KHRS 2021-VIRTUAL: The 13th Annual Scientific Sessions of the Korean Heart Rhythm Society.

His Bundle Pacing

Dr Joseph YS Chan

Head of Division of Cardiology
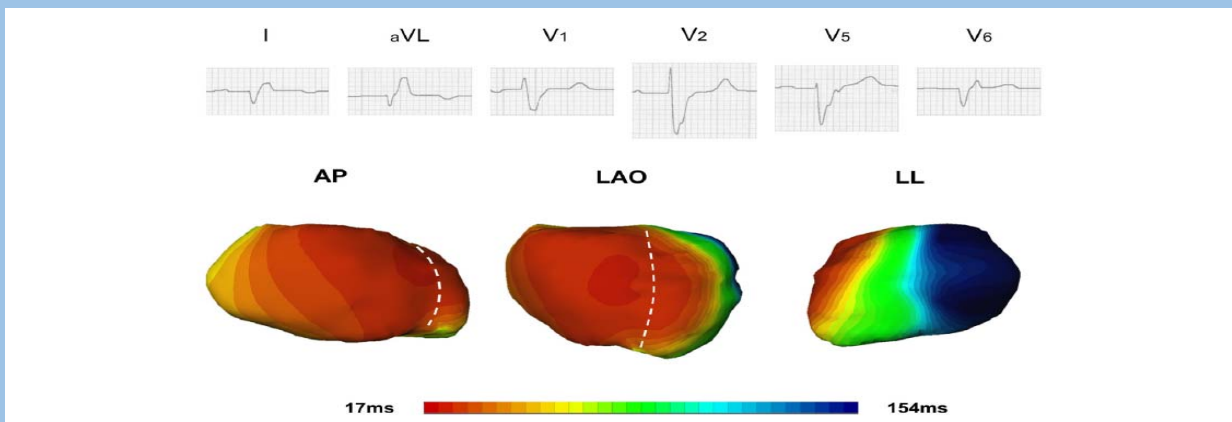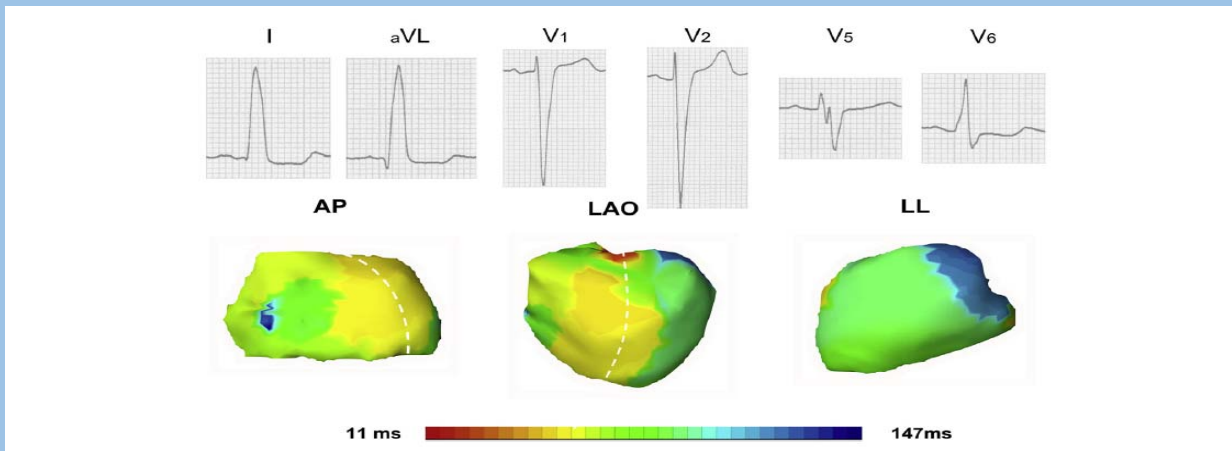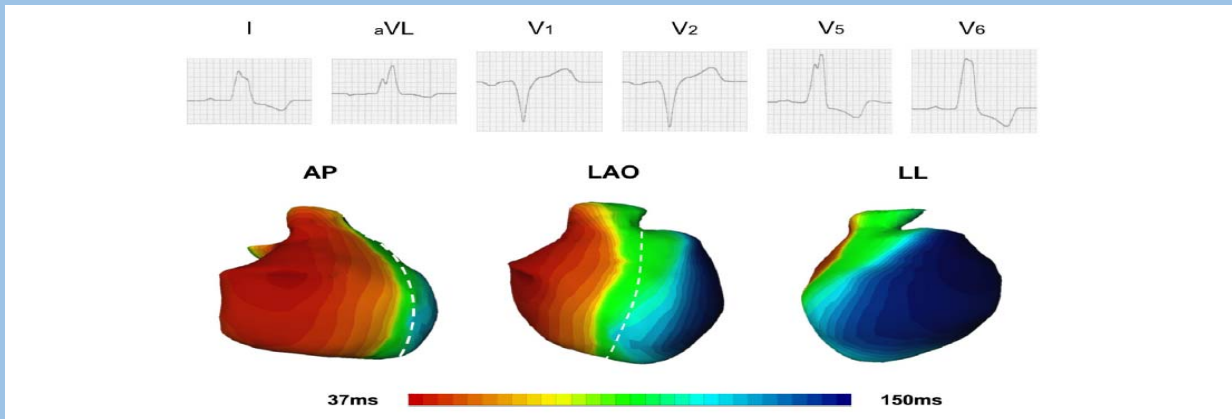
Prince of Wales Hospital

Chinese University of Hong Kong

Disclosure

- Honoraria- Medtronic

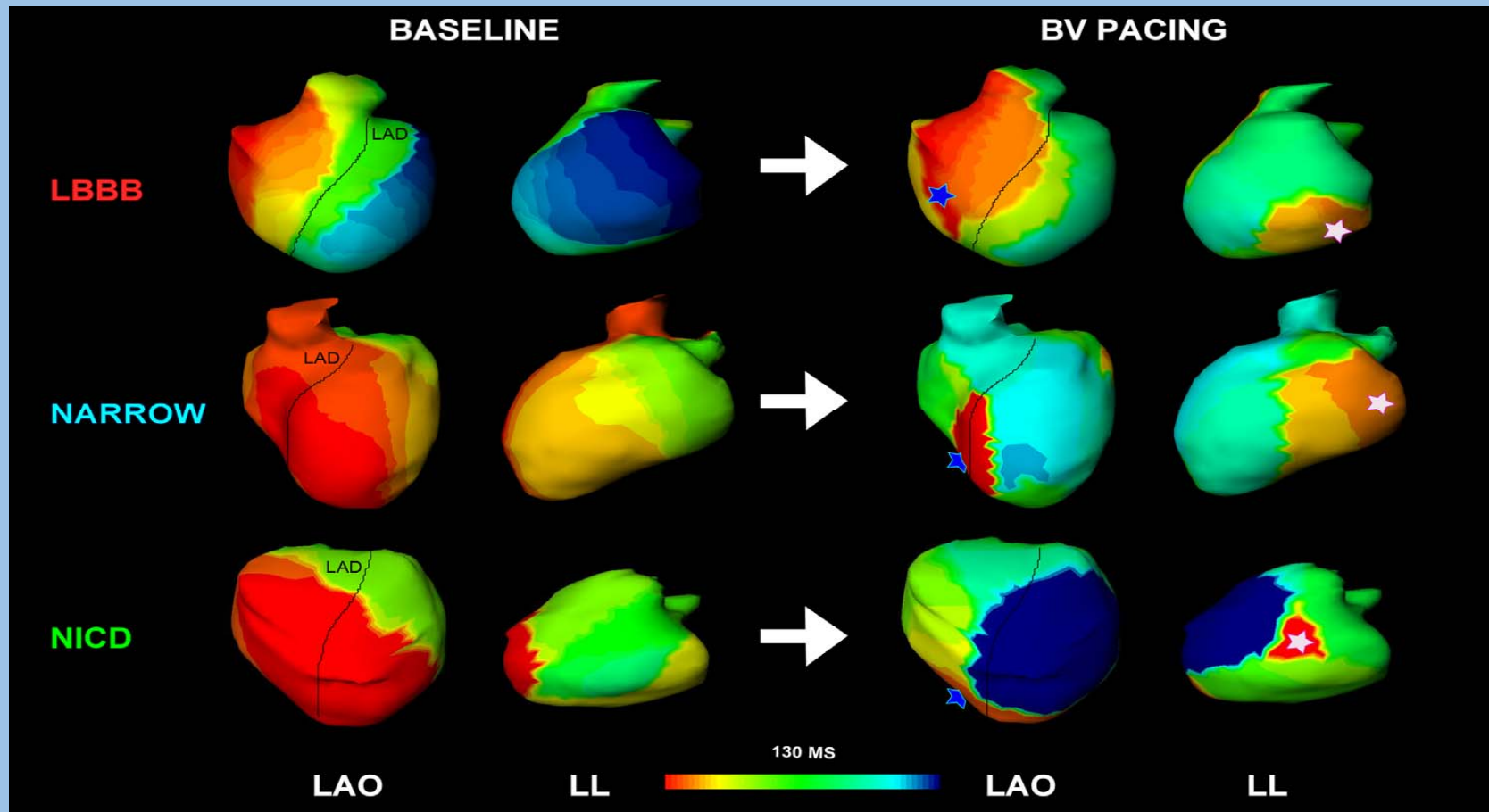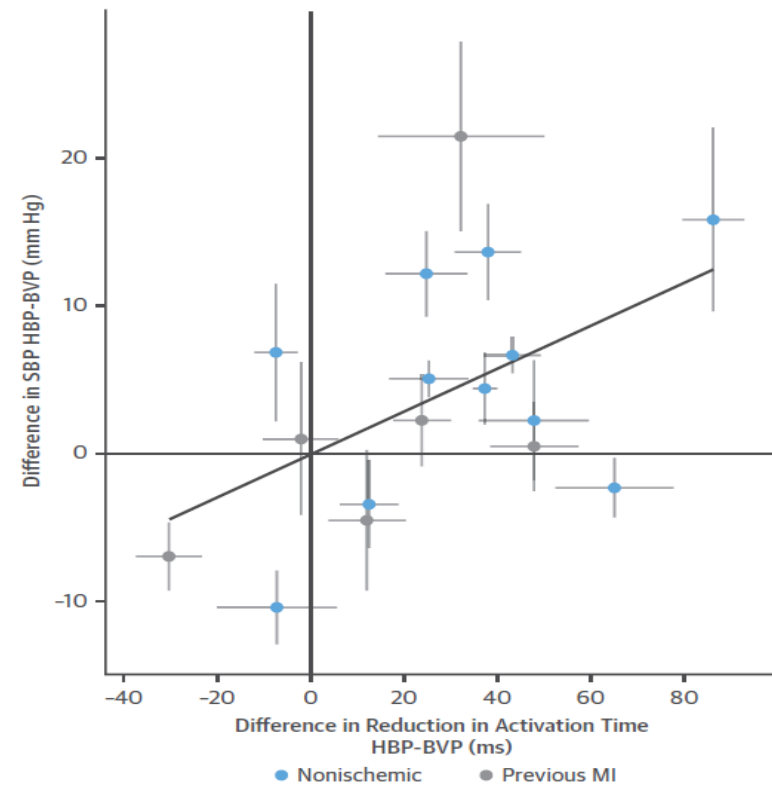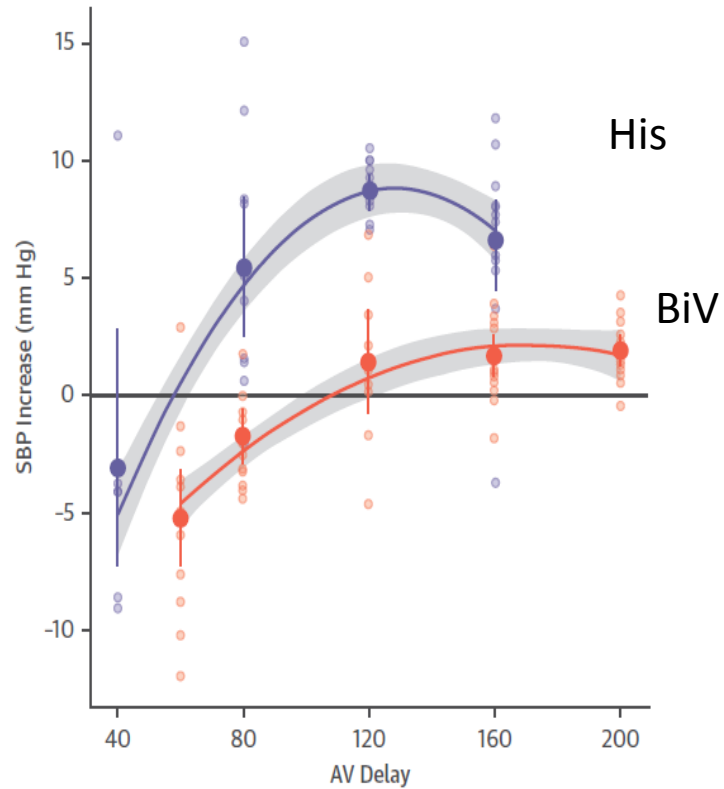# Physiological System Pacing in Heart Failure Patients

Baseline Characteristics	Responders (n = 21)	Nonresponders (n = 11)	p Value
Age, yrs	65 ± 8	67 ± 11	0.5
Male	17 (81)	11 (100)	0.3
Ischemic cardiomyopathy	8 (38)	6 (55)	0.5
Ejection fraction	26 ± 4	26 ± 4	0.9
QRS duration, ms	157 ± 19	139 ± 24	<0.05
LBBB pattern	16 (76)	2 (18)	0.003
RVTAT, ms	60 ± 30	59 ± 25	0.9
LVTAT, ms	112 ± 29	89 ± 29	0.04
VEU, ms	72 ± 16	38 ± 23	<0.001

Ploux S et al JACC 2013

BiV induced Dyssynchrony

Ploux S et al Heart Rhythm 2015

Acute Hemodynamics - His vs Biv

Arnold AD et al JACC 2018

His-sync

Upadhyay G et al Heart Rhythm 2019

His-sync

Upadhyay G et al Heart Rhythm 2019

Left bundle pacing

P Vijayaraman et al Heart Rhythm Case Report 2019
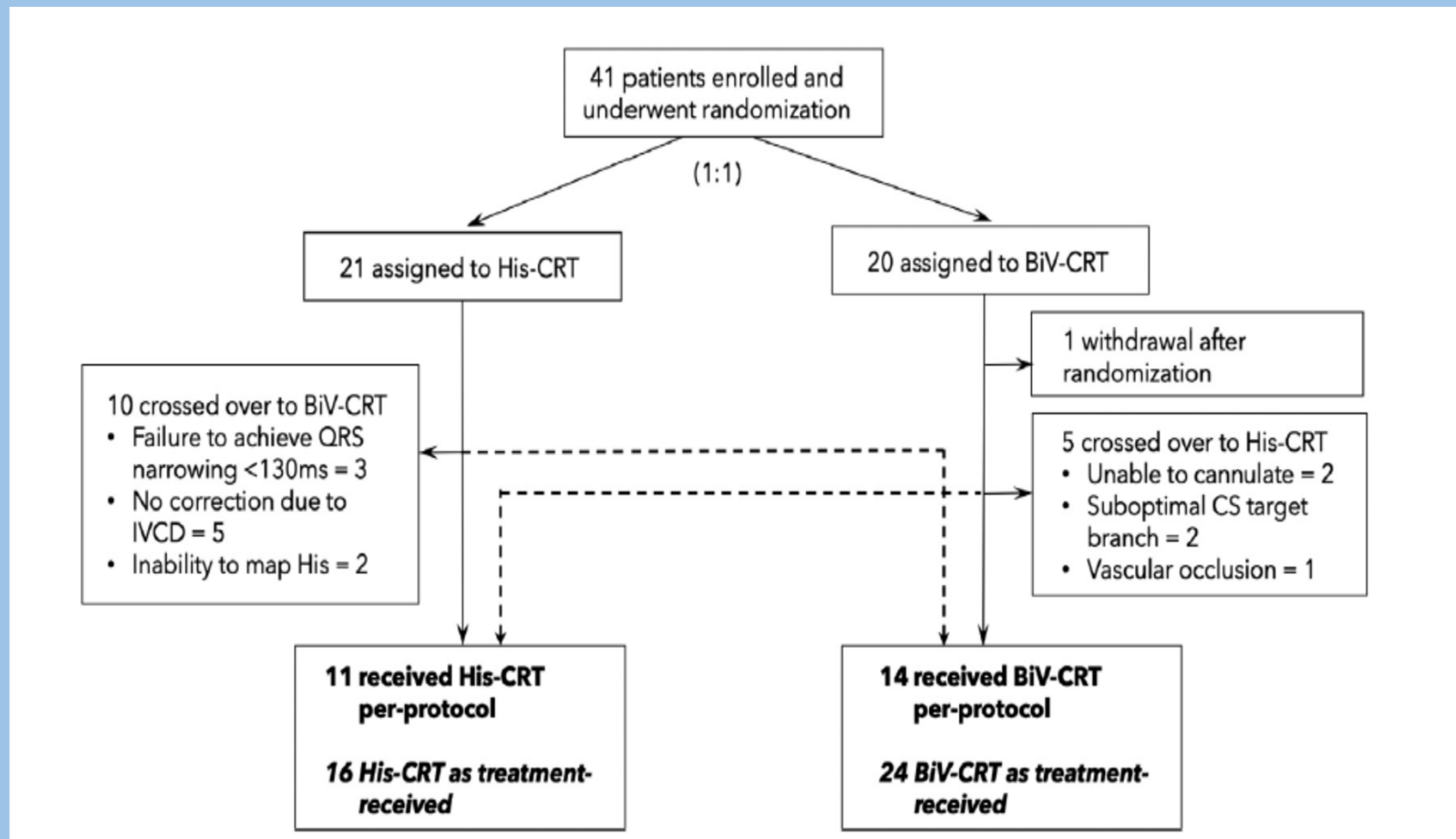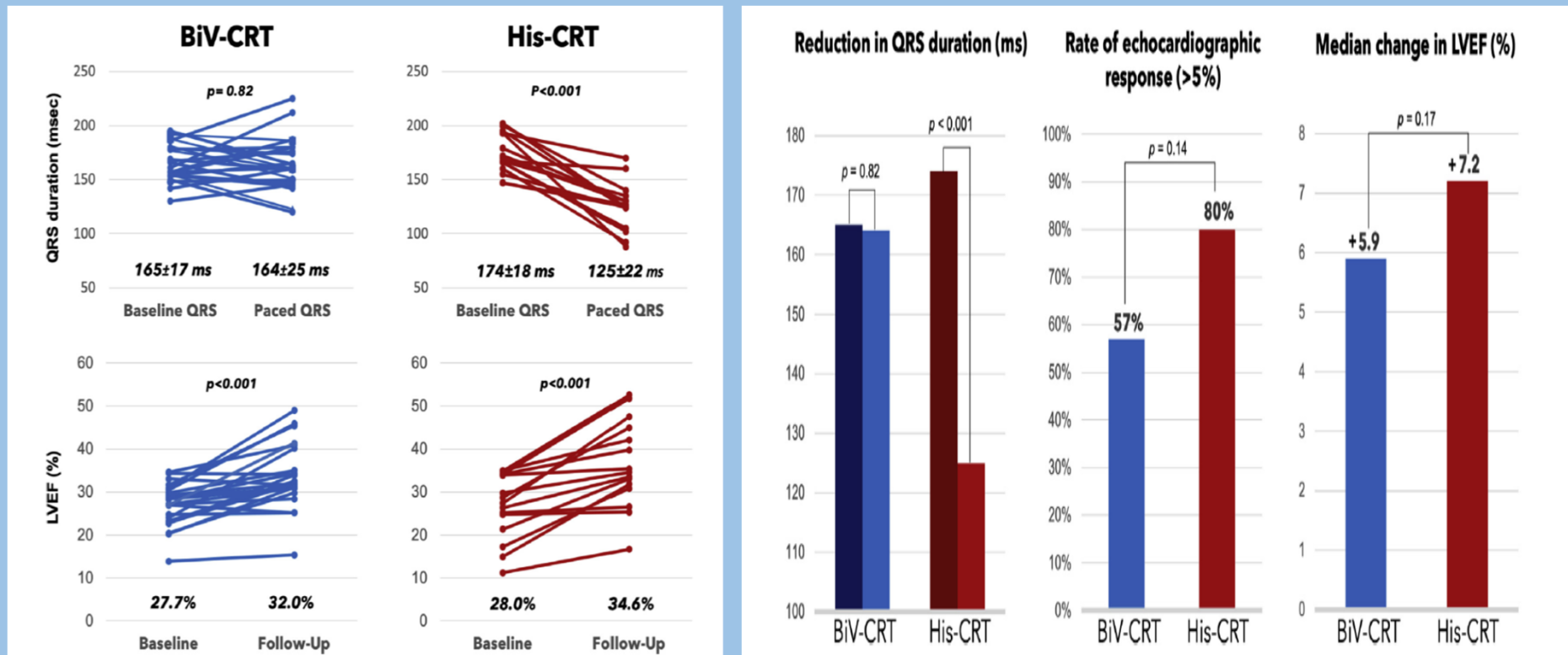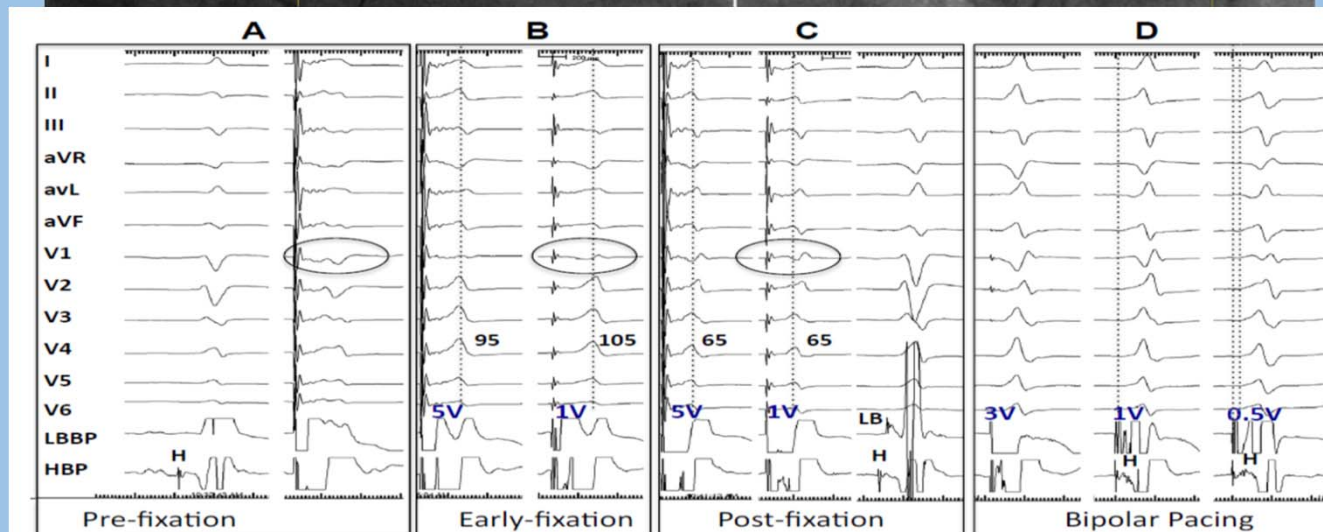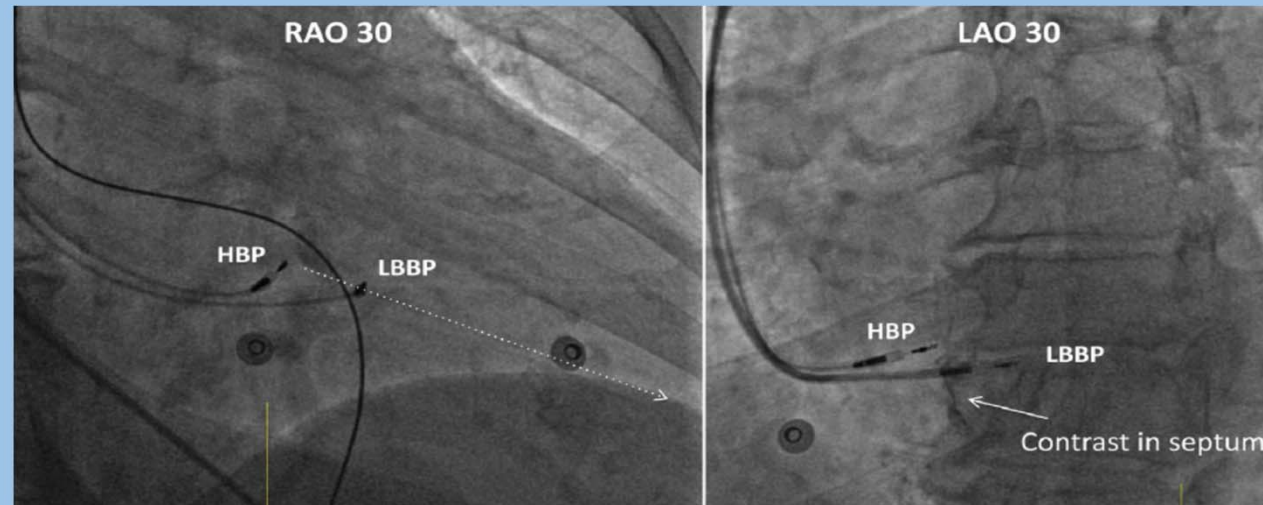
LBBB case
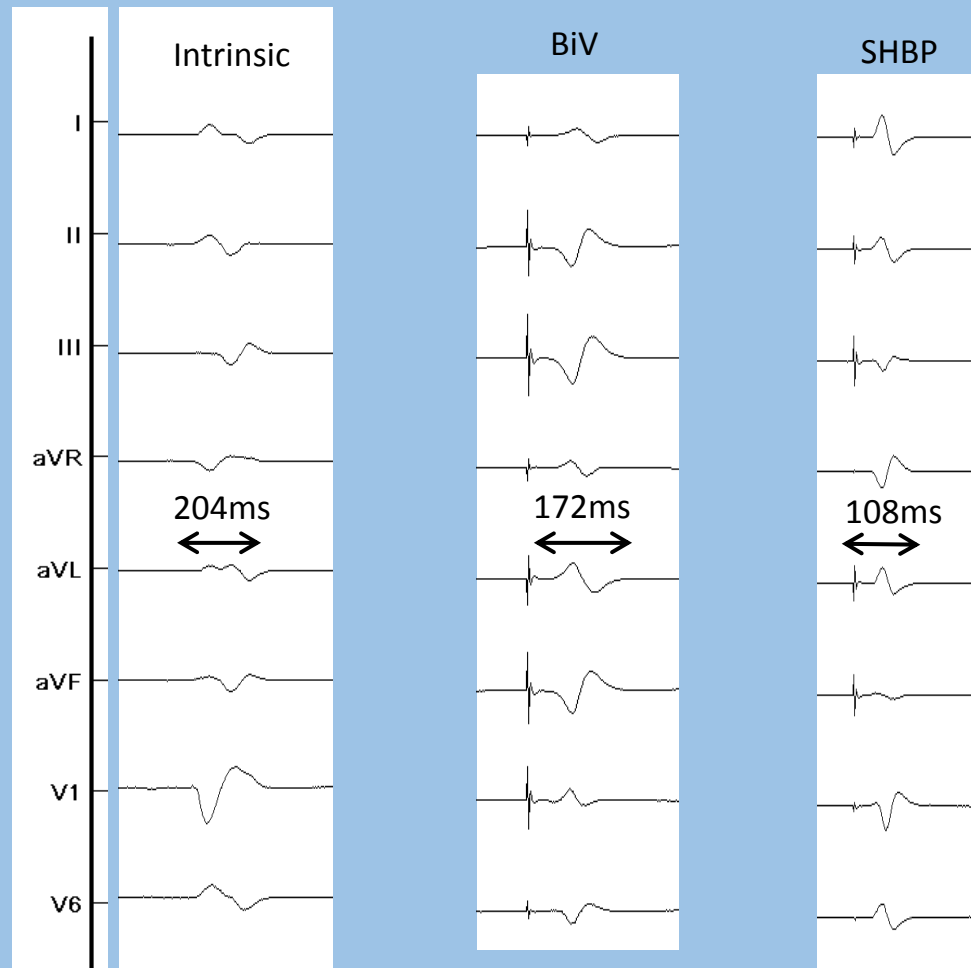
	Intrinsic	SHBP	BiV
RV activation Time (ms)	27	41	46
LV activation Time (ms)	82	51	68
Total Activation Time (ms)	108	51	72

SHBP vs Peri-LBBB vs Intrinsic

Intrinsic   SHBP   PLBP
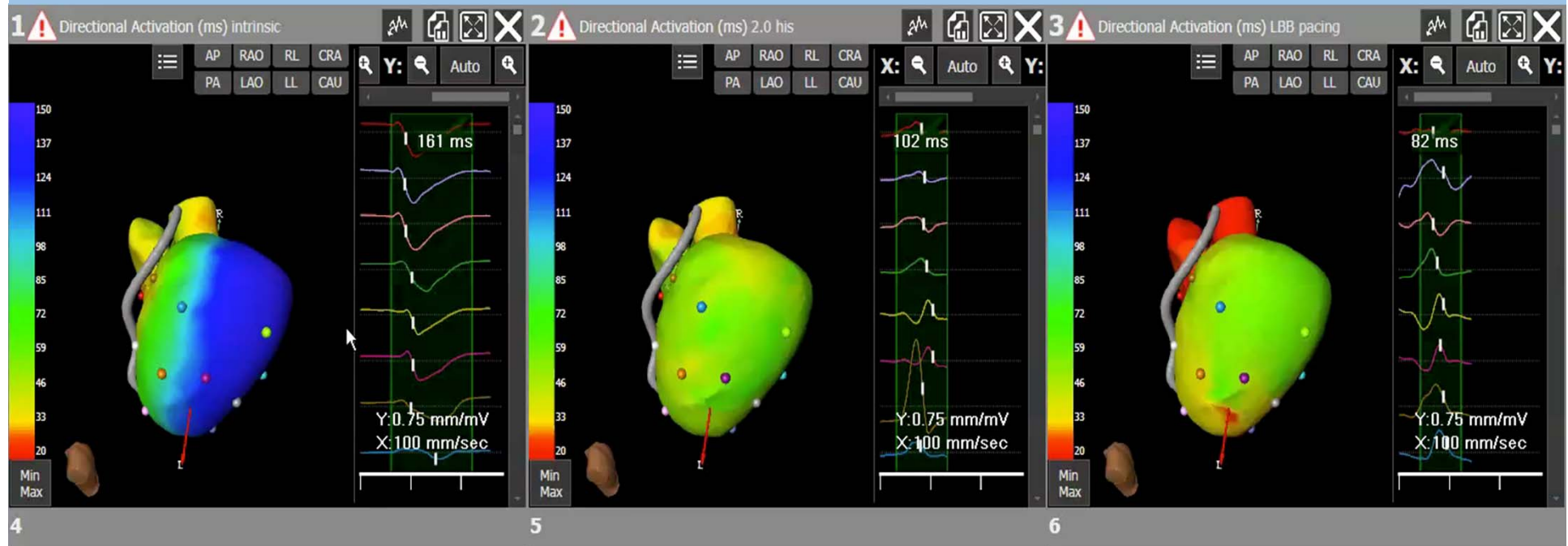
	Intrinsic	SHBP	Peri-LBB
RV activation Time (ms)	23	19	26
LV activation Time (ms)	110	36	42
Total Activation Time (ms)	117	38	48

JYS Chan et al Europace 2019
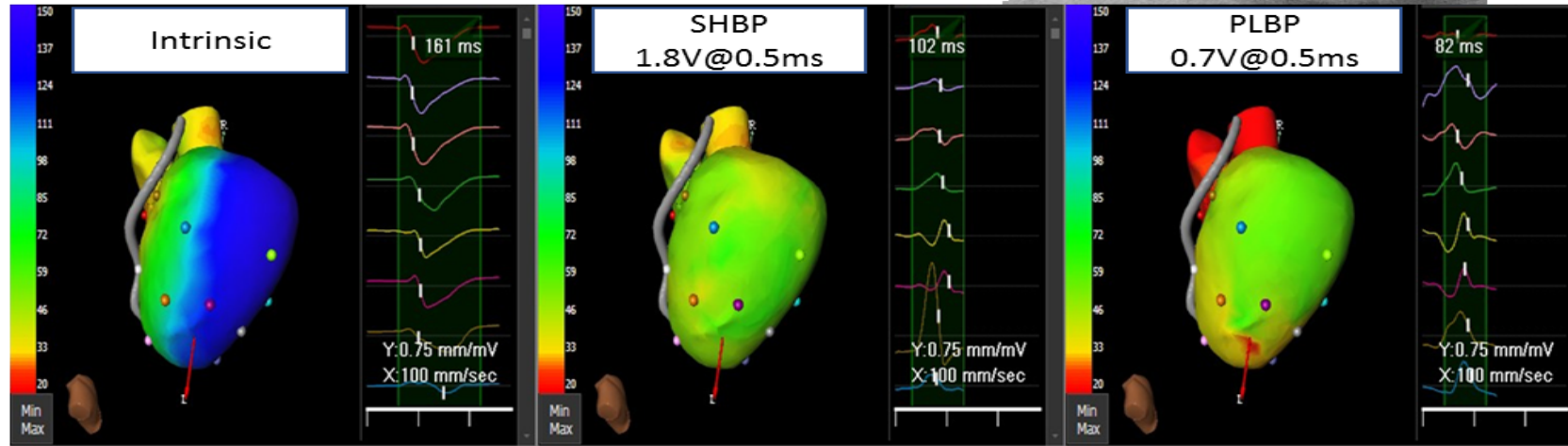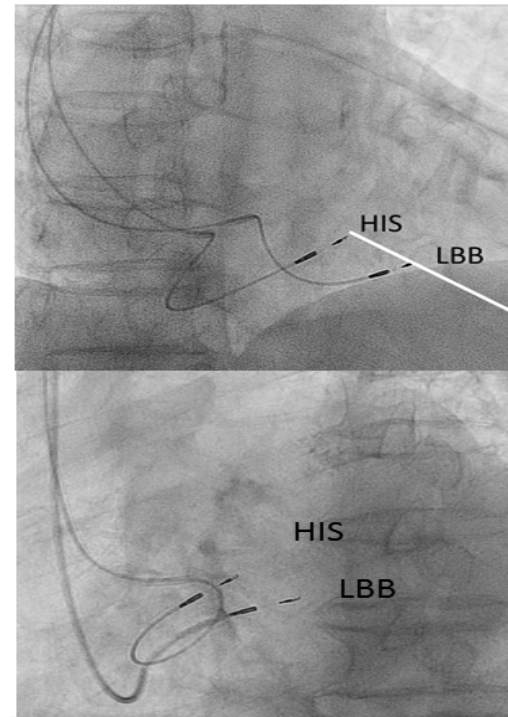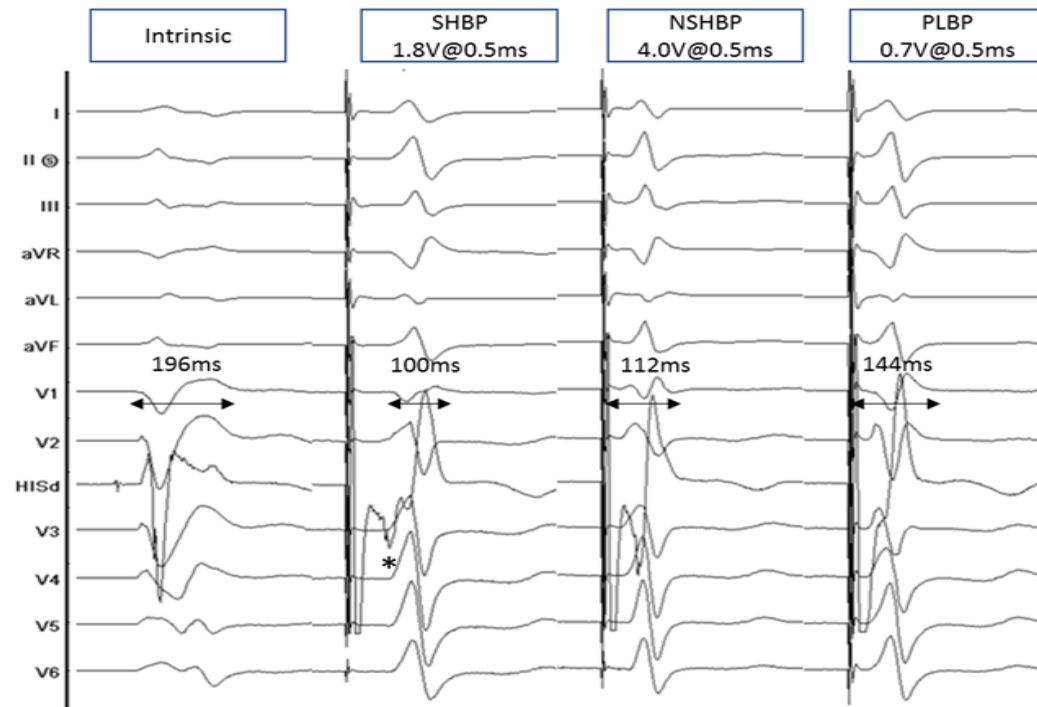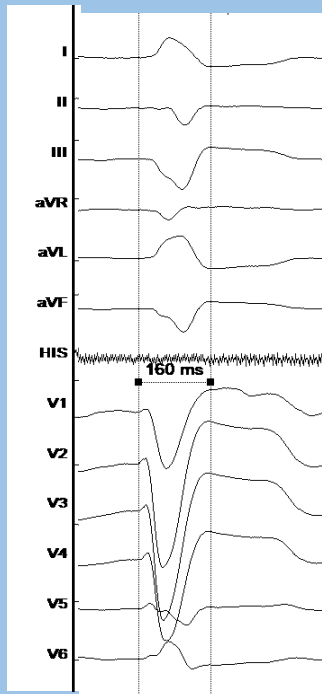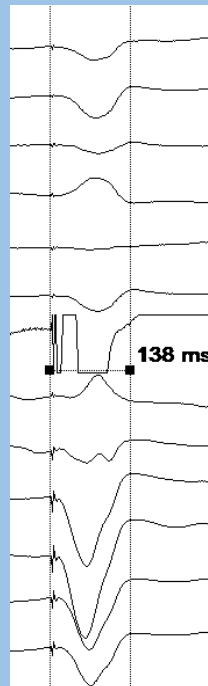
LBBB

Intrinsic   BiV   NSHP With correction   LBBP   LBBP 50msec offset RV
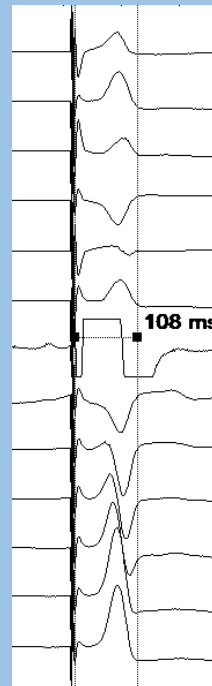
I
II
III
aVR
aVL
aVF
HIS
V1
V2
V3
V4
V5
V6

160 ms   138 ms   108 ms   132 ms   152 ms   100 ms
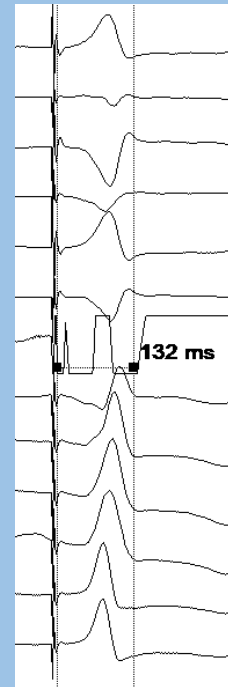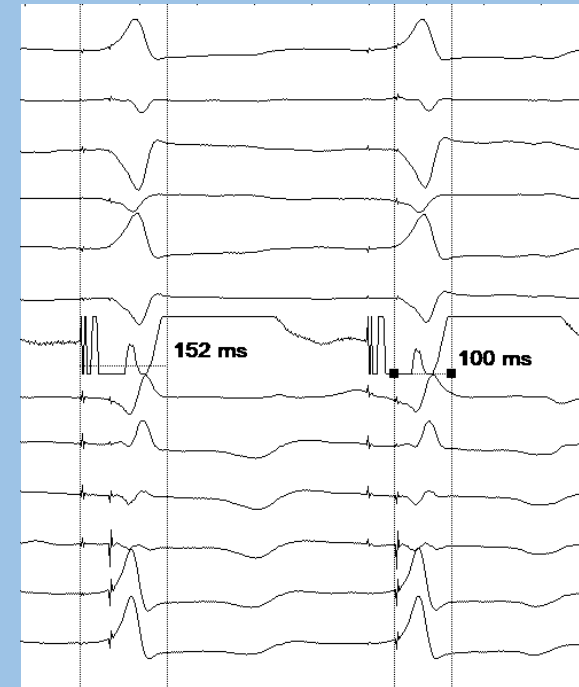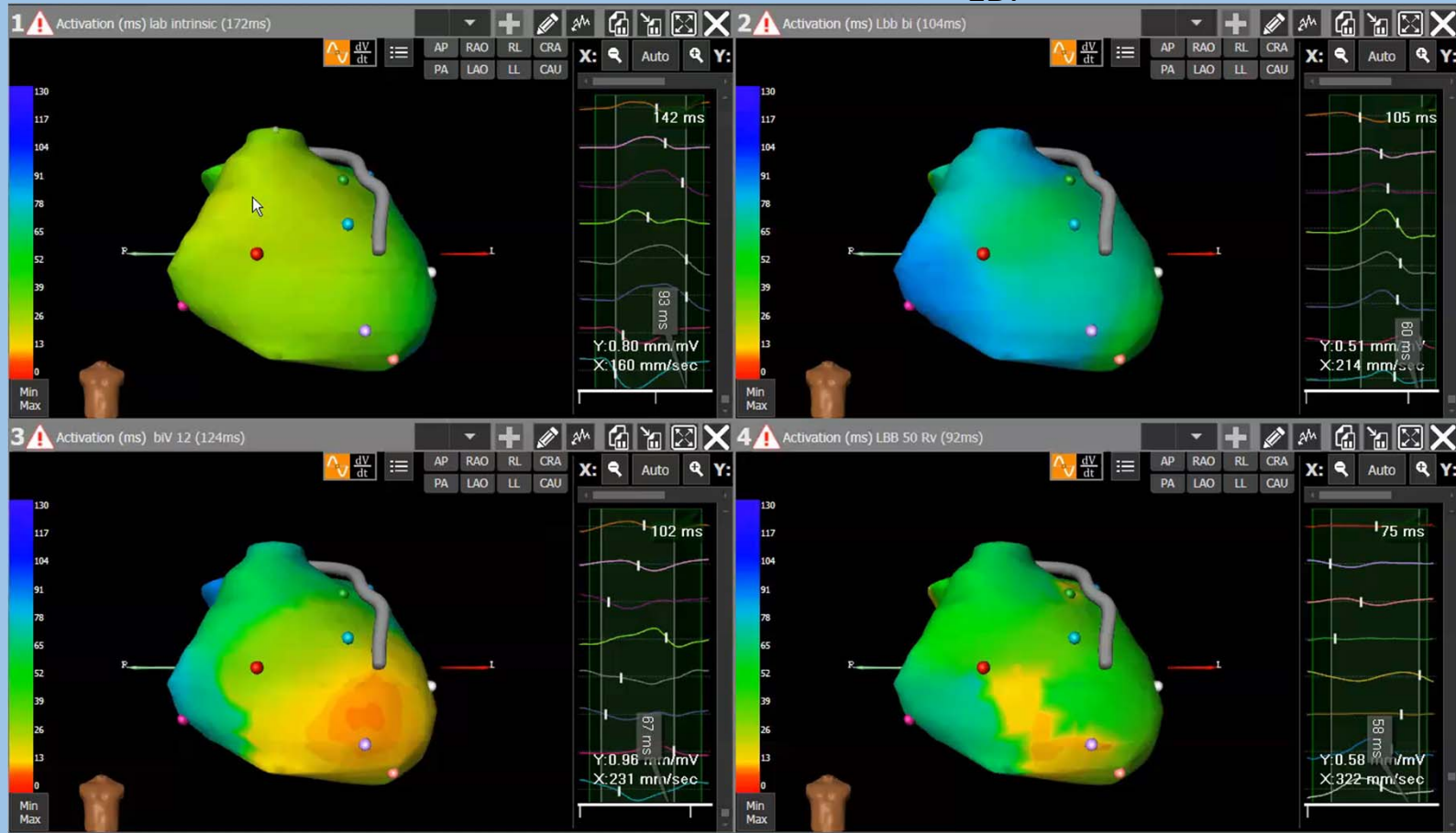
Intrinsic	BiV	LBP	LBP 50ms RV
172ms	124ms	104ms	92ms

A Native
B Tip pacing
C AV Delay
D Bipolar pacing
E LBBP + RVP
F His capture + LBBP

Huang W et al JACC EP 2020
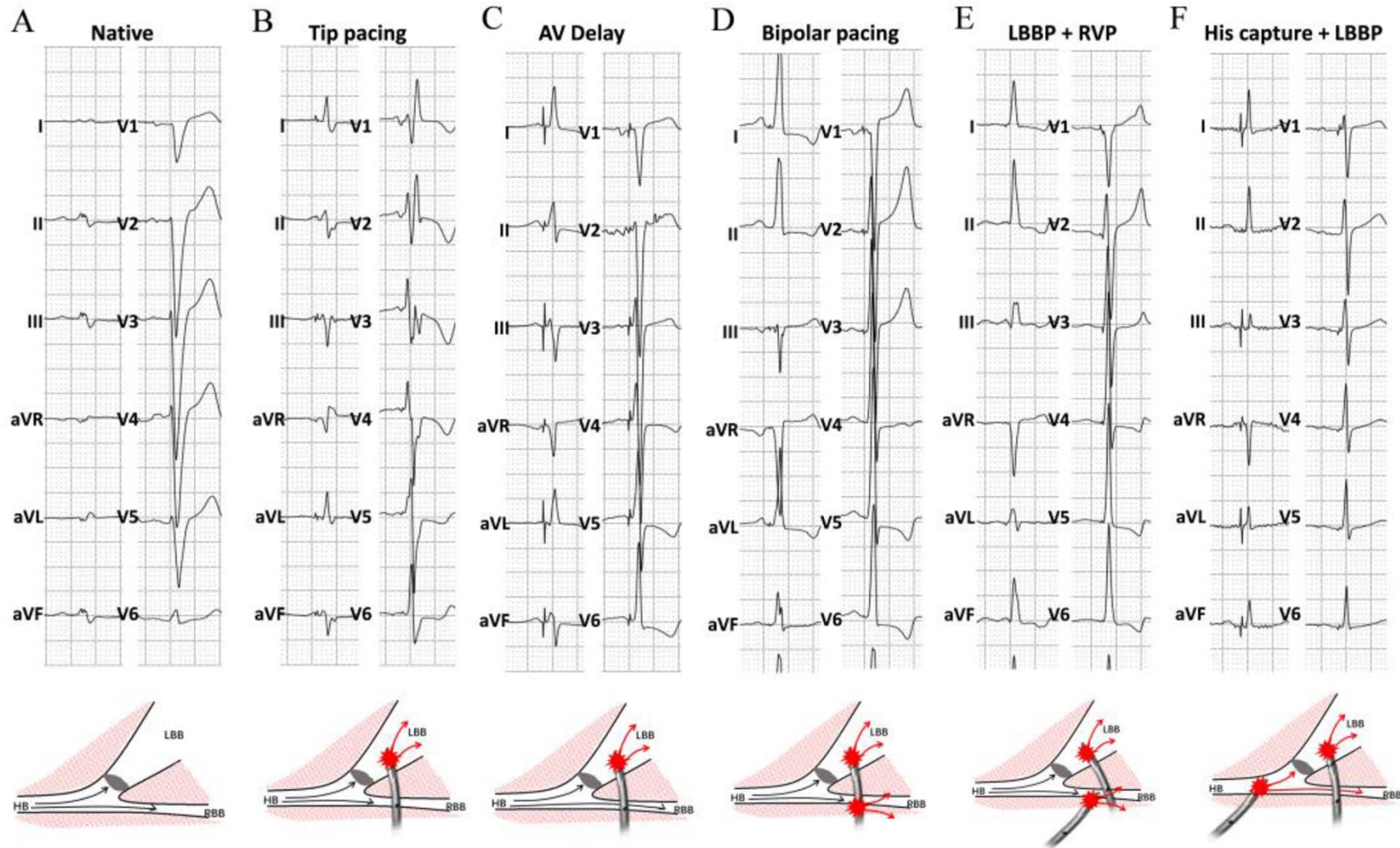
LBBB (Bi- bundle capture)
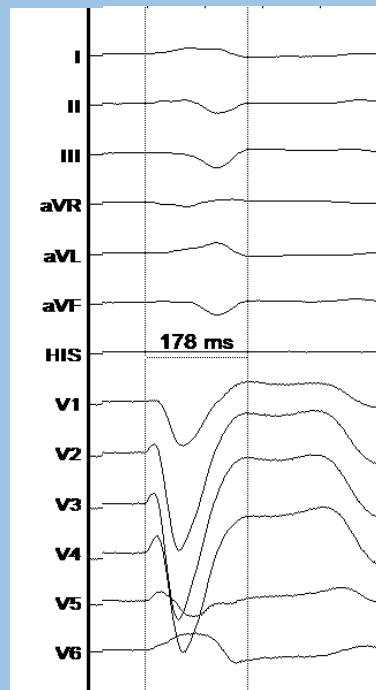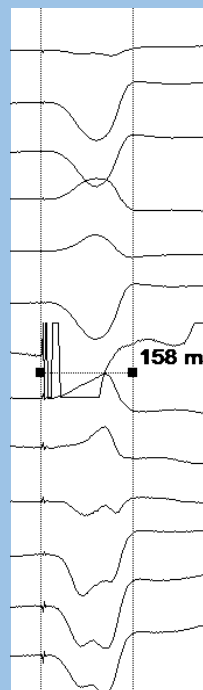
Intrinsic | BiV | NSHBP with correction | LBP unipolar | LBP bipolar | LBP AVD 100ms
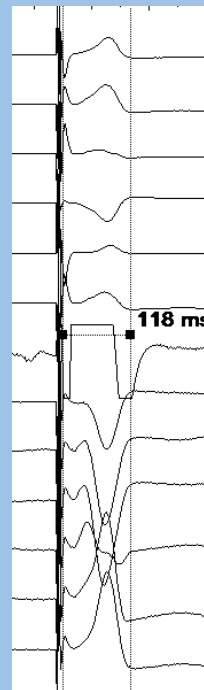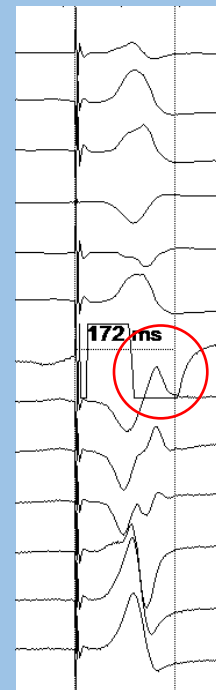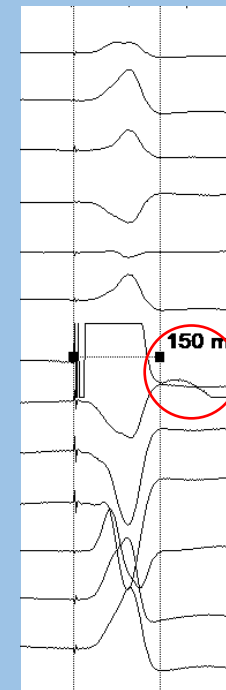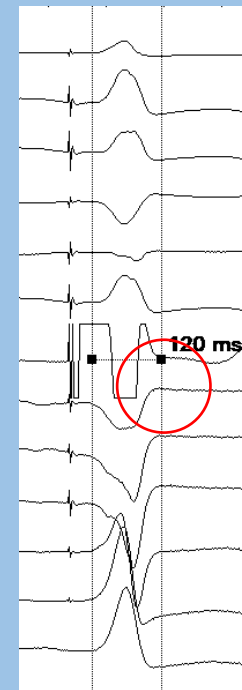
Intrinsic

NSHBP

BiV
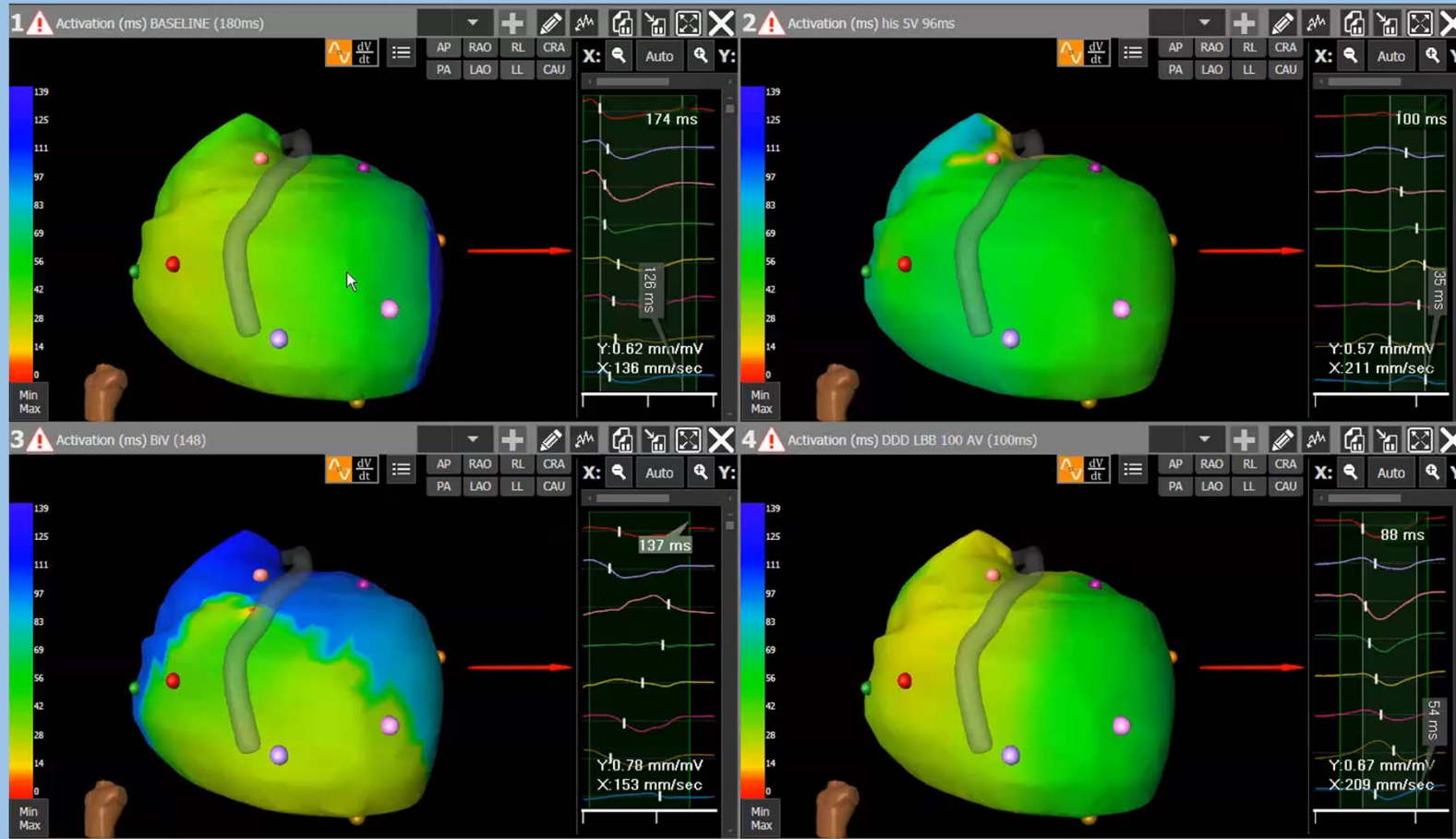
LBBP AVD 100

Instrinsic	BiV	NSHBP	LBBP AVD 100
180ms	148ms	96ms	100ms

RBBB

Hara H et al EHJ 2012
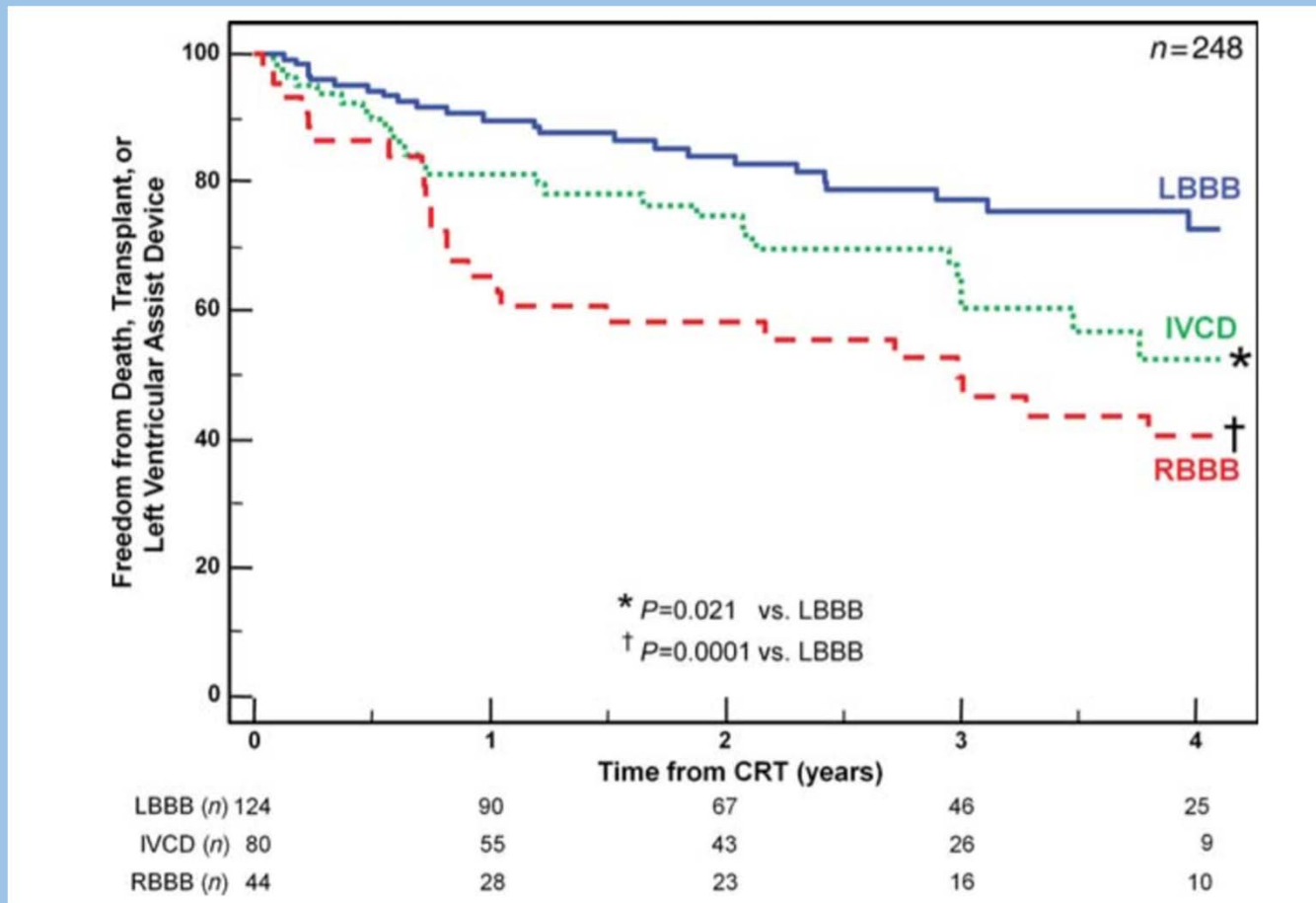
ORIGINAL ARTICLE

Permanent His Bundle Pacing for Cardiac Resynchronization Therapy in Patients With Heart Failure and Right Bundle Branch Block

Sharma PS et al Cir EP 2018

No Correction with SHBP

Sharma PS. et al Cir EP 2018
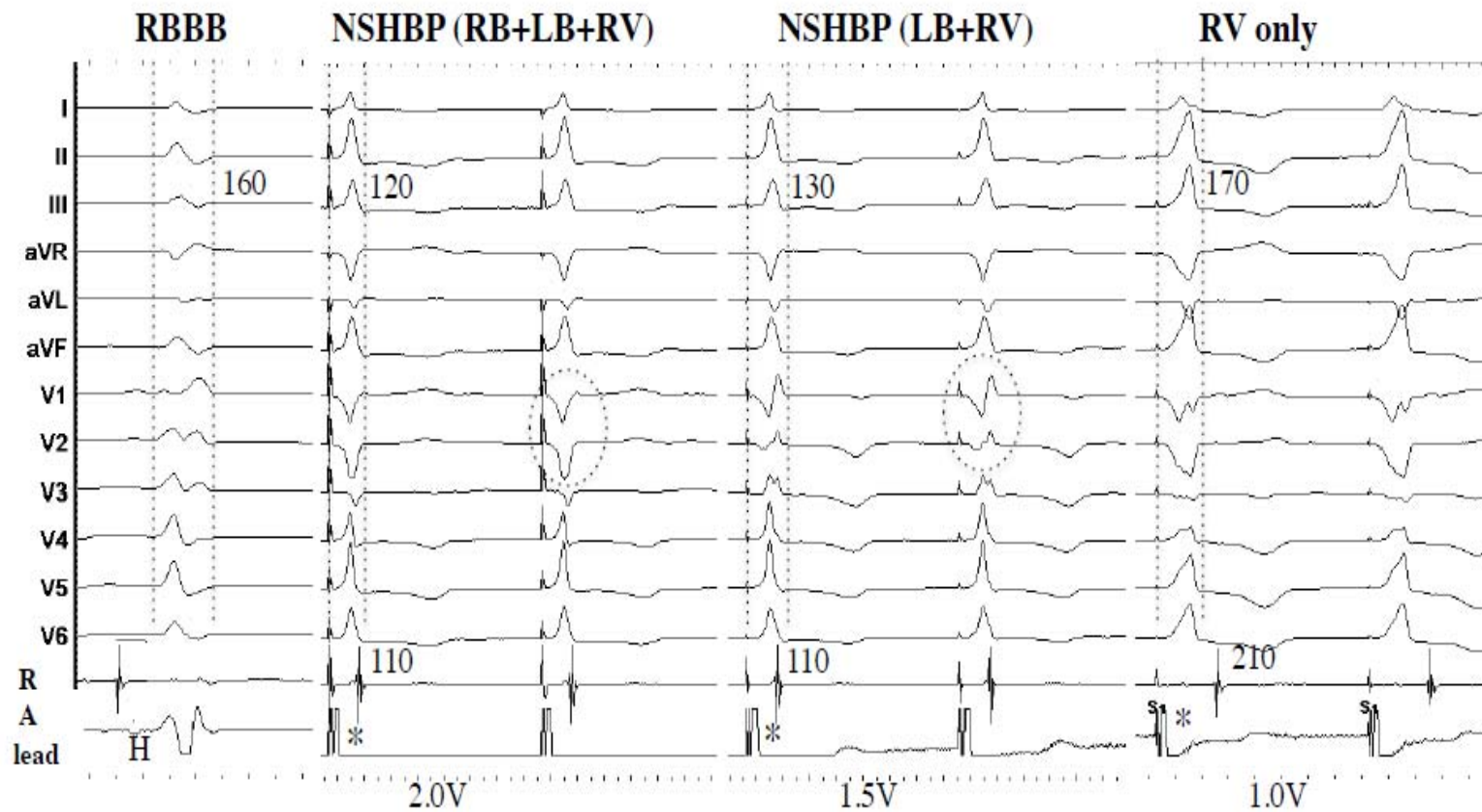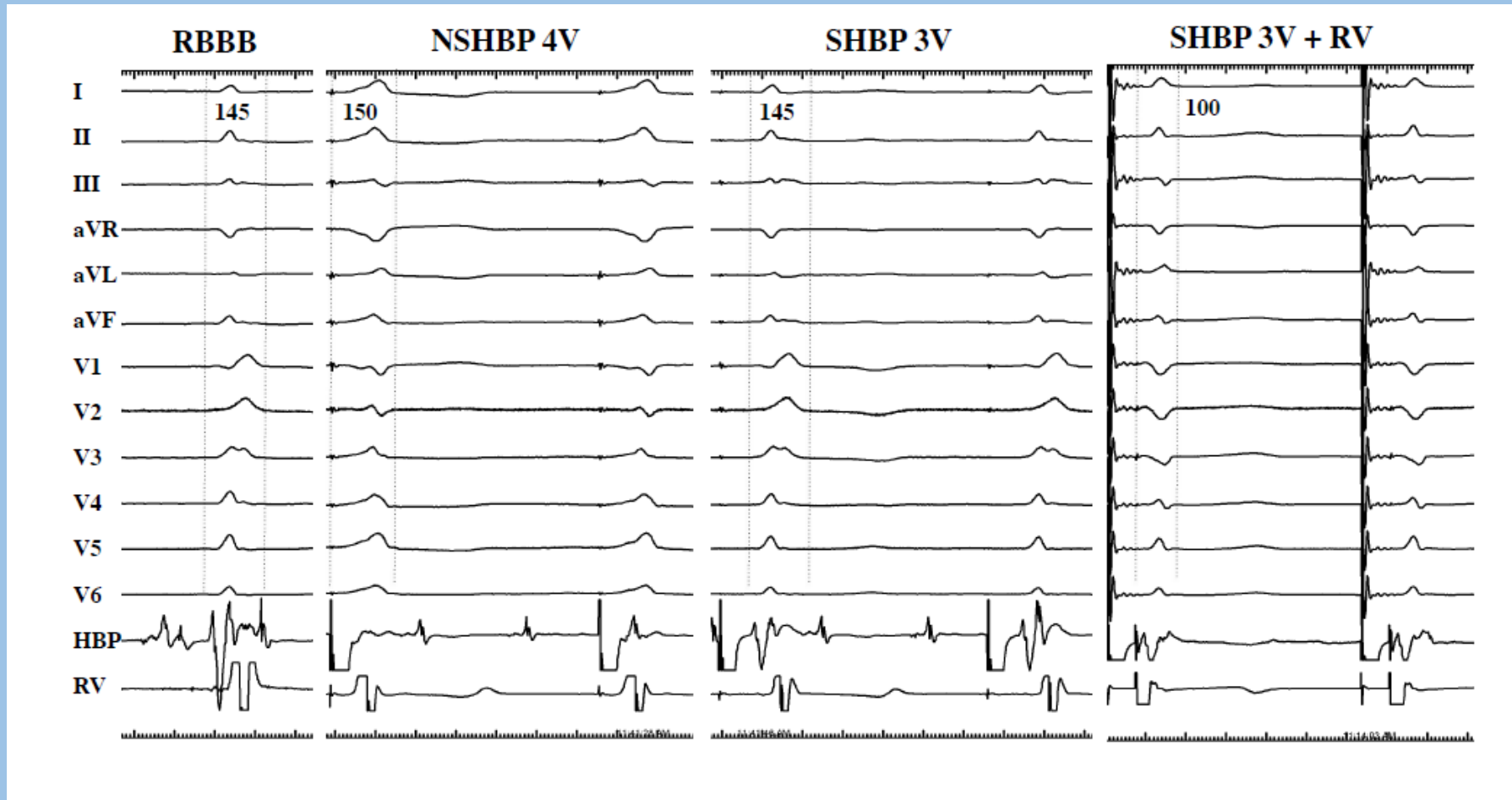
QRSd and LVEF pre-and post HBP
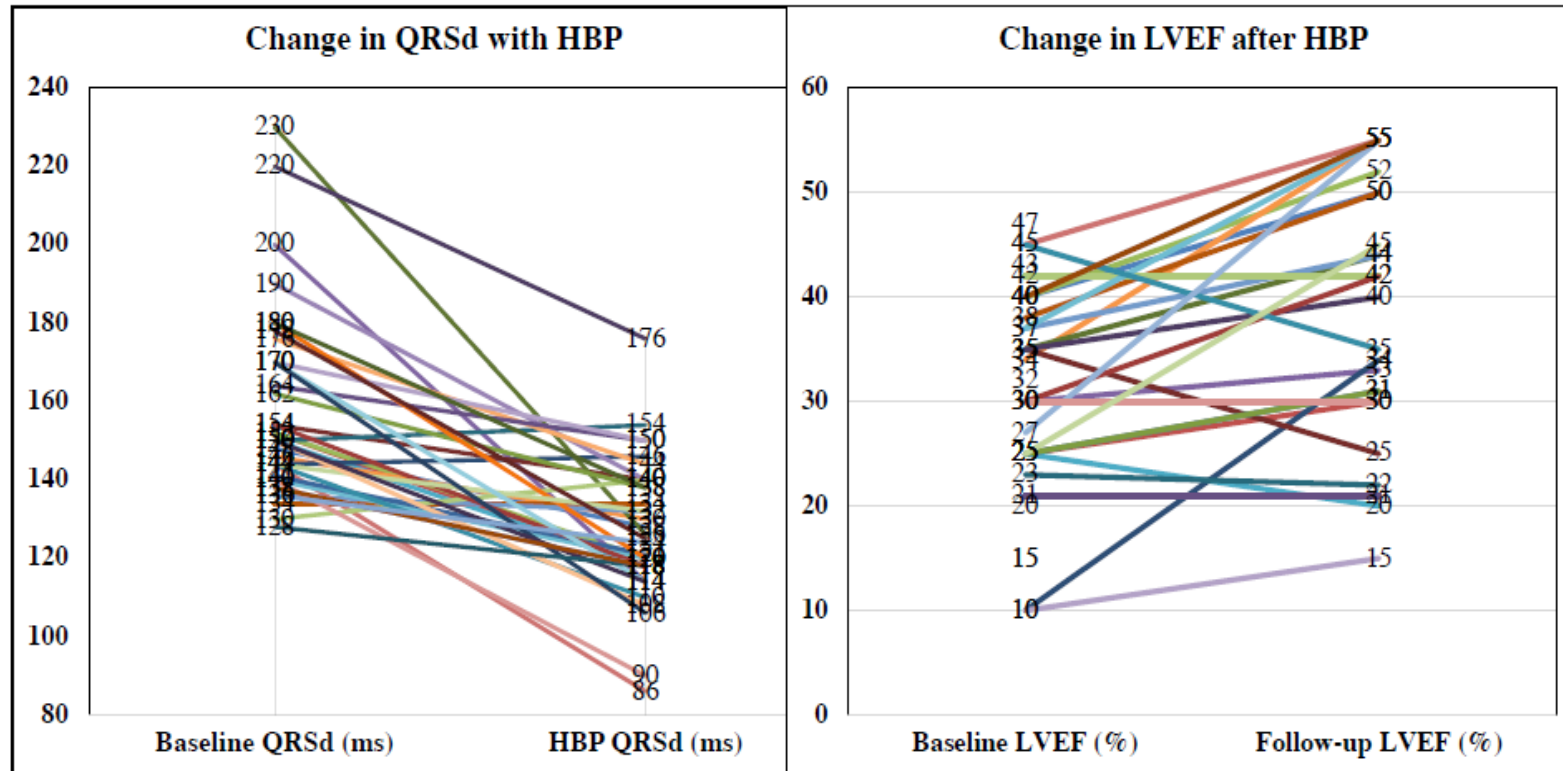
HBP with RBBB correction was seen in 78% of patients (S-HBP 34% and NS-HBP in 66%).

Sharma PS et al Cir EP 2018

RBBB

	Intrinsic	RV	BiV	His with partial correction
I				
II				
III				
aVR				
aVL				
aVF				
V1				
V2				
V3	182ms	238ms	174ms	122ms
V4				
V5				
V6				
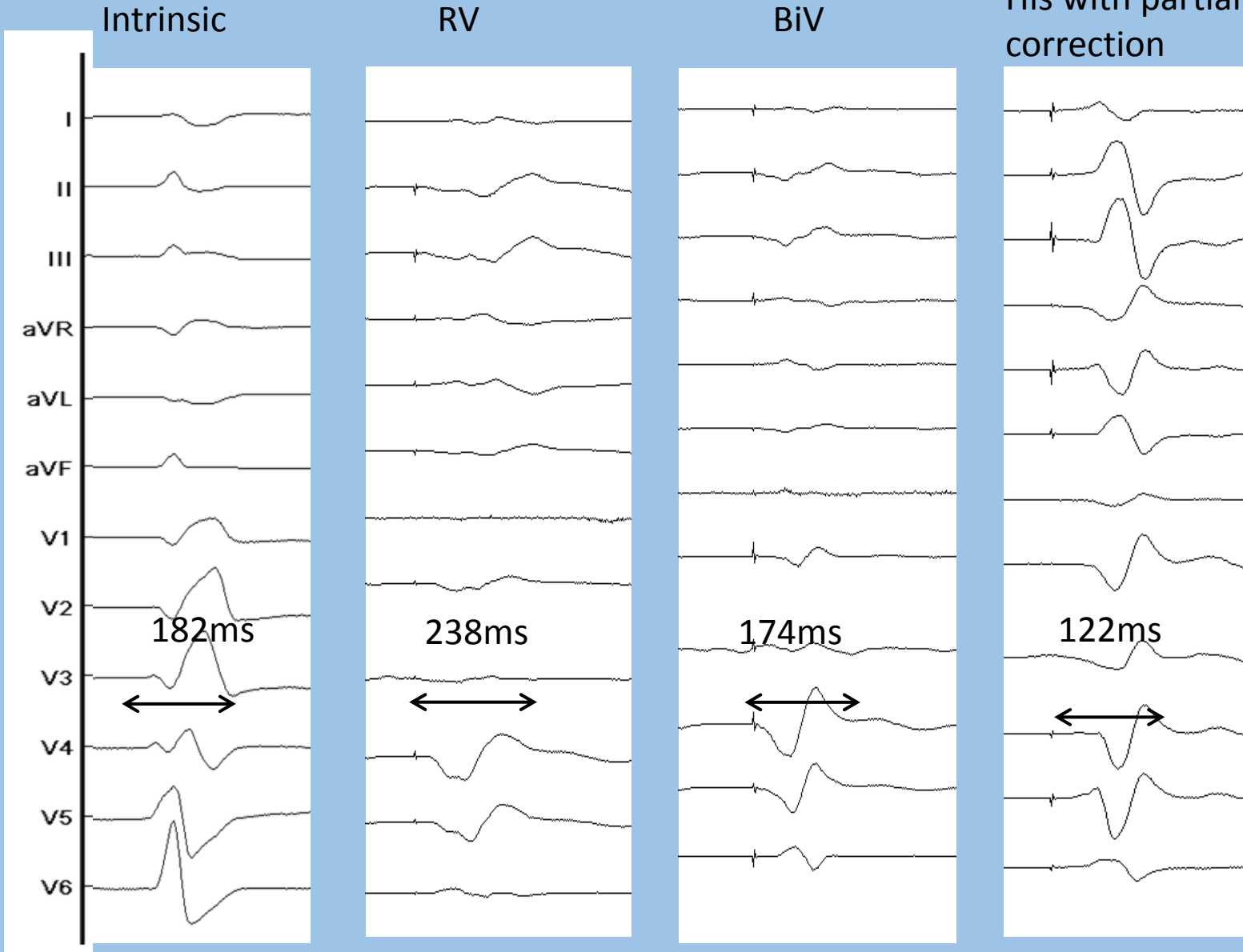
RBBB cases
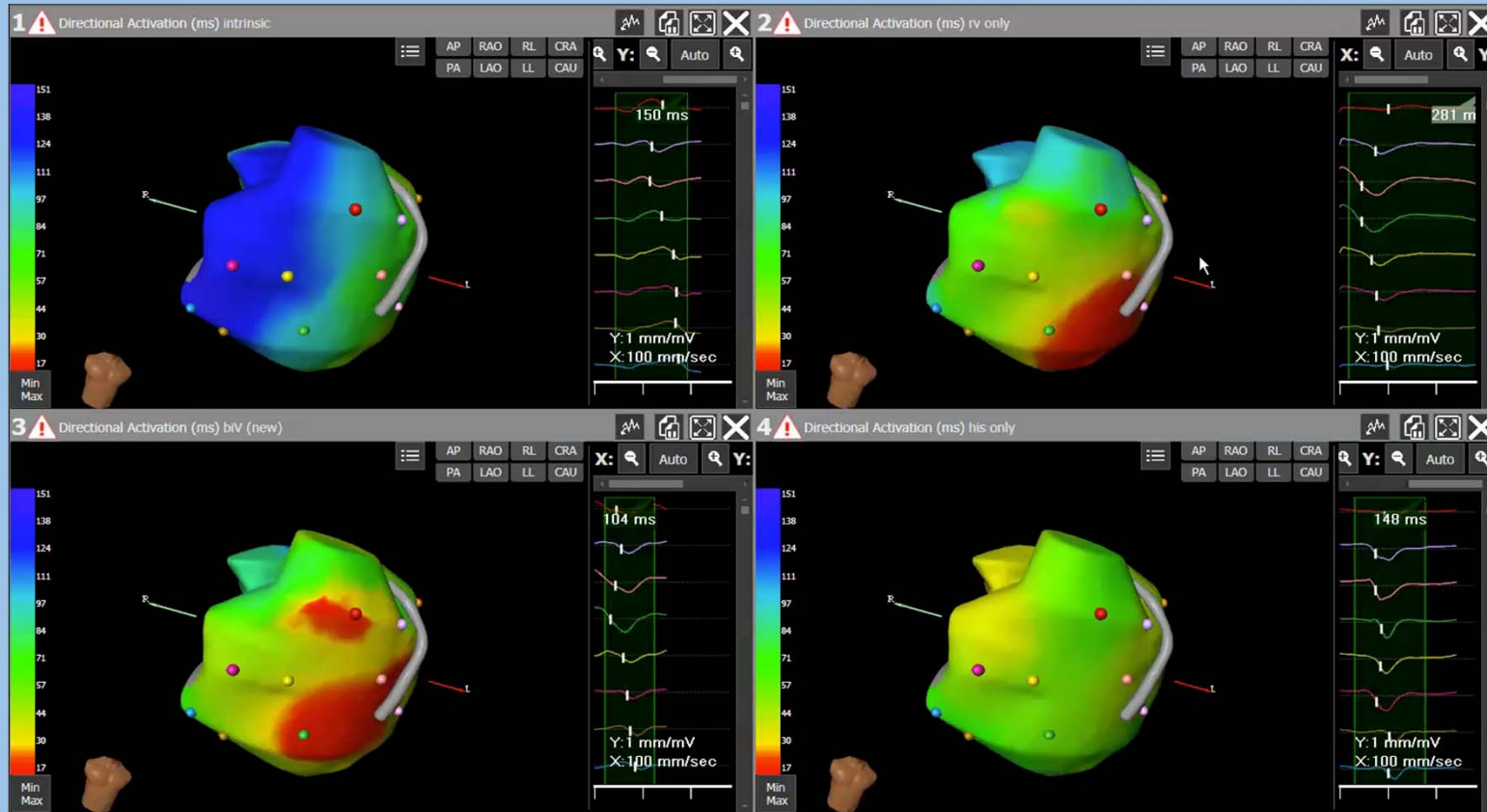
Intrinsic · RV · BIV · His

	Intrinsic	RV	BiV	HIS
RV activation Time (ms)	64	75	64	51
LV activation Time (ms)	41	129	64	59
Total Activation Time (ms)	109	143	85	59

RBBB

	Intrinsic	RV	NSHBP	His + LV
I				
II				
III				
aVR				
aVL				
aVF				
V1				
V2				
V3	184ms	175ms	176ms	151ms
V4				
V5				
V6				
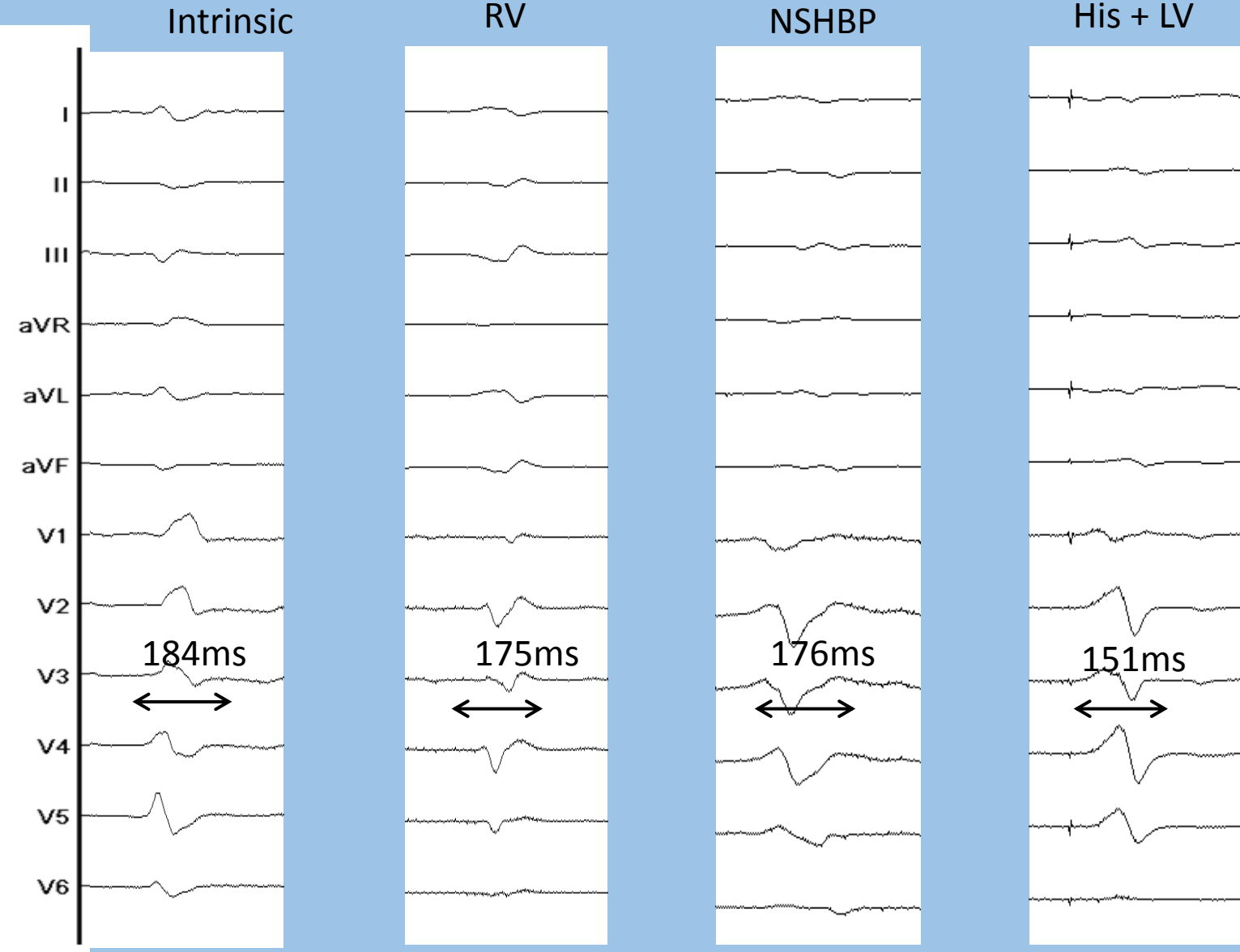
Intrinsic

RV
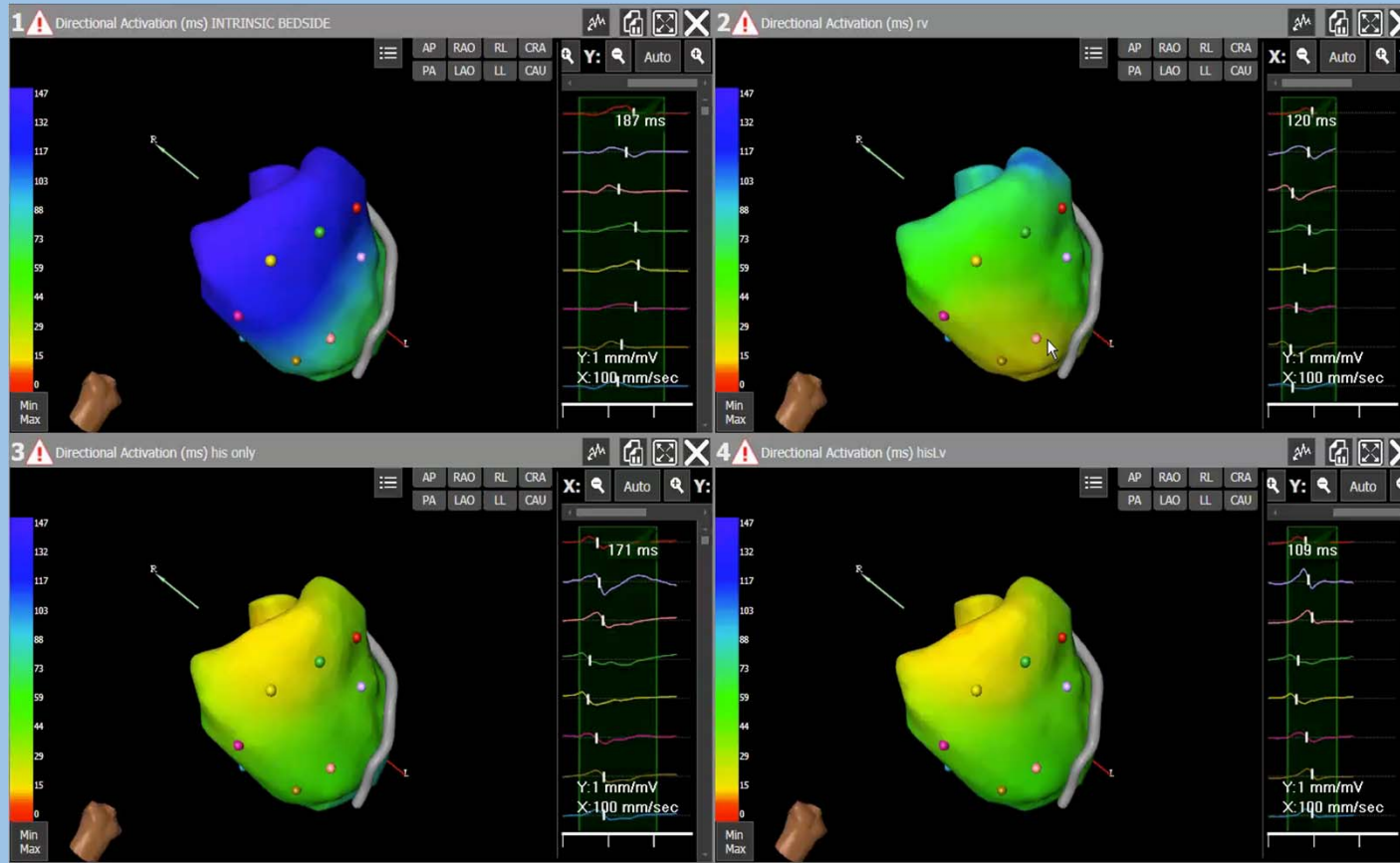
NSHP

His + LV

	Intrinsic	RV	His	His + LV
RV activation Time (ms)	82	64	40	38
LV activation Time (ms)	46	59	59	52
Total Activation Time (ms)	112	106	111	55

RBBB

Intrinsic RV BiV NSHBP With correction His 40msRV LBP LBP 40msRV

170 ms · 352

208 ms · 288 BPM

198 ms · 303 BPM

164ms · 94 ms · 638

108 ms · 555 BPM

140 ms · 428 BPM

100 ms · 600 BPM
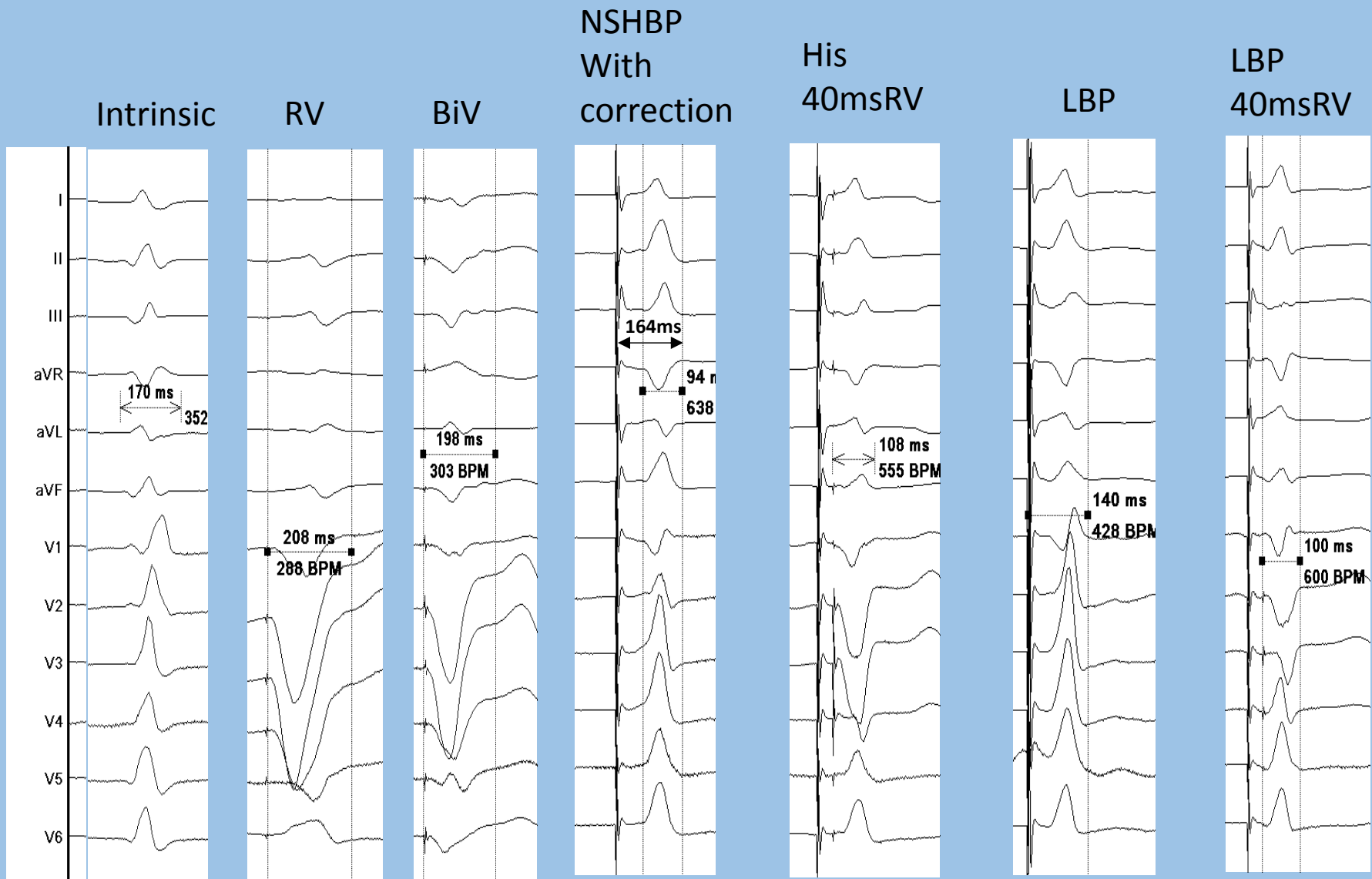
Intrinsic

SHBP without correction
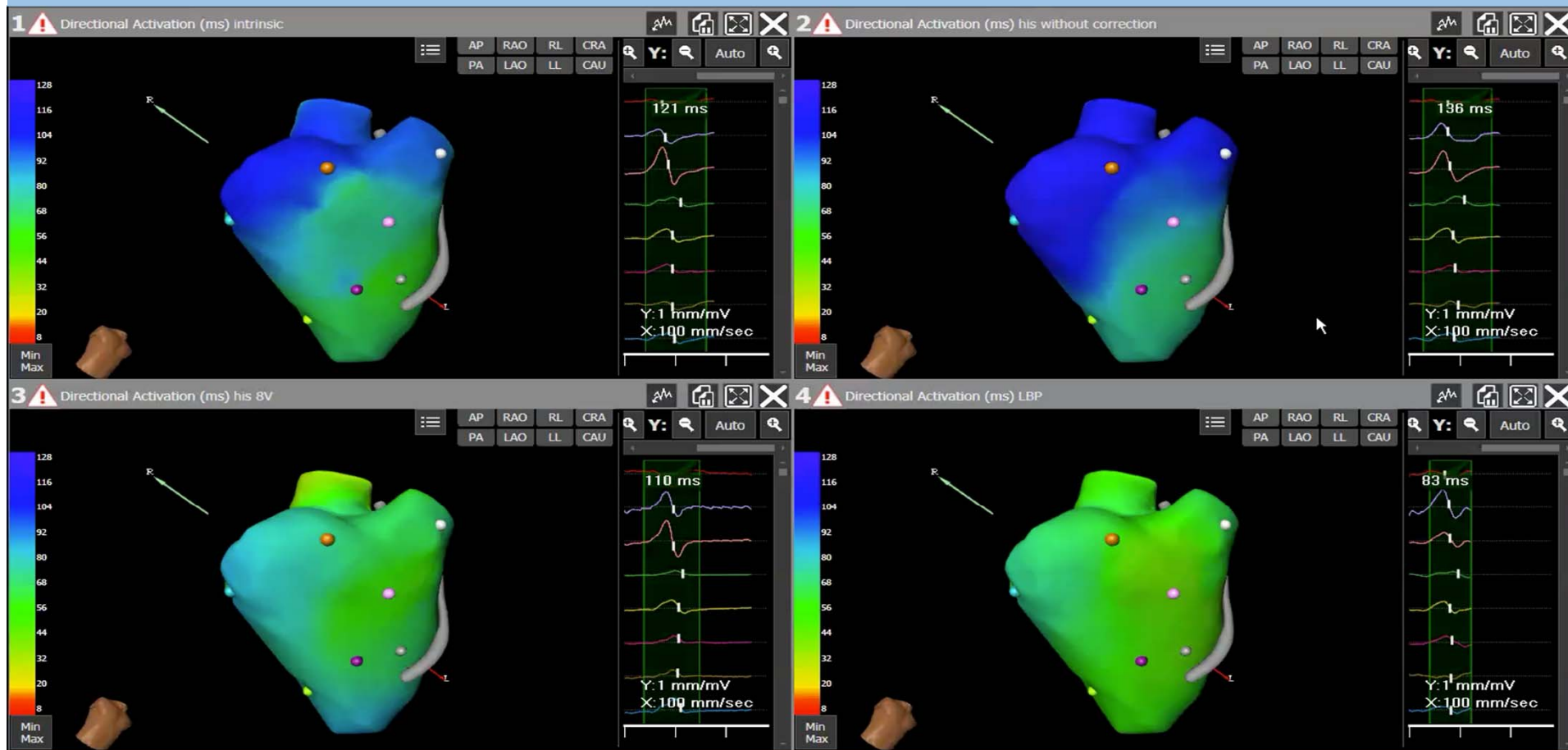
NSHBP with correction

LBBP

HIS40RV

LBBP40RV
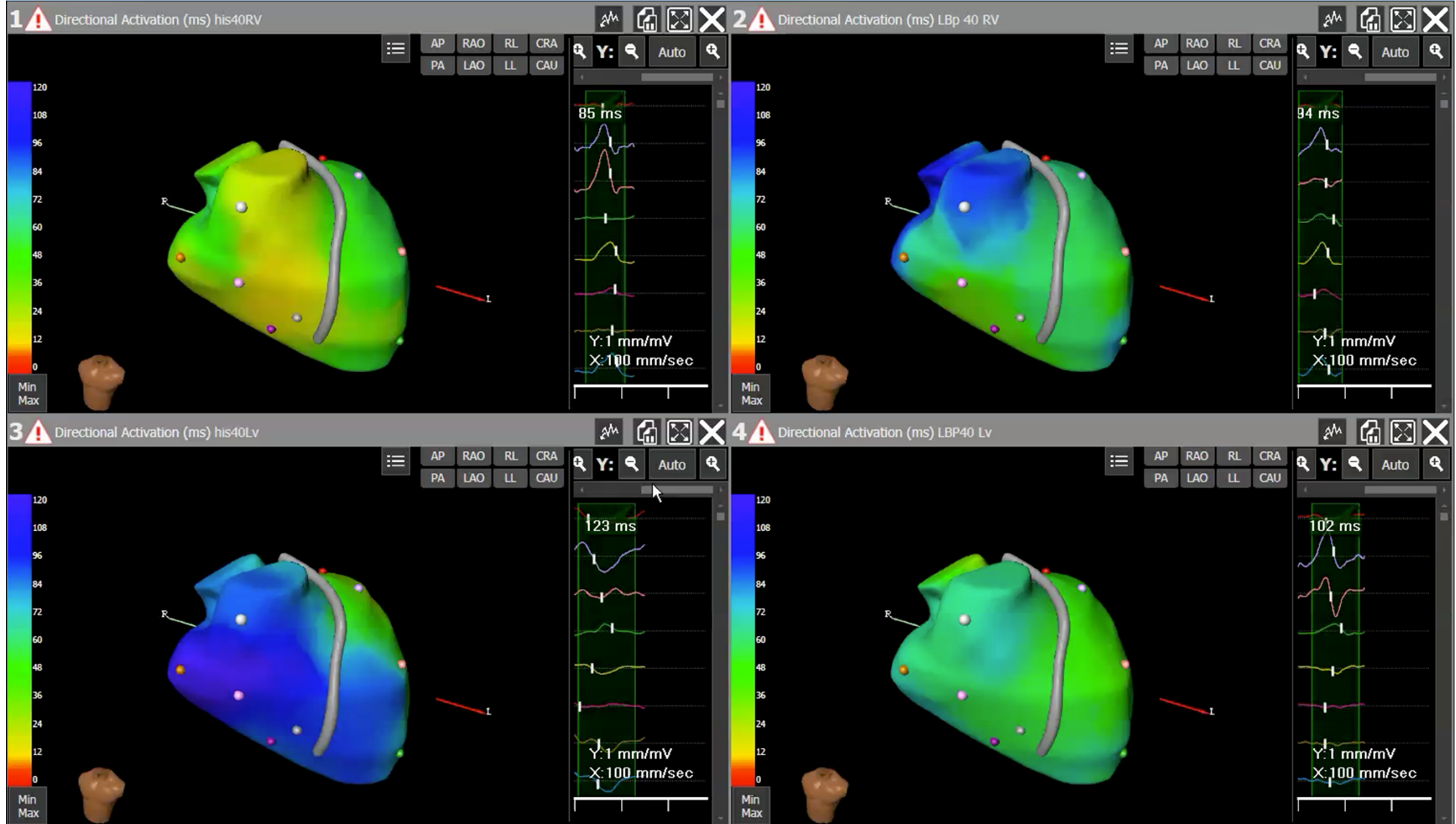
HIS40LV

LBBP40LV

	Intrinsic	NSHBP With correction	SHBP without correction	LBP	BiV	His40RV	LBP40RV	His40LV	LBP40LV
RV activation Time (ms)	38	22	47	31	57	63	37	78	60
LV activation Time (ms)	45	40	46	31	72	58	44	77	76
Total Activation Time (ms)	76	41	72	40	86	63	49	142	86

Non LBBB
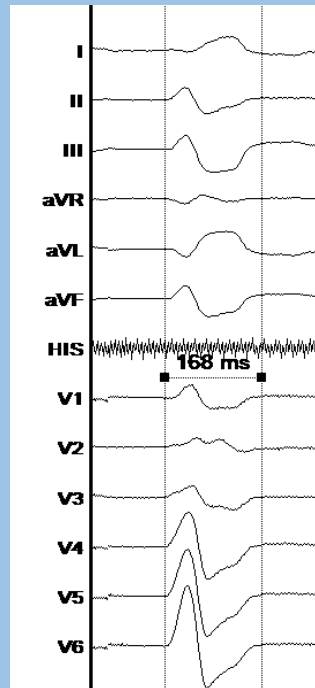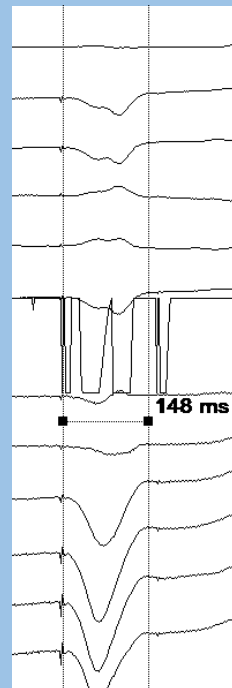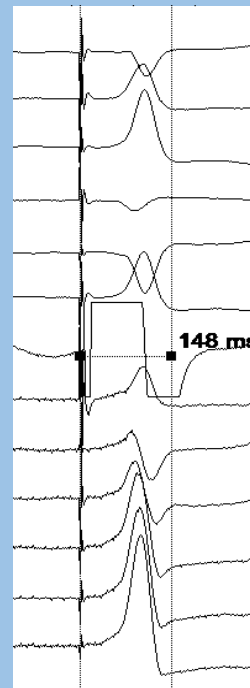
Intrinsic   BiV   NSHP   His 40ms LV   His AVD 80
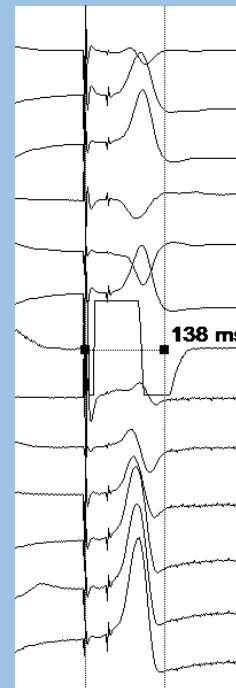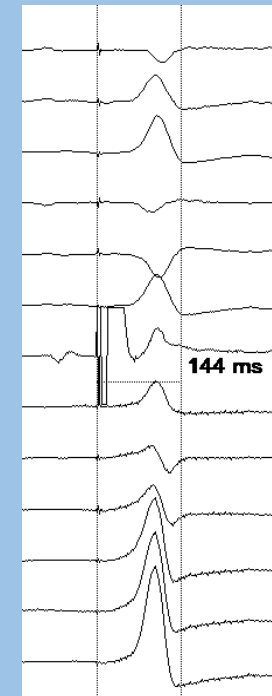
Intrinsic

NSHBP
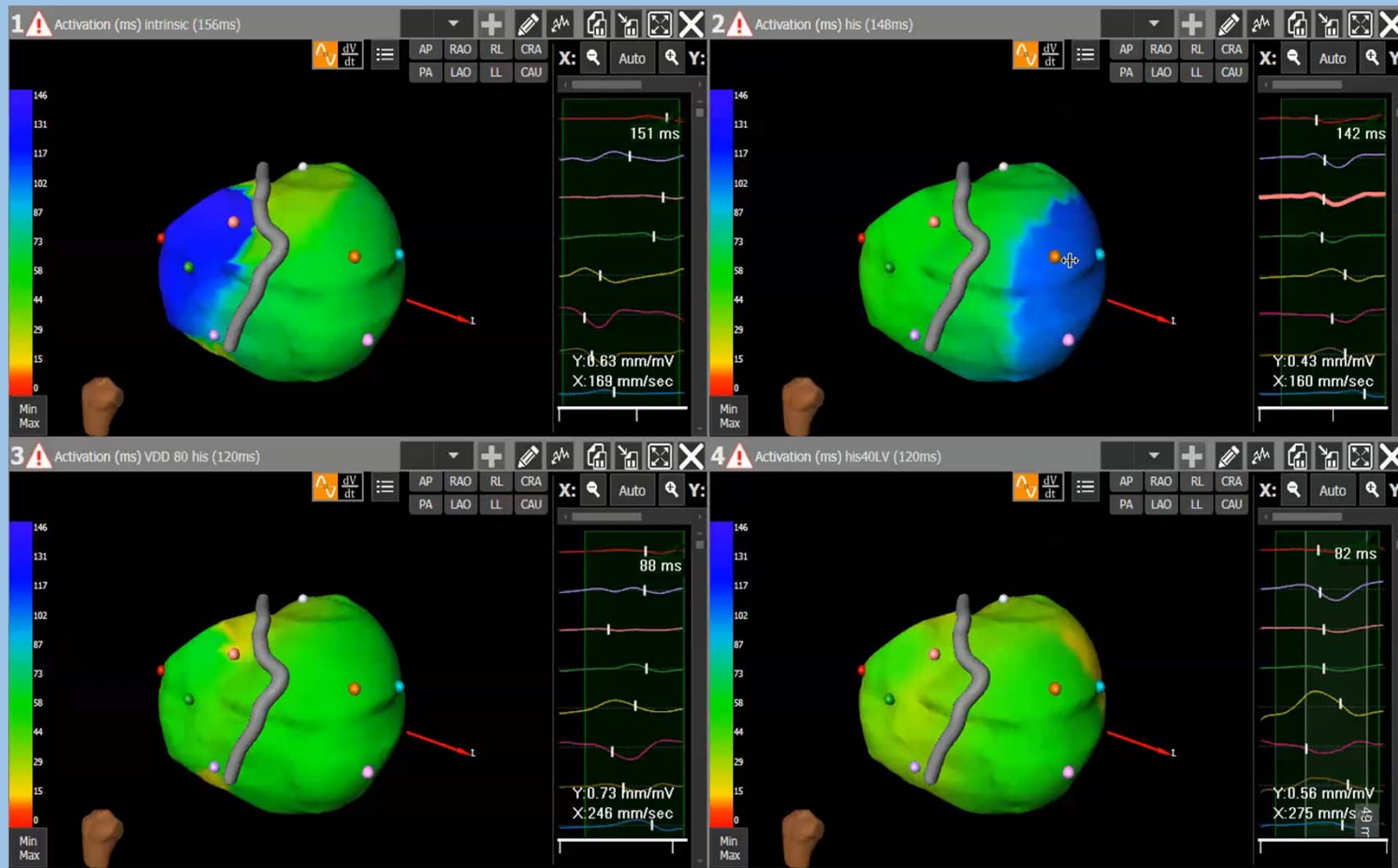
His AVD 80msec

His 40ms LV

Intrinsic	BiV	NSHP	His AVD 80	His 40 LV
156ms	136ms	148ms	120ms	120ms

ECGi guided CRT implantation in non LBBB

During implantation:

Initial lead placement:

- His lead
- LV lead via CS
- RV lead
- +/- Left bundle lead (after the 7th patient)

New HIS bundle pacemaker lead placement

Pacemaker leads come into heart through the subclavian vein

Sinoatrial node

HIS bundle

Atrioventricular node

Right atrium

Right ventricle

Septum

Right bundle branch

Left bundle pacing

Conventional LV lead via coronary sinus
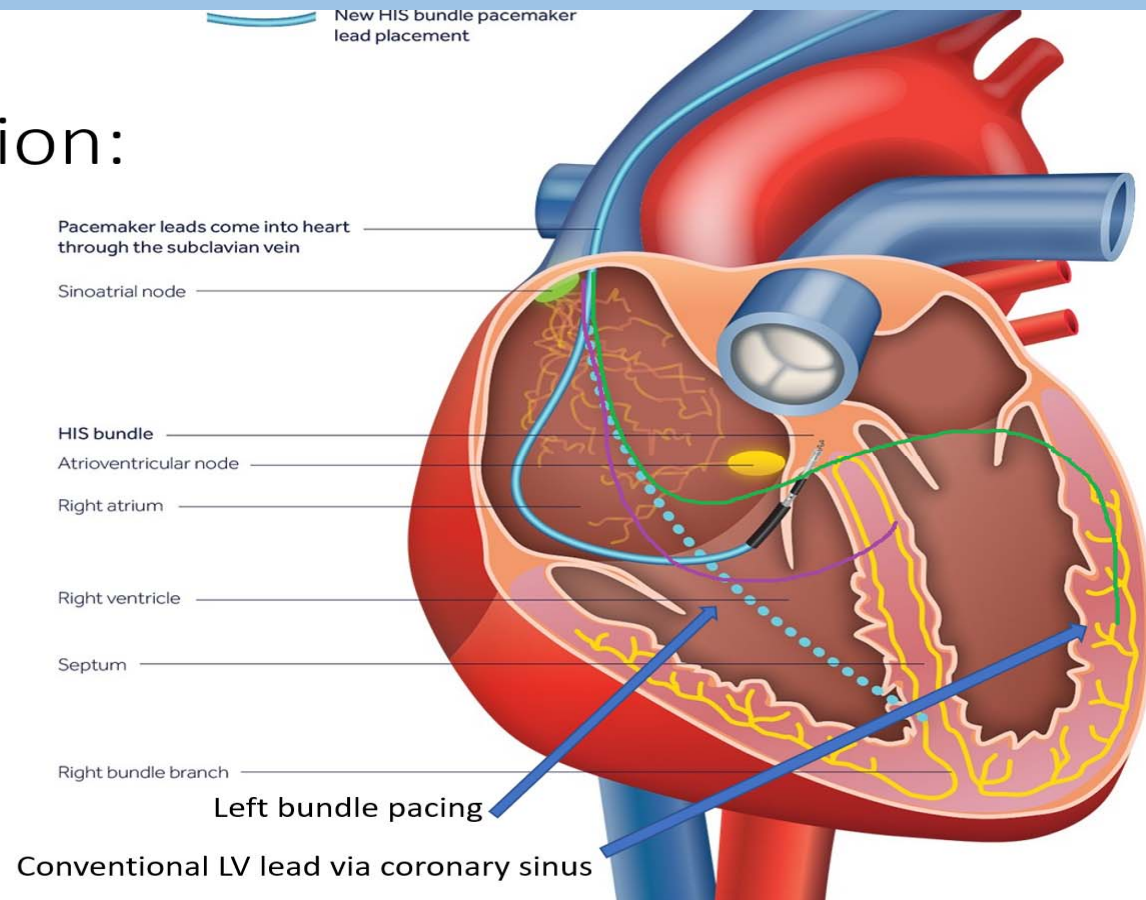
Results:

12 patients recruited with baseline Echo, ECG, clinical assessment
(8 RBBB + 4 IVCD patients)

- 1 patient died before first FU period

11 patients had completed FU Echo, ECG and clinical assessment after 3-6 months of CRT implantation
(4 had His pacing; 4 had LB pacing as final configuration)

Table 4. Patient Characteristics, Electrocardiographic and Echocardiographic outcomes

Patient	Age	Gender	Etiology	QRS pattern	Rhythm	Pacing configuration	Device	CrCl	NYHA	QRS (ms)		TAT (ms)			LVEF (%)		FU NYHA	TAT% change	LVESV% change
										Pre	Post	Pre	BiVP	Final	Pre	Post			
1	70	M	NICM	RBBB	pAF	HBP + BiVP	CRTD	81	3	162	98	112	88	52	26	30	3	-54%	-21%
2	62	M	ICM	RBBB	NSR	LV pacing	CRTP	57	2	154	160	94	98	88	34	29	1	-6%	+25%
3	69	M	NICM	RBBB	NSR	HBP	CRTP	94	3	186	160	109	85	74	21	25	1	-32%	-17%
4	75	F	NICM	IVCD	pAF	HBP	CRTD	68	3	156	128	111	NA	46	32	49	2	-59%	-16%
5	83	F	NICM	RBBB	pAF	BiVP VV 20	CRTP	47	4	136	134	98	102	61	30	47	2	-38%	-13%
6	55	M	NICM	IVCD	pAF	BiVP-ACRT	CRTD	54	3	136	133	92	52	47	17	23	2	-49%	-17%
7	53	M	NICM	RBBB	AF	LBP-LV 60	CRTD	33	3	184	154	82	79	58	15	14	3	-29%	+5%
8	82	M	ICM	RBBB	NSR	LBP	CRTP	106	3	156	108	76	86	49	28	40	2	-47%	-18%
9	64	M	NICM	RBBB	NSR	LBP	CRTD	49	3	196	148	129	63	40	22	36	2	-69%	-24%
10	83	M	NICM	IVCD	AF	HBP-LV 60	CRTD	23	2	152	127	102	86	62	24	NA	NA	NA	NA
11	66	M	NICM	RBBB	NSR	RVP (septal)	CRTD	95	3	188	144	118	98	82	32	33	2	-31%	+3%
12	72	M	NICM	IVCD	NSR	LBP	CRTD	28	4	174	122	140	108	58	20	30	2	-59%	-27%
							Mean	61	3.1	165	135	105	86	59	25.1	32.4	2	-43%	-11%
							Standard deviation	28	0.5	20	20	19	17	15	7	10	0.6	5.4	4.7

8 RBBB patients; 4 IVCD patients
8 had physiological pacing (4 with His pacing; 4 with Left bundle pacing)

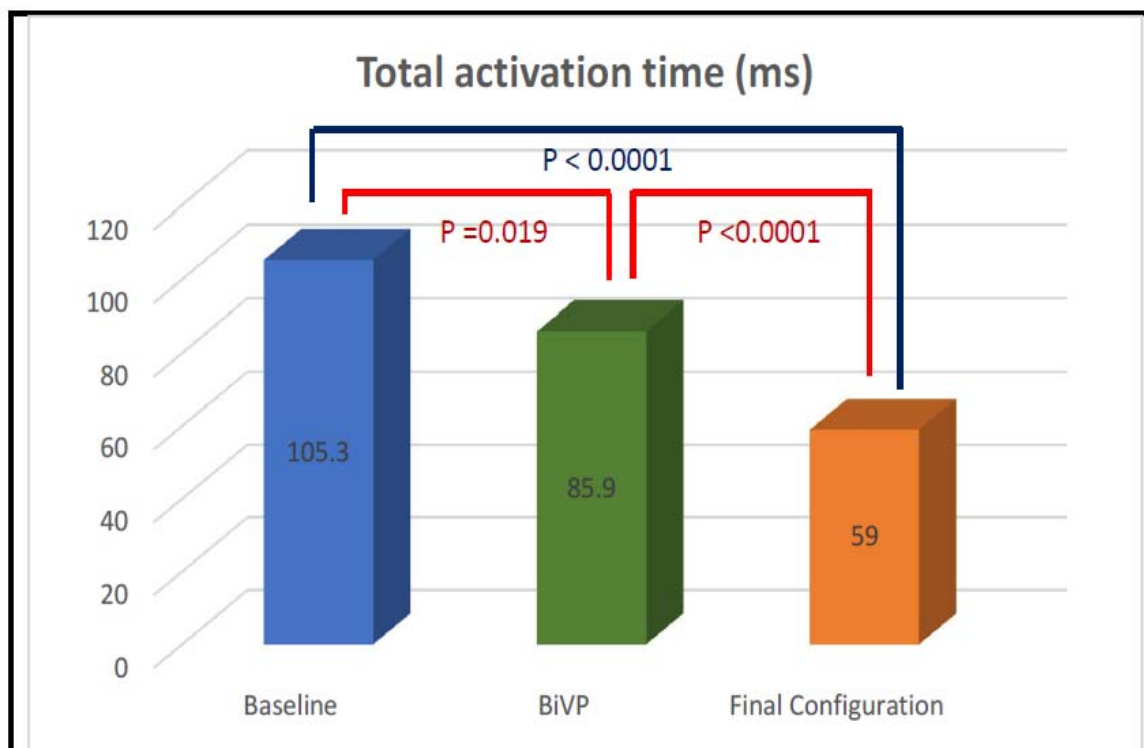# Immediate effect of resynchronization:

Figure 3. Total activation time at baseline, during biventricular pacing and final configuration. ECGi guided CRT implantation with physiological pacing options resulted in significantly shorter total activation time than conventional biventricular pacing, suggesting a superior resynchronization effect.
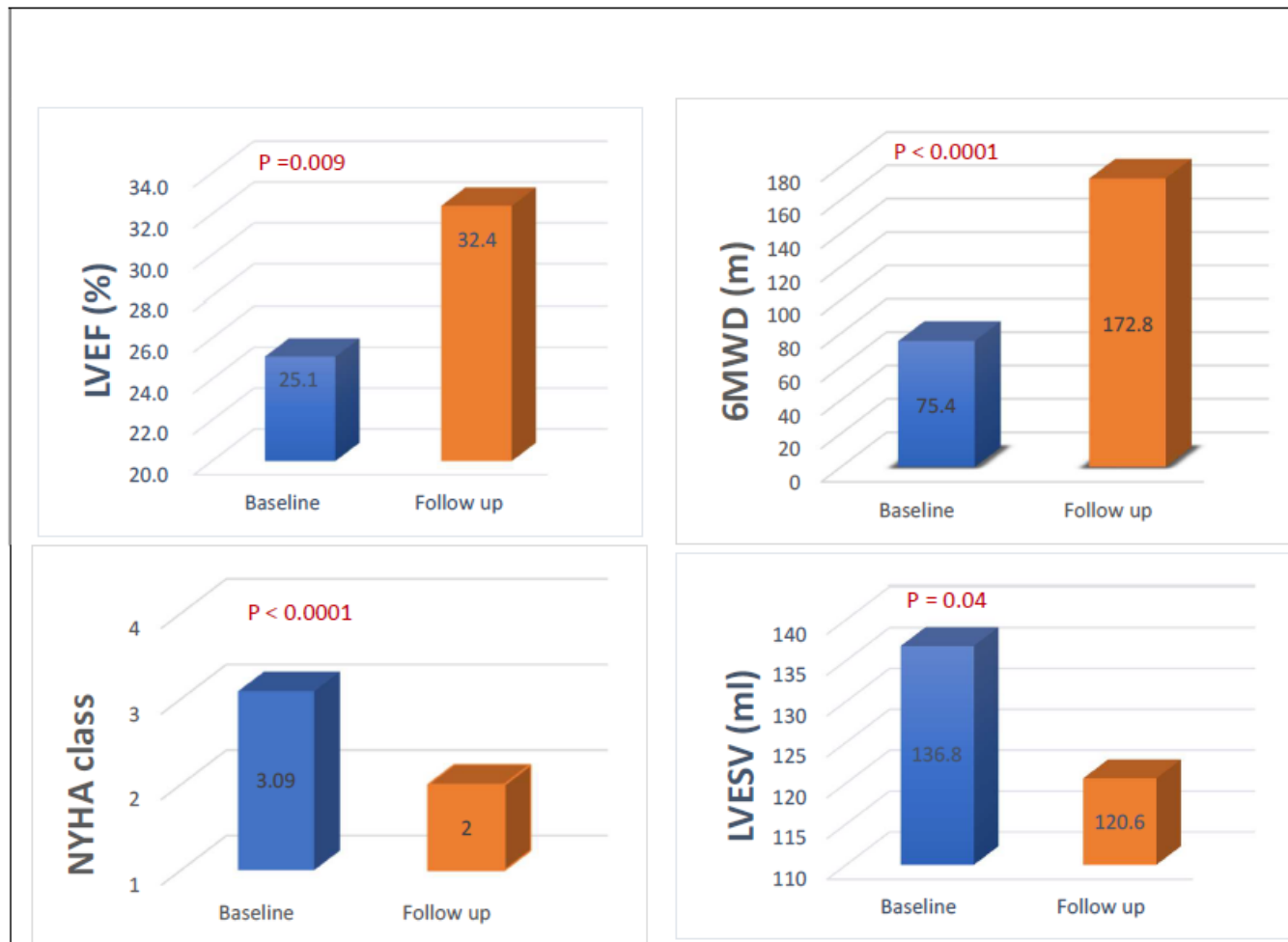
Figure 4. Change in clinical and echocardiographic parameters after ECGi guided CRT implantation with physiological pacing options. Significant improvement in clinical (NYHA and 6MWD) and echocardiographic parameters (LVEF and LVESV) were observed.

ENHANCE CRT study 248 patients
LVEF improved between baseline and 6 months from 24.8 to 28.8 in the QLV arm
and from 25.8 to 30.9 in the control arm in 6 months
Singh J et al JACC EP

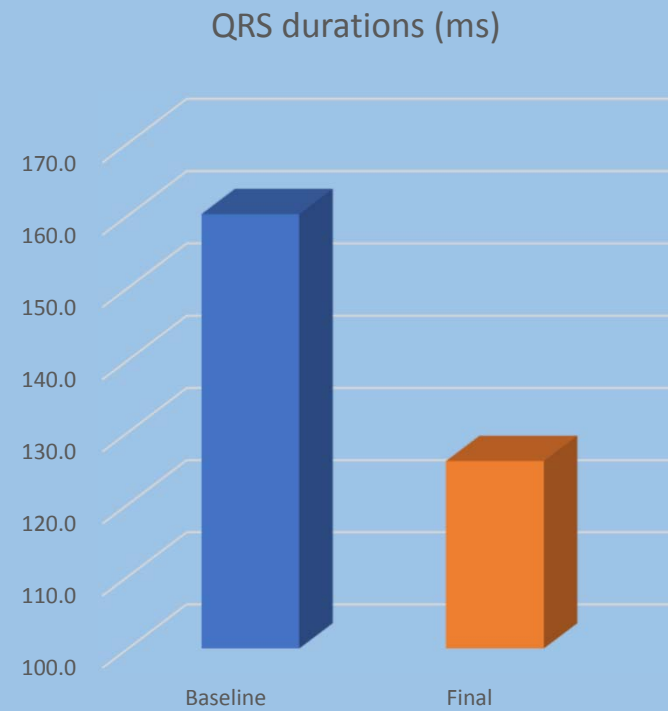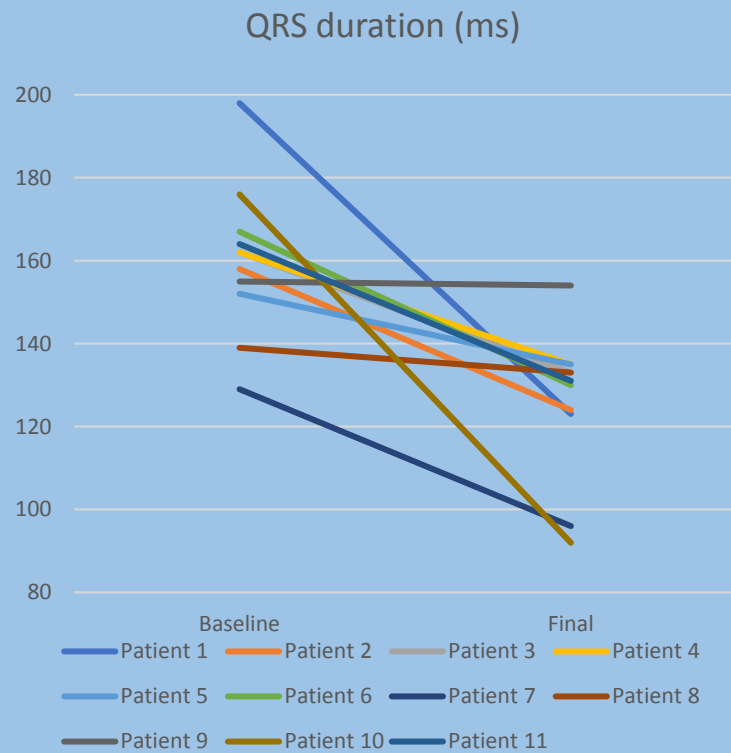# Clinical and echo responder rate:

- **Echo responder rate 58%**
  - if we define LVESV reduction >=15% as responder

- **Clinical responder rate 75%**
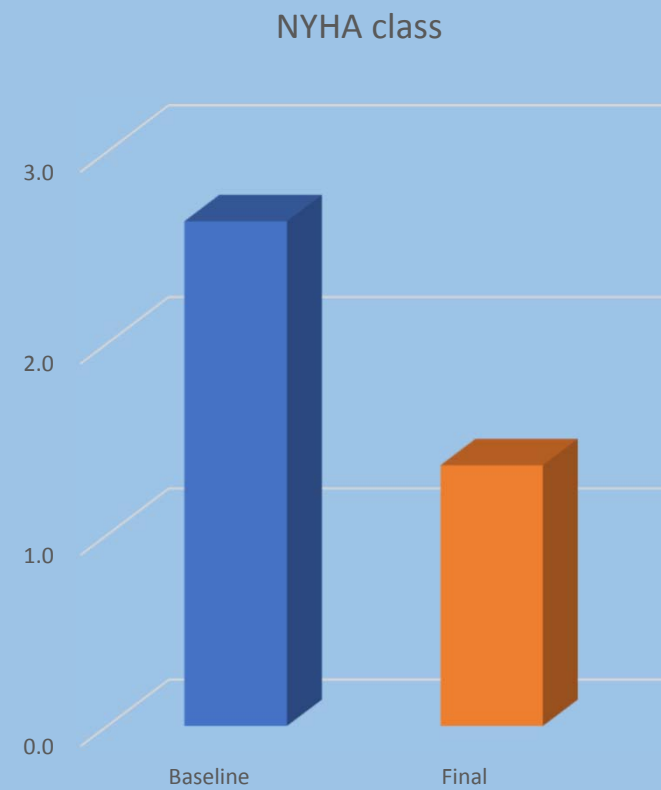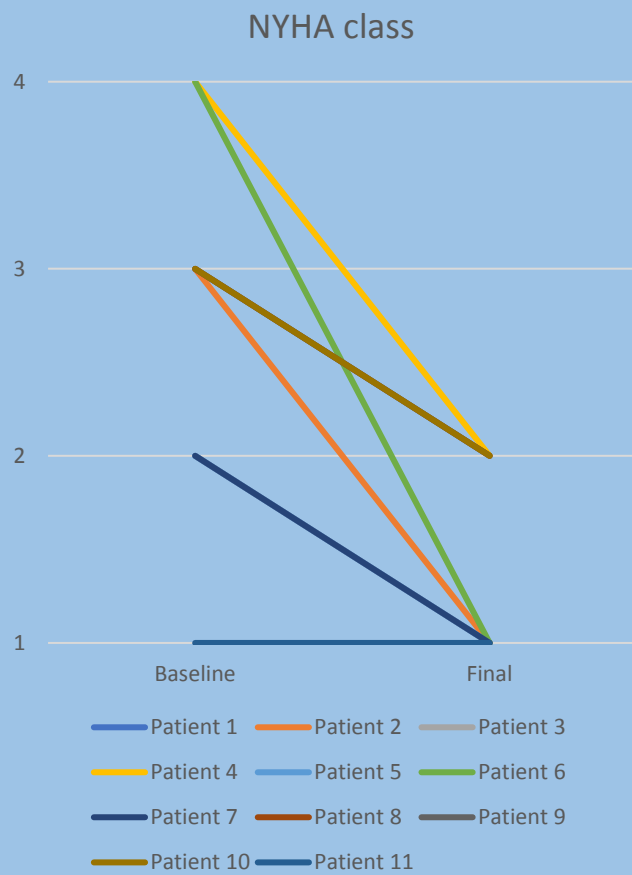 - if we define NYHA class improvement by >= 1 class as responder

LBBB patients

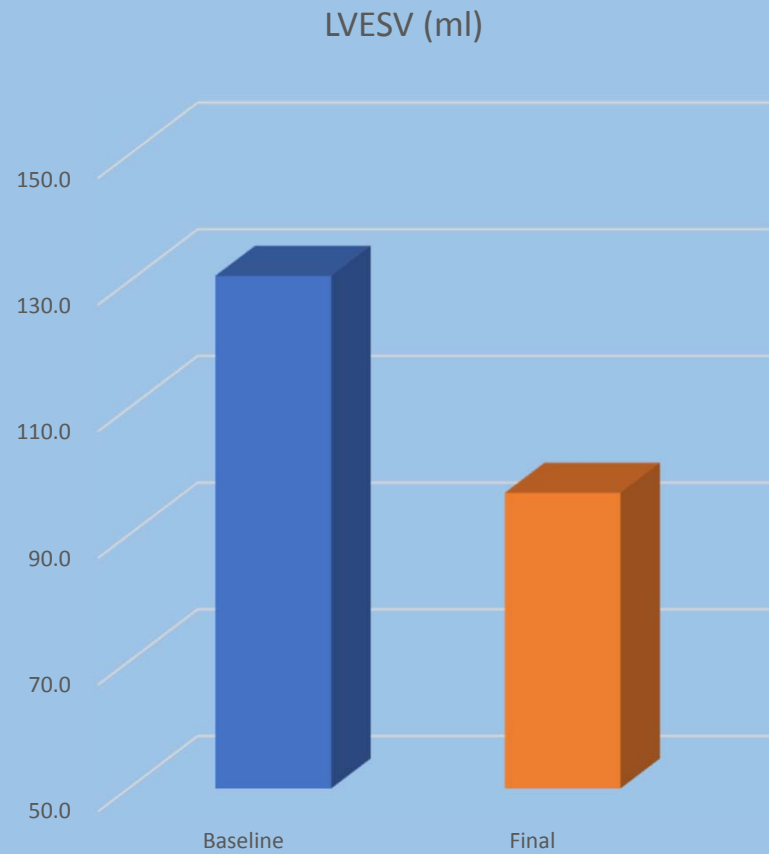|	Age	Gender	Pacing configuration	Device	NYHA	QRS (ms)		TAT (ms)			LVEF (%)		FU NYHA	TAT% change	LVESV % change
						Pre	Post	Pre	BiVP	Final	Pre	Post			
1	63	M	LBB tip to HIS tip	CRTD	2	198	123	140	100	52	35	63	1	62.86	55.67
2	77	F	HIS pacing	CRTD	3	158	124	93	106	44	25	64	1	52.69	67.92
3	60	M	LBP	CRTD	2	162	133	104	91	60	27	35	1	42.31	7.04
4	85	M	HIS40LV	CRTP	4	162	135	76	106	69	16	21	2	9.21	-23.79
5	79	M	HIS pacing	CRTD	2	152	135	111	77	40	30	50	1	NA	NA
6	54	F	LV pacing AVD120	CRTD	4	167	130	108	103	64	30	56	1	40.74	51.22
7	76	F	LBP AVD 60	CRTD	2	129	96	89	88	38	35	60	1	57.30	54.23
8	80	M	LBP	CRTP	3	139	133	87	91	60	28	38	2	31.03	25.50
9	59	M	LBP	CRTD	3	155	154	96	61	61	30	38	2	NA	30.00
10	80	M	LBP AVD 100	CRTD	3	176	92	128	82	54	18	38	2	57.81	22.32
11	69	M	BiV-CRT	CRTD	1	164	131	104	53	53	20	40	1	49.04	NA
				Mean	2.6	160	126	103	87	54	27	46	1.4	45.1	32.2

LBBB patients

LBBB patients

NYHA class

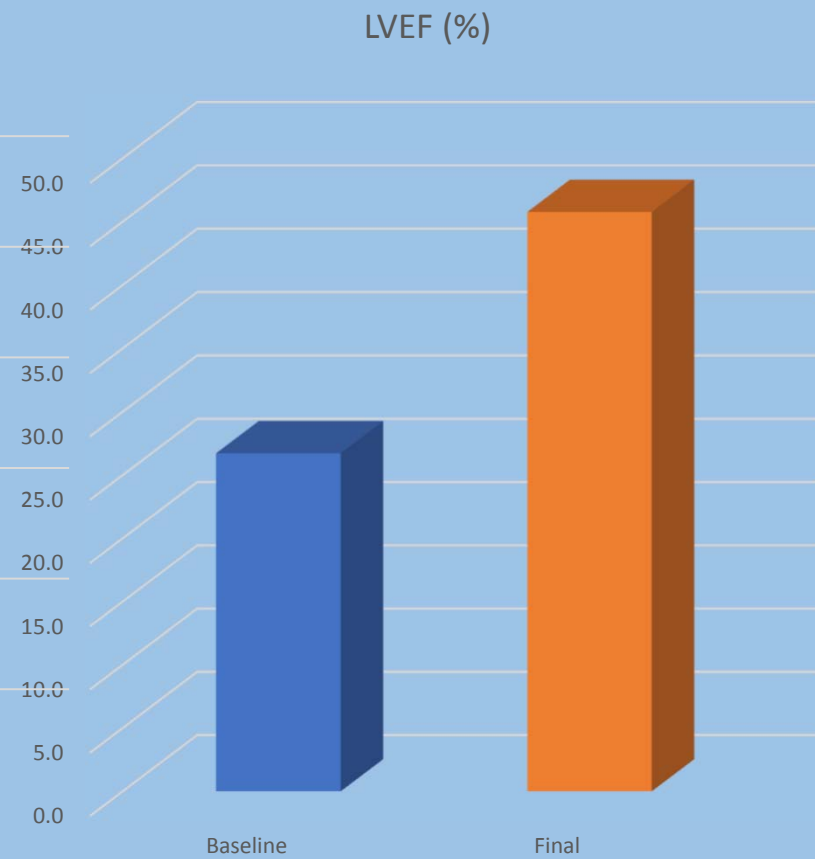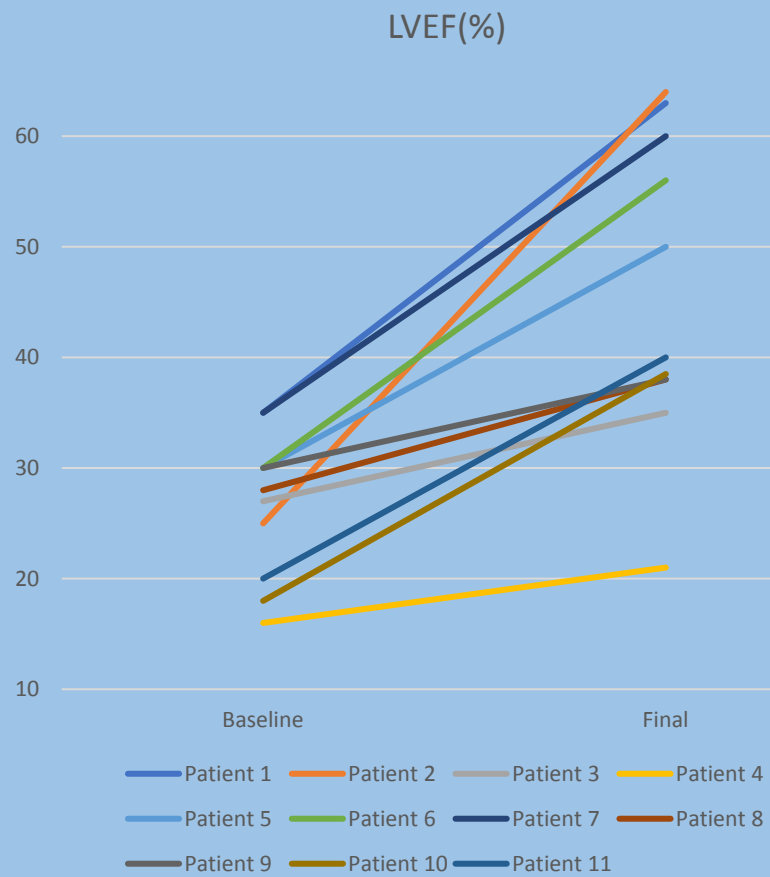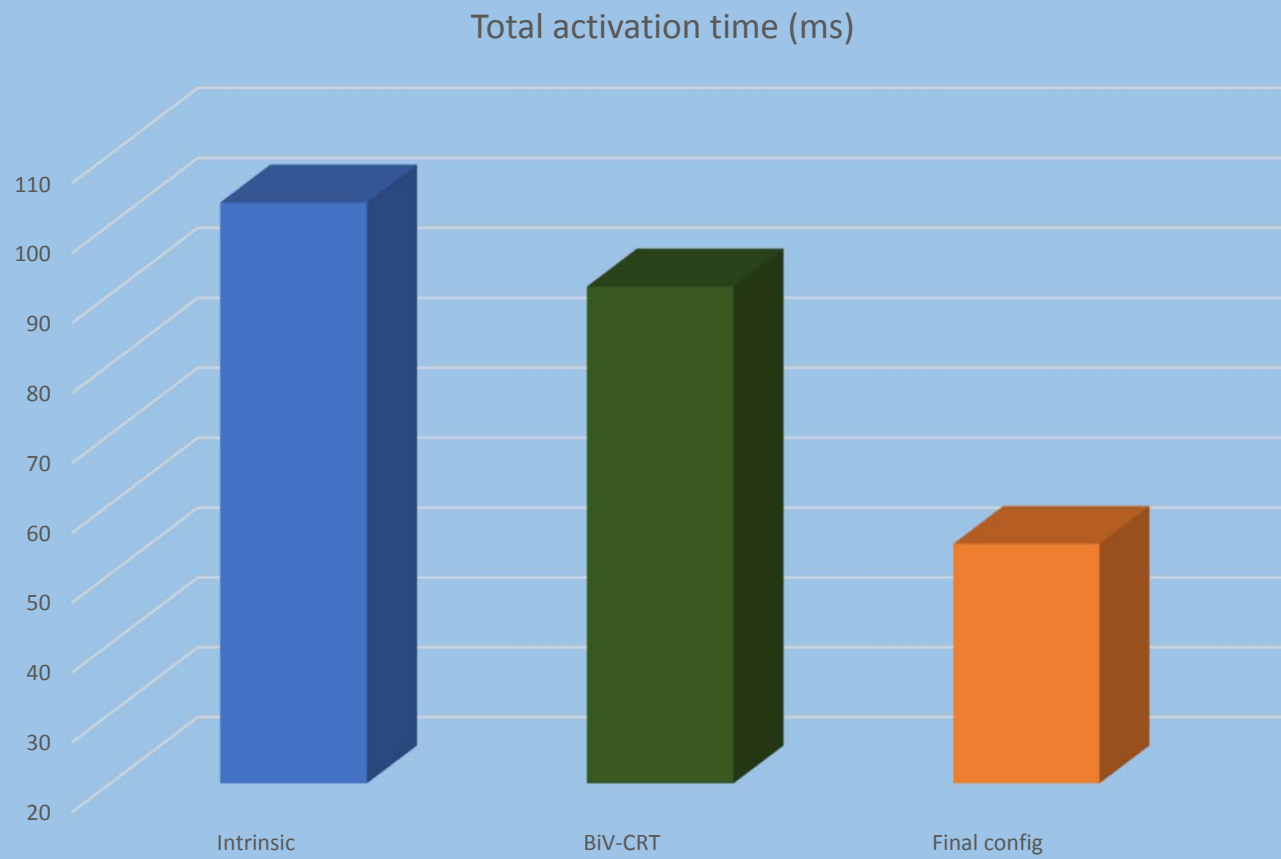| | Patient 1 | Patient 2 | Patient 3 |
	Patient 4	Patient 5	Patient 6
	Patient 7	Patient 8	Patient 9
	Patient 10	Patient 11	

LBBB patients

LBBB patients
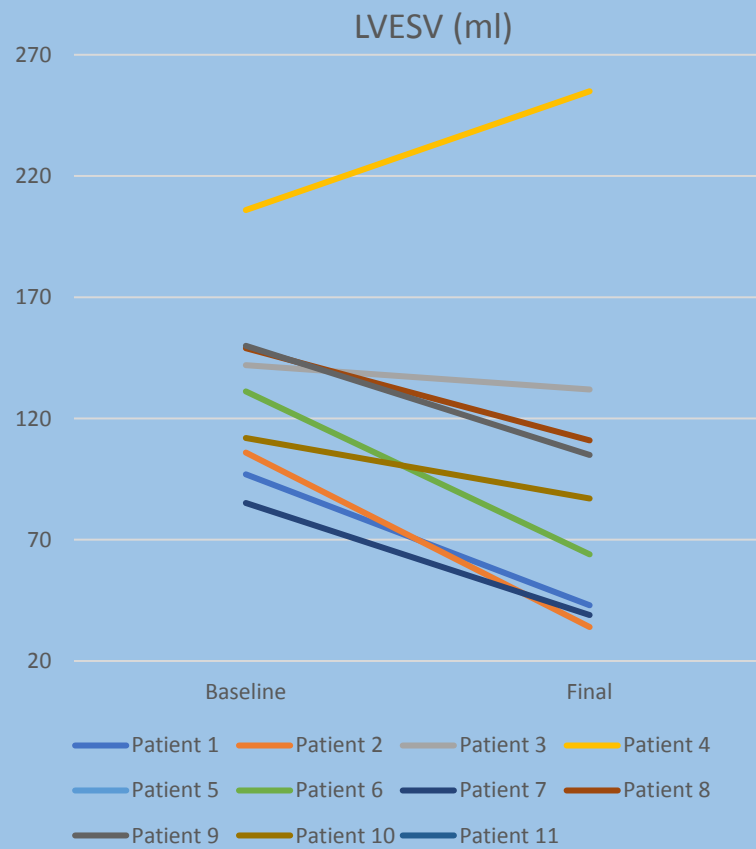
LBBB patients

Total activation time (ms)

Conclusions

- ECGi can provide information on global picture of the activation pattern and timing that may not be provided by 12 lead ECG

- ECGi guided CRT implantation for patient with heart failure and widened QRS complex may provide a better guide for lead configuration to achieve best synchronization