

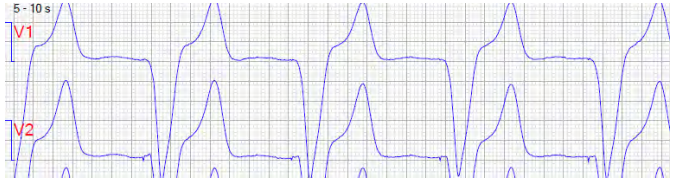
Fysiologisk pacing hos individer med hjärtsvikt

Piotr Szamlewski, SÄS

Regional fortbildninsdag 20261002

REGIONAL UTBILDNING maj 2023



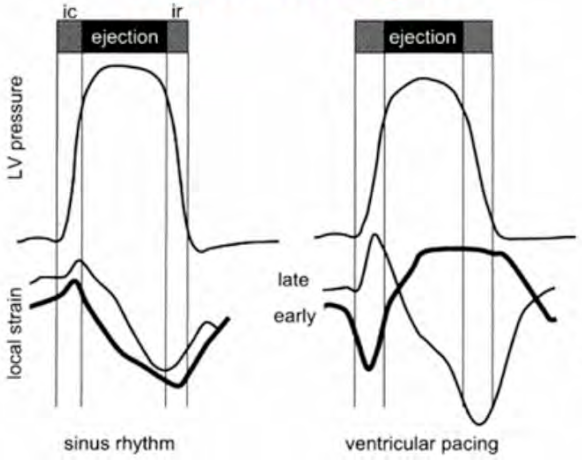


Right Ventricular Pacing

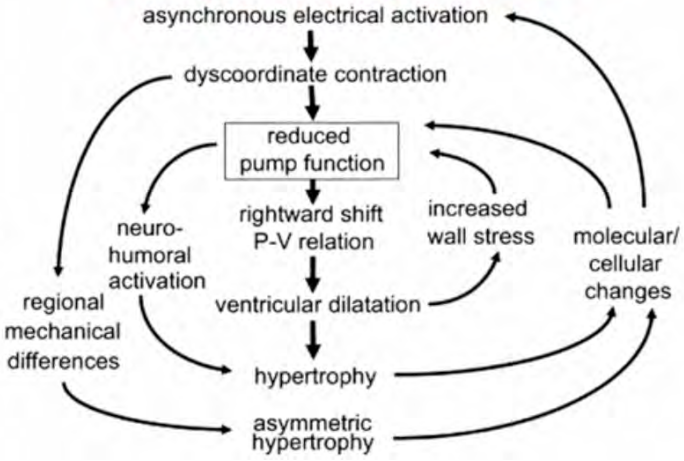
EHRA
European Heart Rhythm Associati

A Form of Desynchronization Therapy

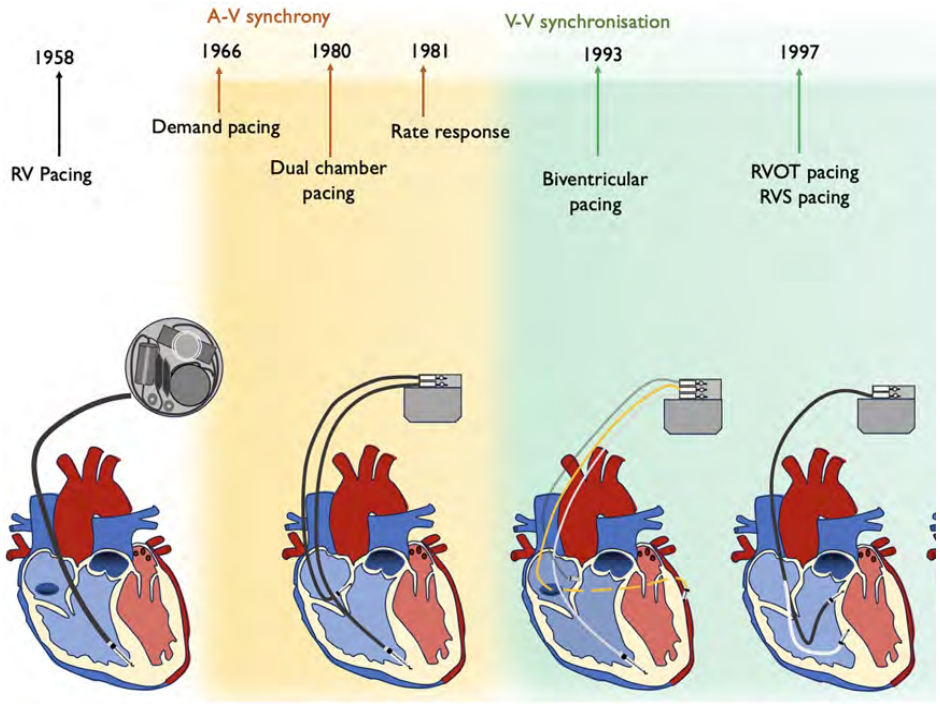
Acute Changes

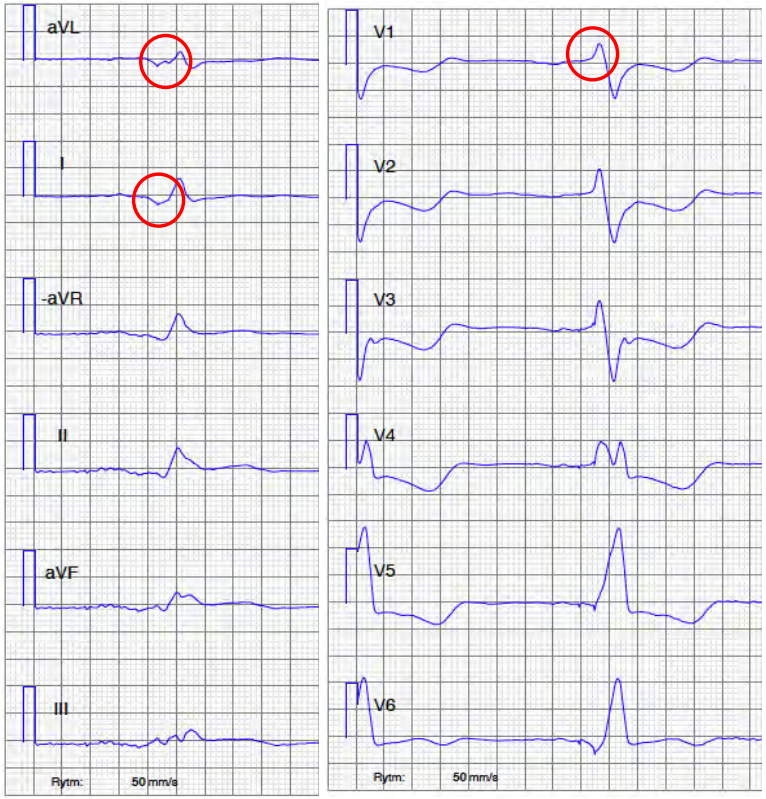


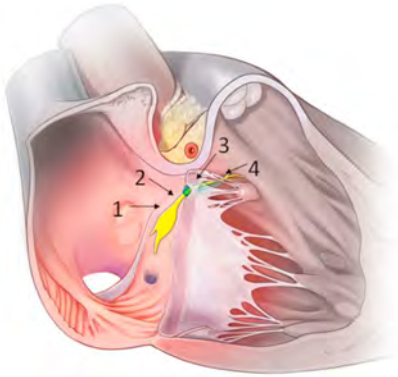
Longstanding Effects



Biventrikulär kammarpacing







S-HBP

Selective His bundle pacing
Capture of the His bundle alone,
without capture of local myocardium

NS-HBP

Non-selective His bundle pacing
Simultaneous capture of both the His
bundle and local myocardium

MOP

Myocardium-only pacing*
Only the local myocardium is captured
No capture of conduction system

Left ventricular septal pacing*
Capture of the left side of the IVS,
without capture of the conduction system

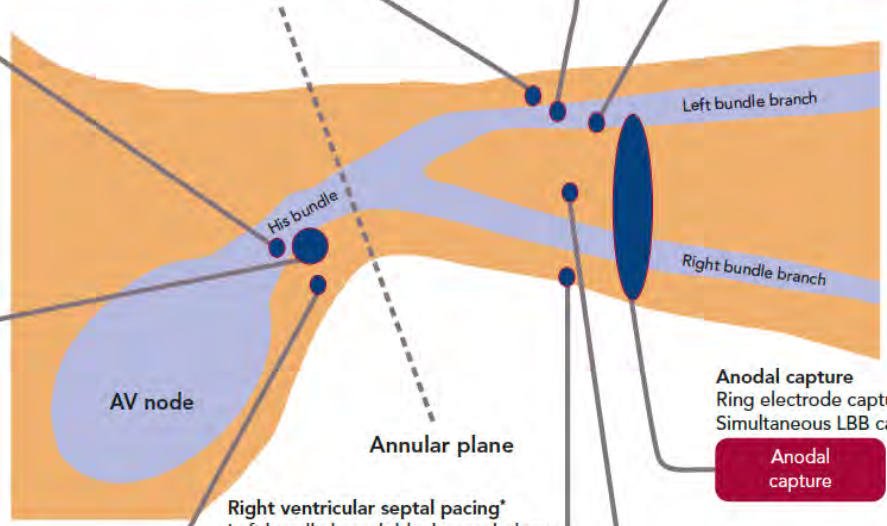
LVSP

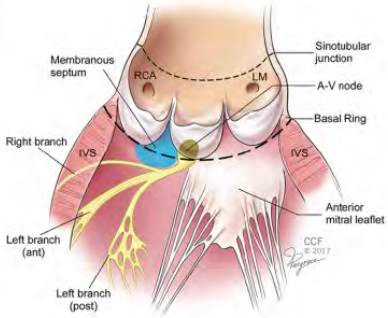
Selective left bundle branch pacing
Capture of the LBB alone, without
capture of local myocardium

S-LBBP

Non-selective left bundle branch pacing
Simultaneous capture of the LBB and
local left ventricular septal myocardium

NS-LBBP





Anodal capture
Ring electrode captures the right side of IVS
Simultaneous LBB capture by tip electrode

Anodal capture

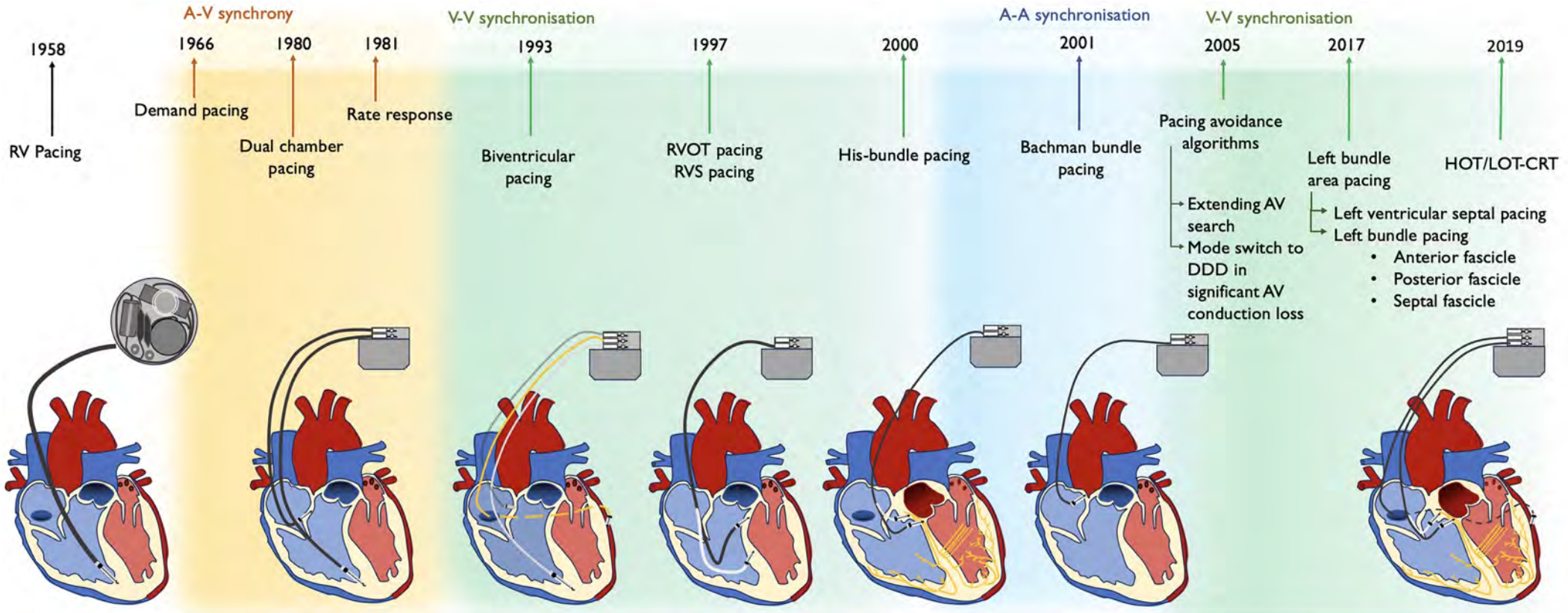
Right ventricular septal pacing*
Left bundle branch block morphology
Site of approach for left bundle pacing

RVSP

Mid-septal capture*
Morphology observed during traversal
of IVS while attempting left bundle pacing

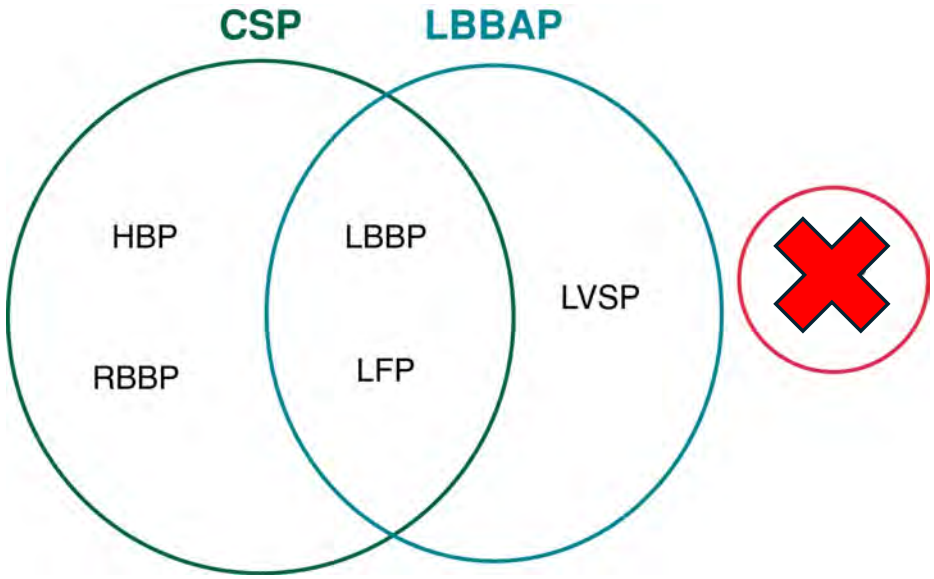
Mid-septal capture

Pacing hos individer med hjärtsvikt - evolution

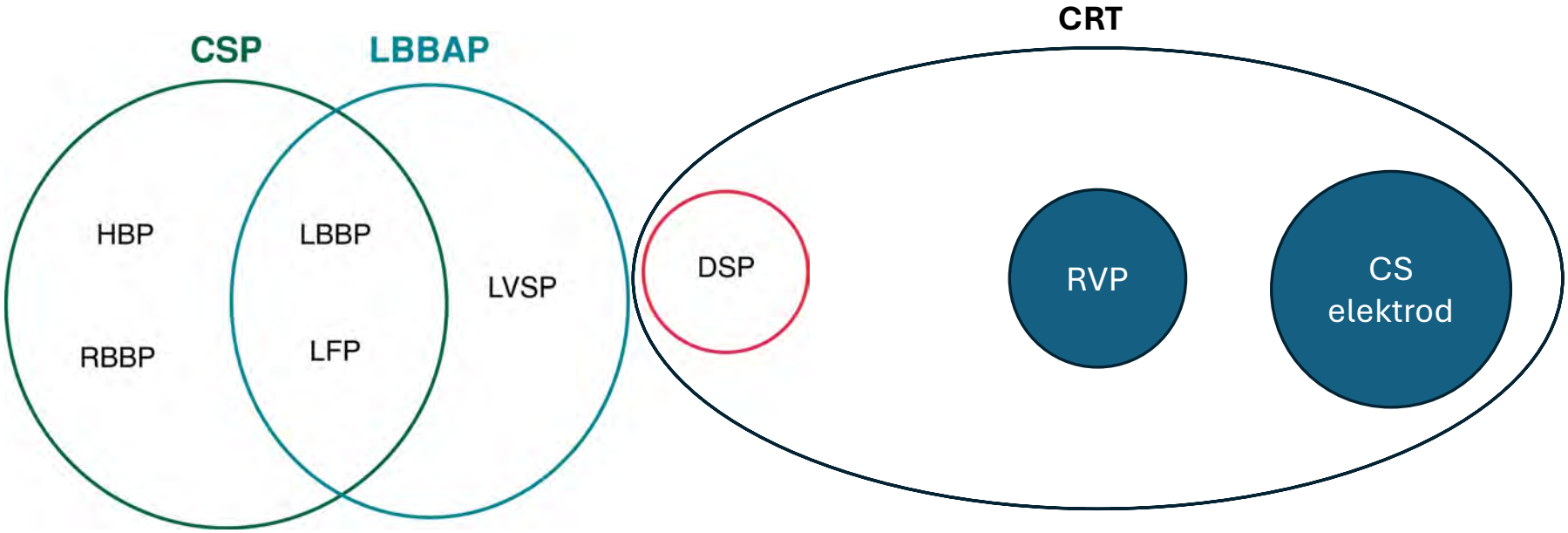


CSP= Conduction System Pacing vs LBBAP – Left Bundle Branch Area Pacing

- LBBB = Left BundleBranch Pacing
- LVSP = Left Ventricular Septal Pacing
- LFP = Left Fascikulär Pacing
  (LPFP -posterior, LAFP-anterior,LSFP -septal)
- HBP = His Bundle pacing
- RBBP = Right Bundle Branch Pacing
- ~~DSP – Deep Septal Pacing~~

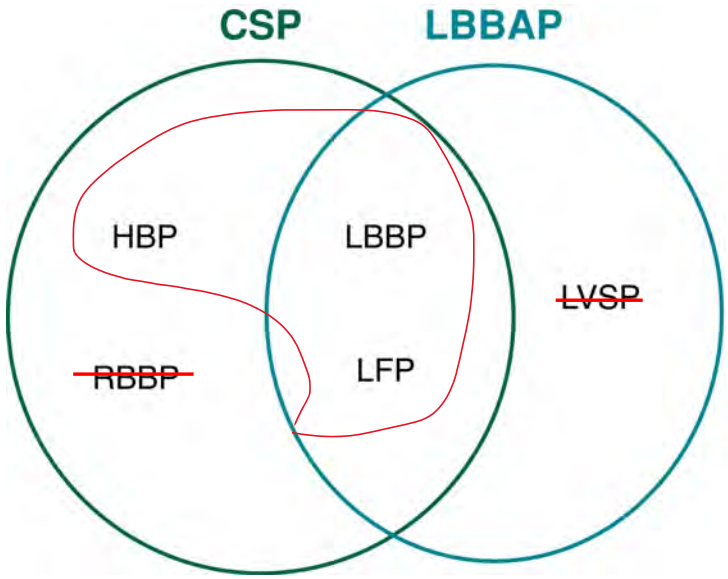


Cardiac Physiologic Pacing (CPP)

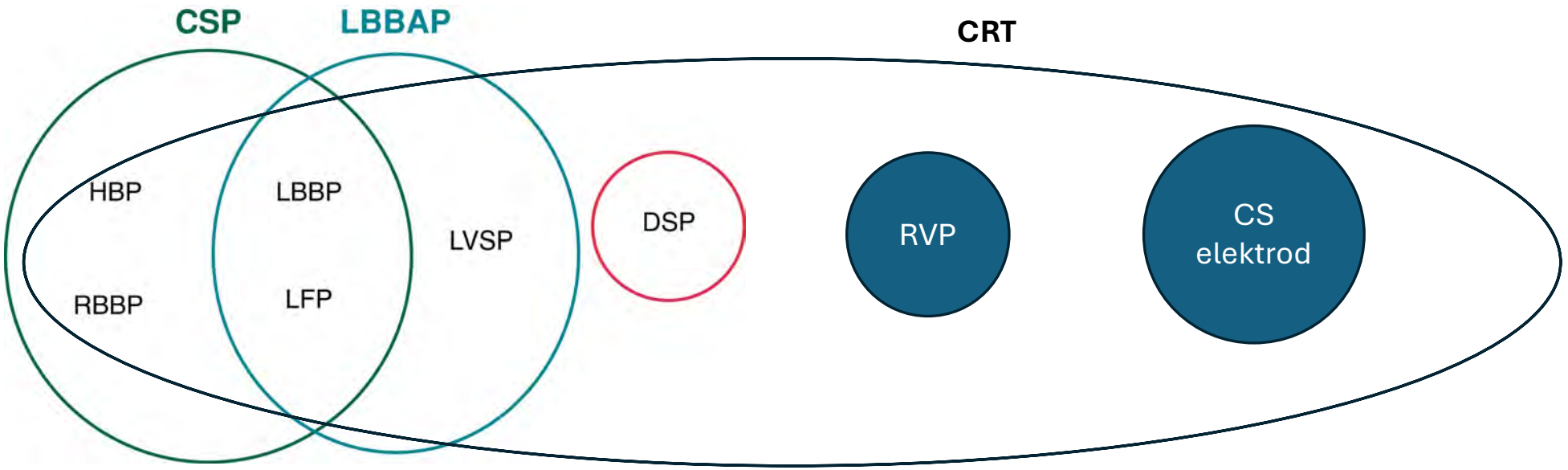


CSP= Conduction System Pacing vid hjärtsvikt

- LBBB = Left BundleBranch Pacing
- LFP = Left Fascikulär Pacing
  (LPFP -posterior, LAFP-anterior, LSFP -septal)
- HBP = His Bundle pacing



Cardiac Physiologic Pacing



Möjliga strategier

1. HOT-CRT =HBP+CS
2. LOT-CRT= LBBAP+CS


I
II
III
AVR
AVL
AVF
V1
V2
V3
V4
V5
V6
HIS
Stim
ECG
0.50
0.75
1.00
x2
100
I
II
III
AVR
AVL
AVF
V1
V2
V3
V4
V5
V6
HIS
Stim
ECG
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
3.25
3.50
3.75
4.00
4.25
4.50
4.75
5.00
5.25
5.50
5.75
6.00
6.25
6.50
x2
50

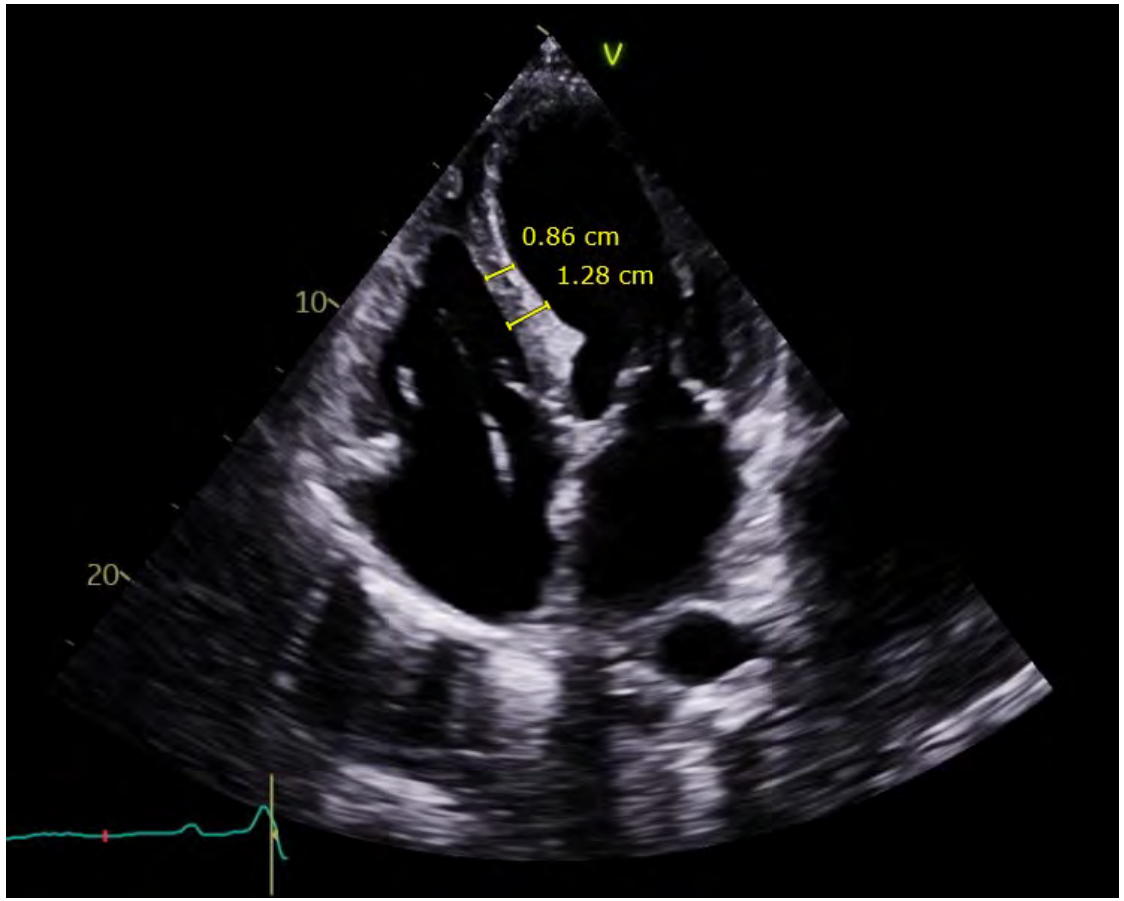
New recommendations in 2021 (13)

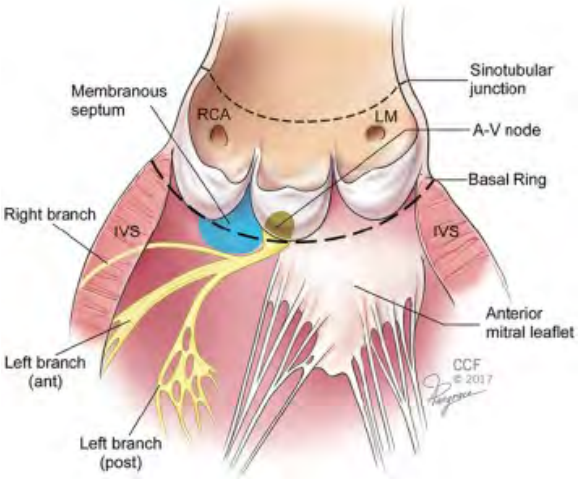
Recommendations	Class	Level
Alternate site pacing – *His bundle pacing (continued)*		
In CRT candidates in whom coronary sinus lead implantation is unsuccessful, HBP should be considered as a treatment option along with other techniques such as surgical epicardial lead.	**IIa**	**B**
In patients treated with HBP, implantation of a right ventricular lead used as "backup" for pacing should be considered in specific situations (e.g. pacemaker-dependency, high-grade AVB, infranodal block, high pacing threshold, planned AVJ ablation), or for sensing in case of issues with detection (e.g. risk of ventricular undersensing or oversensing of atrial/His potentials).	**IIa**	**C**

AVB = atrioventricular block; AVJ = atrioventricular junction; CRT = cardiac resynchronization therapy; HBP = His bundle pacing.

©ESC

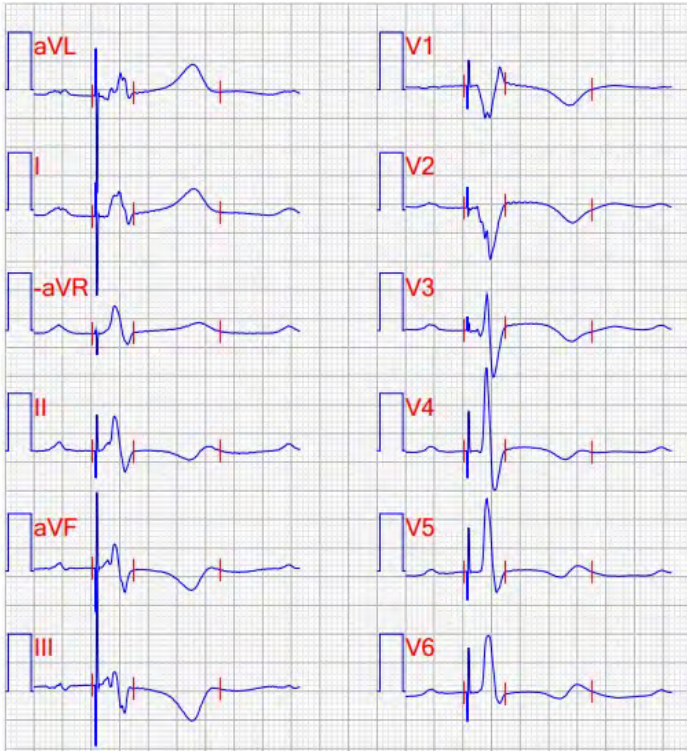
2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab364)

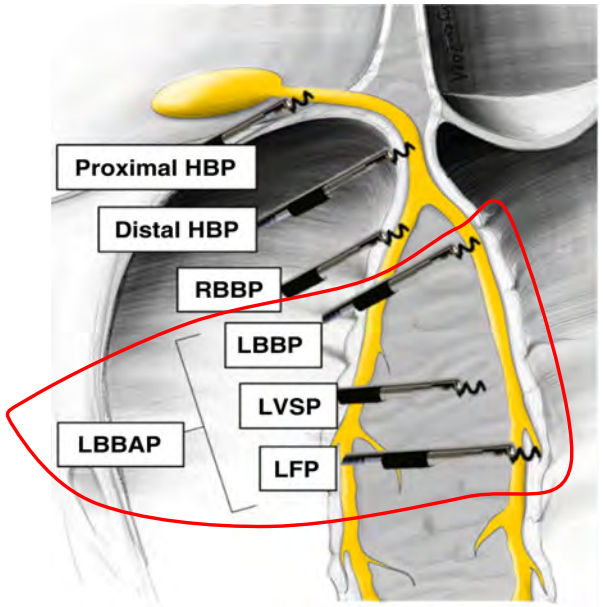

V
0.86 cm
1.28 cm
10
20


Membranous septum
RCA
LM
Sinotubular junction
A-V node
Basal Ring
Right branch
IVS
IVS
Anterior mitral leaflet
Left branch (ant)
Left branch (post)
CCF
© 2017

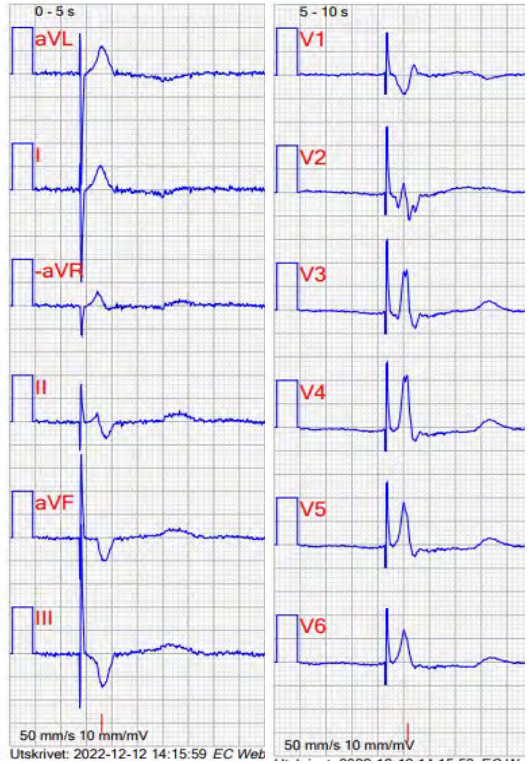
LBBAP = Left Bundle Branch Area Pacing

selektiv LBBP





nonselektiv LBBP



REGIONAL UTBILDNING maj 2023

Take Home Message

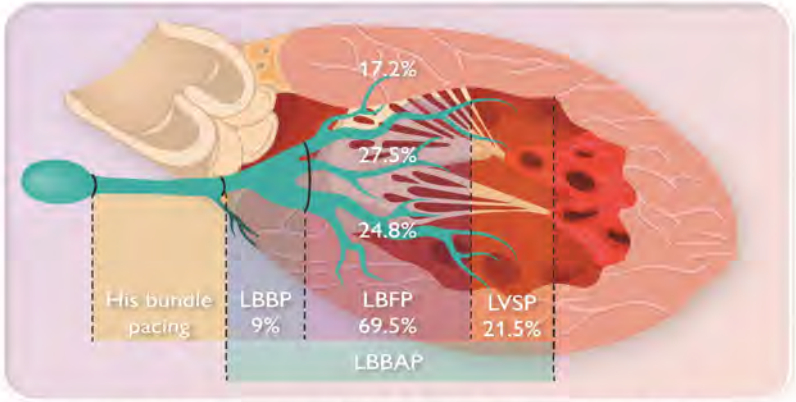
LBBAP is feasible as a primary pacing strategy for any pacing indication. This study redefines LBBAP from a proximal to more a straightforward distal conduction system pacing technique. Success rate in heart failure patients and safety need to be improved.

MELOS — MULTICENTER EUROPEAN LEFT BUNDLE BRANCH AREA PACING OUTCOMES STUDY

Prospective, multicenter, registry-based observational study

2533 Participants

14 European centres



LBBAP implantation success	
Bradycardia indication success	92.4%
Heart failure indication success	82.2%

LBBAP lead complications	8.3%
• Acute perforation to LV	3.7%
• Lead dislodgement	1.5%
• Acute chest pain	1.0%
• Capture threshold rise	0.7%
• Acute coronary syndrome	0.4%
• Trapped/damaged helix	0.4%
• Delayed perforation to LV	0.1%
• Other	0.7%

Independent predictors of LBBAP lead implantation failure

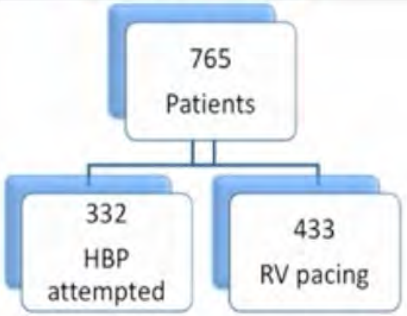
Heart failure indication	**OR 1.49**, 95% CI 1.01–2.21
Baseline QRS duration, per 10 ms	**OR 1.08**, 95% CI 1.03–1.14
LVEDD, per 10 mm increase	**OR 1.53**, 95% CI 1.26–1.86

https://doi.org/10.1093/eurheartj/ehac445

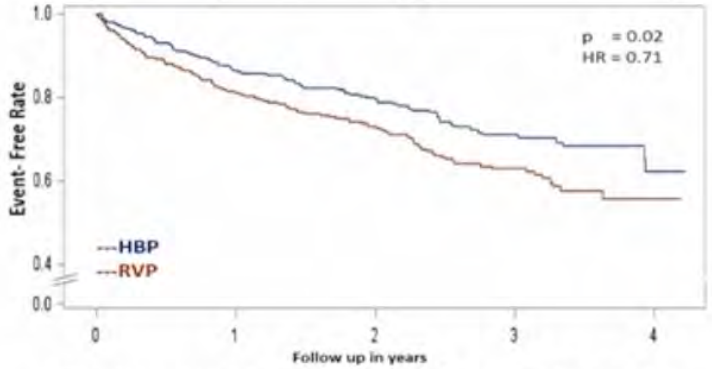
REGIONAL UTBILDNING maj 2023

Clinical Outcomes

HBP vs RVP

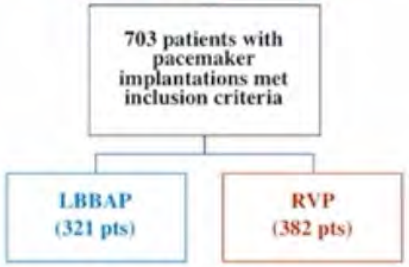


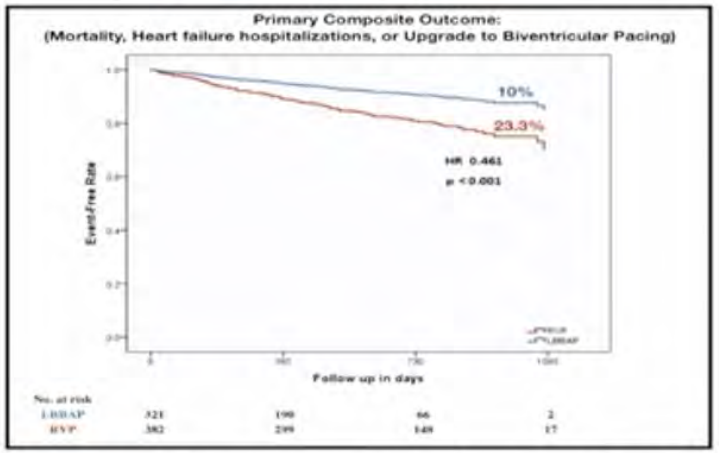
Primary Outcome (Death, HFH or upgrade to biventricular pacing)



Abdelrahman M, Vijayaraman P, et al. JACC 2018

LBBAP vs RVP

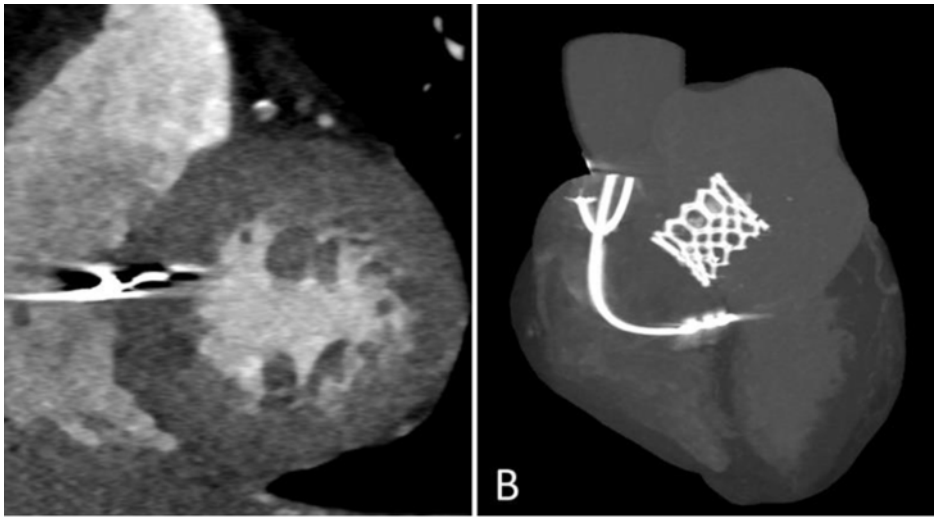




Sharma PS, Vijayaraman P, et al. Heart Rhythm 2022

Vad har hänt under de gångna 3 åren?

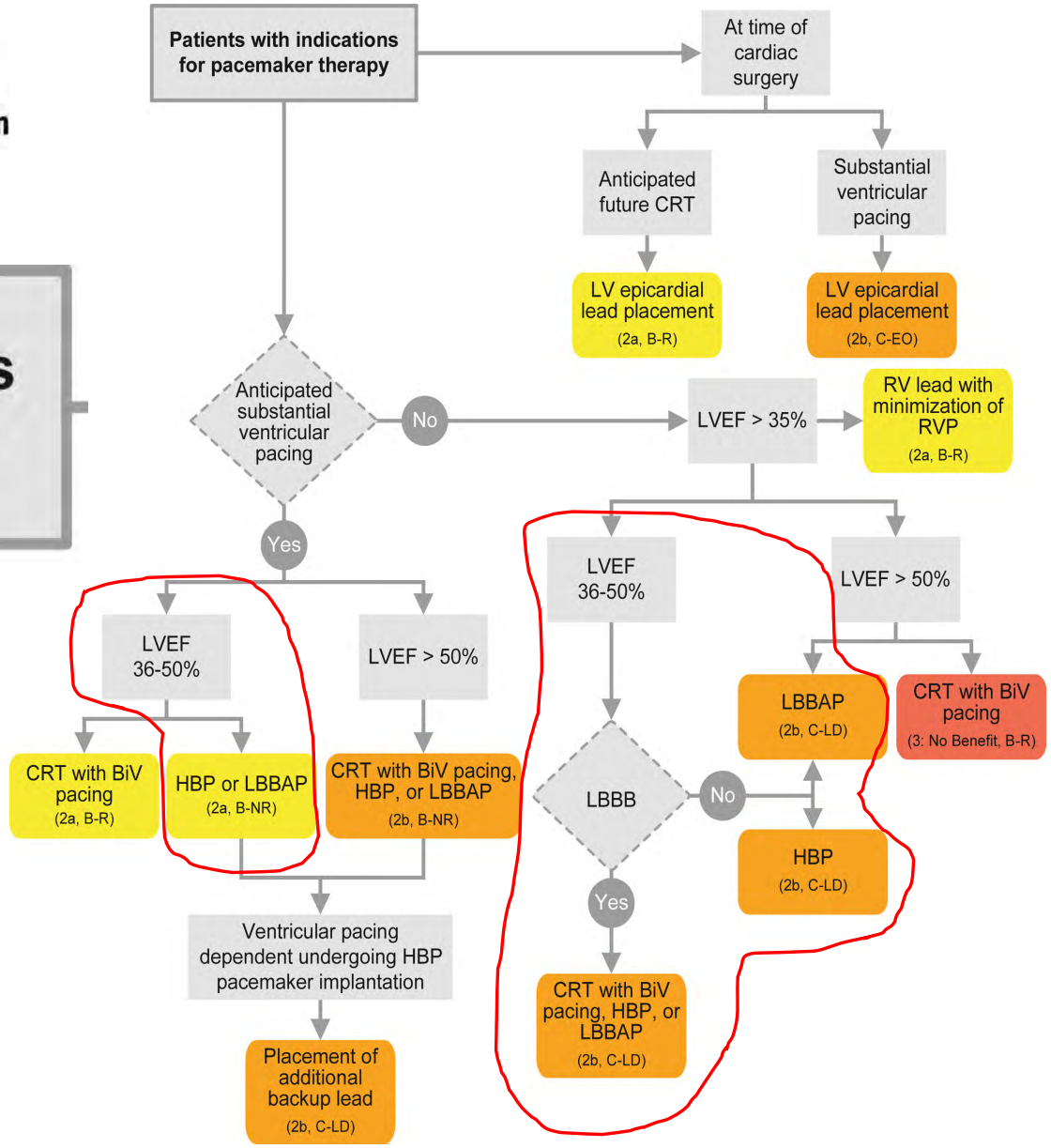
- Fördjupad kunskap
- Fler patienter med implanterade CSP-system
- Nya specialutvecklade elektroder och enheter
- Stor portfolio av hjälpmedel
- Kartläggningssystem



NEWS FROM THE HEART RHYTHM SOCIETY

2023 HRS/APHRS/LAHRS guideline on cardiac physiologic pacing for the avoidance and mitigation heart failure

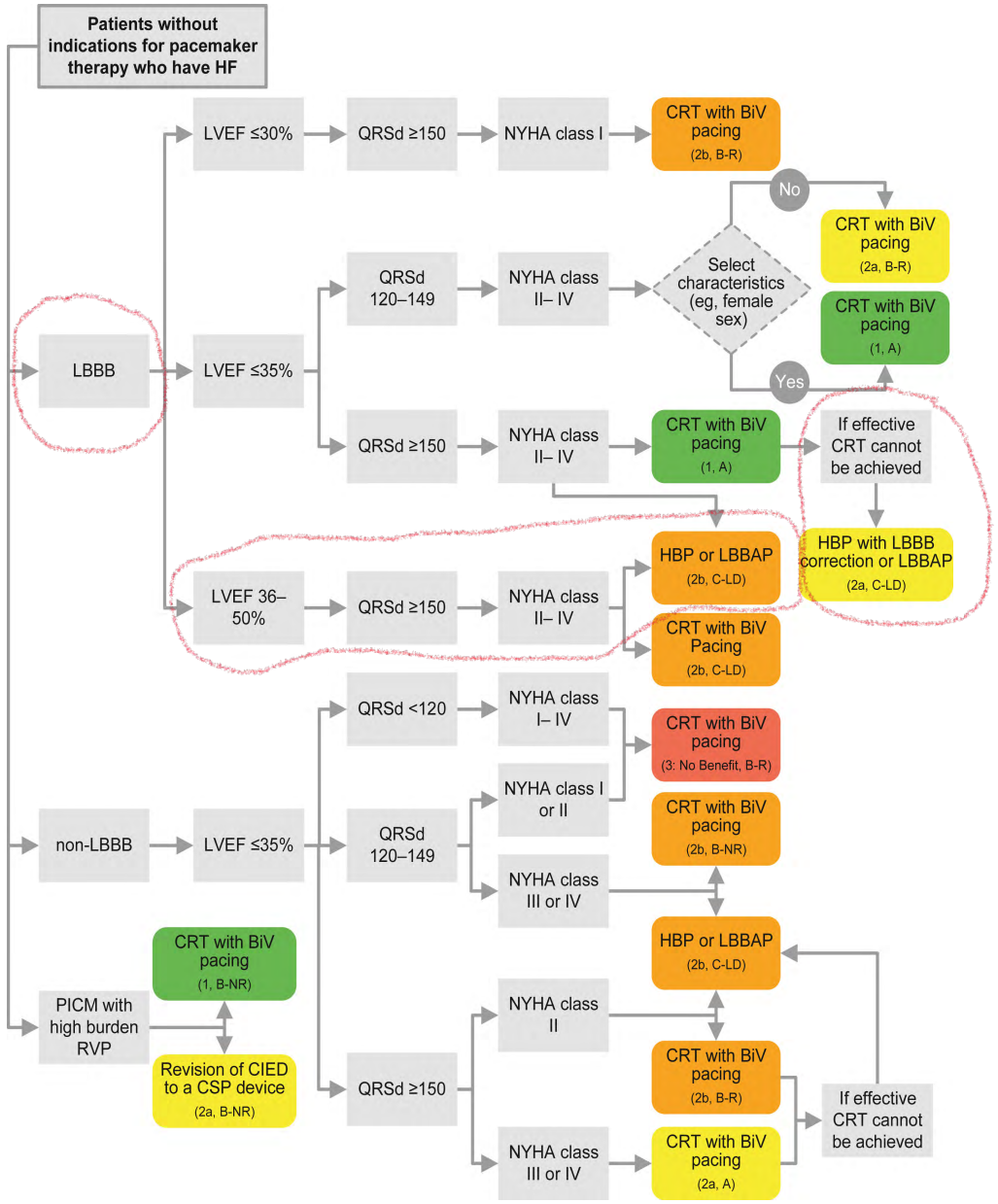
Patients with indications for pacemaker therapy



NEWS FROM THE HEART RHYTHM SOCIETY

2023 HRS/APHRS/LAHRS guideline on cardiac physiologic pacing for the avoidance and mitigation of heart failure

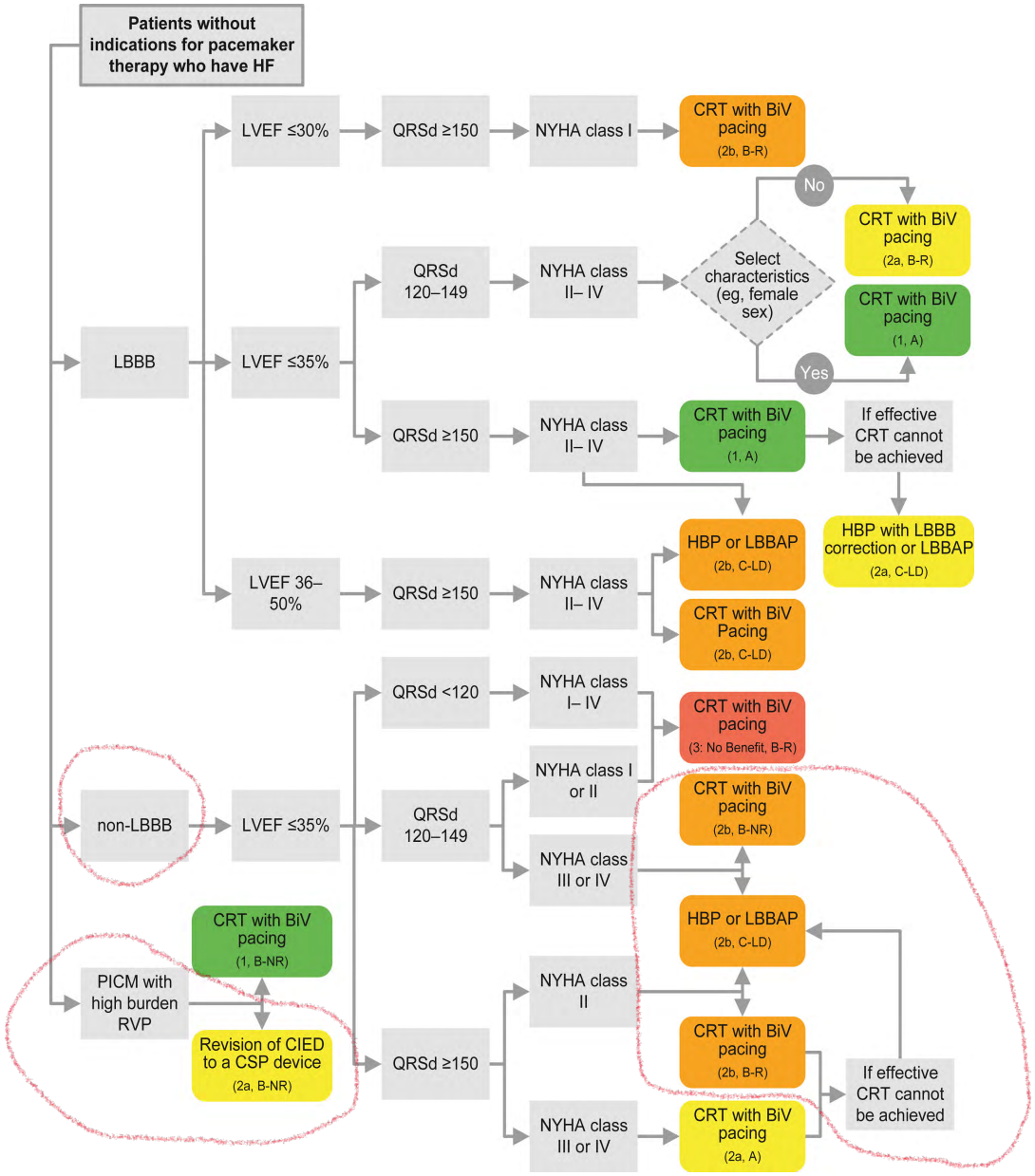
Patients without indications for pacemaker therapy who have HF



NEWS FROM THE HEART RHYTHM SOCIETY

2023 HRS/APHRS/LAHRS guideline on cardiac physiologic pacing for the avoidance and mitigation of heart failure

Patients without indications for pacemaker therapy who have HF



ESC European Society of Cardiology

Europace (2023) **25**, 682–687
https://doi.org/10.1093/europace/euac201

EHRA SURVEY

Conduction system pacing in everyday clinical practice: EHRA physician survey

Bratislav Kircanski [1,2], Serge Boveda [3,4,5], Frits Prinzen [6], Antonio Sorgente [7], Ante Anic [8], Giulio Conte [9], and Haran Burri [10]*

[1]University Clinical Centre of Serbia, Pacemaker Centre, Belgrade, Serbia; [2]Faculty of Medicine, University of Belgrade, Belgrade, Serbia; [3]Heart Rhythm Department, Clinique Pasteur, 31076 Toulouse, France; [4]Universitair Ziekenhuis Brussel—VUB, Heart Rhythm Management Centre, Brussels, Belgium; [5]INSERM U970, 75908 Paris Cedex 15, France; [6]Department of Physiology, Maastricht University, Maastricht, The Netherlands; [7]Epicura Centre Hospitalier, Hornu, Belgium; [8]Department for Cardiovascular Diseases, University Hospital Center Split, Split, Croatia; [9]Cardiology Department, Fondazione Cardiocentro Ticino, Lugano, Switzerland; and [10]Cardiac Pacing Unit, Cardiology Department, University Hospital of Geneva, Rue Gabrielle Perret Gentil 4, 1205 Geneva, Switzerland

Received 12 October 2022; accepted after revision 18 October 2022; online publish-ahead-of-print 23 November 2022

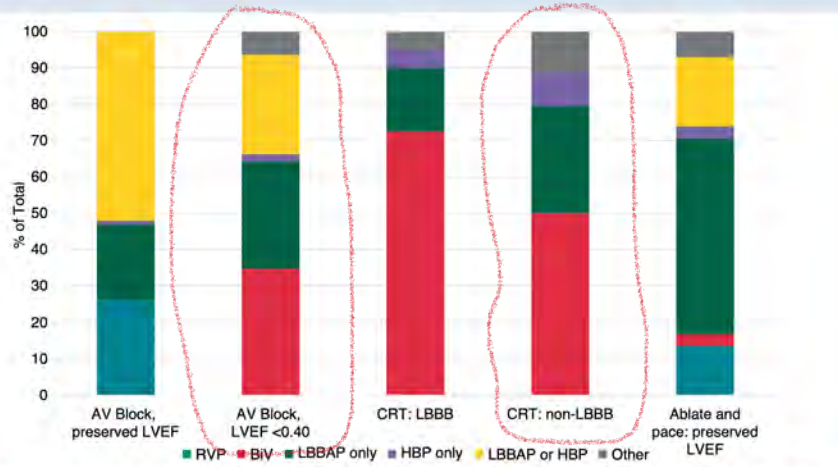


Figure 1 Preferred pacing modality according to indication amongst physicians who implant conduction system pacing. 'Other' includes His-optimized and left bundle pacing optimized CRT (HOT-CRT and LOT-CRT, respectively). AV, atrioventricular; BiV, biventricular; CRT, cardiac resynchronization therapy; HBP, is bundle pacing; LBBAP, left bundle branch area pacing; LBBB, left bundle branch block; LVEF, left ventricular ejection fraction; RVP, right ventricular pacing.

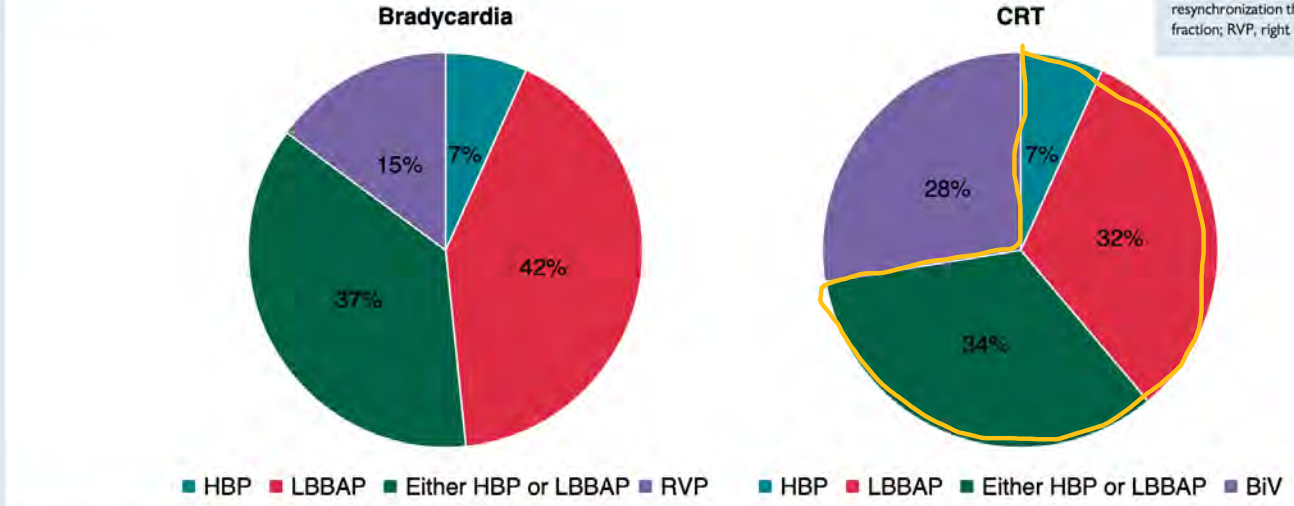
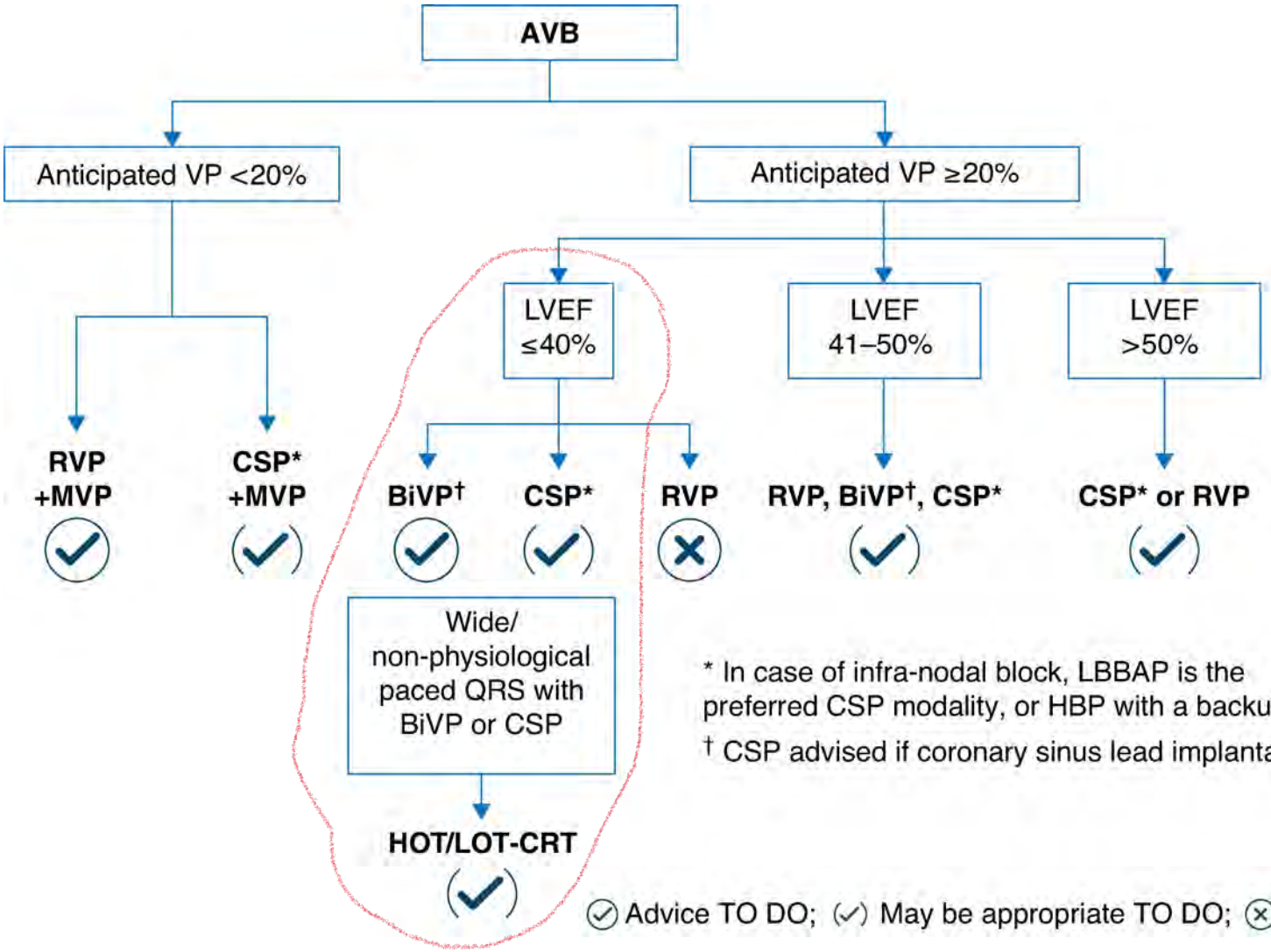


Figure 5 Anticipated application of different pacing modalities according to indication. Abbreviations as in *Figure 1*.

ESC European Society of Cardiology Europace (2025) 27, euaf050 https://doi.org/10.1093/europace/euaf050 EHRA DOCUMENT EHRA European Heart Rhythm Association

European Society of Cardiology (ESC) clinical consensus statement on indications for conduction system pacing, with special contribution of the European Heart Rhythm Association of the ESC and endorsed by the Asia Pacific Heart Rhythm Society, the Canadian Heart Rhythm Society, the Heart Rhythm Society, and the Latin American Heart Rhythm Society



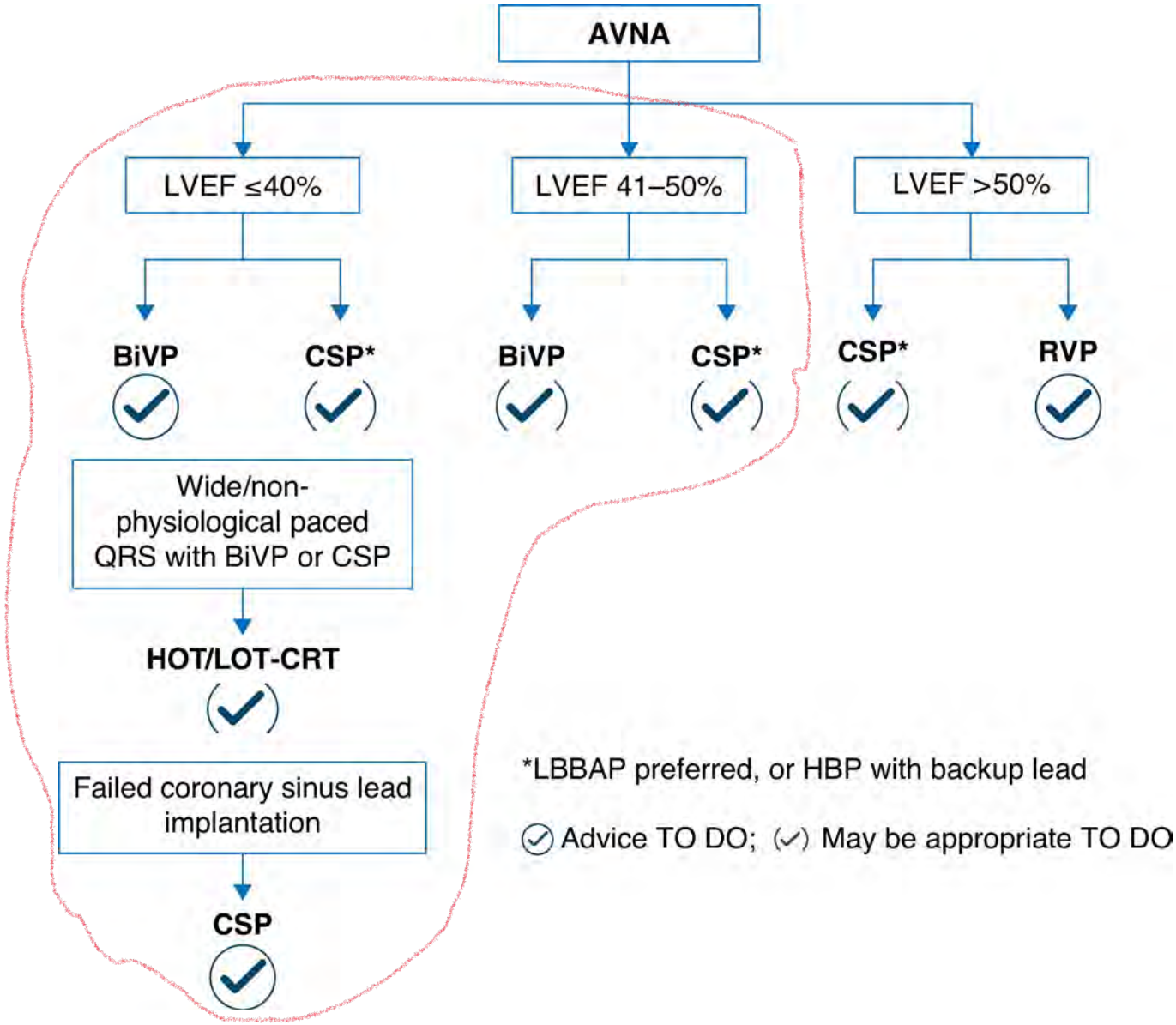
* In case of infra-nodal block, LBBAP is the preferred CSP modality, or HBP with a backup lead

† CSP advised if coronary sinus lead implantation fails

✓ Advice TO DO; (✓) May be appropriate TO DO; ✗ Advice NOT DO DO

Europace, Volume 27, Issue 4, April 2025, euaf050, https://doi.org/10.1093/europace/euaf050

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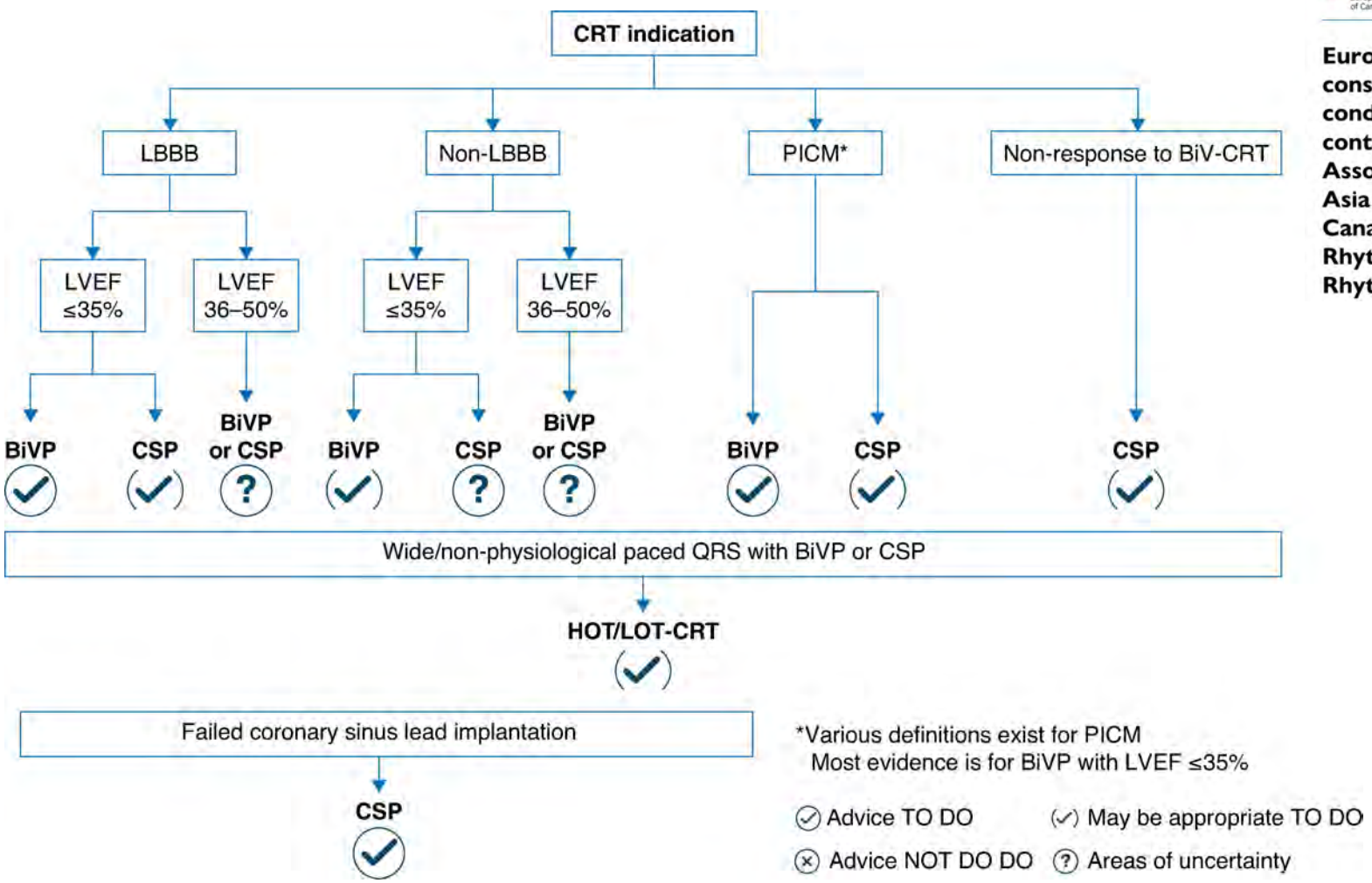


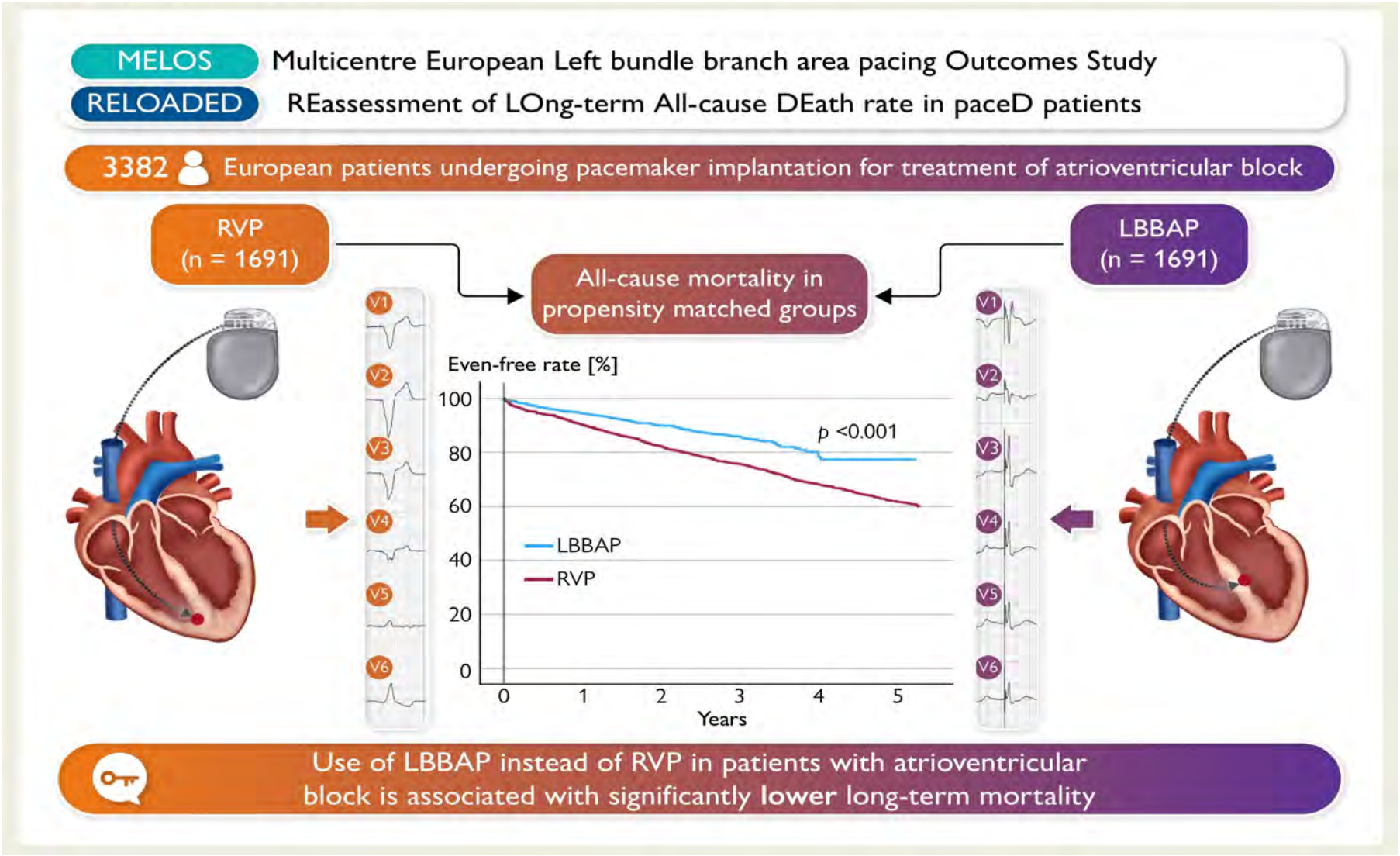
ESC European Society of Cardiology
Europace (2025) 27, euaf050 https://doi.org/10.1093/europace/euaf050
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ESC European Society of Cardiology Europace (2025) 27, euaf050 https://doi.org/10.1093/europace/euaf050 EHRA DOCUMENT EHRA European Heart Rhythm Association

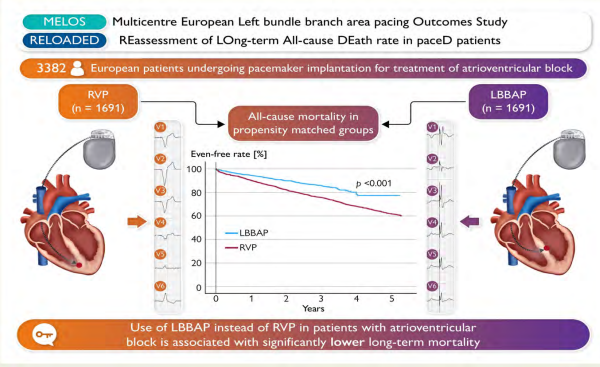
European Society of Cardiology (ESC) clinical consensus statement on indications for conduction system pacing, with special contribution of the European Heart Rhythm Association of the ESC and endorsed by the Asia Pacific Heart Rhythm Society, the Canadian Heart Rhythm Society, the Heart Rhythm Society, and the Latin American Heart Rhythm Society

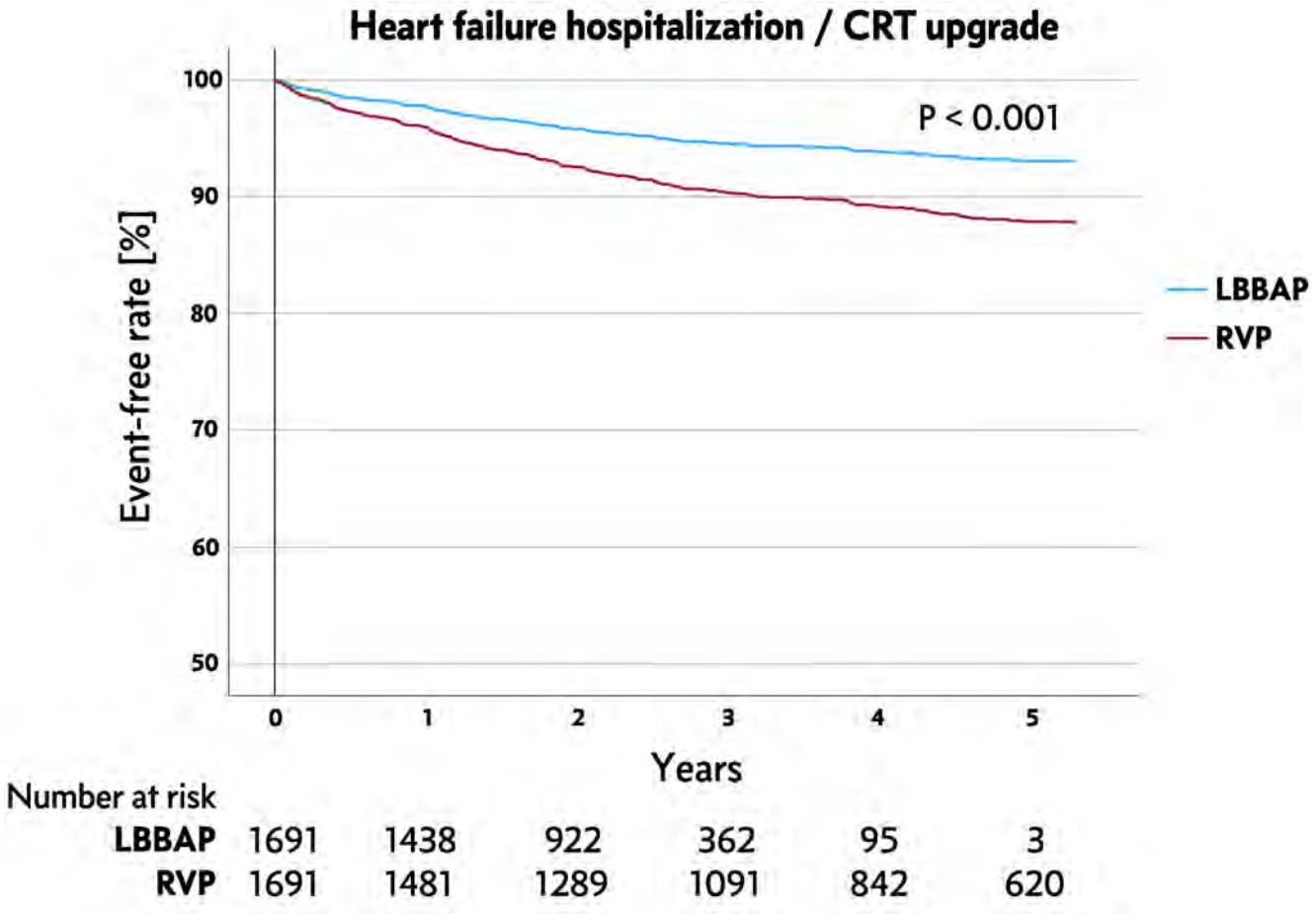




Eur Heart J, Volume 47, Issue 13, 1 April 2026, Pages 1541–1550, https://doi.org/10.1093/eurheartj/ehaf699

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Eur Heart J, Volume 47, Issue 13, 1 April 2026, Pages 1541–1550, https://doi.org/10.1093/eurheartj/ehaf699

ESC GUIDELINES

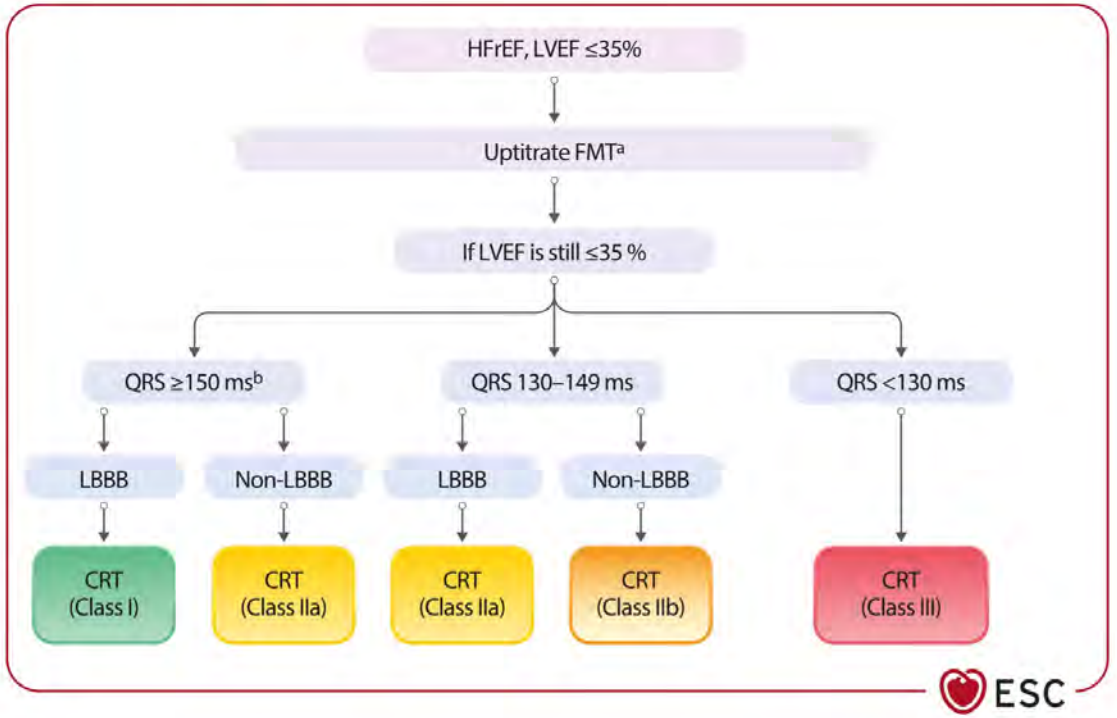
2026 ESC Guidelines for the management of heart failure

Developed by the task force for the management of heart failure of the European Society of Cardiology (ESC)

With the special contribution of the Heart Failure Association (HFA) of the ESC

Endorsed by the European Association for Cardio-Thoracic Surgery (EACTS)

Figure 10 Indications for cardiac resynchronization therapy implantation in heart failure



2026 ESC Guidelines for the management of heart failure (European Heart Journal; 2026 – doi: 10.1093/eurheartj/ehag100

JAMA Cardiology

RCT: Long-Term Outcomes of Left Bundle-Branch Pacing vs Biventricular Pacing in Heart Failure

POPULATION

136 Men, 64 Women

Adults with a left ventricular ejection fraction ≤35% and left bundle-branch block

Mean (SD) age, 64.8 (9.5) y

SETTINGS / LOCATIONS

6 Centers in China

INTERVENTION

200 Participants randomized

100 LBBP
Treatment with left bundle-branch pacing (LBBP)

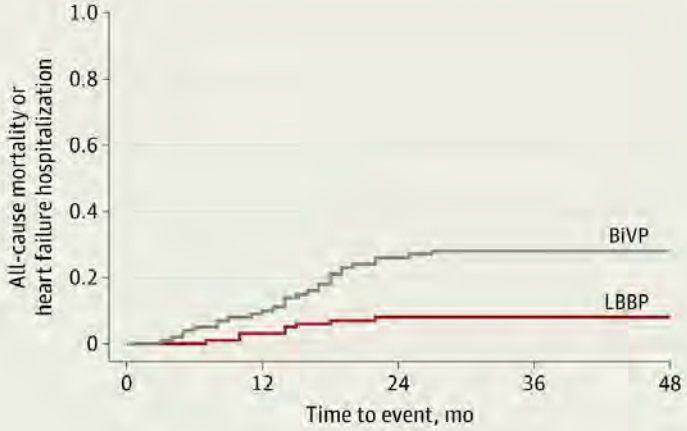
100 BiVP
Treatment with biventricular pacing (BiVP)

PRIMARY OUTCOME

Composite outcome of all-cause mortality and heart failure hospitalization (HFH), with HFH defined as any urgent visit or hospitalization with heart failure signs or symptoms requiring intravenous diuretic therapy

FINDINGS

At a median follow-up of 36 mo, the LBBP group had a significantly lower risk of the composite outcome of all-cause mortality and HFH compared to the BiVP group



Hazard ratio for the composite outcome:
0.26; 95% CI, 0.12-0.57; *P*<.01

Chen X, Liu X, Li R, et al. Long-term outcomes of left bundle-branch pacing vs biventricular pacing in heart failure: the HeartSync-LBBP randomized clinical trial. *JAMA Cardiol*. Published online March 11, 2026. doi:10.1001/jamacardio.2026.0083

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Kliniska situationer

Klass I indikation

- Misslyckad implantation av LV elektrod/ej tekniskt möjligt
- Icke responders
- De novo implantation hos individer med AV block och sänkt EF

Klass II indikation

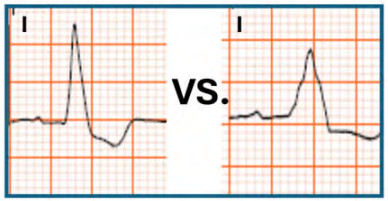
- Smalare än 150 ms QRS-komplex
- Icke LBBB
- Uppgradering från DDD pace

Preventiv indikation

- Hög andel kammarpace
- T ex inför His ablation

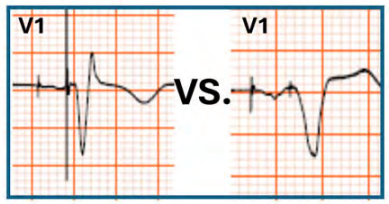
QRS < 171 ms | QRS > 171 ms

Baseline QRS



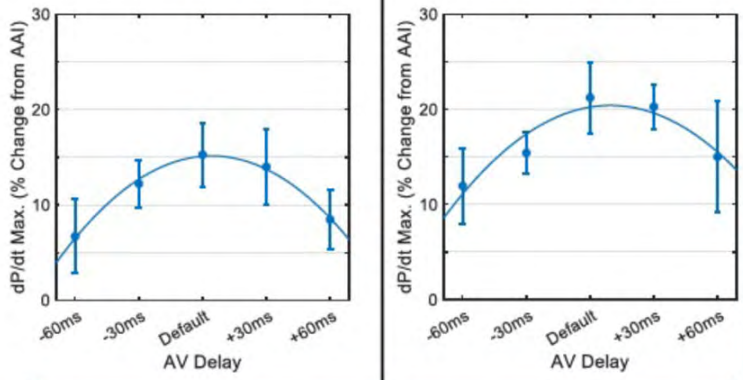
The SUBSTRATE

LBBAP | Deep Septal Pacing (DSP)



The CAPTURE TYPE

Individualized Optimization of Resynchronization

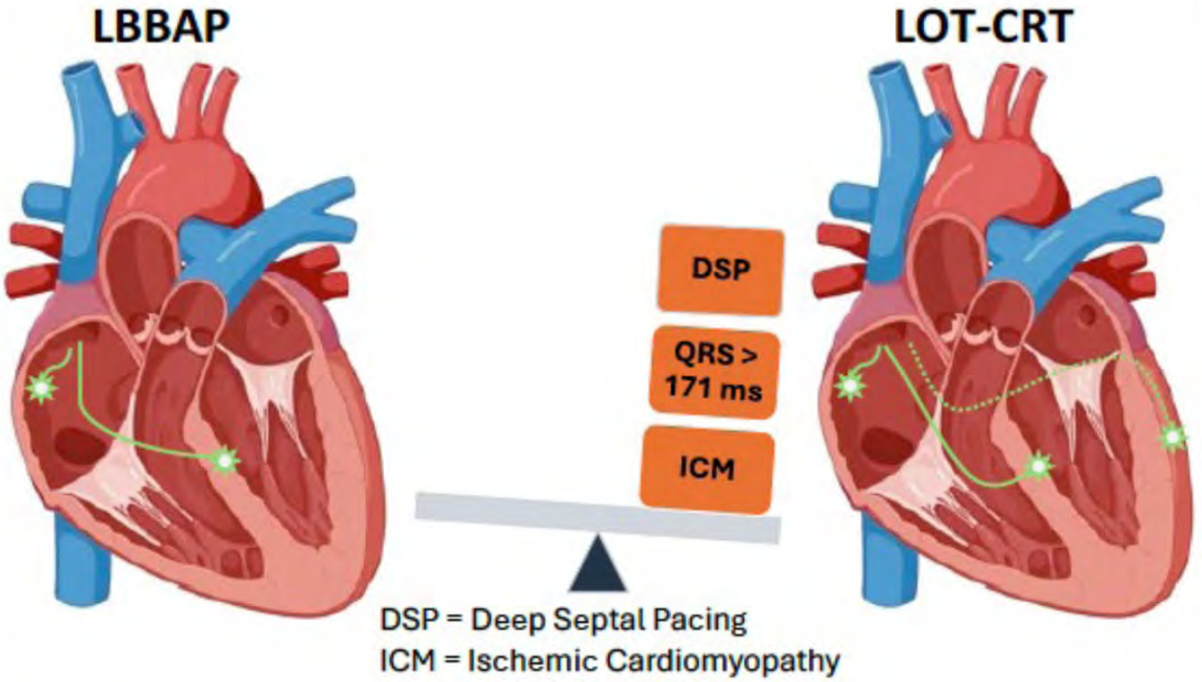


	LBBAP	LOT-CRT
♀ Patient with: • DSP • ICM • QRS 175ms	$LVdP/dt_{max}$ ↑ by **15%** QRSduration ↓ by **27ms**	$LVdP/dt_{max}$ ↑ by **20%** QRSduration ↓ by **40ms**
♂ Patient with: • LBBAP • non-ICM • QRS 166ms	$LVdP/dt_{max}$ ↑ by **15%** QRSduration ↓ by **8ms**	$LVdP/dt_{max}$ ↑ by **16%** QRSduration ↓ by **16ms**

Combined Results

Patient population (N=48):

ICM (29%) versus NICM (71%); LBBB (40%) versus IVCD (60%); LBBAP (56%) versus DSP (44%); and Anodal capture (54%)



DSP = Deep Septal Pacing

ICM = Ischemic Cardiomyopathy

Conclusions: Subjects with suboptimal LBBAP (i.e., DSP), wider QRS, and ICM are more likely to benefit from LOT-CRT. Anodal capture is detrimental during LBBAP.

6.2.3. Conduction system pacing

Conduction system pacing (CSP), including His bundle and left bundle branch area pacing, aims to engage the Purkinje network for rapid and synchronous LV activation.[426] Left bundle branch area pacing may prove to be a feasible alternative to CRT when implantation is challenging. However, no RCT with patient-centred outcomes has evaluated the efficacy or long-term safety of CSP in HFrEF. Therefore, no recommendations can currently be made. See *Evidence Table 22* and Supplementary data online, *Section S3.1.3* for further details.[427–433]

ESC European Heart Journal (2026) 00, 1–112
https://doi.org/10.1093/eurheartj/ehag100

2026 ESC Guidelines for the management of heart failure

Developed by the task force for the management of heart failure of the European Society of Cardiology (ESC)

With the special contribution of the Heart Failure Association (HFA) of the ESC

Endorsed by the European Association for Cardio-Thoracic Surgery (EACTS)

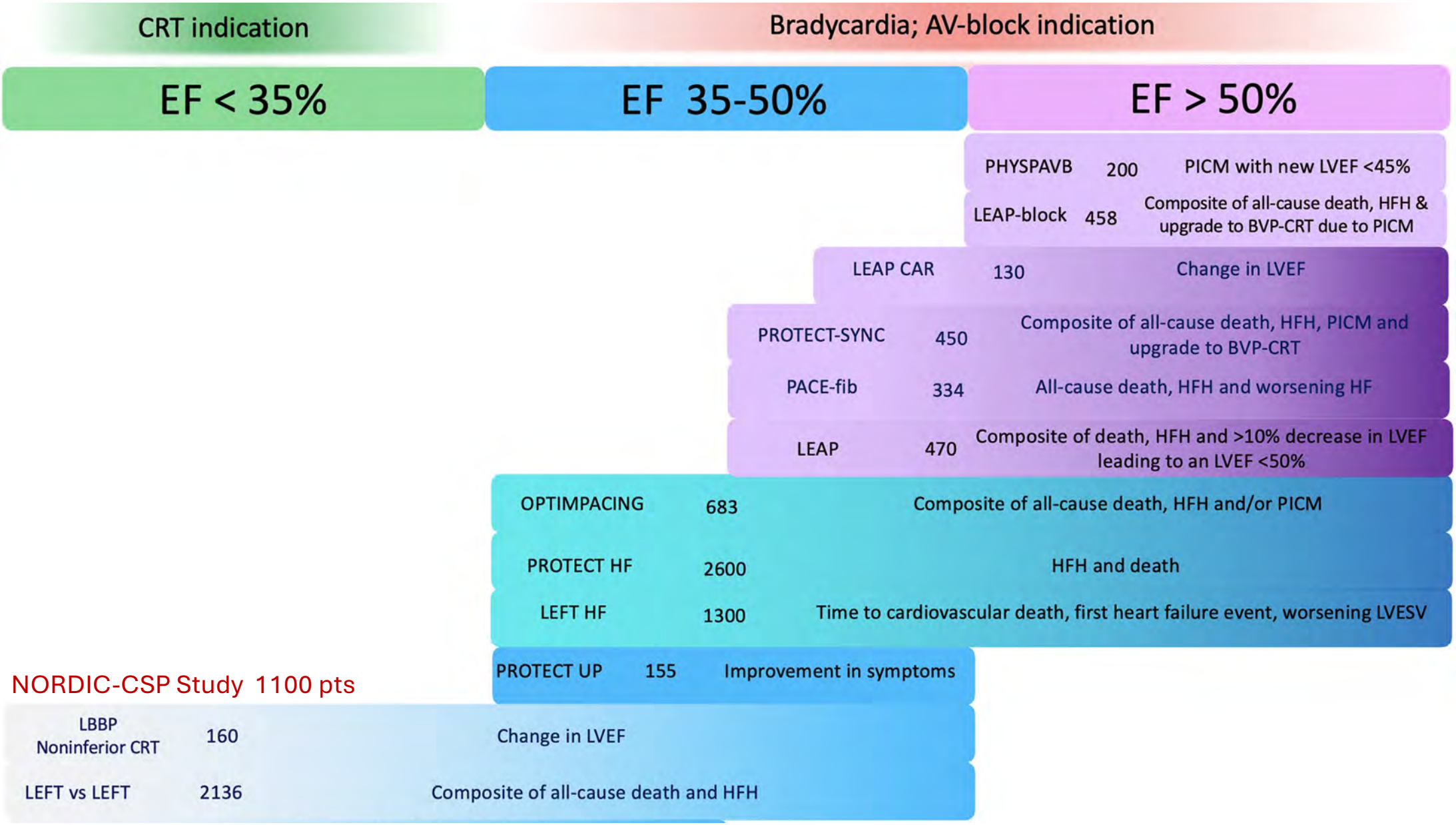
3.2.4. Conduction system pacing

Direct stimulation of the His bundle or left bundle branch is termed 'selective', whereas indirect stimulation involving the additional recruitment of the local myocardium is termed 'non-selective'.

Although conduction system pacing is, in essence, a form of cardiac resynchronization therapy (CRT), the term CRT will be reserved for trans-coronary vein (trans-CV) CRT in this guideline.

In an RCT of 50 patients with HFrEF, changes in LVEF at 6 months were similar to trans-CV CRT.[40] Despite these findings, low implantation success rates (≤75%) and long-term complications, notably the development of atrioventricular block (as high as 19.6%),[41] unacceptable thresholds, and loss of capture at follow-up[42,43] have led experienced operators to largely abandon His bundle pacing.

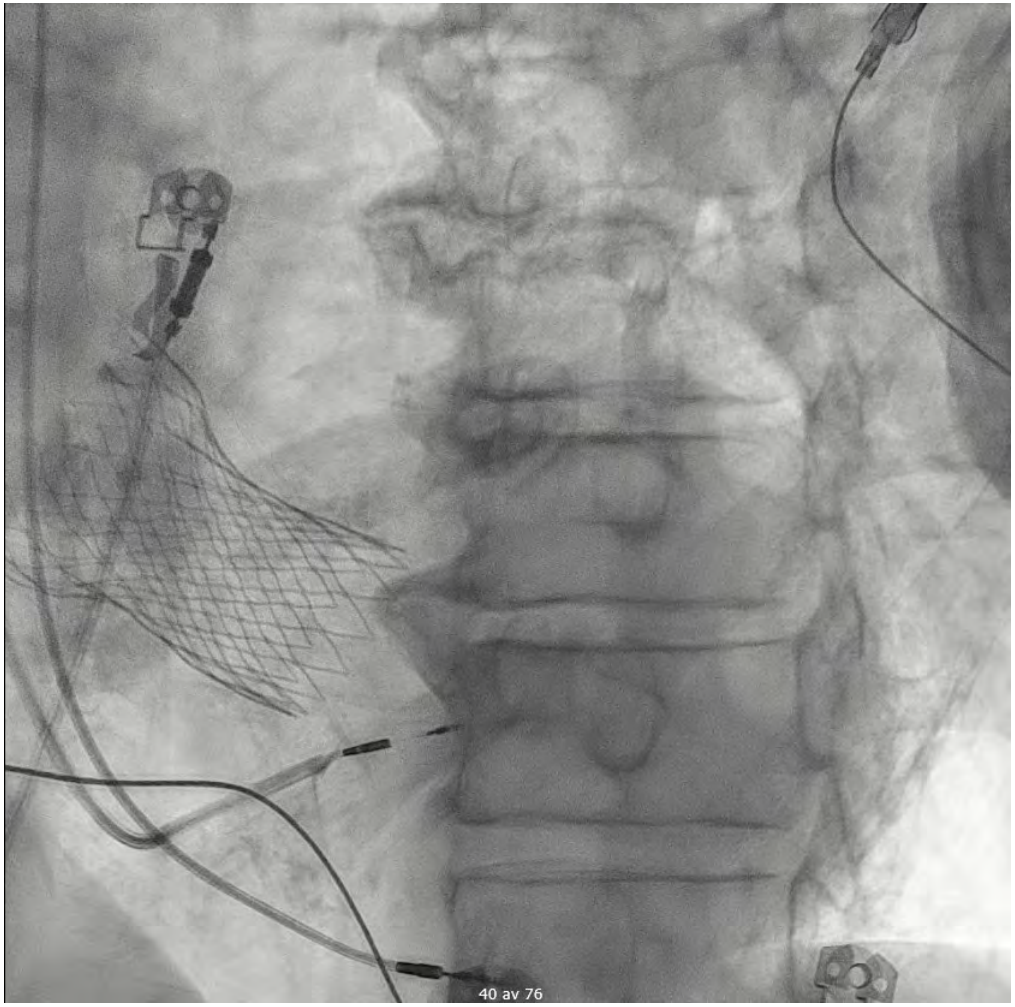
In a prospective study of 187 patients with an LVEF ≤40%, the implant success rate of left bundle branch area pacing (LBBAP) was 81% in patients with a left bundle branch block (LBBB). However, this figure was only 54.5% in those with a non-LBBB.[44] In the only RCT comparing LBBAP with trans-CV CRT, a higher LVEF was observed after LBBAP.[45] Although it is reasonable to use LBBAP if implantation of a trans-CV lead is not successful, LBBAP cannot be recommended as first line in CRT candidates.[46] In this context, no studies have satisfactorily addressed whether LBBAP should be used in CRT 'non-responders'.

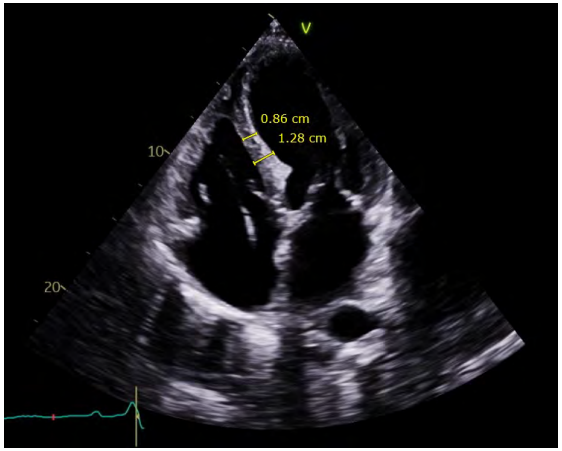

CRT indication
Bradycardia; AV-block indication
EF < 35%
EF 35-50%
EF > 50%
PHYSPAVB 200 PICM with new LVEF <45%
LEAP-block 458 Composite of all-cause death, HFH & upgrade to BVP-CRT due to PICM
LEAP CAR 130 Change in LVEF
PROTECT-SYNC 450 Composite of all-cause death, HFH, PICM and upgrade to BVP-CRT
PACE-fib 334 All-cause death, HFH and worsening HF
LEAP 470 Composite of death, HFH and >10% decrease in LVEF leading to an LVEF <50%
OPTIMPACING 683 Composite of all-cause death, HFH and/or PICM
PROTECT HF 2600 HFH and death
LEFT HF 1300 Time to cardiovascular death, first heart failure event, worsening LVESV
PROTECT UP 155 Improvement in symptoms
NORDIC-CSP Study 1100 pts
LBBP Noninferior CRT 160 Change in LVEF
LEFT vs LEFT 2136 Composite of all-cause death and HFH

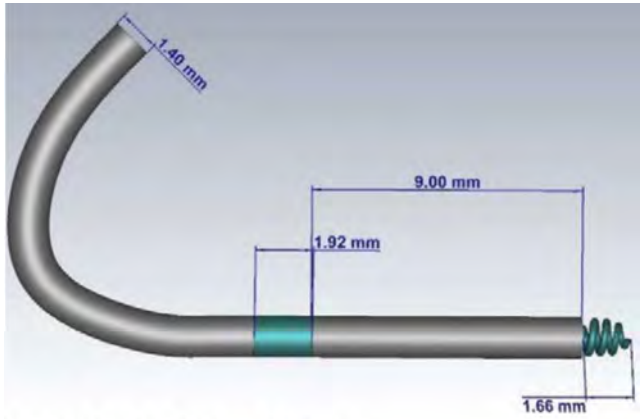
- AV block efter TAVI
- EF 30-40%





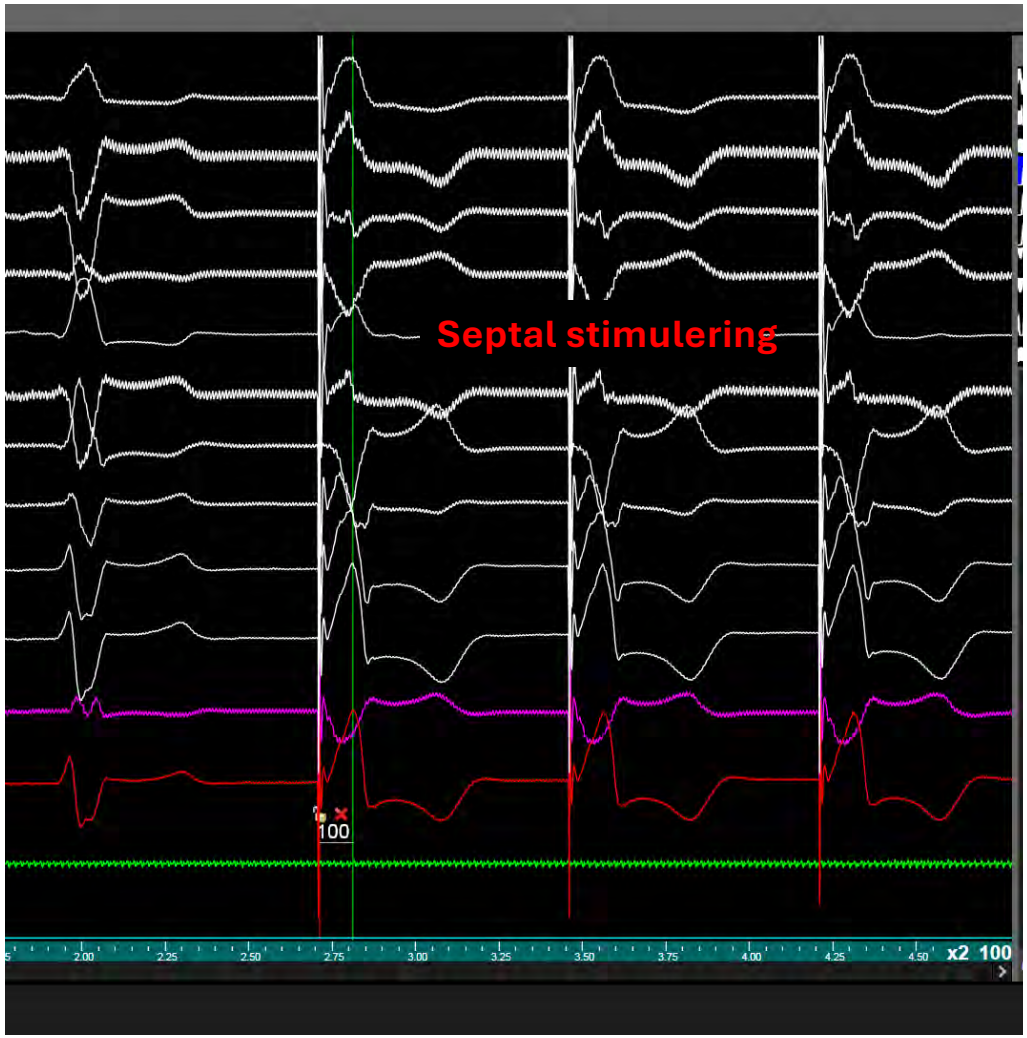




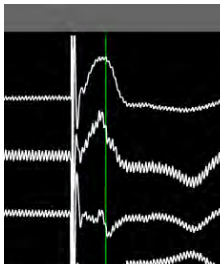


3D-model of the Select Secure 3830 Electrode by Medtronic

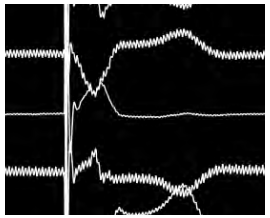
Egna QRS



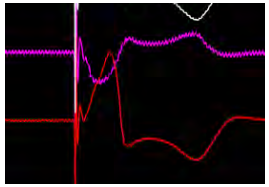
I
II
III
aVL
aVR
aVF
V_2
V_3
V_4
V_5
V_1
V_2



Positiv QRS i II

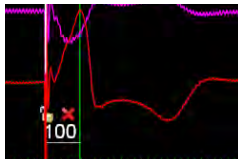


Diskordant QRS
aVR
aVL



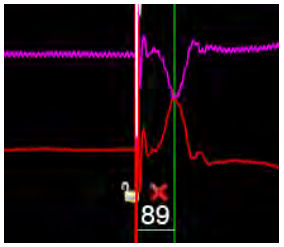
W mönster i V_1

LVAT (left ventricle activation time)
> 80 ms om egna QRS smala

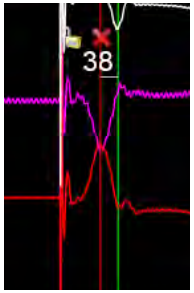


Mätningar under ingreppet

- R signal /unipolär, bipolär/
- Skadepotential /unipolär
- Pacingimpedans/ förändringar under sekvenser av skruvning
- QRS morfologi
- Pacingtröskel



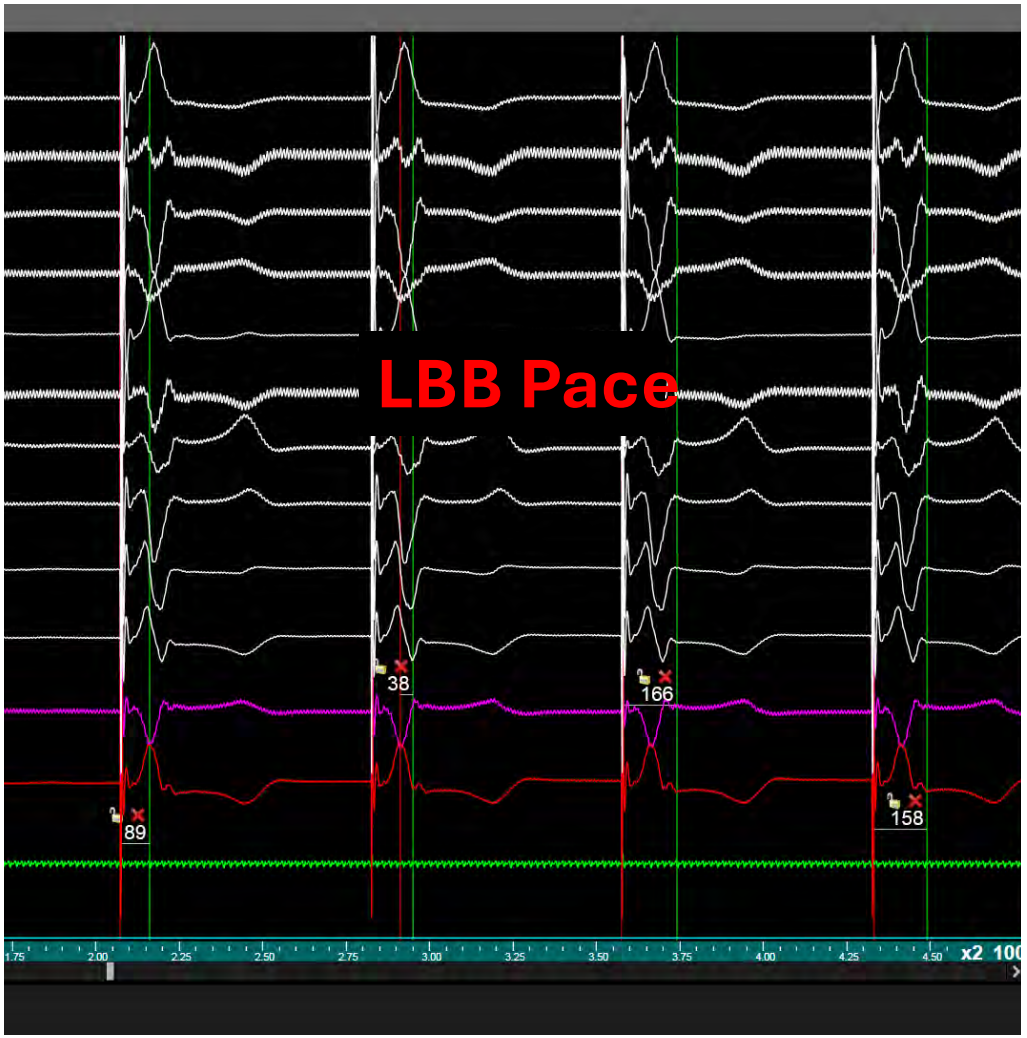
LVAT < 80 ms om egna QRS smala
LVAT < 90 ms om egna QRS breddökade



V_6 - V_1 interpeak interval > 33 ms

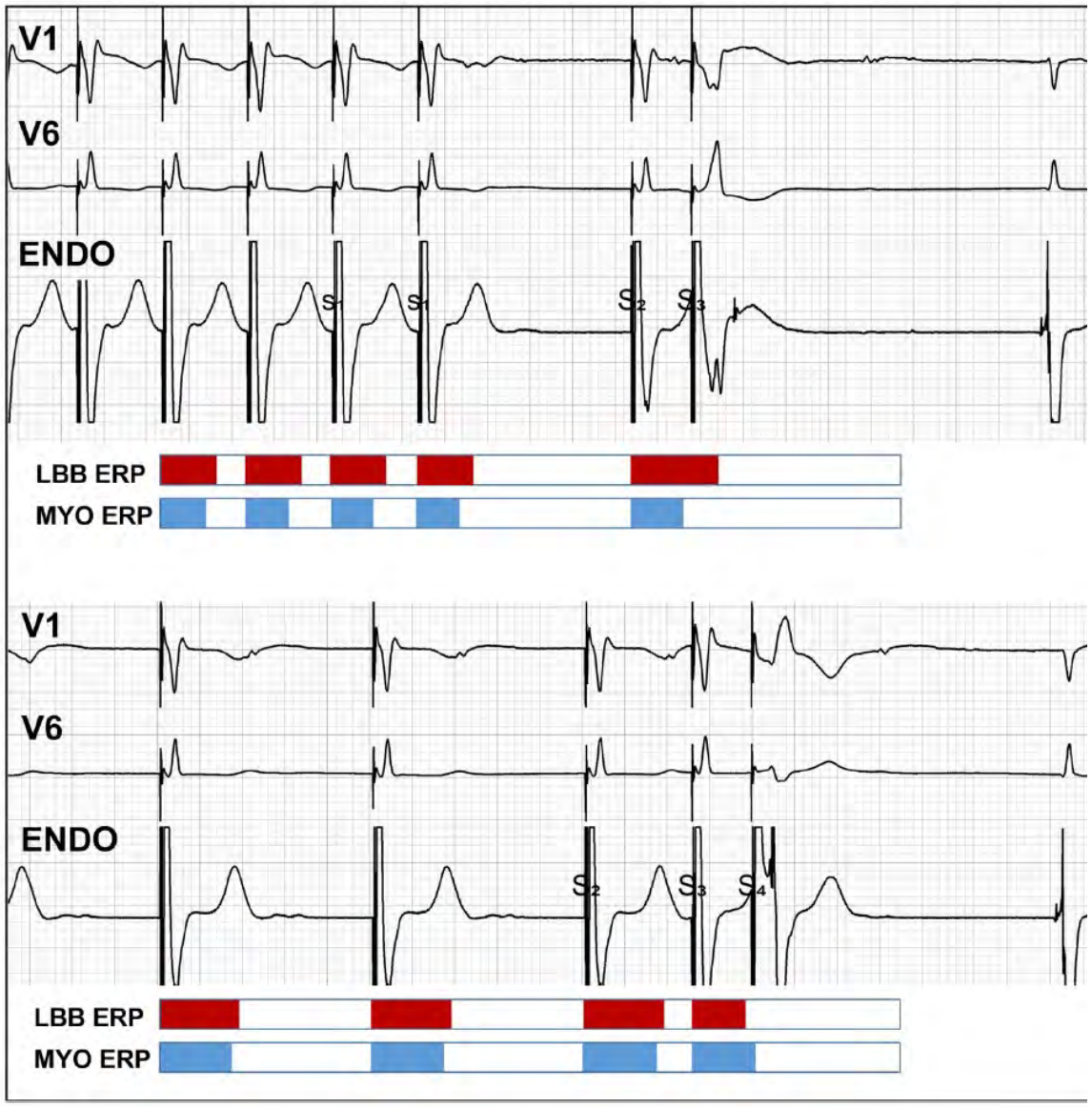


Qr eler qR i V_1




File
Display
Printing
Measurements
Ablator
Setup
Help
I
II
III
AVR
AVL
AVF
V2
V3
V4
V5
V1
V6
HIS
69
40
135
REVIEW
EP # : 7139.1 Type :
Patient : Elfring / Nils / Male / 19390806
Started: 12/12/2022 9:00:12 AM
12/12/2022 9:02:20 AM Study ended.
12/12/2022 9:02:20 AM Study appended
10:19:30
12/12/2022 11:16:18 AM Study ended.
13:38:39 Screencopy : Screenshot.000.png
Stim
ECG
x2 150
LOG
Patient
Clock


File
Display
Printing
Measurements
Ablator
Setup
Help
I
II
III
AVR
AVL
AVF
V2
V3
V4
V5
V1
V6
HIS
21
REVIEW
EP # : 7139.1 Type :
Patient : Elfring / Nils / Male / 19390806
Started: 12/12/2022 9:00:12 AM
12/12/2022 9:02:20 AM Study ended.
12/12/2022 9:02:20 AM Study appended
10:19:30
12/12/2022 11:16:18 AM Study ended.
Stim
ECG
x2 150
LOG
Patient
Clock
EP-TRACER

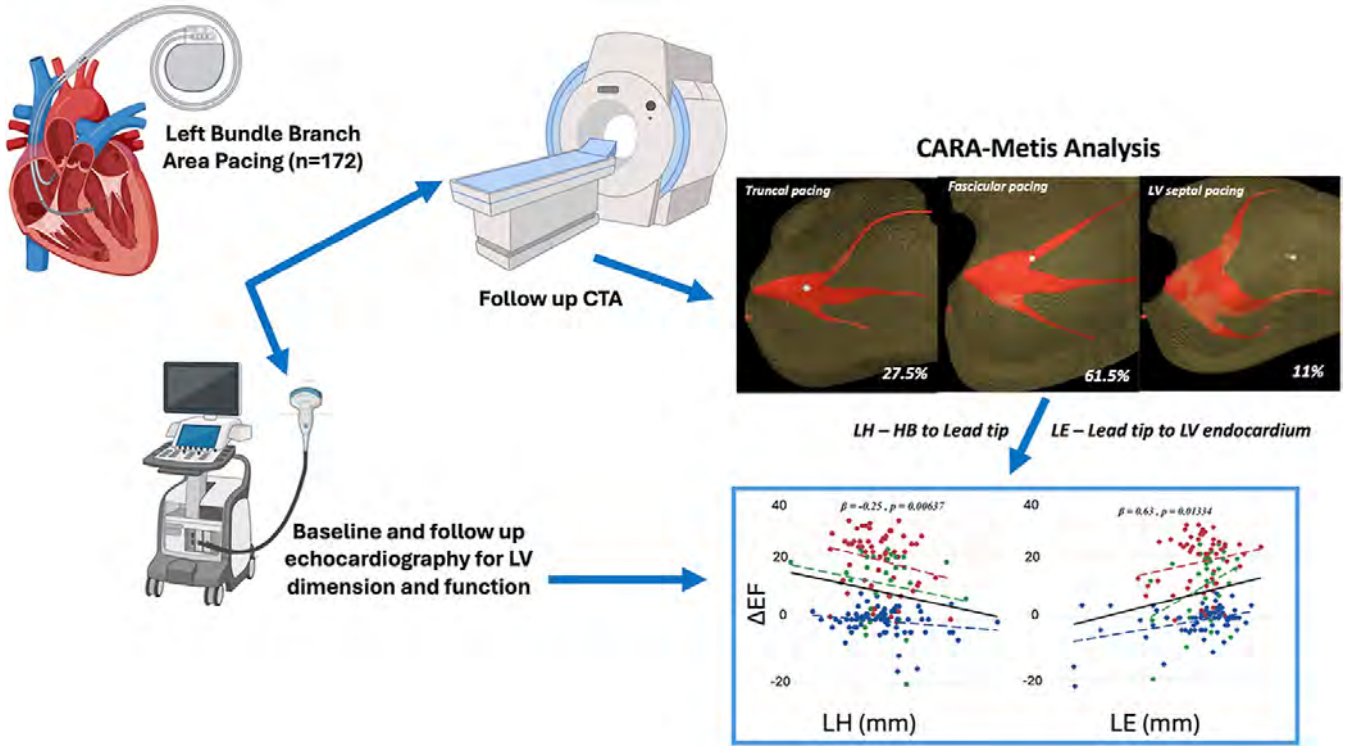


Programmerad stimulering för att verifiera elektrodkontakt med retledningssystemet

LBBB och myokardiet har olika refraktära tider

RBBB blockeras när Ashmans fenomen uppträder

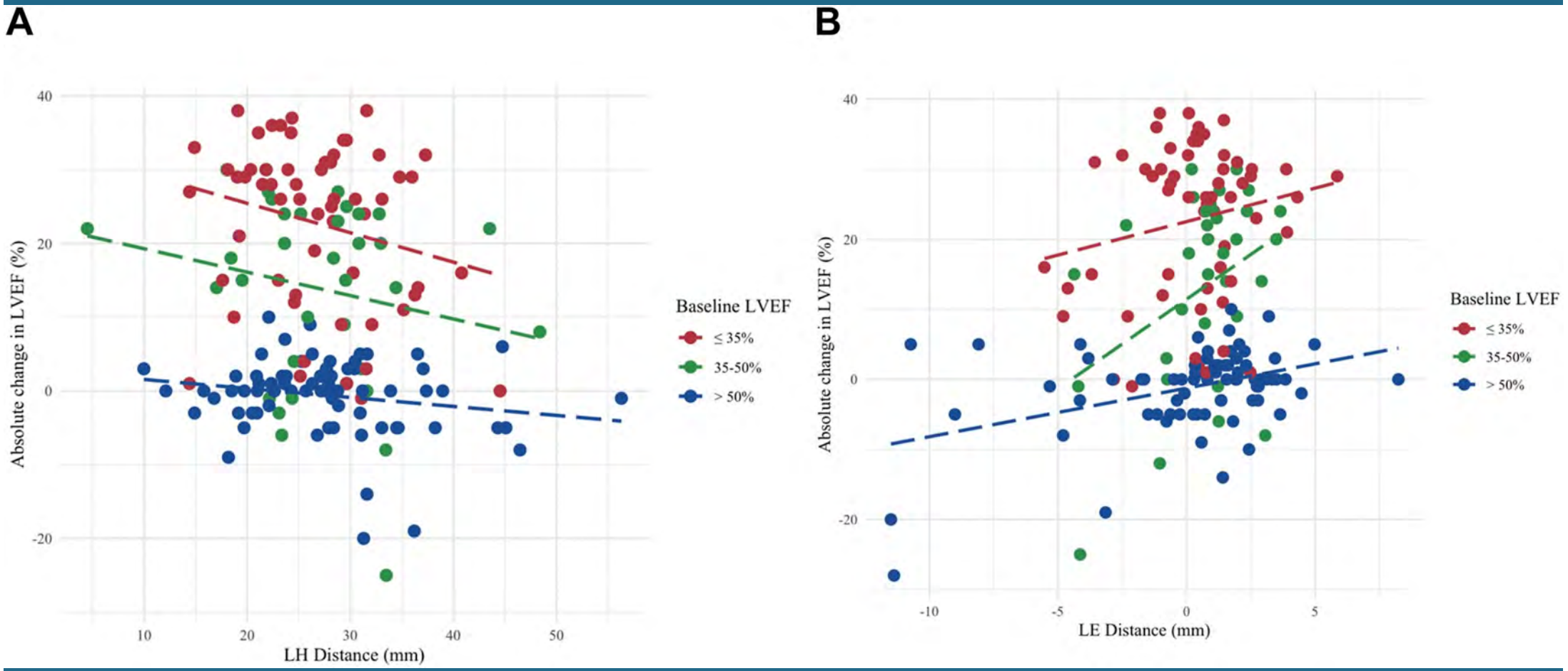
Har placering av LBB elektrod en betydelse?



Hierarchical physiologic pacing to enhance clinical outcomes in conduction system pacing

Shunmuga Sundaram Ponnusamy, MD, DM, PDF(EP), FHRS,[1] Ajay Pillai, MD,[2] Daniel Burkhoff, MD, PHD,[3] Justin T. Tretter, MD,[4] Shlomo A. Ben-Haim, MD,[4] Pugazhendhi Vijayaraman, MD, FHRS,[5] Kenneth A. Ellenbogen, MD, FHRS[2]

(Heart Rhythm 2026;23:114–122) © 2025 Heart Rhythm Society.


A
B
Absolute change in LVEF (%)
LH Distance (mm)
LE Distance (mm)
Baseline LVEF
≤ 35%
35-50%
> 50%
40
20
0
-20
10
20
30
40
50
-10
-5
0
5

JAMA Cardiology

RCT: Conduction System vs Biventricular Pacing in Heart Failure

POPULATION

87 Men, 86 Women



Adults with symptomatic heart failure (HF) with reduced ejection fraction and left bundle-branch block

Median age, 62 y; range 37-81 y

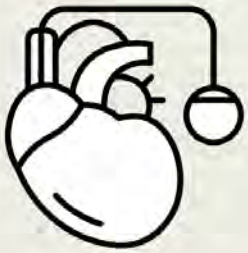
SETTINGS / LOCATIONS



14 Hospitals in Brazil

INTERVENTION

173 Participants randomized and analyzed



87 Conduction system pacing
Resynchronization with conduction system lead, preferentially left bundle-branch area pacing

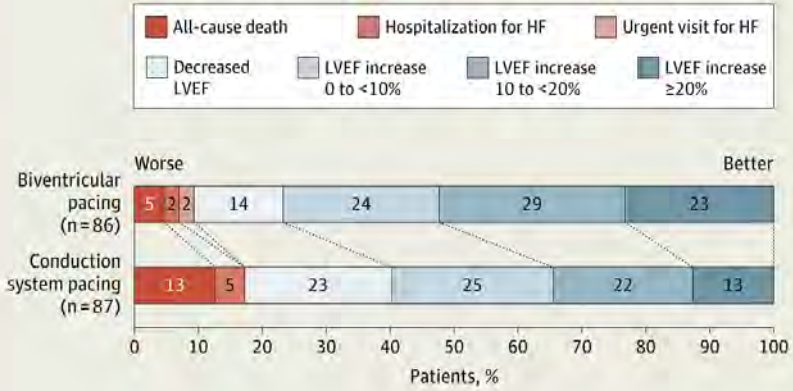
86 Biventricular pacing
Standard resynchronization with coronary sinus lead

PRIMARY OUTCOME

HF-related composite, assigned based on the worst event experienced by 12 mo (all-cause death, HF hospitalization, urgent visit requiring IV diuretic, or change in left ventricular ejection fraction [LVEF]); noninferiority margin for the odds ratio was 1.2

FINDINGS

Conduction system pacing failed to meet noninferiority criteria and was inferior to biventricular pacing for the primary end point at 12 mo



Odds ratio for the primary outcome, 2.36 (95% CI, 1.37-4.06); $P = .99$ for noninferiority; $P = .002$ for between-group difference

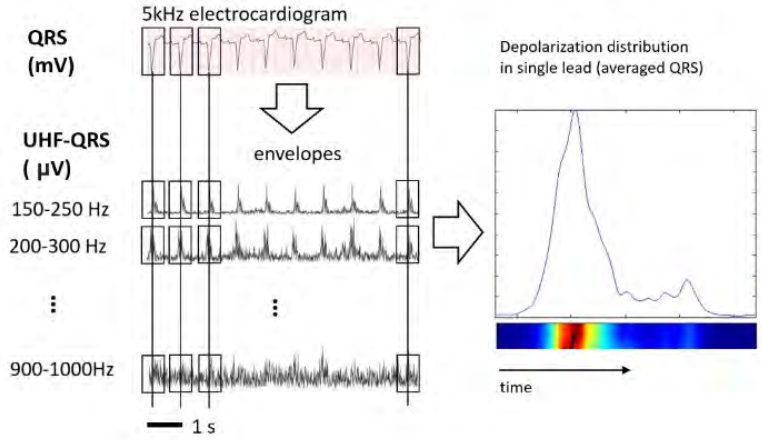
Zimerman A, Dal Forno A, Rohde LE, et al. Conduction system vs biventricular pacing in heart failure: the PhysioSync-HF randomized clinical trial. *JAMA Cardiol*. Published online March 11, 2026. doi:10.1001/jamacardio.2026.0101

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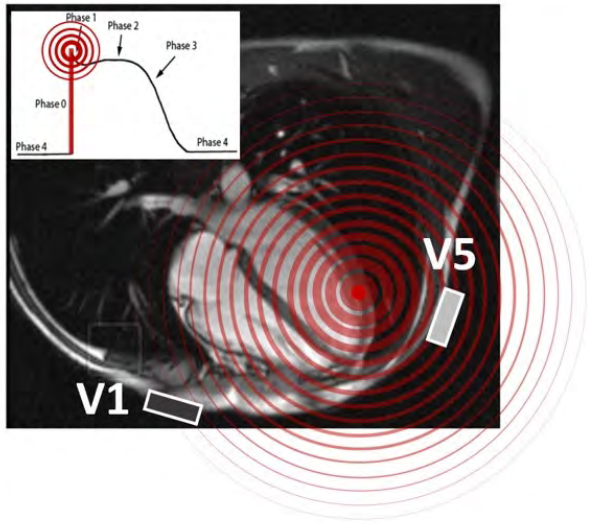
From high-fidelity ECG to UHF-ECG map

Advanced processing of ultra-high-frequency µV signals



High-frequency signal propagation is short

Tt is more location specific than regular ECG signal



12 avl ECG/intrakardiella signaler/pacingmanövrar informerar om hur aktiverigen går till



- Selective
- Nonselective
- Myokardiell

UHF ECG – Hur aktiveringen ser ut



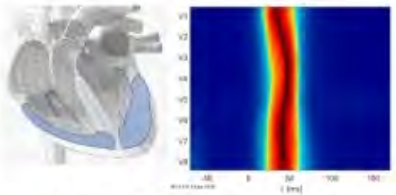
- synkron
- dyssynkron
- duration av lokal depolarisation, homogenitet

UHF-EKG-tekniken ger ny information om elektrisk aktivering av myokardium från en standardelektroduppsättning

- Enkelt att använda
- Lätt att tolka
- Insamling i realtid

Ventricular Electrical Delay (VED or e-DYS)

Calculation available in automated and manual models

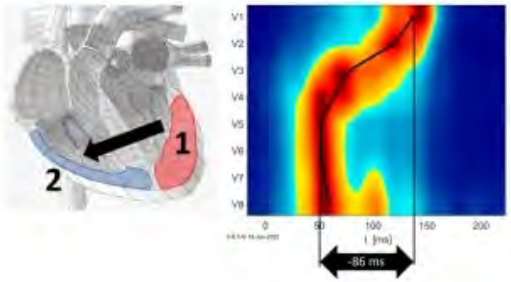


Negative VED means delayed right ventricular activation.

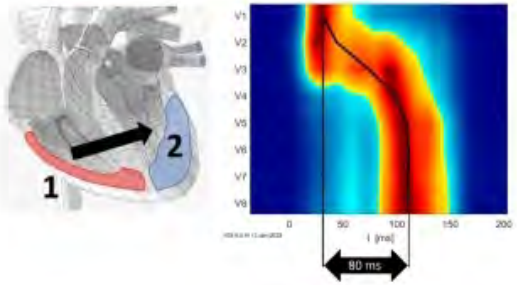
Positive VED indicates delayed left ventricular activation.

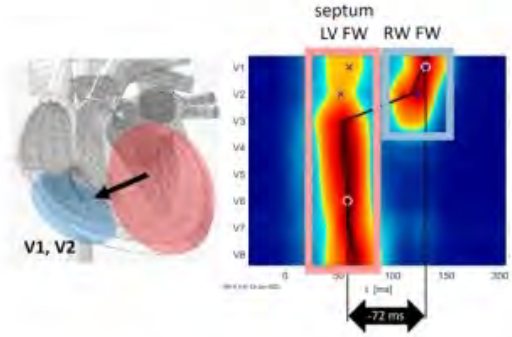
RBBB -20 ms **NORMAL** 20 ms **LBBB**

negative value — positive value



VED
Ventricular Electrical Delay

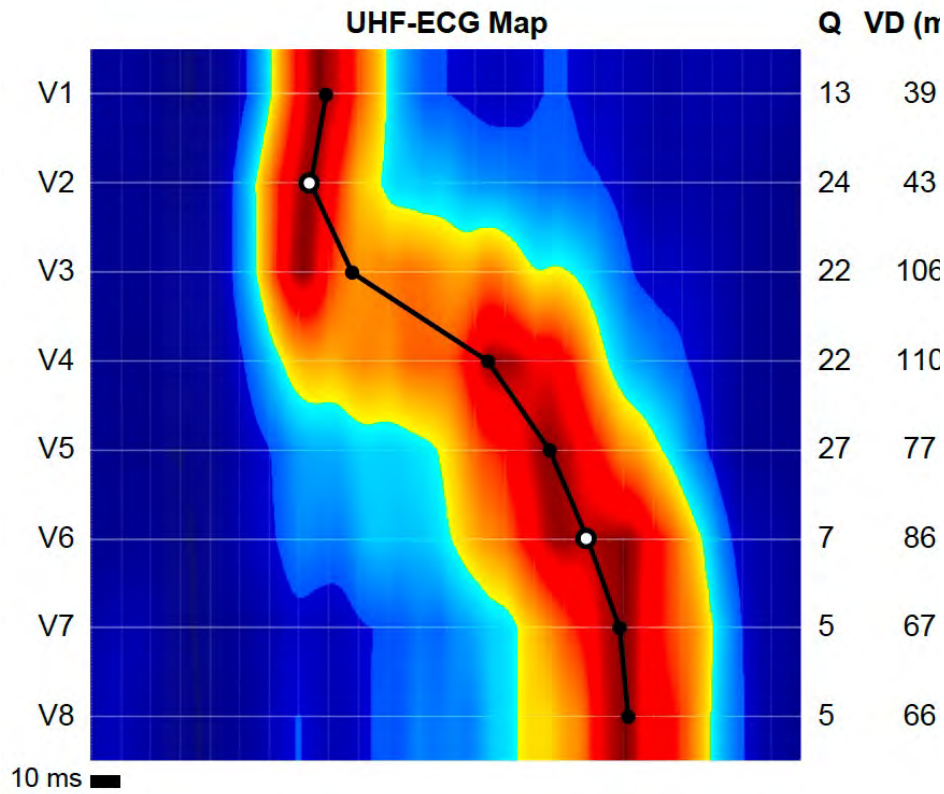




FÖRE INGREPPET

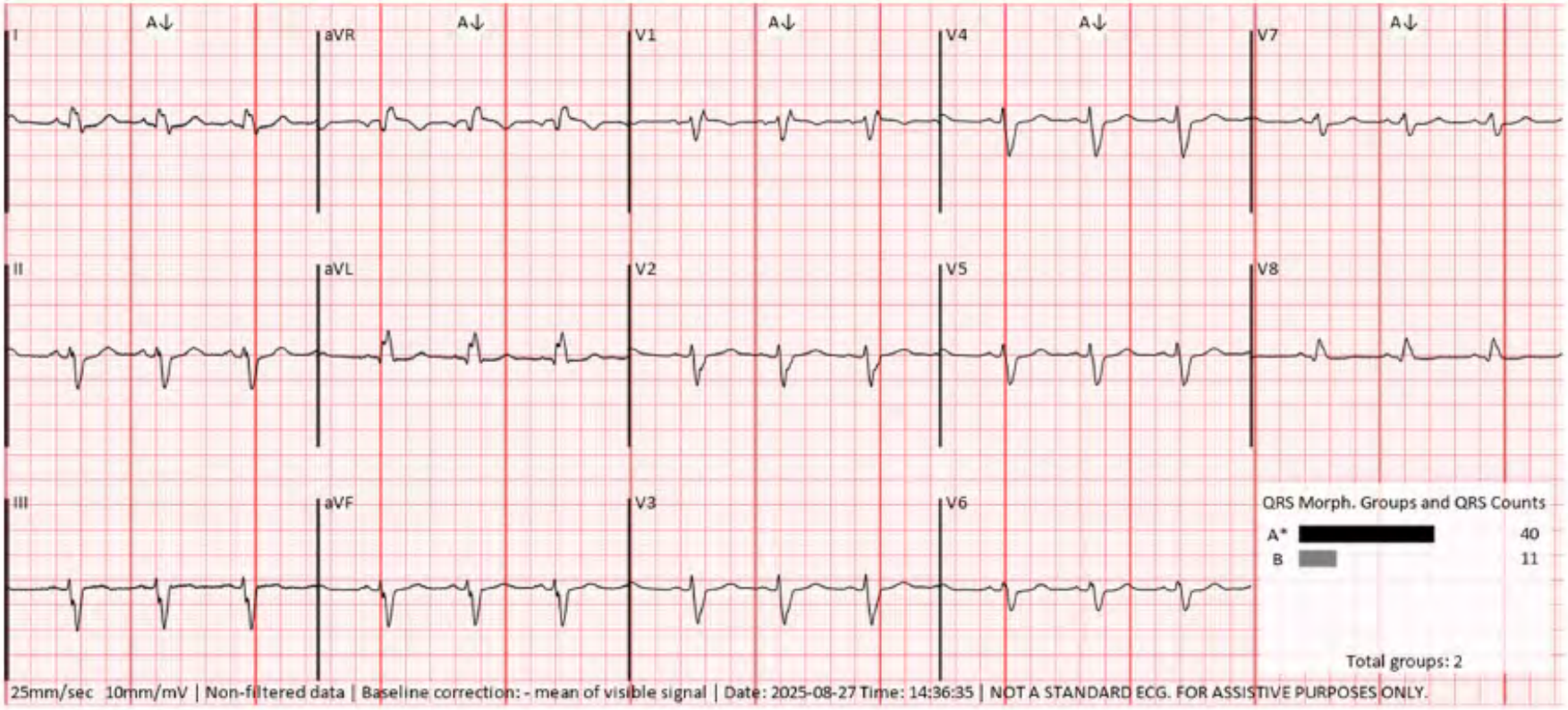
Särskilt i komplexa och osäkra fall

- För att bekräfta förekomst av dyssynkroni
- För att konstatera om vi är I behov av att resynkronisera
- Vad ska vi resynkronisera
- För att välja adekvat device



Man, 60 år, DCM

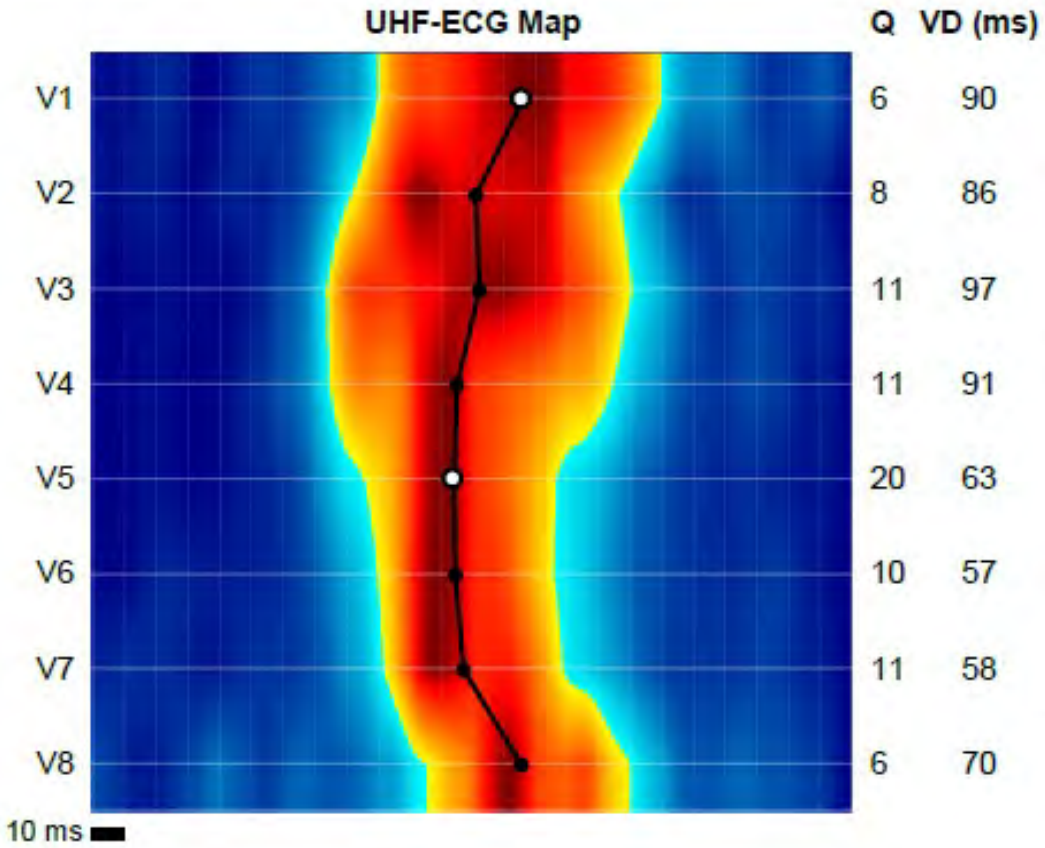
RBBB+LAHB
QRS 135-140 ms
EF 25%
MRI - fibros



Manual avg. QRS measurements (first 4 only)
(none)

Manual avg. UHF-QRS measurements (first 4 only)
(none)

Detail page for the Measurement ID 338



Recorded	2025-08-27 14:35:59
Duration	41 seconds (00:00:41)
Operator	(non-defined)

Automated Results

VED16	-22 ms	VED18	-22 ms
MeanVD16	81 ms	MeanVD18	76 ms

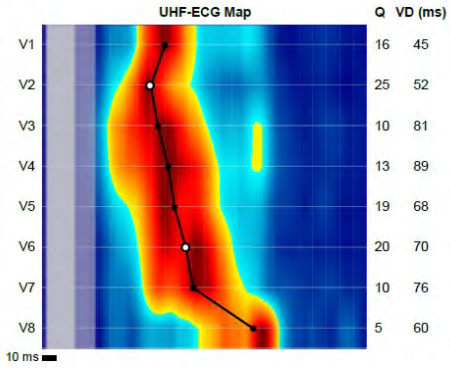
QRS (all groups)	51x
QRS (major gr.)	40x, label A, 78.4%
Two-peak pttrn	(none)

Manual measure (none)

UHF-ECG Device Information

Deploy ID	5_ABBOTT_EU
Software	VDI Vision 1.0.4.3-R
VDIAQ ID	(01)08594214060018(21)00000E911F0A

Detail page for the Measurement ID 339



Recorded 2025-08-27 14:37:29
Duration 39 seconds (00:00:39)
Operator (non-defined)

Automated Results

VED16	26 ms	VED18	76 ms
MeanVD16	68 ms	MeanVD18	68 ms

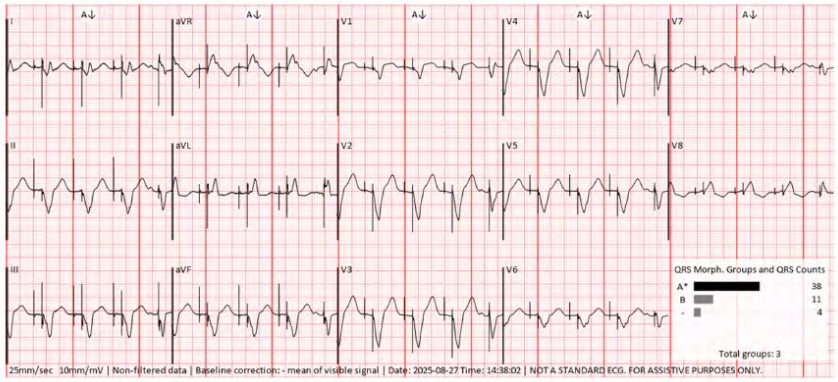
QRS (all groups) 53x
QRS (major gr.) 38x, label A, 71.7%
Two-peak pttrn (none)

Manual measure (none)

UHF-ECG Device Information

Deploy ID 5_ABBOTT_EU
Software VDI Vision 1.0.4.3-R
VDIAQ ID (01)08594214060018(21)00000E911F0A

Measurement comment: RV pace

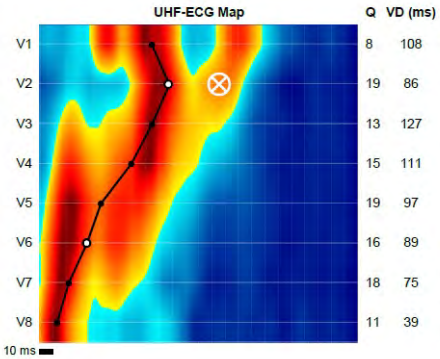


Manual avg. QRS measurements (first 4 only)
(none)

Manual avg. UHF-QRS measurements (first 4 only)
(none)

RV pace

Detail page for the Measurement ID 340



Recorded 2025-08-27 14:46:34
Duration 39 seconds (00:00:39)
Operator (non-defined)

Automated Results

VED16	-62 ms	VED18	-84 ms
MeanVD16	103 ms	MeanVD18	91 ms

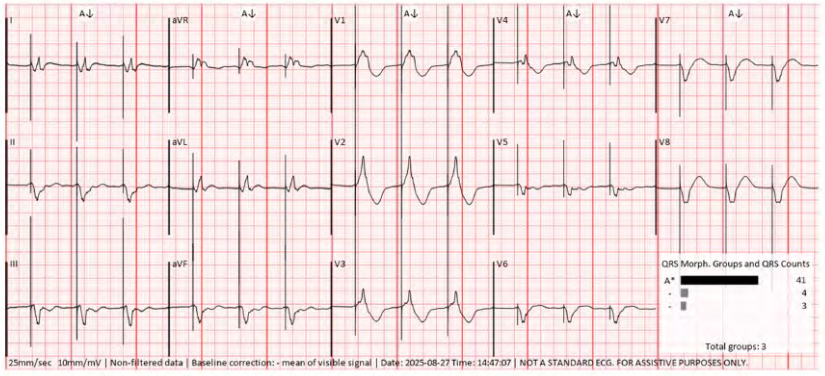
QRS (all groups) 48x
QRS (major gr.) 41x, label A, 85.4%
Two-peak pttrn Lead V2

Manual measure (none)

UHF-ECG Device Information

Deploy ID 5_ABBOTT_EU
Software VDI Vision 1.0.4.3-R
VDIAQ ID (01)08594214060018(21)00000E911F0A

Measurement comment: (none)

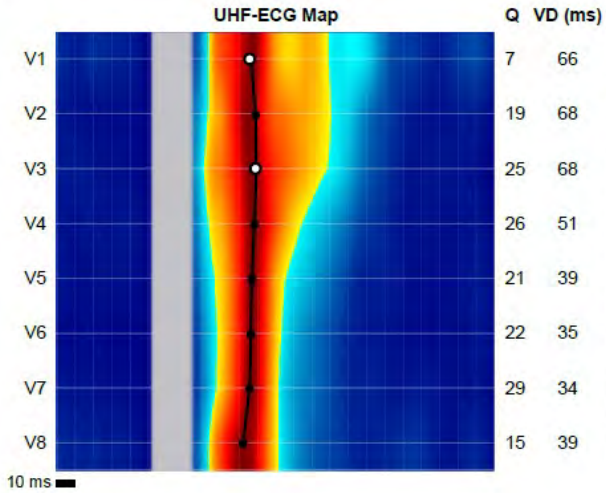


Manual avg. QRS measurements (first 4 only)
(none)

Manual avg. UHF-QRS measurements (first 4 only)
(none)

LV pace

Detail page for the Measurement ID 342



Recorded	2025-08-27 14:49:47
Duration	63 seconds (00:01:03)
Operator	(non-defined)

Automated Results

VED16	3 ms	VED18	-7 ms
MeanVD16	54 ms	MeanVD18	50 ms

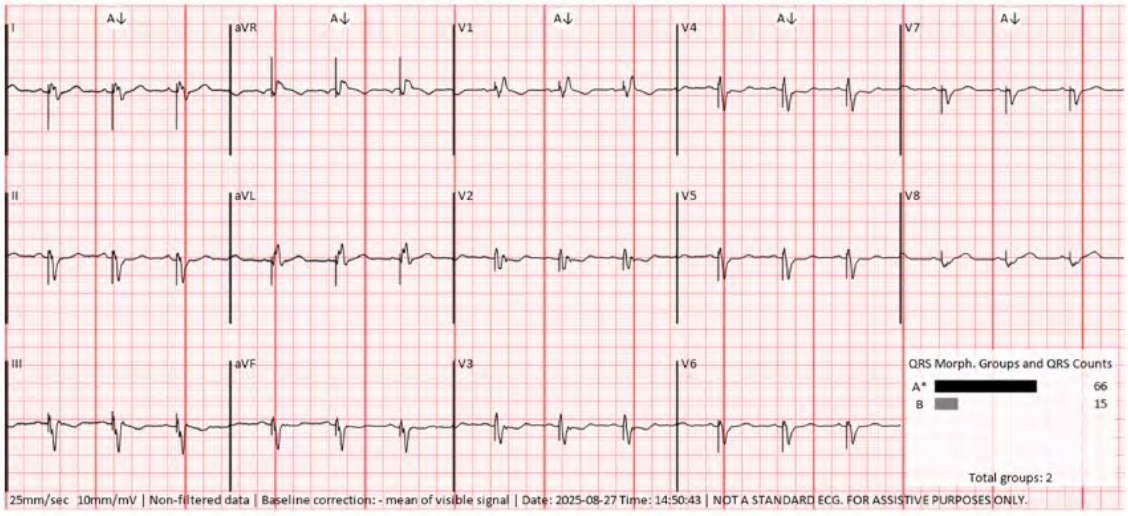
QRS (all groups)	81x
QRS (major gr.)	66x, label A, 81.5%
Two-peak pttrn	(none)

Manual measure (none)

UHF-ECG Device Information

Deploy ID	5_ABBOTT_EU
Software	VDI Vision 1.0.4.3-R
VDIAQ ID	(01)08594214060018(21)00000E911F0A

Measurement comment: (none)

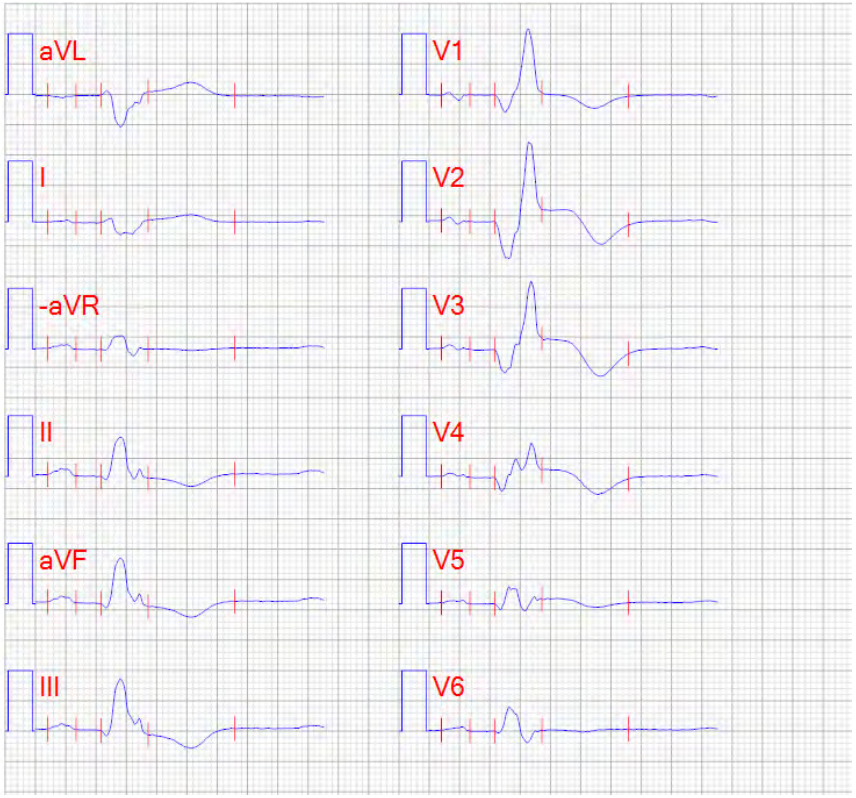


Manual avg. QRS measurements (first 4 only)
(none)

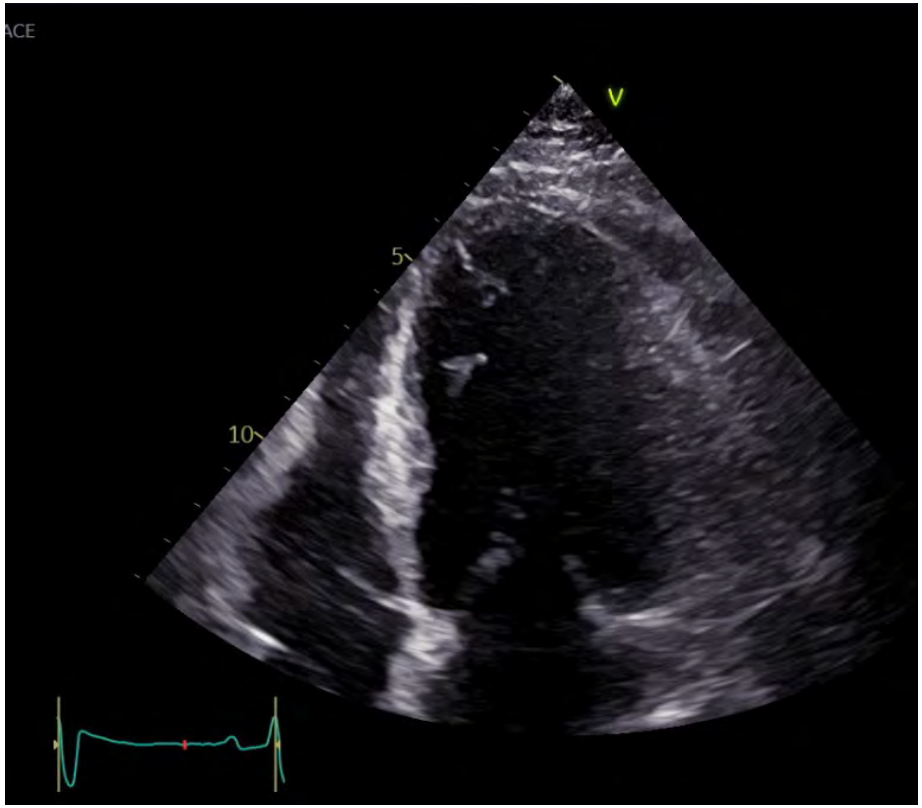
Manual avg. UHF-QRS measurements (first 4 only)
(none)

SyncAV plus delta 15%
LV pace only

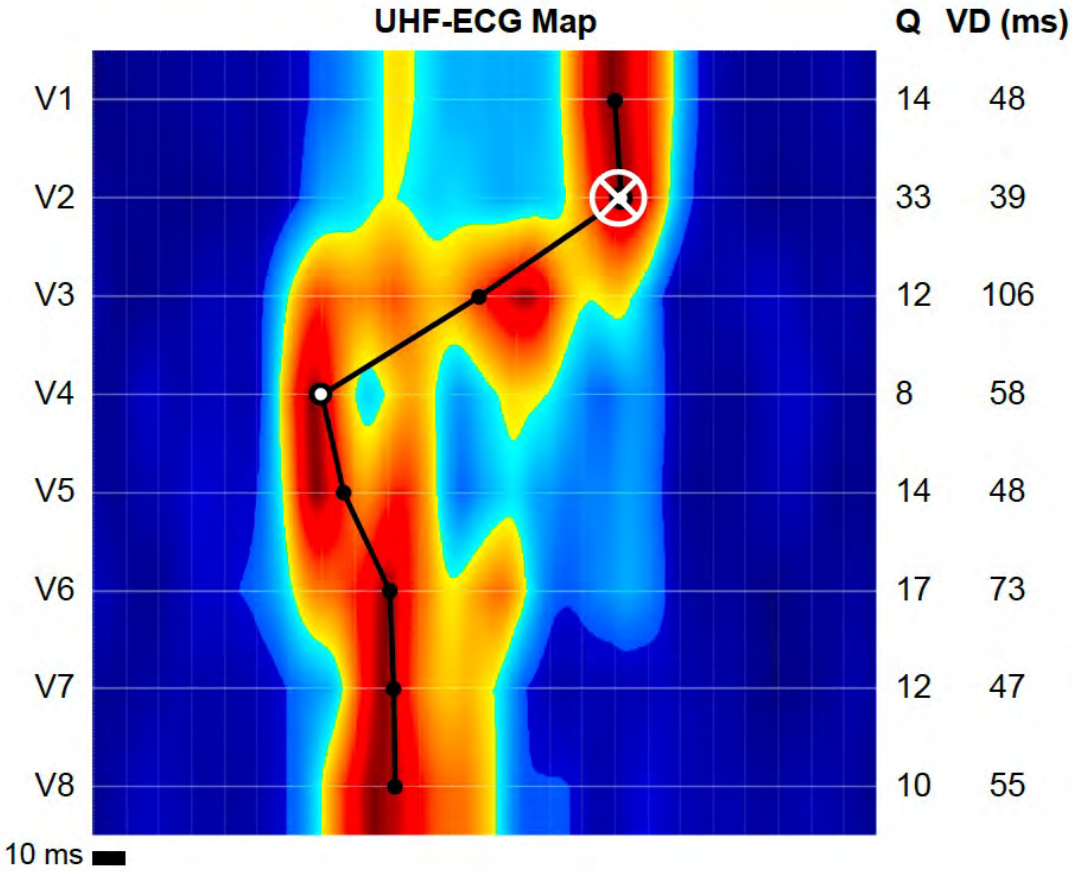
Man, 62 år
Anterior STEMI, PCI/LAD
AV block III, temporarär pacemaker
EF 30%, apical akinesi



Day 10
Normal AV tid, RBBB. QRS 155 ms
AV block II Mobitz II, RV pacing 10-15 sec/dag
10 mg Bisoprolol



DR ICD or CRTD?



Recorded	2026-02-26 13:08:23
Duration	95 seconds (00:01:35.0)
Operator	(non-defined)

Automated Results

VED16	-92 ms	VED18	-92 ms
MeanVD16	62 ms	MeanVD18	59 ms

QRS (all groups)	87x
QRS (major gr.)	87x, label A, 100.0%
Two-peak pttrn	Lead V2

Manual measure (none)

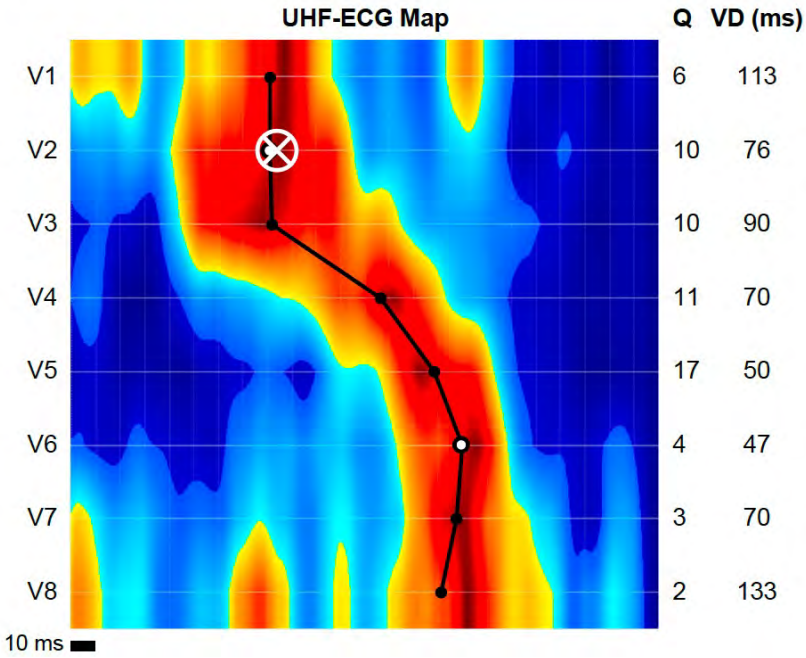
UHF-ECG Device Information

Deploy ID	31_ABBOTT_SWE
Software	VDI Vision 1.1.0.1-R
VDIAQ ID	(01)08594214060018(21)000010E74304

Measurement comment: nativa

No electrical dyssyncrony in LV lateral wall

UHF- ECG periproceduralt



Recorded	2026-05-07 08:38:47
Duration	112 seconds (00:01:51.8)
Operator	(non-defined)

Automated Results

VED16	79 ms	VED18	79 ms
MeanVD16	74 ms	MeanVD18	81 ms

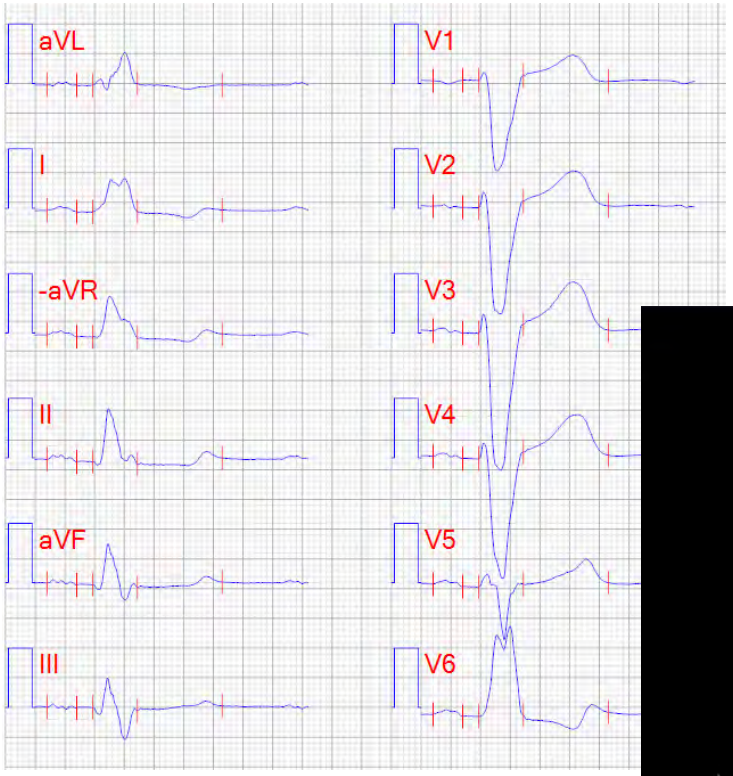
QRS (all groups)	150x
QRS (major gr.)	150x, label A, 100.0%
Two-peak pttrn	Lead V2

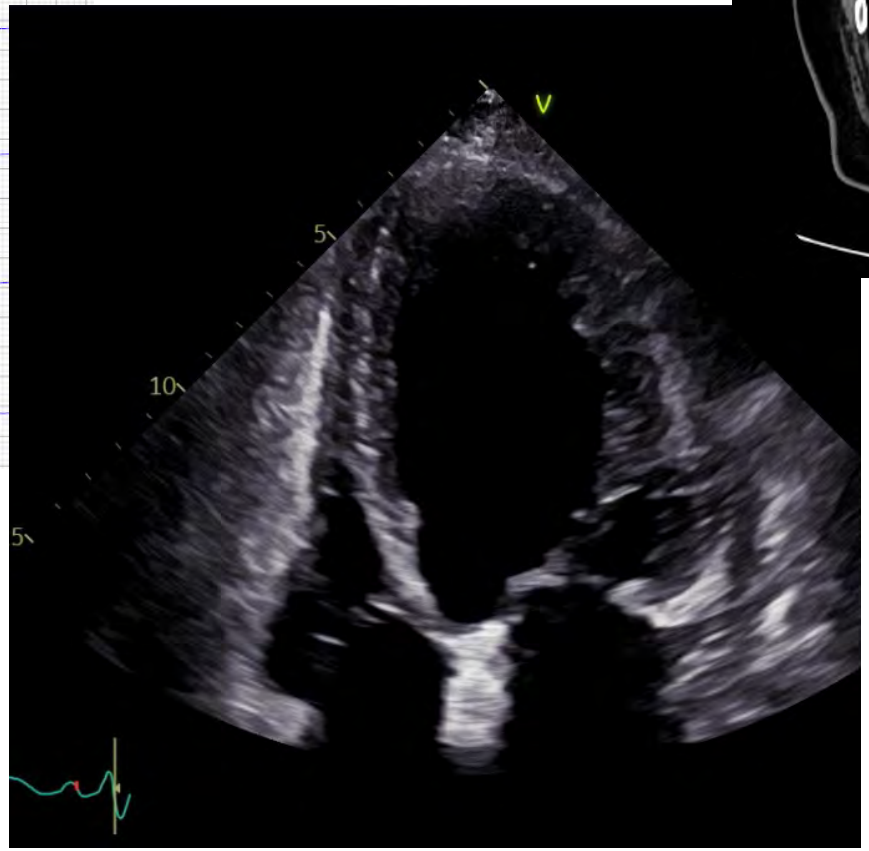
Manual measure (none)

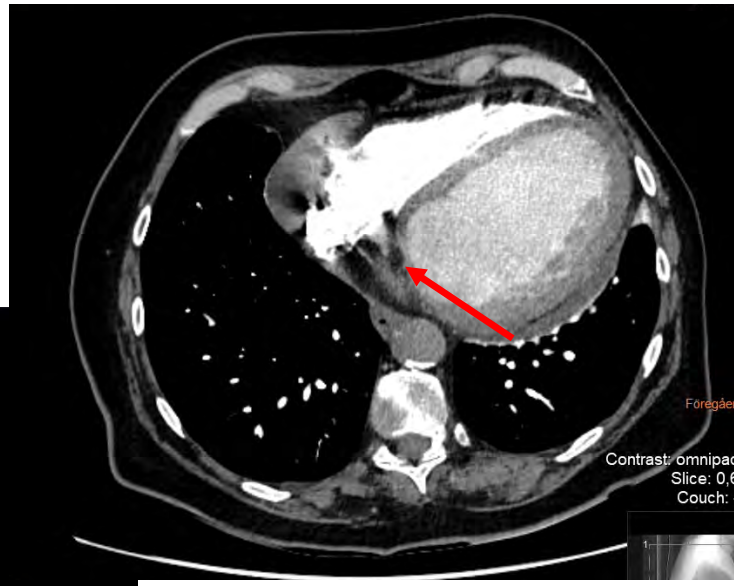
UHF-ECG Device Information

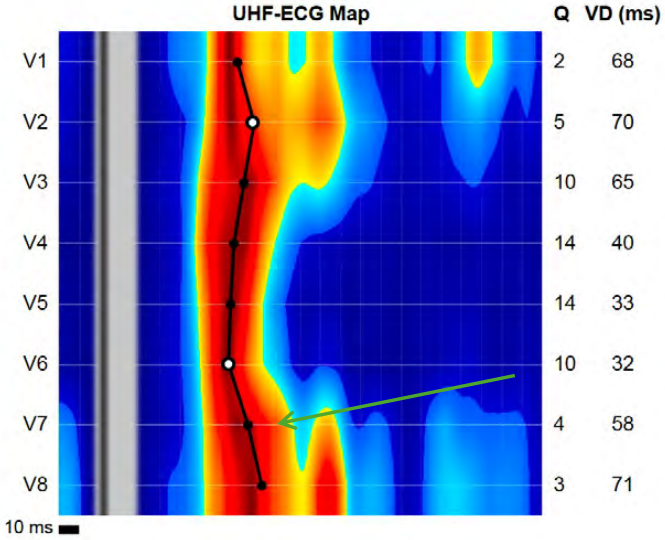
Deploy ID	31_ABBOTT_SWE
Software	VDI Vision 1.1.0.1-R
VDIAQ ID	(01)08594214060018(21)000010E74304

- Kvinna, 80 år
- DCM
- LBBB
- EF 15%


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


V
5
10
5


Föregåe
Contrast: omnipa
Slice: 0,
Couch:



Recorded	2026-05-07 08:35:30
Duration	95 seconds (00:01:35.2)
Operator	(non-defined)

Automated Results

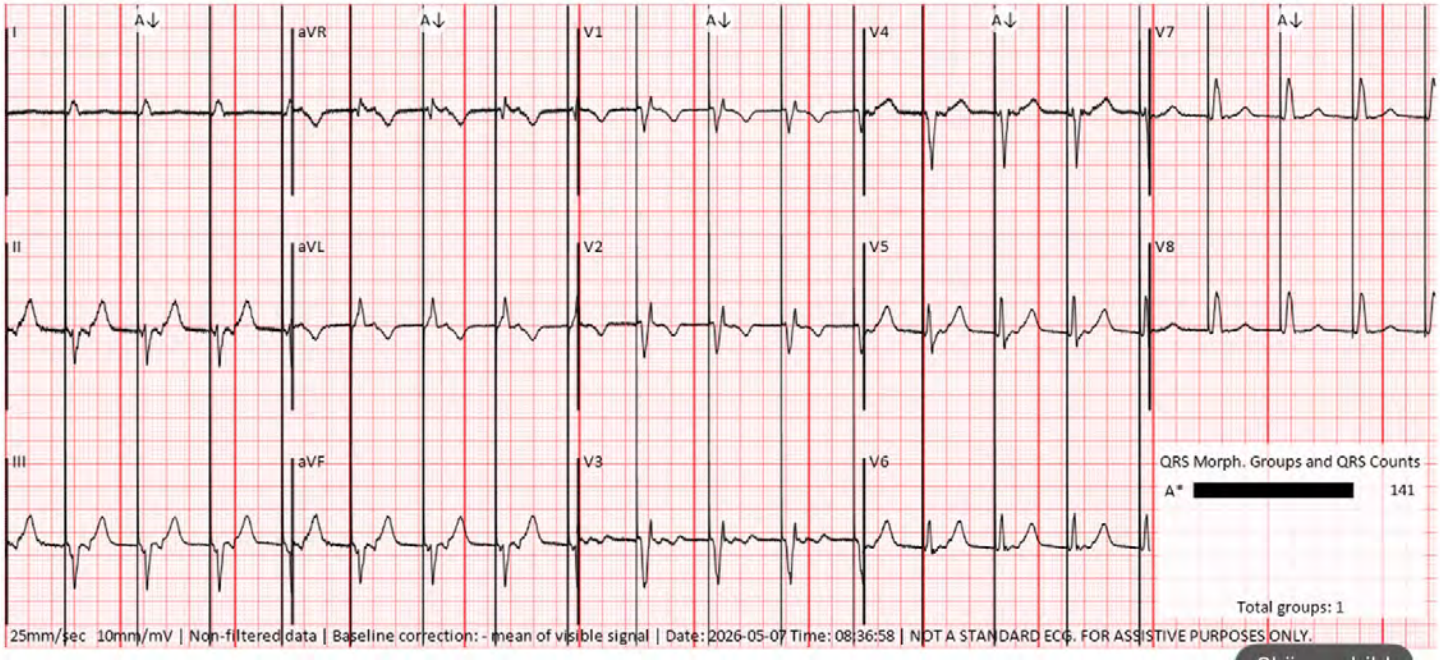
VED16	-13 ms	VED18	17 ms
MeanVD16	51 ms	MeanVD18	55 ms

QRS (all groups)	141x
QRS (major gr.)	141x, label A, 100.0%
Two-peak pttrn	(none)

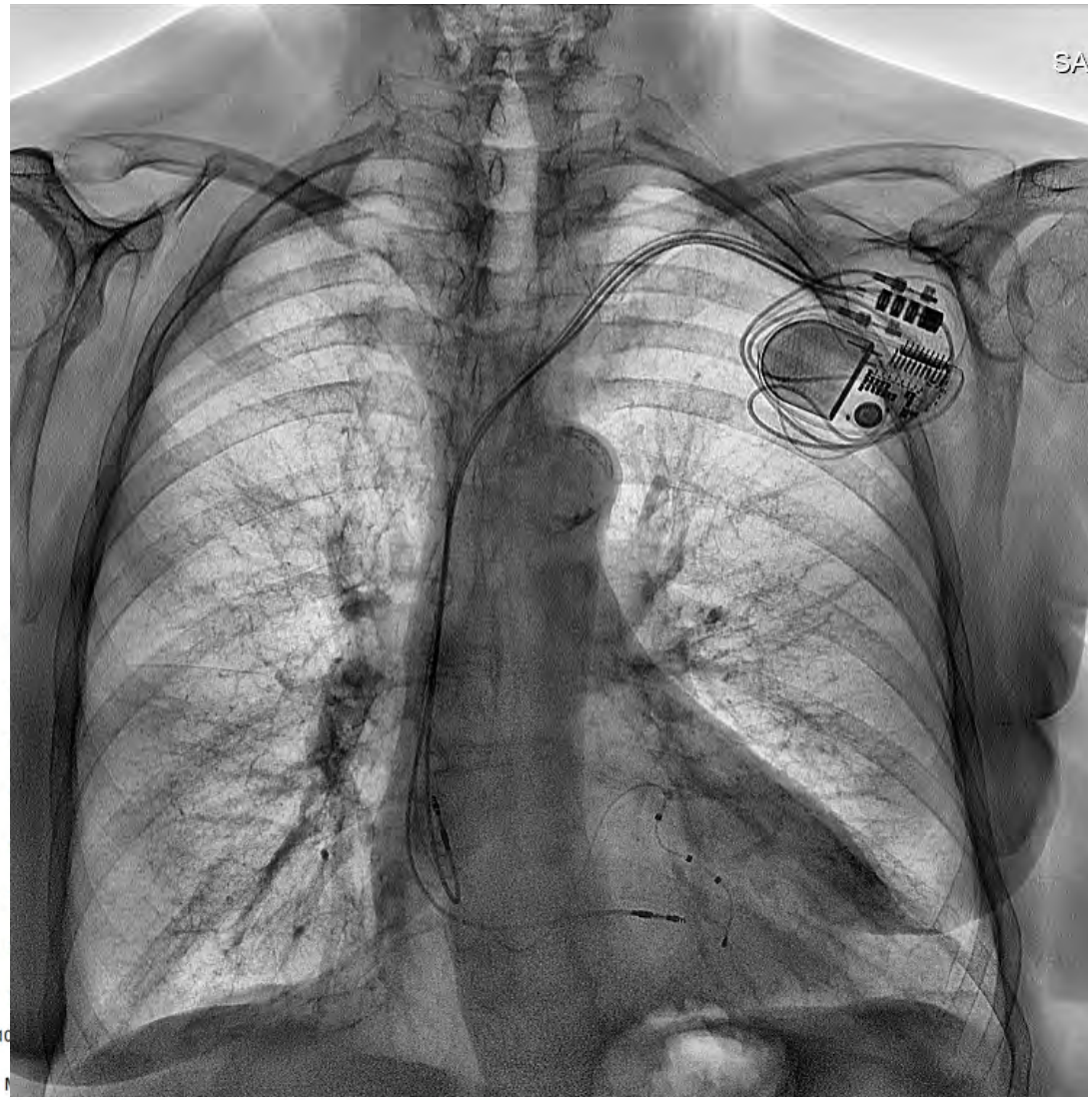
Manual measure (none)

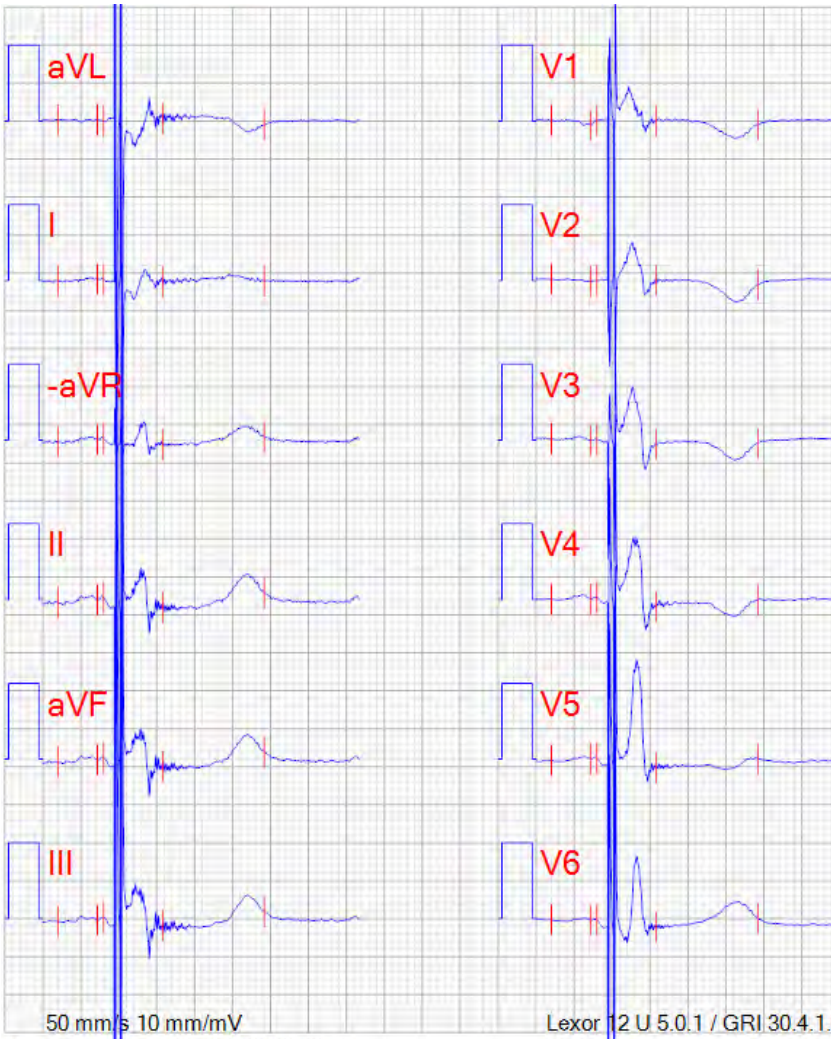
UHF-ECG Device Information

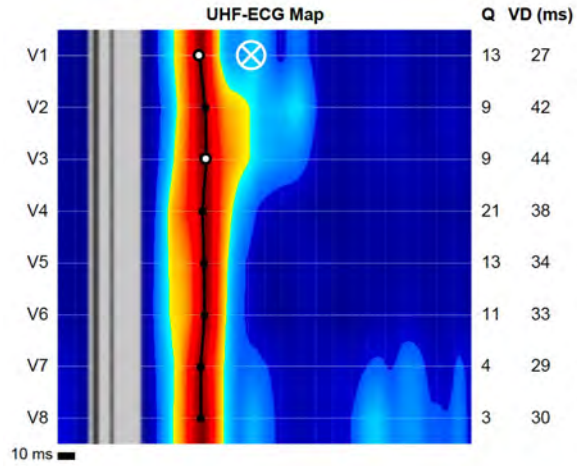
Deploy ID	31_ABBOTT_SWE
Software	VDI Vision 1.1.0.1-R
VDIAQ ID	(01)08594214060018(21)000010E74304



Är vi nöjda?




aVL
I
-aVR
II
aVF
III
V1
V2
V3
V4
V5
V6
50 mm/s 10 mm/mV
Lexor 12 U 5.0.1 / GRI 30.4.1.



Recorded	2026-05-07 09:38:57
Duration	51 seconds (00:00:51.3)
Operator	(non-defined)

Automated Results

VED16	4 ms	VED18	4 ms
MeanVD16	36 ms	MeanVD18	35 ms

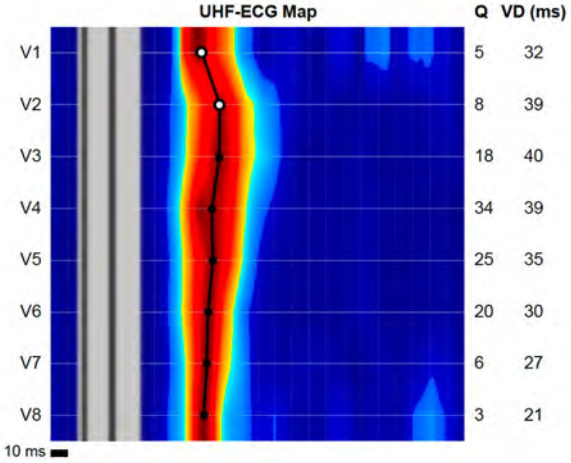
QRS (all groups)	83x
QRS (major gr.)	83x, label A, 100.0%
Two-peak pttrn	Lead V1

Manual measure (none)

UHF-ECG Device Information

Deploy ID	31_ABBOTT_SWE
Software	VDI Vision 1.1.0.1-R
VDIAQ ID	(01)08594214060018(21)000010E74304

Measurement comment: LV 10ms fore RV



Recorded	2026-05-07 10:03:07
Duration	171 seconds (00:02:50.5)
Operator	(non-defined)

Automated Results

VED16	10 ms	VED18	10 ms
MeanVD16	36 ms	MeanVD18	33 ms

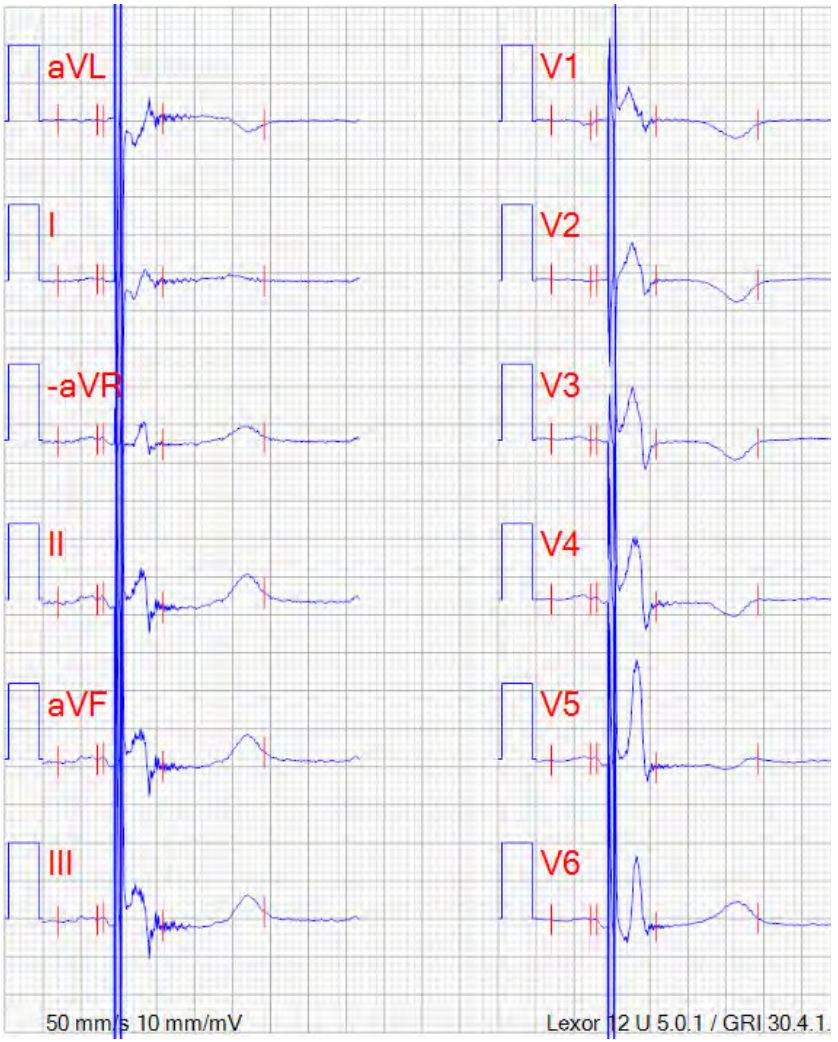
QRS (all groups)	268x
QRS (major gr.)	266x, label A, 99.3%
Two-peak pttrn	(none)

Manual measure (none)

UHF-ECG Device Information

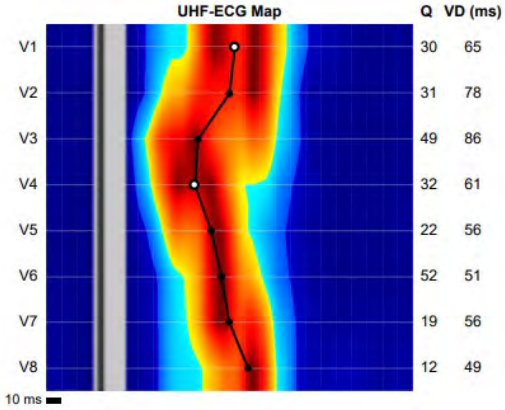
Deploy ID	31_ABBOTT_SWE
Software	VDI Vision 1.1.0.1-R
VDIAQ ID	(01)08594214060018(21)000010E74304

Measurement comment: LOT CRT LV-15 ms-LBBP



Man, född 1946
DCM
AF
EF 10%





Recorded 2026-03-06 15:06:48
Duration 56 seconds (00:00:55.5)
Operator (non-defined)

Automated Results

VED16	-26 ms	VED18	35 ms
MeanVD16	66 ms	MeanVD18	63 ms

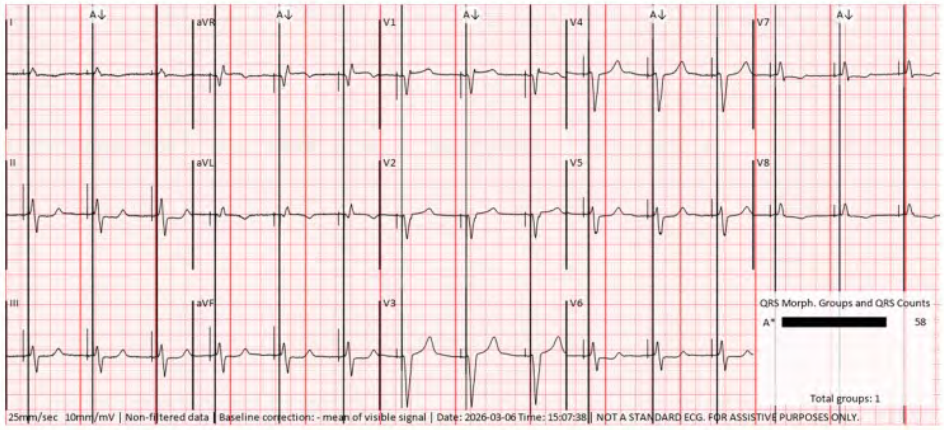
QRS (all groups) 58x
QRS (major gr.) 58x, label A, 100.0%
Two-peak pttrn (none)

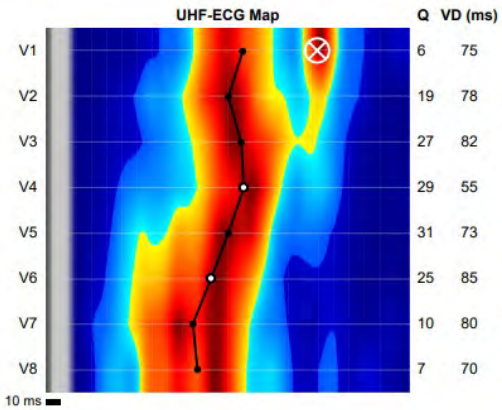
Manual measure (none)

UHF-ECG Device Information

Deploy ID 31_ABBOTT_SWE
Software VDI Vision 1.1.0.1-R
VDIAQ ID (01)08594214060018(21)000010E74304

Measurement comment: LBBP only unip





Recorded 2026-03-06 15:09:05
Duration 61 seconds (00:01:00.6)
Operator (non-defined)

Automated Results

VED16	-22 ms	VED18	-34 ms
MeanVD16	75 ms	MeanVD18	75 ms

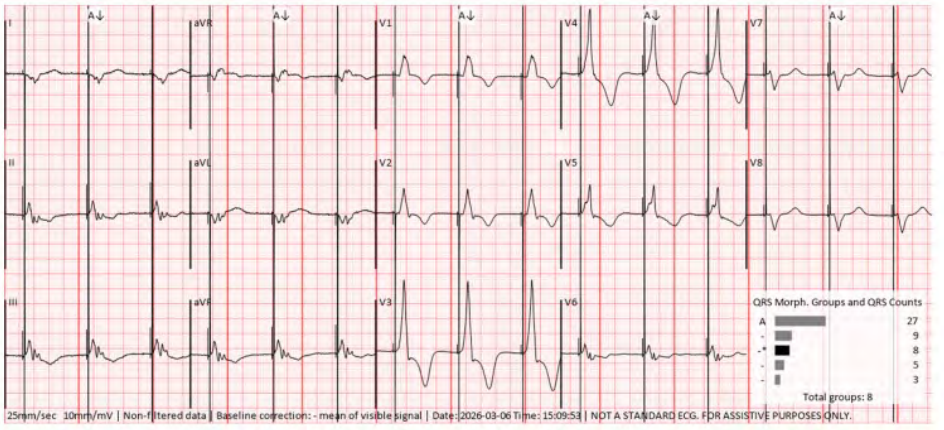
QRS (all groups) 55x
QRS (major gr.) 27x, label A, 49.1%
Two-peak pttrn Lead V1

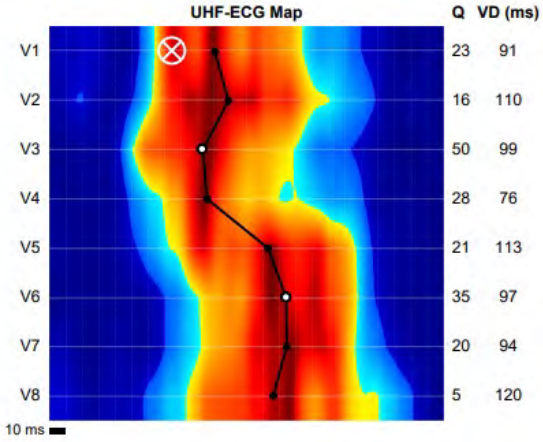
Manual measure (none)

UHF-ECG Device Information

Deploy ID 31_ABBOTT_SWE
Software VDI Vision 1.1.0.1-R
VDIAQ ID (01)08594214060018(21)000010E74304

Measurement comment: LV only





Recorded	2026-03-06 15:05:26
Duration	61 seconds (00:01:01.0)
Operator	(non-defined)

Automated Results

VED16	51 ms	VED18	
MeanVD16	98 ms	MeanVD18	

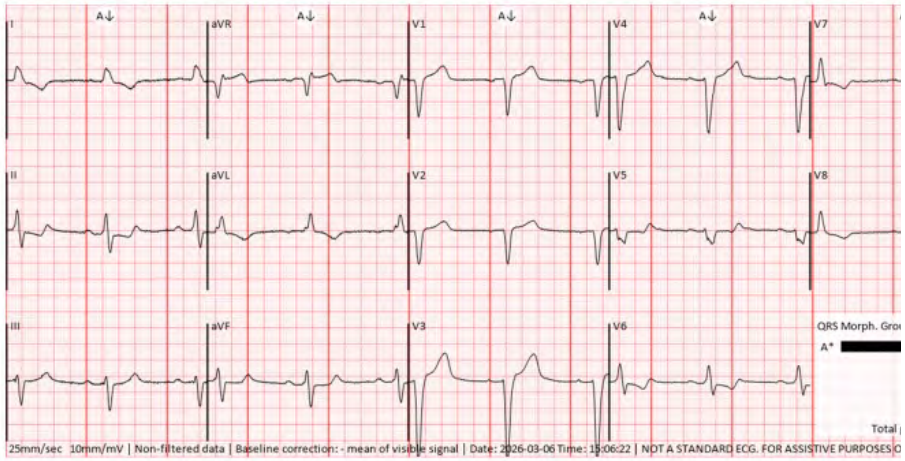
QRS (all groups)	51x
QRS (major gr.)	51x, label A, 100.0%
Two-peak pttrn	Lead V1

Manual measure (none)

UHF-ECG Device Information

Deploy ID	31_ABBOTT_SWE
Software	VDI Vision 1.1.0.1-R
VDIAQ ID	(01)08594214060018(21)000010E

Measurement comment: egen



Recorded	2026-03-06 15:29:42
Duration	58 seconds (00:00:58.3)
Operator	(non-defined)

Automated Results

VED16	-11 ms	VED18	
MeanVD16	54 ms	MeanVD18	

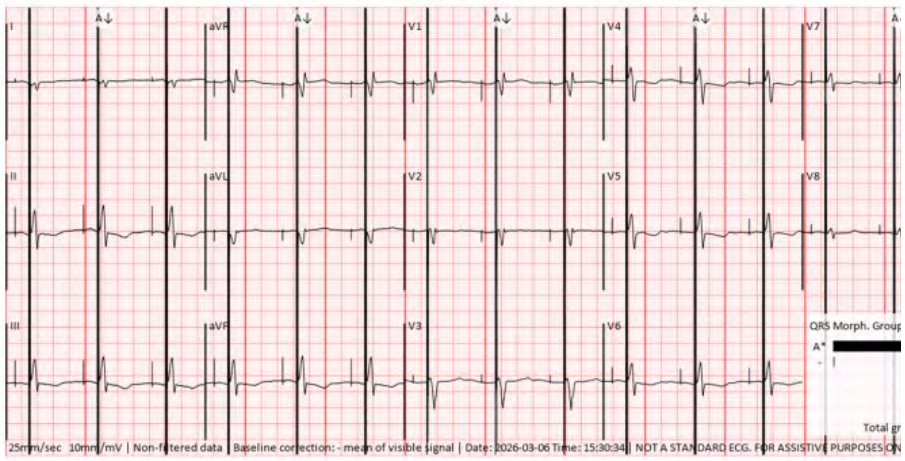
QRS (all groups)	62x
QRS (major gr.)	61x, label A, 98.4%
Two-peak pttrn	(none)

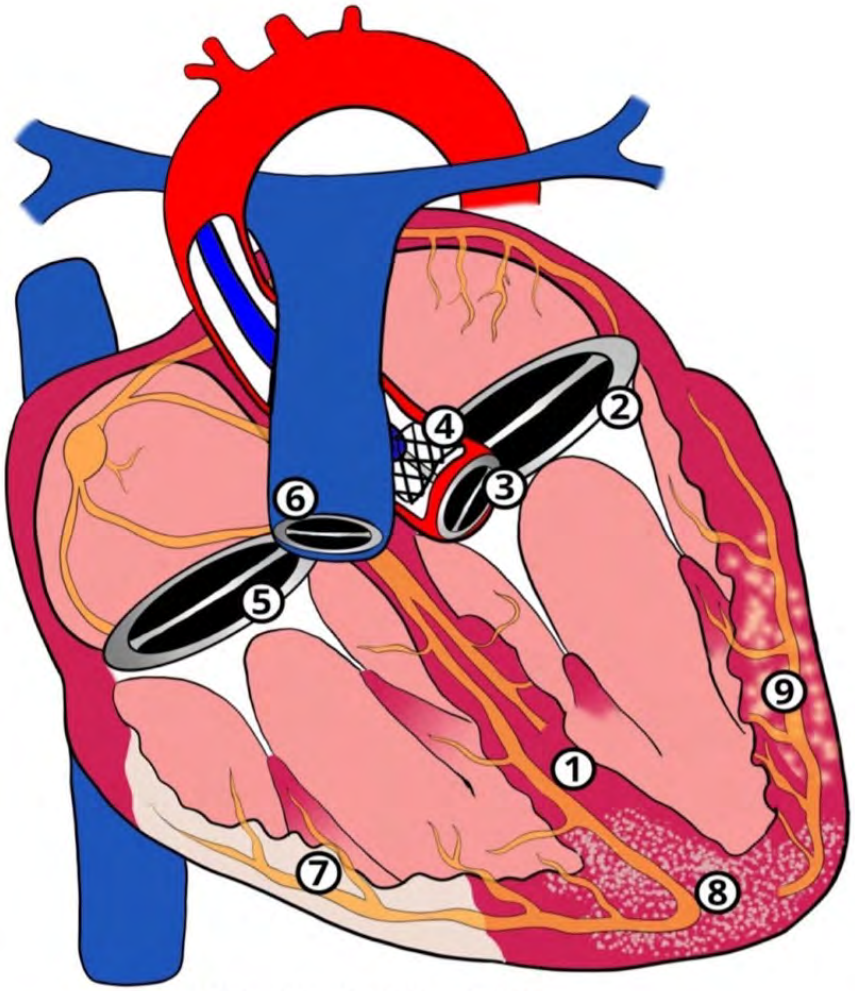
Manual measure (none)

UHF-ECG Device Information

Deploy ID	31_ABBOTT_SWE
Software	VDI Vision 1.1.0.1-R
VDIAQ ID	(01)08594214060018(21)000010E

Measurement comment: end of session

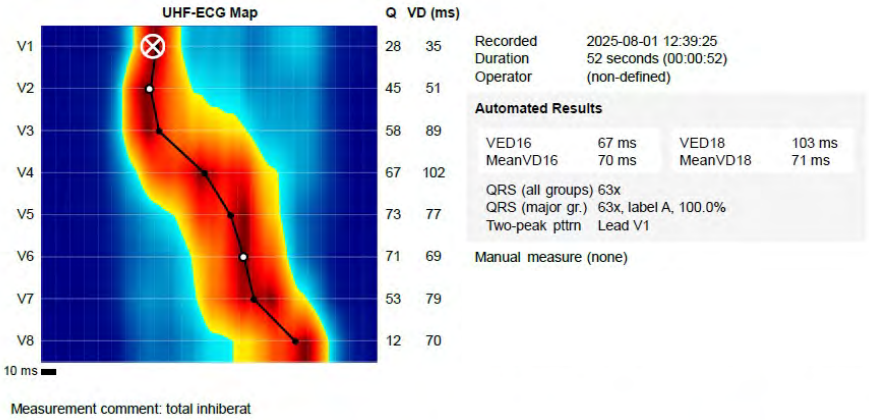


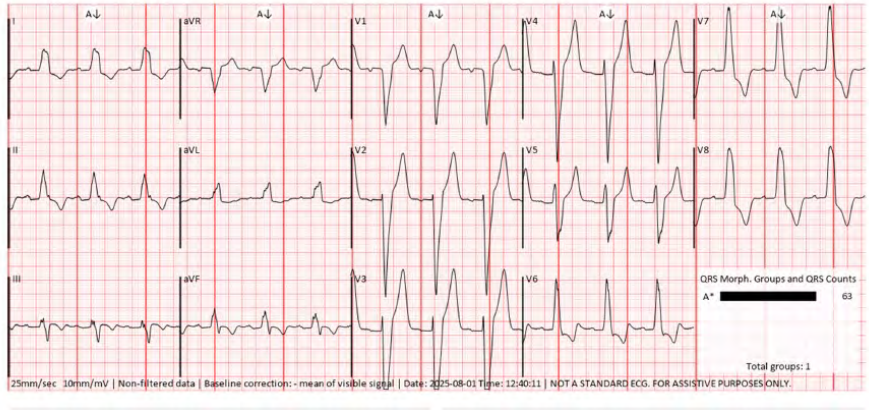


En del tillstånd är lättåtgärdade med CSP

1) Myemectomy for septal hypertrophy
2) Mitral valve surgery
3) Aortic valve surgery
4) Transcatheter aortic valve implantation (TAVI)
5) Tricuspid valve surgery
6) Pulmonary valve surgery
7) Myocardial infarction
8) Infiltrative cardiomyopathy - sarcoidosis/amyloidosis
9) Myocardial fibrosis

Man, 52 år
Bikuspid aortaklaff med både stenos och insufficiens.
Postoperativt...

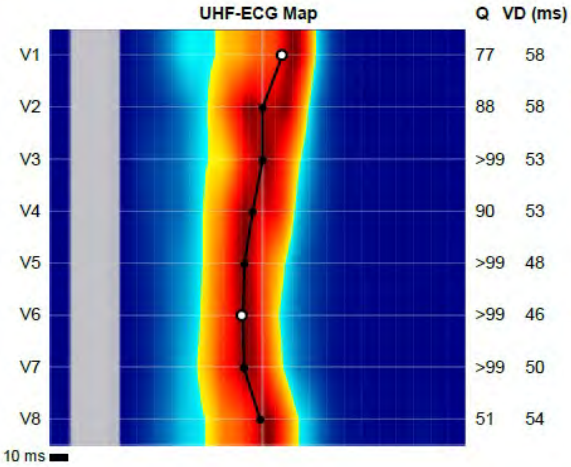




AV block -----
AV block I + LBBB+ låg WB punkt efter 7 dagar
EF 40%

LBBAP

Detail page for the Measurement ID 214



Recorded	2025-08-01 12:40:35
Duration	49 seconds (00:00:49)
Operator	(non-defined)

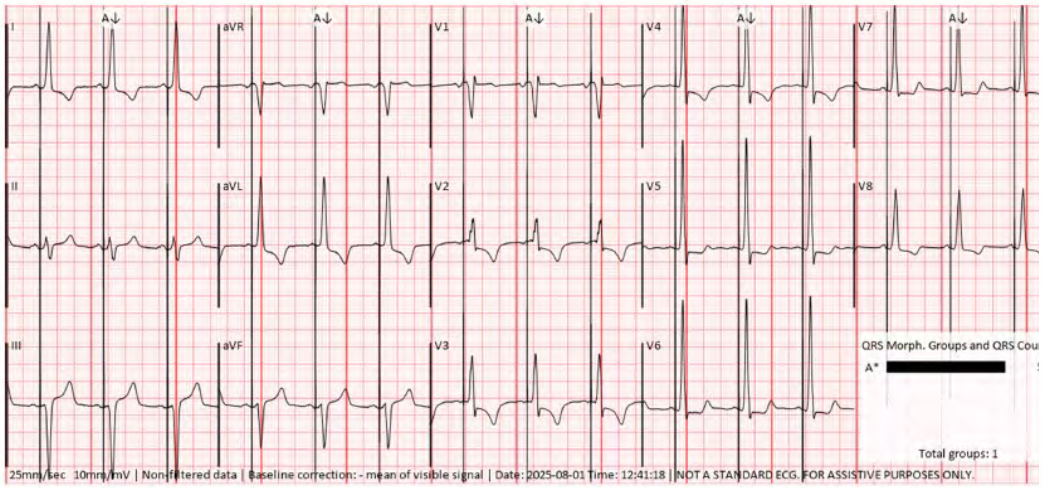
Automated Results

VED16	-23 ms	VED18	-23 ms
MeanVD16	53 ms	MeanVD18	53 ms

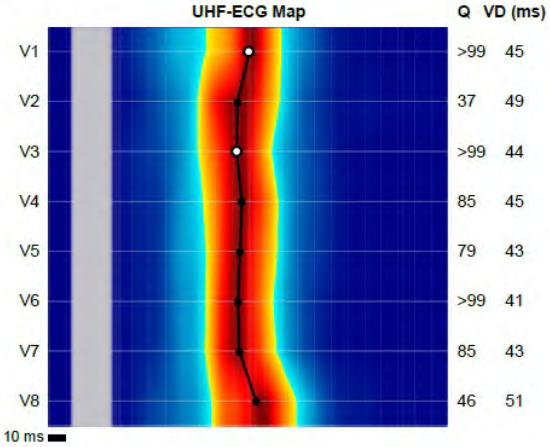
QRS (all groups) 58x
QRS (major gr.) 58x, label A, 100.0%
Two-peak pttrn (none)

Manual measure (none)

Measurement comment: 80mS avtid



Detail page for the Measurement ID 216



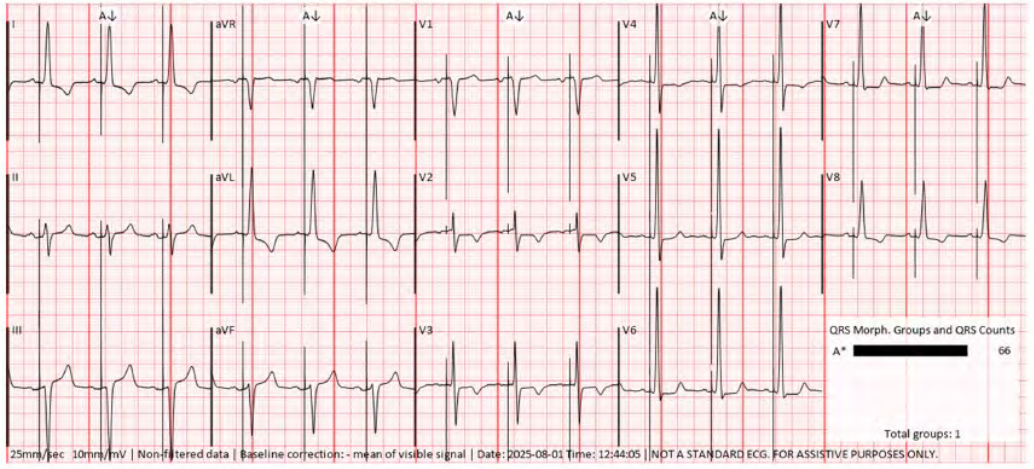
Recorded	2025-08-01 12:43:16
Duration	55 seconds (00:00:55)
Operator	(non-defined)

Automated Results

VED16	-7 ms	VED18	12 ms
MeanVD16	45 ms	MeanVD18	45 ms

QRS (all groups) 66x
QRS (major gr.) 66x, label A, 100.0%
Two-peak pttrn (none)

Measurement comment: 120 mS AVtid, output 1 V unipolart

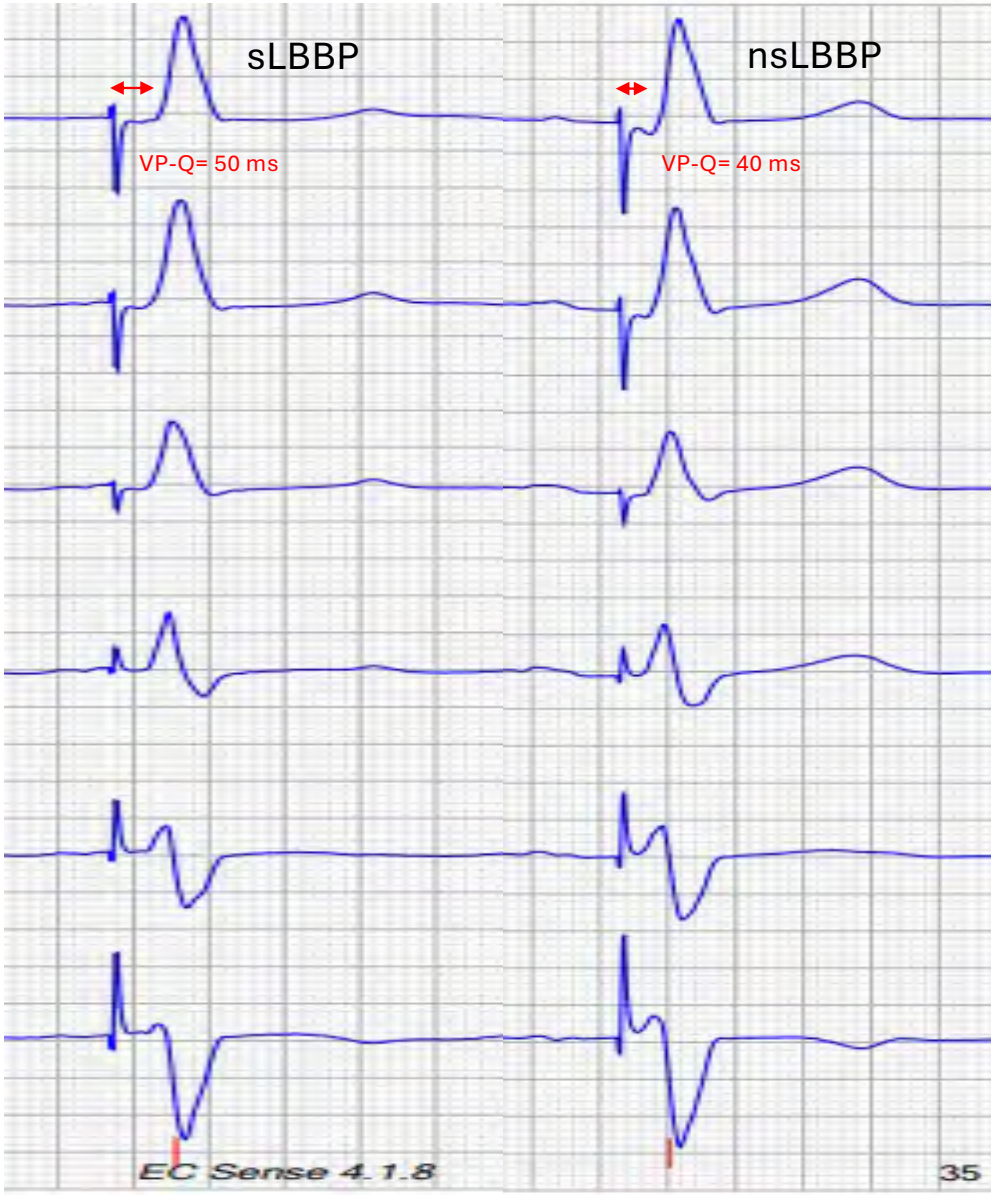


Postoperativt

- Pacemakerkontroll
- Rtg kontroll
- EKG

Pacemakerkontroll

- Tröskelvärdekontroll
  - Unipolärt från hög—låg output (dock med 0,4 ms) – notera TV för septal pacing- övergång till LBBP – Loss of capture
  - Bipolärt - övergång från septal –LBBP-loss of capture

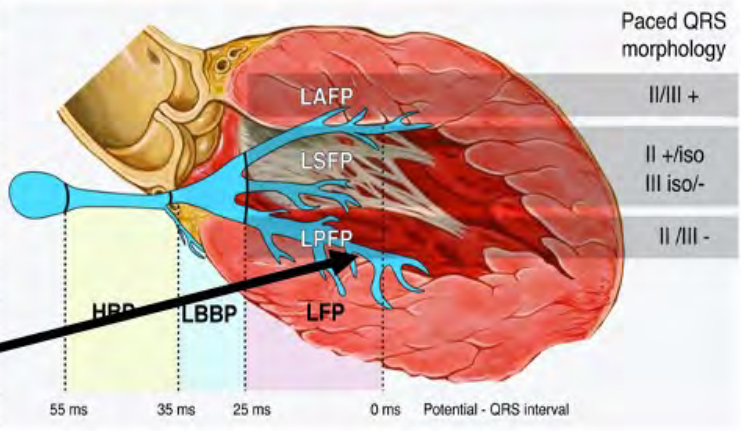

sLBBP
nsLBBP
VP-Q= 50 ms
VP-Q= 40 ms
EC Sense 4.1.8
35


sLBBP
nsLBBP
VP-Q= 50 ms
VP-Q= 40 ms

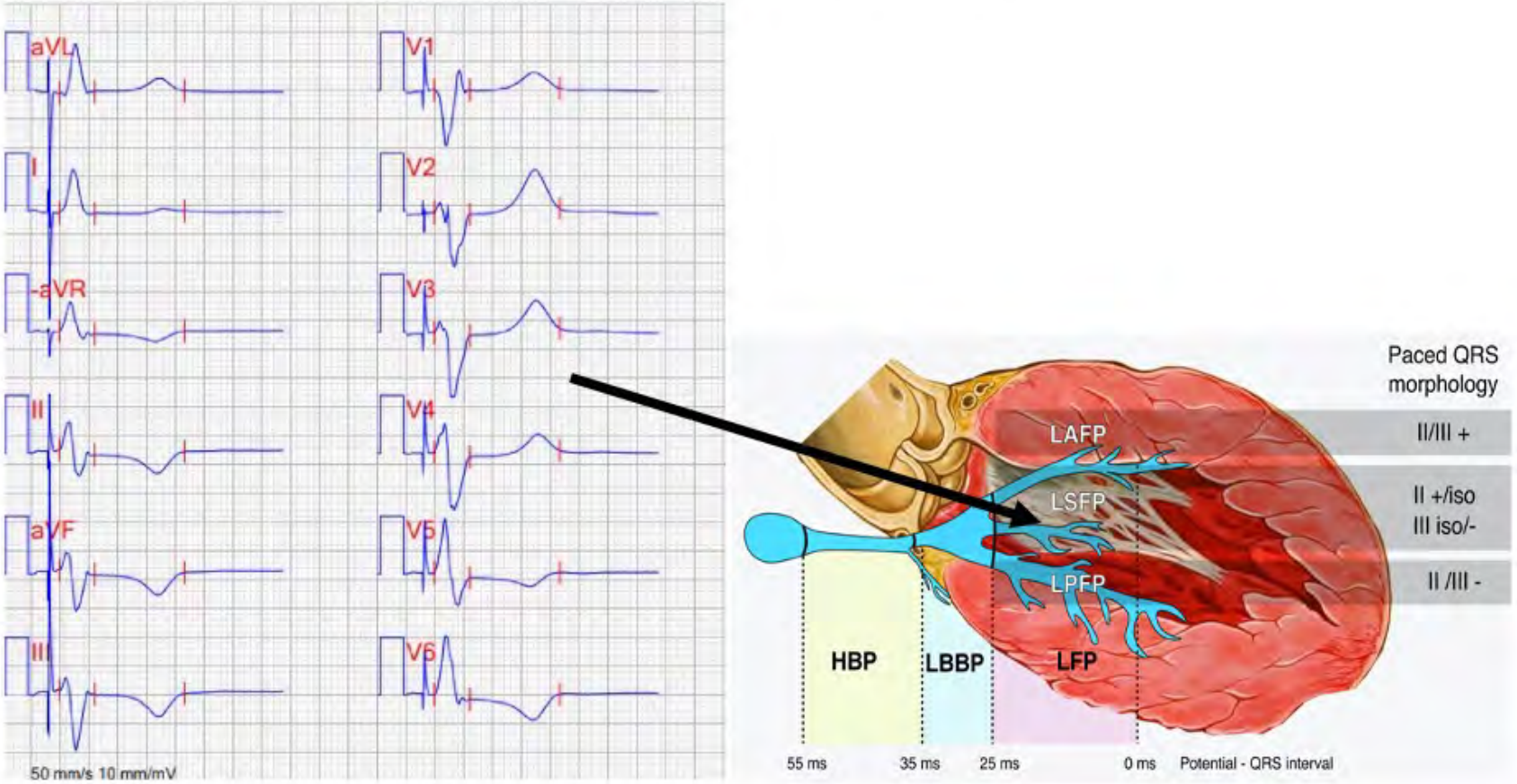
Fascikulär LBBP

- Bakre fascikelpacing (superior elektrisk axel, LAHB like)

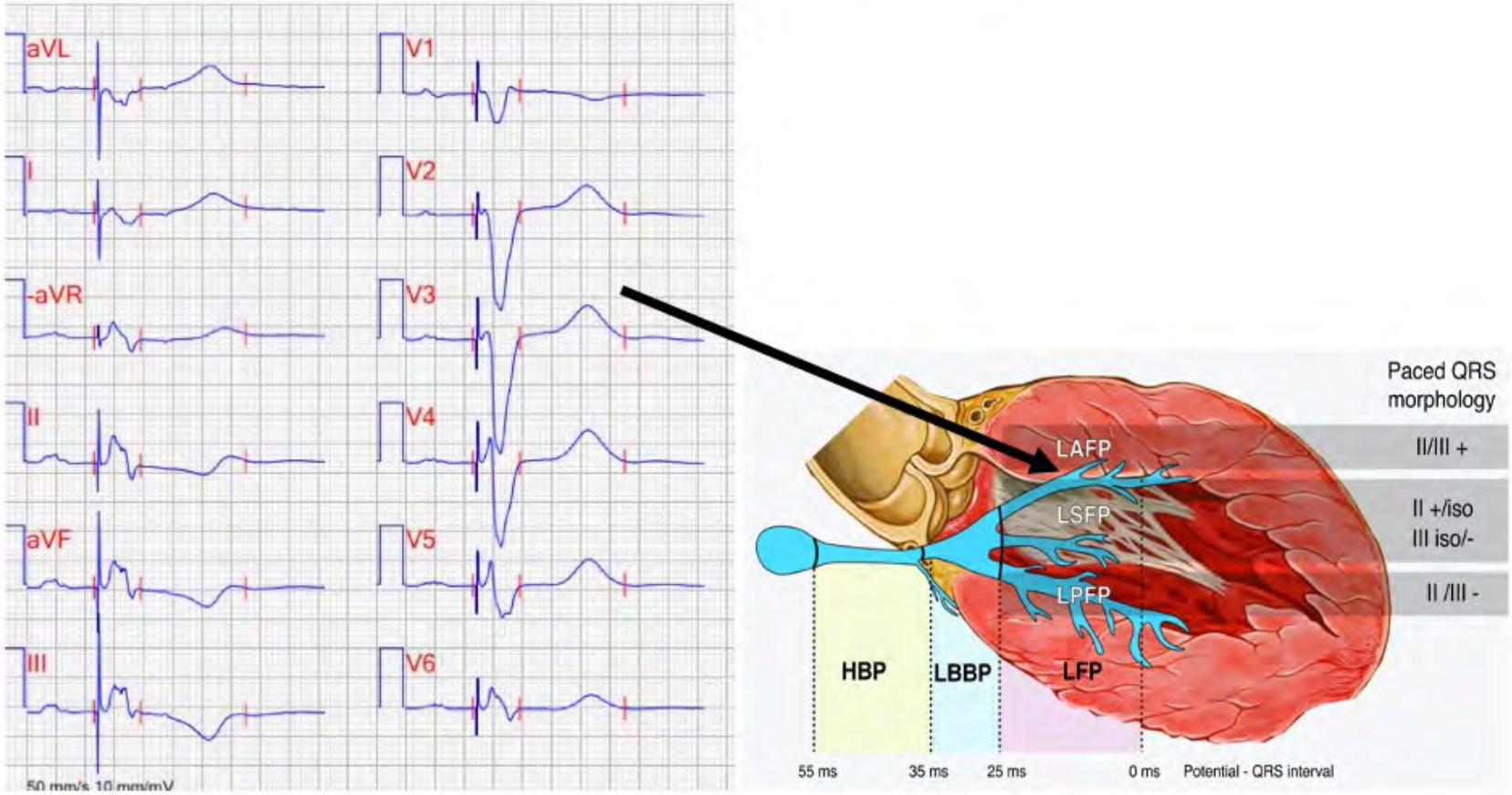




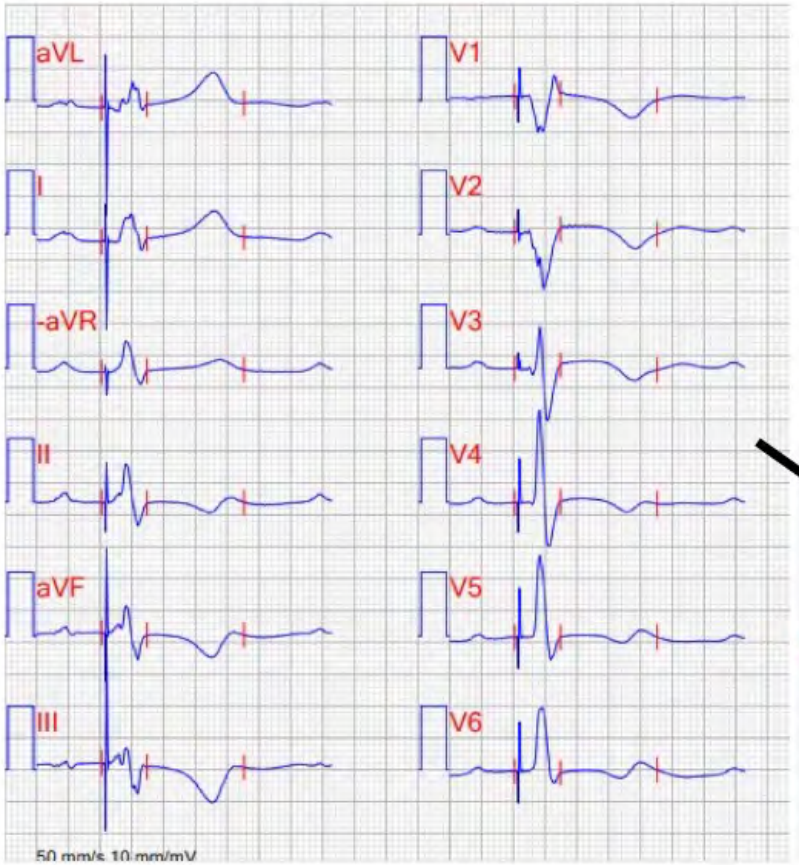
- Septal (positiva, isoelektriska QRS i I, II, negativa i III)

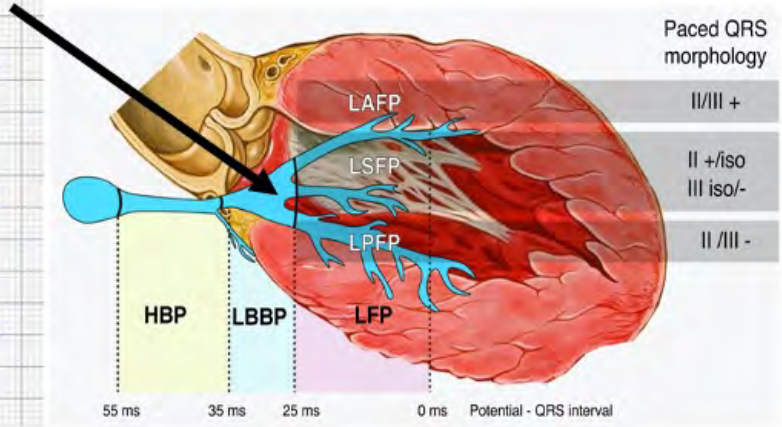


- Anterior fascikelpacing (inferior elektrisk axel -LPHB like)

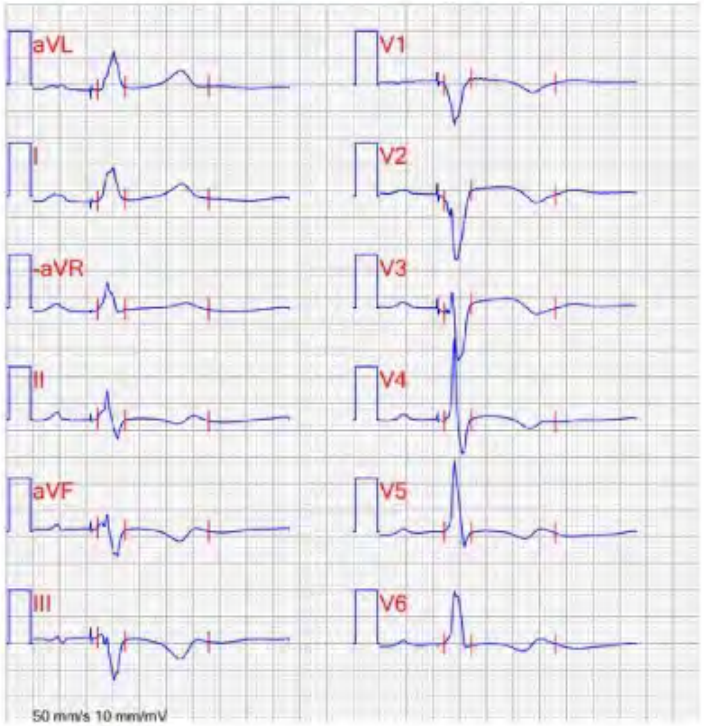


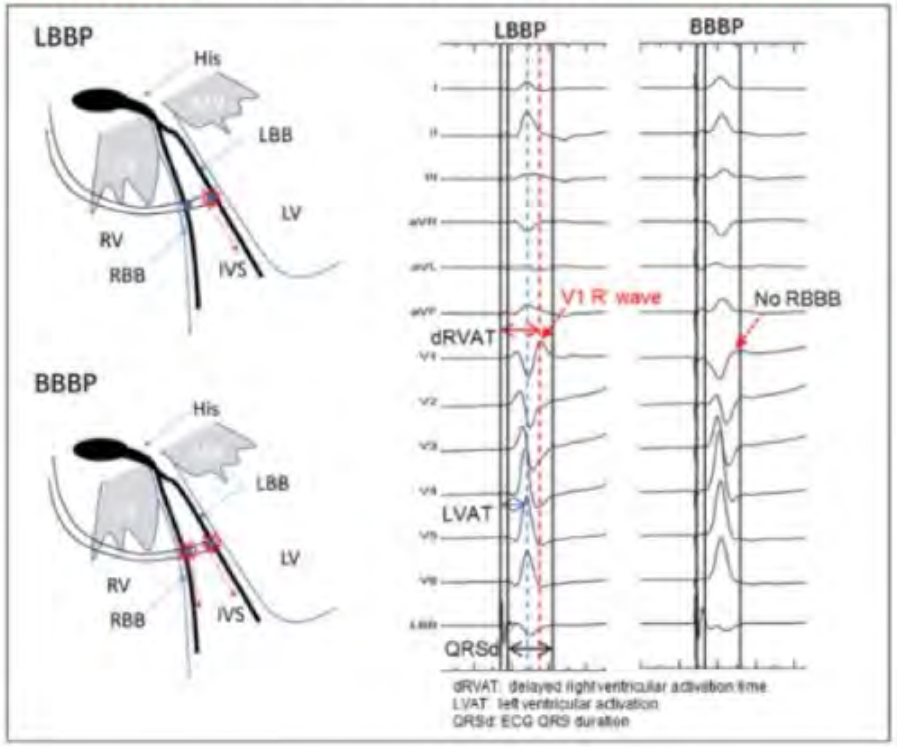
- Proximal sLBBP



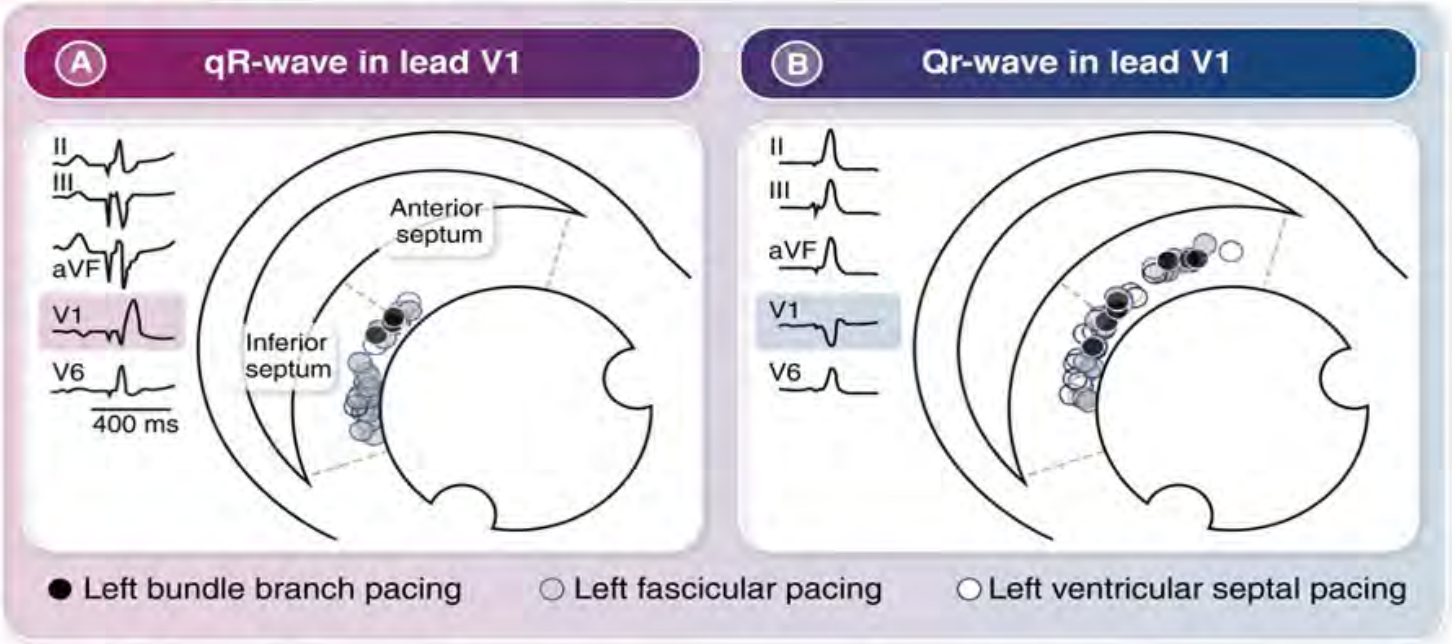


- RBBB korrigering med bipolär stimulering och smalare QRS (så kallade BBBP - bilateral bundle branch pacing) - anodal stimulering korrigerar RBBB

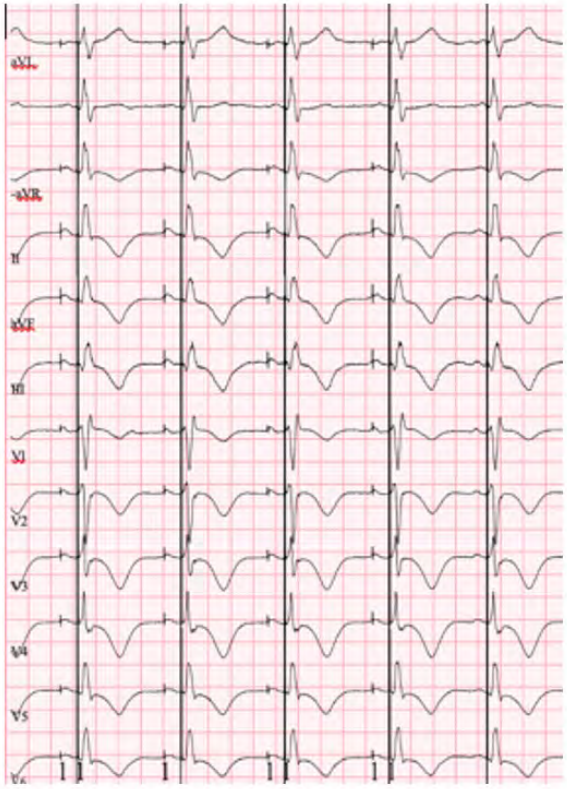




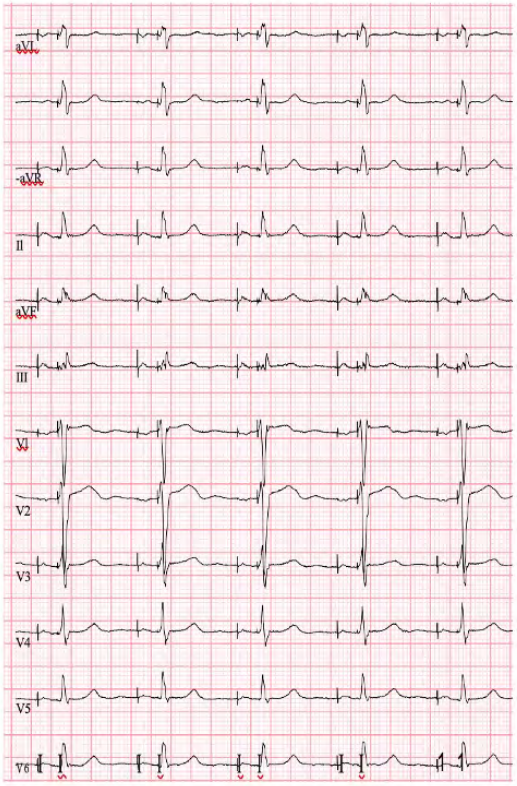
- Läge av LBB elektrod i septum
  - Anteriort – Qr i V_1 och inferior vektor i aVF
  - Inferiort qR i V_1 och S taggar i V_5-V



Djupa negativa T som uttryck för så kallade cardiac memory (särskilt hos patienter med primärt breda QRS eller kronisk högerkammarpacing)
Normaliseras efter ca 4 veckor

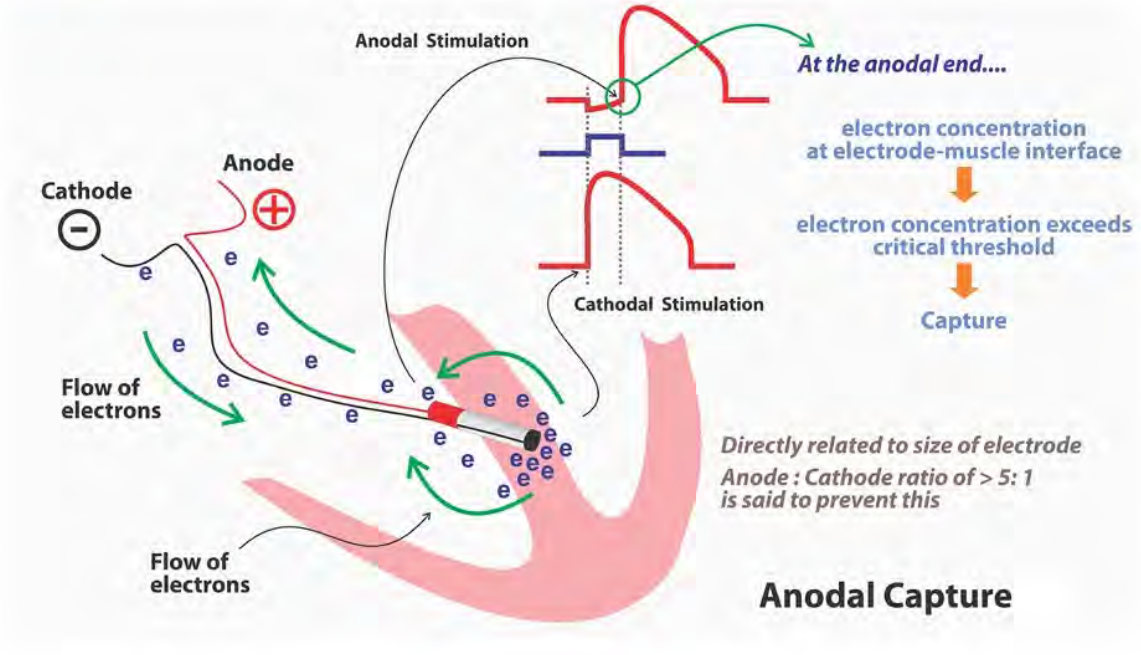


Postoperativt



Efter 4 veckor

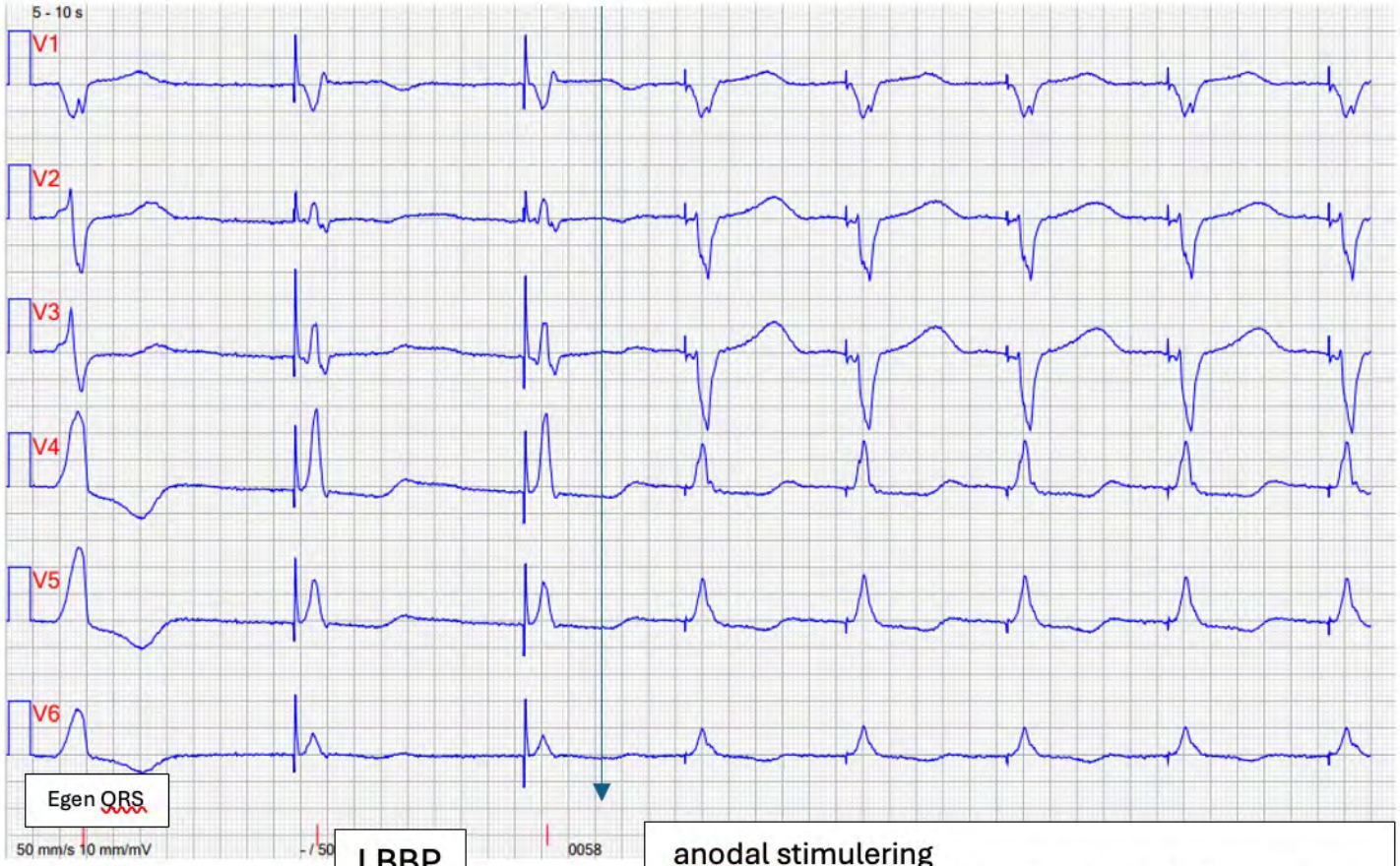
I vanliga fall sker stimuleringen via elektrodens katod (elektrodtipp). Det är den som har kontakt med retledningssystemet. Vid bipolärt pacingmönster observeras dock oftast så kallad anodal stimulering:

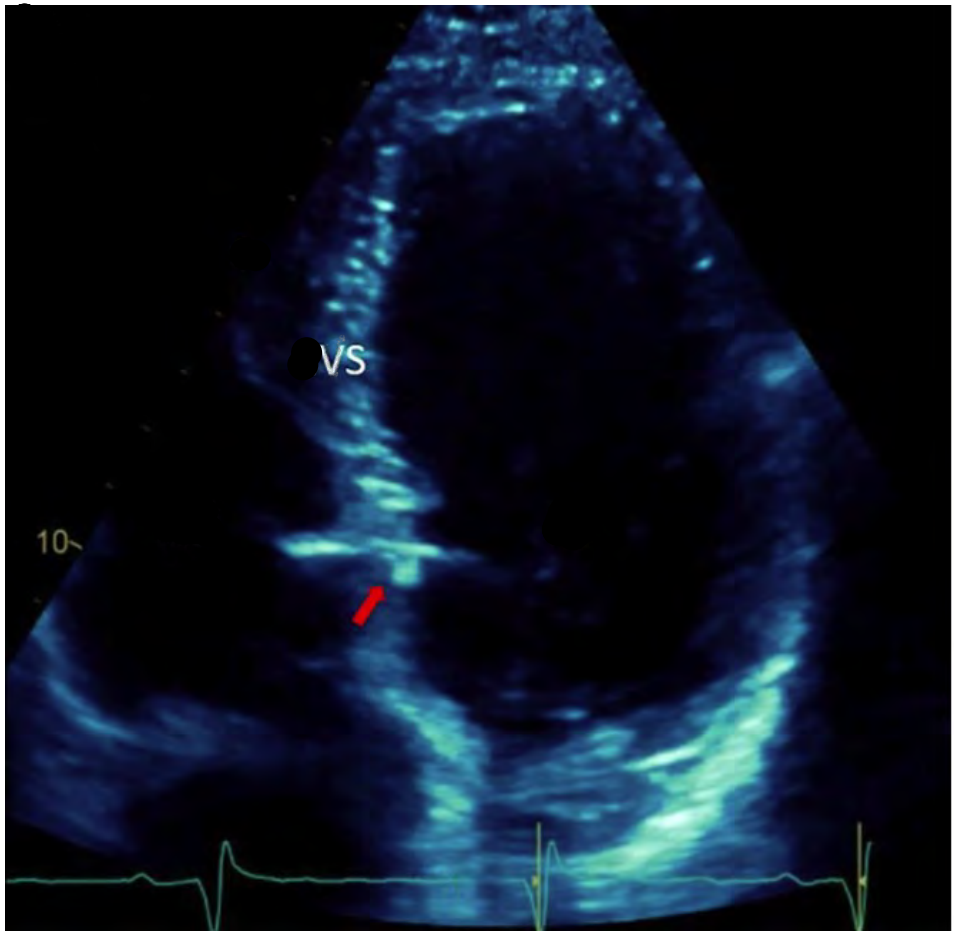


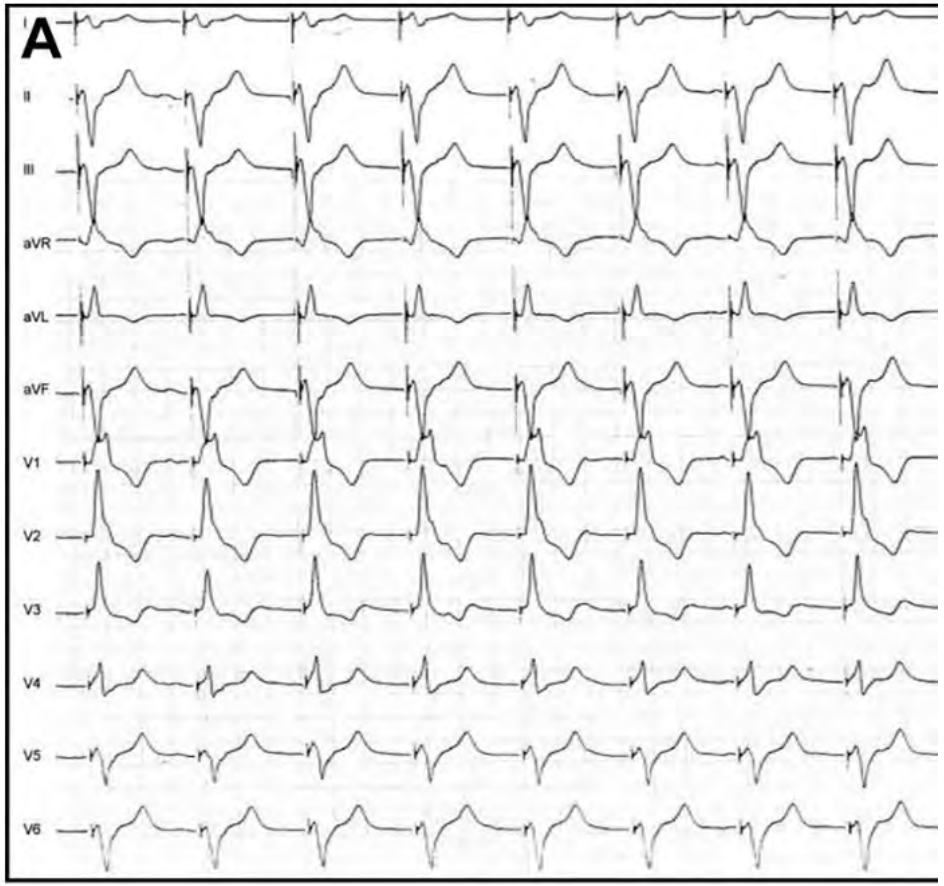
Vid elektrodplaceringen mot LBB har anoden direkt kontakt med muskelcellerna i septum (finns inuti) vilket skapar förutsättningar till anodal stimulering med oftast relativt låg pacingtröskel

- Tröskel för anodal stimulering

3V




VS
10

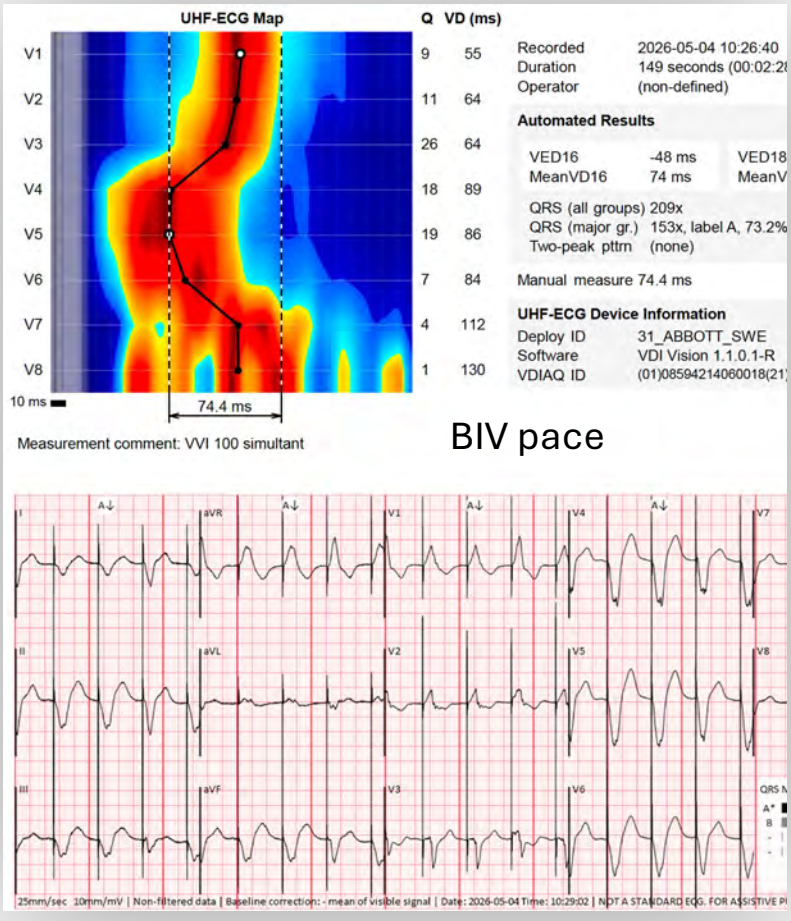

A
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

UHF- ECG
Under follow up

- AV VV timing
- LV vector
- Uni/bipolar LBBP
- Pacingmode (LBB, BIV, fusion)

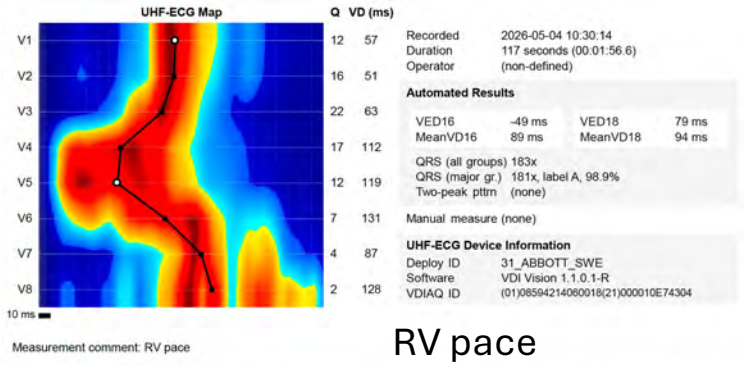
Man 70 år

Avancerad hjärtvikt
CAD
VES
RV pacing



BIV pace

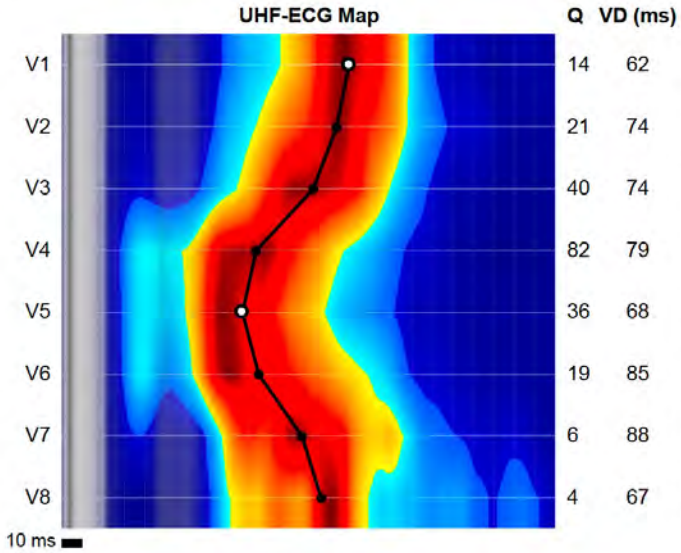
Första kontroll efter uppgraderingen till CRTD



RV pace



Kan vi göra mer?



Measurement comment: Biv LV3 50 ms fore RV

Recorded	2026-05-04 10:47:34
Duration	132 seconds (00:02:11.5)
Operator	(non-defined)

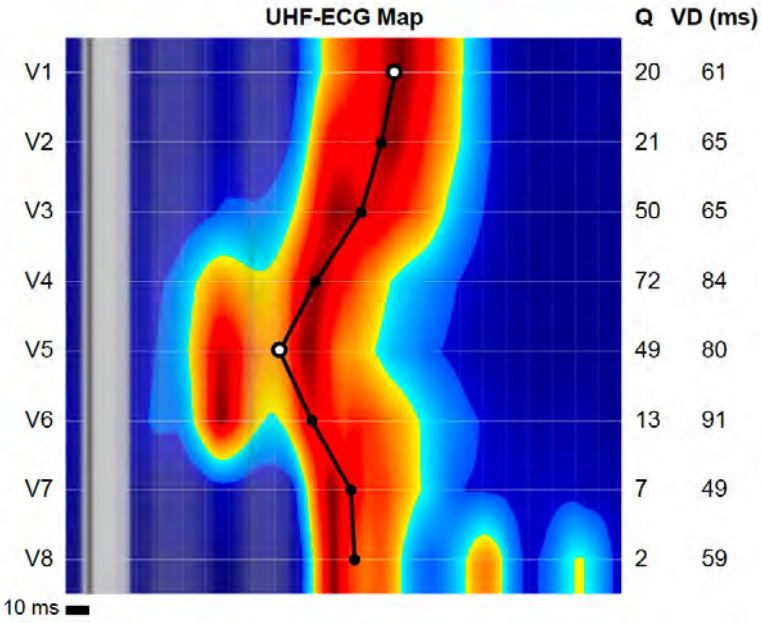
Automated Results

VED16	-52 ms	VED18	-52 ms
MeanVD16	74 ms	MeanVD18	75 ms

QRS (all groups)	190x
QRS (major gr.)	190x, label A, 100.0%
Two-peak pttrn	(none)

Manual measure (none)

Tidigarelagd MPP för konsolidation av LV aktivering
Mindre område aktiveras av RV elektrod



Measurement comment: MPP LV3 30 ms LV1 40 ms RV

Recorded	2026-05-04 11:16:23
Duration	185 seconds (00:03:05.4)
Operator	(non-defined)

Automated Results

VED16	-50 ms	VED18	-50 ms
MeanVD16	75 ms	MeanVD18	69 ms

QRS (all groups)	298x
QRS (major gr.)	295x, label A, 99.0%
Two-peak pttrn	(none)

Manual measure (none)

UHF-ECG Device Information

Deploy ID	31_ABBOTT_SWE
Software	VDI Vision 1.1.0.1-R
VDIAQ ID	(01)08594214060018(21)000010E74304

Att ta hem

- ***Procedurer hos individer på hjärtsviktsindikation bör utföras på centra som har kompetens I hela behandlingsspektrum (CRT och CSP)***

- *Adekvat proximal subendokardiell placering av LBB elektrod med åtkomst till retledningssystemet har stor betydelse hos individer med sänkt EF som behöver resynkroniseras*

- *Patienter med bakomliggande process som omfattar septum/fibrosbildning/inflammation bör i första steget utvärderas beträffande möjlighet till CRT om indikation för fysiologisk pacing föreligger*

