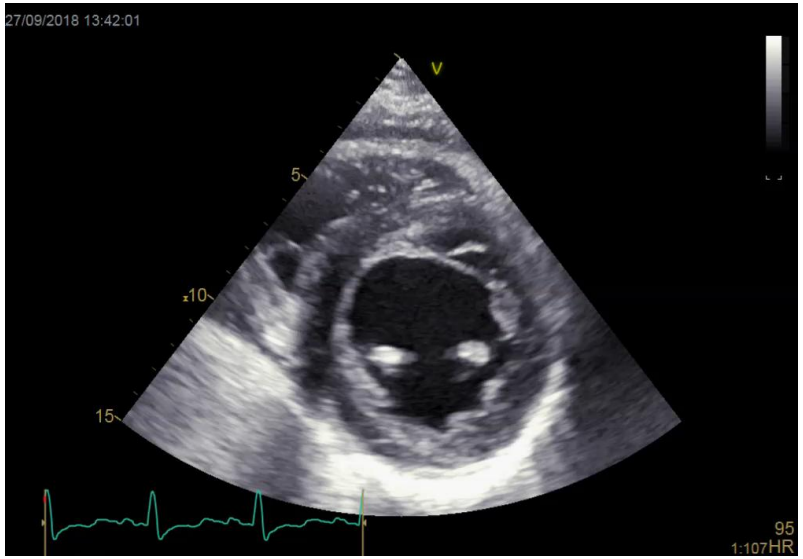
His bundle pacing

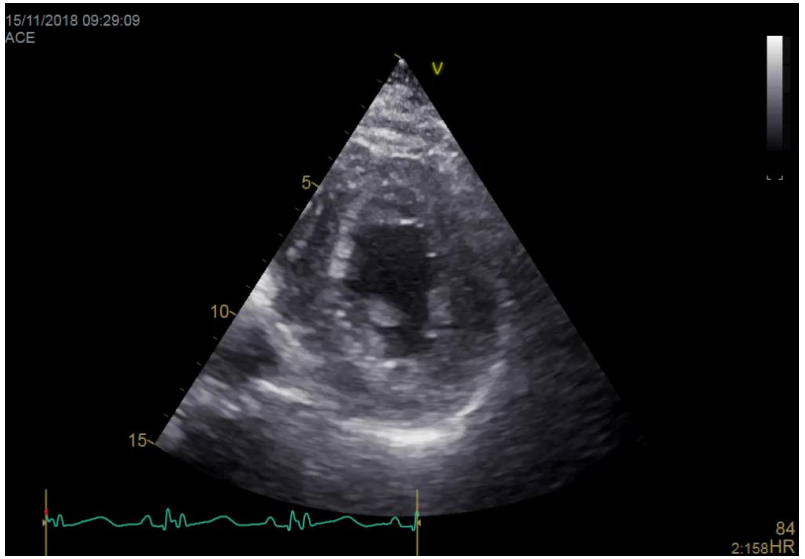


Echocardiography after 4 weeks









Nonselective His bundle pacing and superesponders

- Superresponce to selective His bundle pacing - 2011

- Superresponce with nonselective His bundle pacing

  (Ajijola et al. Hyper-response to cardiac resynchronization with permanent His bundle pacing: Is parahisian pacing sufficient? Heart Rhythm, 2015)