PLACE
PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE
ROMA 2026
CONGRESSO
25 – 27 Giugno

*Symposium: “**LBBaP: new Insights**”*
Fri 26/jun/2026

Settings Optimization with LBBaP Devices

Leonardo MARINACCIO, MD

Cardiology Dptm
AULSS 6 - Ospedale Piove di Sacco

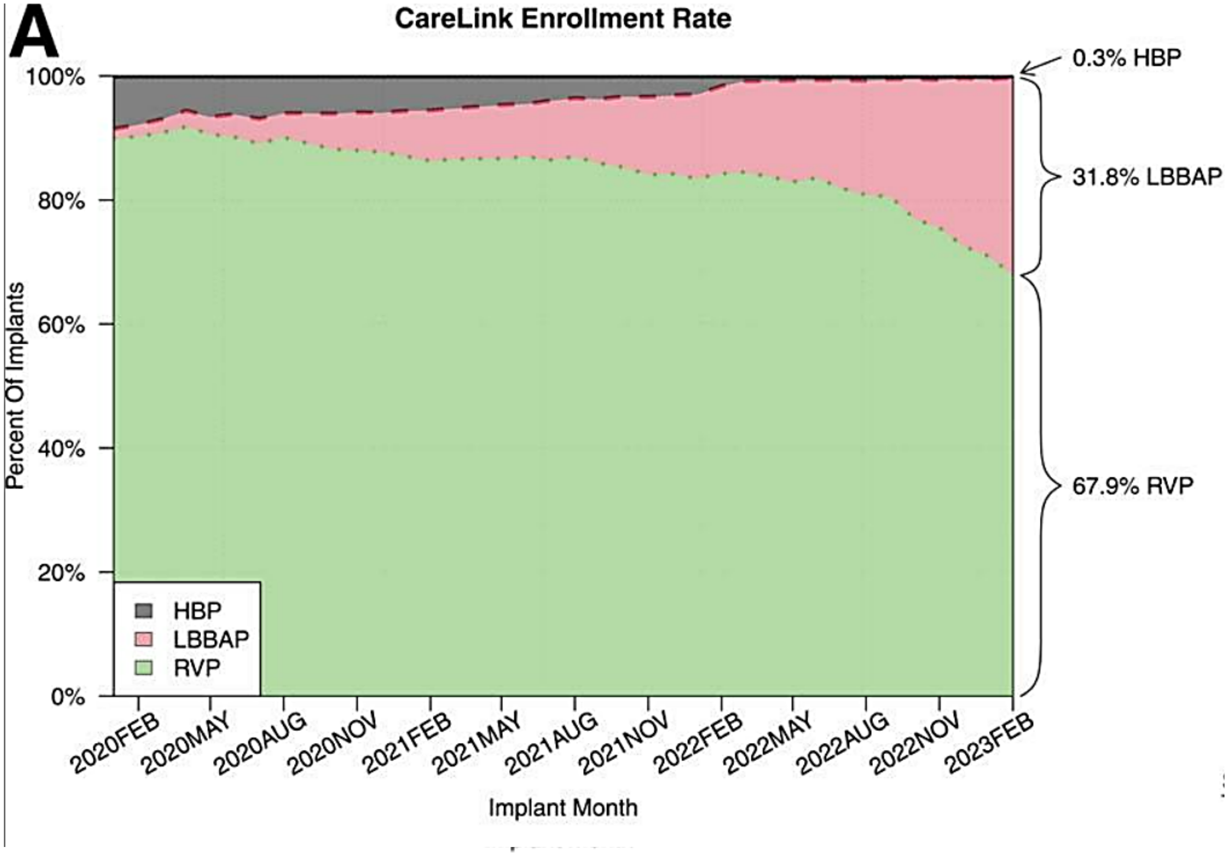
PIOVE di SACCO (Padua), Italy

Background: adoption of LBBaP is rapidly expanding

Mdt CareLink de-novo implants
(based on leads model)

TOT **n = 224.814 patients**

LBBaP adoption 2020-2023:
in only 3 yrs, from 2% to 32% …



Kronborg J et al. Real-world performance of CSP vs. traditional RVp. Circ Arr EP 2023

CSP device settings → manage complexity to ensure pts' SAFETY

Circulation: Arrhythmia and Electrophysiology

REVIEW

Device Programming for His Bundle Pacing

ABSTRACT: Although permanent His bundle pacing was first reported almost 2 decades ago, it is only recently gaining wider adoption, following facilitation of the implant procedure by dedicated tools. An additional challenge is programming the system, as His bundle pacing may have specific configurations and require special considerations which current implantable pulse generators are not designed for. The aim of this article is to provide practical recommendations for programming His bundle pacing, to deliver optimal therapy and ensure patient safety.

Haran Burri, MD
Daniel Keene, MD
Zachary Whinnett, MD
Francesco Zanon, MD
Pugazhendhi Vijayaraman, MD

BURRI H ET AL. CIRC ARRH & EP 2019; UNIV. OF GENEVE (CH)

← **Pure HBP** ↓

AER Arrhythmia & Electrophysiology Review

Cardiac Pacing

Troubleshooting Programming of Conduction System Pacing

Elise Bakelants and Haran Burri

Department of Cardiology, University Hospital of Geneva, Geneva, Switzerland

LBBaP + HBP

Abstract

Conduction system pacing (CSP) comprises His bundle pacing and left bundle branch area pacing and is rapidly gaining widespread adoption. Effective CSP not only depends on successful system implantation but also on proper device programming. Current implantable impulse generators are not specifically designed for CSP. Either single chamber, dual chamber or CRT devices can be used for CSP depending on the underlying heart rhythm (sinus rhythm or permanent atrial arrhythmia) and the aim of pacing. Different programming issues may arise depending on the device configuration. This article aims to provide an update on practical considerations for His bundle and left bundle branch area pacing programming and follow-up.

Keywords

Conduction system pacing, His bundle pacing, left bundle branch area pacing, programming, troubleshooting

BAKELANTS E, BURRI H. ARRH & EP REVIEW 2021; UNIV. OF GENEVE (CH)

Permanent His Bundle Pacing: A programming and troubleshooting guide

Jillian L. Hanifin, Venkatesh Ravi, Richard G. Trohman, Parikshit S. Sharma*

Rush University Medical Center, Chicago, IL, USA

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ABSTRACT

Permanent His Bundle Pacing (HBP) has recently gained popularity. However, implanting physicians and those who perform the device checks must invest in additional education in order to accurately program these devices, identify changes in morphology and perform troubleshooting to help achieve the best outcomes for the patients. This paper reviews key aspects of HBP and provides the educational tools for successful HBP follow-up and troubleshooting.

Hanifin JL et al. Indian Pacing and Electrophysiology Journal (2020)
Rush Univ. of Chicago-IL (USA)

CSP → device selection + configuration

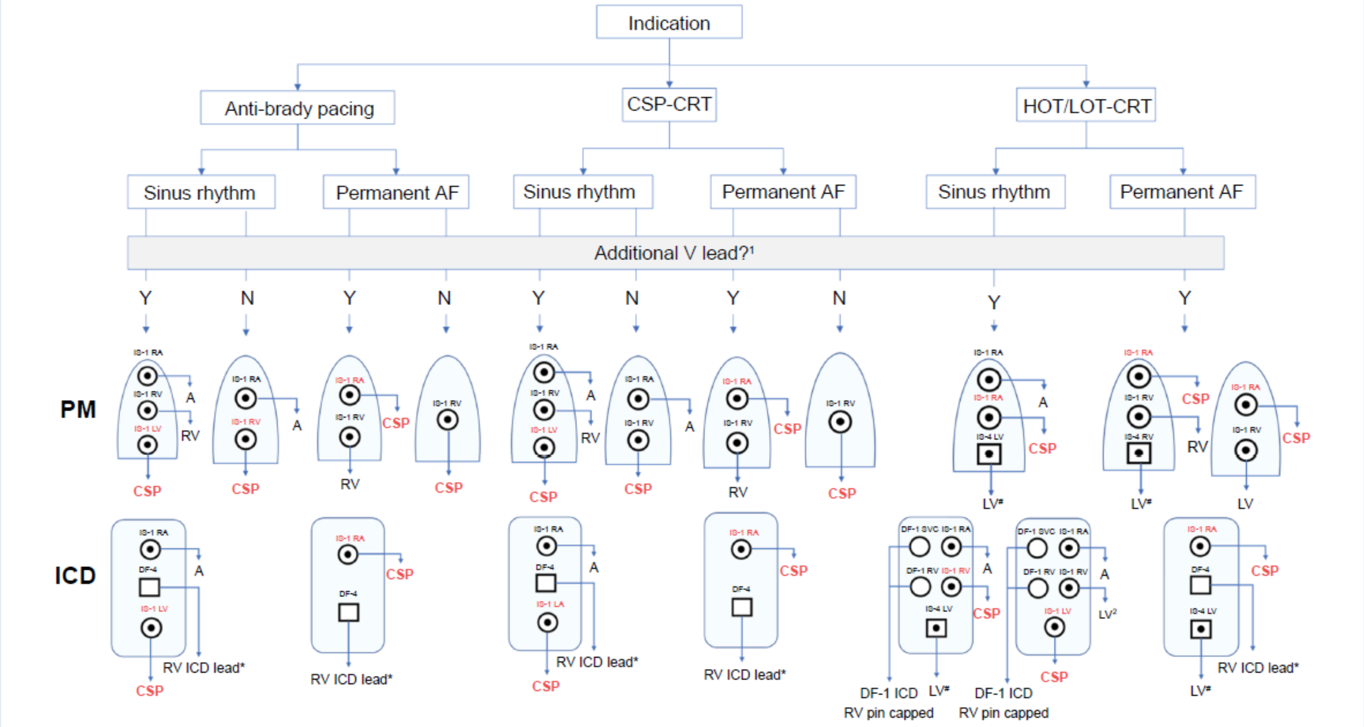


Figure 7 Device configuration for CSP according to device indication, underlying rhythm (i.e. requirement for an atrial lead), presence on an additional ventricular lead. In all cases with a CSP lead plugged to the RV port, adequate sensing must be ensured. Not shown here are additional configurations with Y-adapters.[1] Additional ventricular lead may be indicated for ICD therapy, backup pacing, adequate ventricular sensing, or CRT optimization.[2] The LV lead is plugged to the RV port in case the CSP lead does not provide proper sensing (atrial or His potential oversensing and ventricular undersensing are issues that may be encountered with HBP). * DF-1 ICD lead may also be used; # IS-1 LV lead may also be used.

Burri H et al. EHRA clinical consensus statement on CSP implantation: executive summary. Europace 2023 Apr

1. Clinical indication

2. Underlying rhythm (SR/AF)

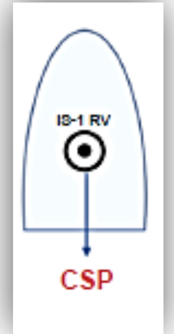
3. Additional RV lead (yes/no)
   [RV back-up, ICD, RV sensing, CRT]

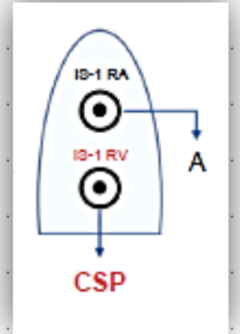
PM *(SC, DC, CRTP)*

ICD *(DC, CRTD)*

LBBaP (w/o back-up) : choice of device (1/4)

ANTI-BRADY	Perman. AF	SR (or Parox AF)
Device	**SC-PM**	**DC-PM**
Pacing Mode	VVI	DDD
RA lead	-	RA port
LBBaP lead	**RV port**	**RV port**





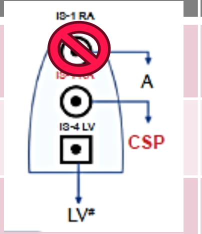
CRT-P proximal disease	Perman. AF	SR (or Parox AF)
Device	**SC-PM**	**DC-PM**
Pacing Mode	VVI	DDD
RA lead	-	RA port
LBBaP lead	**RV port**	**RV port**

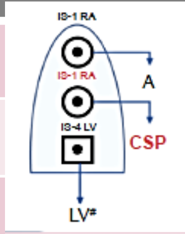
AF: ATRIAL FIBRILLATION
SR: SINUS RHYTHM

SC-PM: SINGLE-CHAMBER PACEMAKER
DC-PM: DUAL-CHAMBER PACEMAKER

LBBaP (w/o back-up) : choice of device (2/4)

LOT-CRT(P)





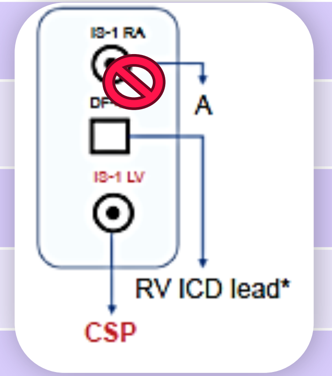
CRT – distal disease	Permanent AF	SR (or paroxysmal AF)
Device	**CRT-PM**	**CRT-PM**
RA lead	-	RA port
LBBaP lead	**RV port**	**RV port**
LV (CS) lead	LV port	LV port
Pacing Mode	VVI-CRT	DDD-CRT
VV delay	**Fusion LBBap / LVp**	**Fusion LBBap / LVp**
AV delay	*NA*	**Optimized** *(hemodyn or EGM-based methods)*

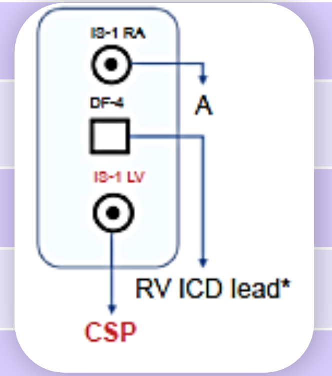
AF: ATRIAL FIBRILLATION
SR: SINUS RHYTHM

SC-PM: SINGLE-CHAMBER PM
DC-PM: DUAL-CHAMBER PM
CRT-PM: TRIPLE-CHAMBER PM

LBBaP (w/o back-up) : choice of device (3/4)

CRT-D proximal disease	Perman. AF	SR (or Parox AF)
Device	**CRT-ICD**	**CRT-ICD**
Pacing Mode	VVI	DDD
Atrial Lead	-	RAport
Coil lead	RV Icd	RV Icd
LBBaP lead	**LV port**	**LV port**





AF: ATRIAL FIBRILLATION

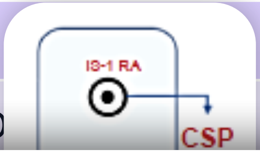
SR: SINUS RHYTHM

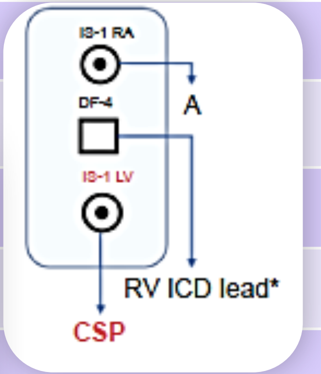
SC-ICD: SINGLE-CHAMBER ICD

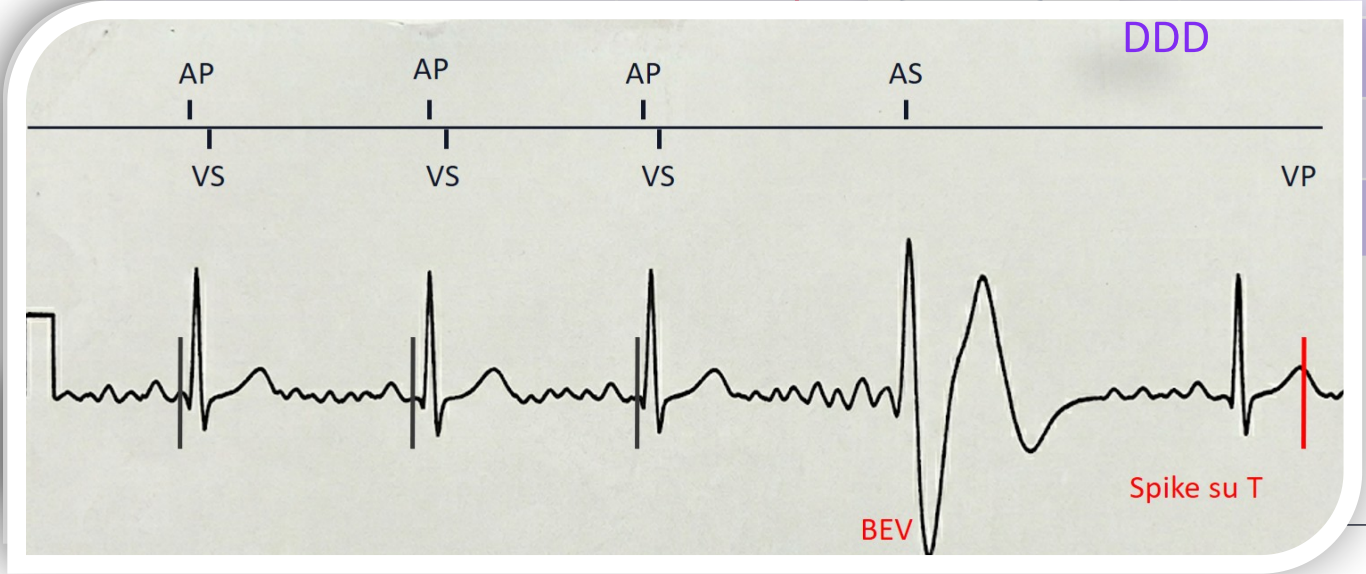
DC-ICD: DUAL-CHAMBER ICD

LBBaP (w/o back-up) : choice of device (3/4)

CRT-D proximal disease	Perman. AF	SR (or Parox AF)
Device	DC-ICD	CRT-ICD
Pacing Mode	DDI ~~AAI~~ ~~DDD~~	DDD







AF: ATRIAL FIBRILLATION

SR: SINUS RHYTHM

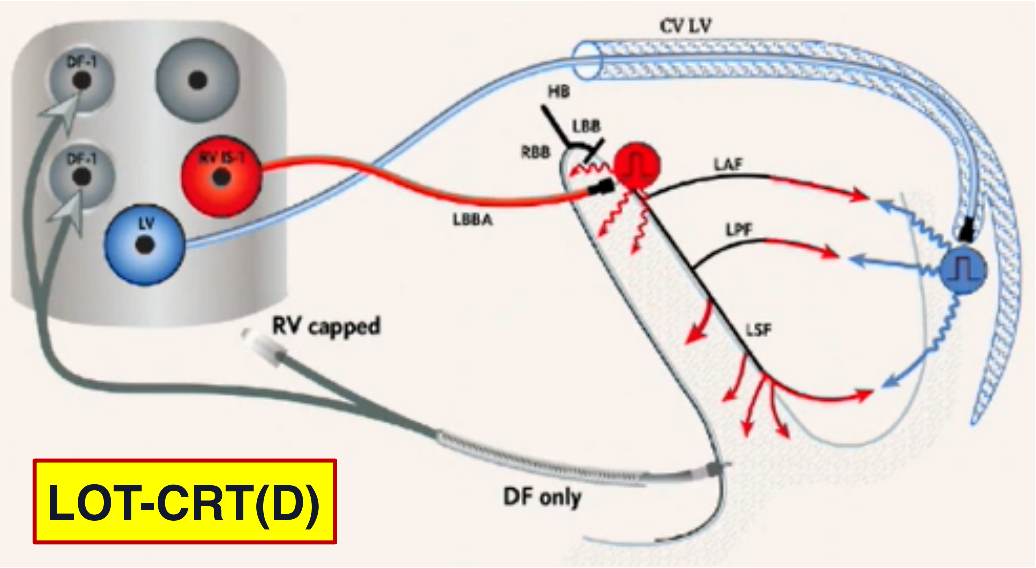
SC-ICD: SINGLE-CHAMBER ICD

DC-ICD: DUAL-CHAMBER ICD

LBBaP (w/o back-up) : choice of device (4/4)

Lead implant steps:

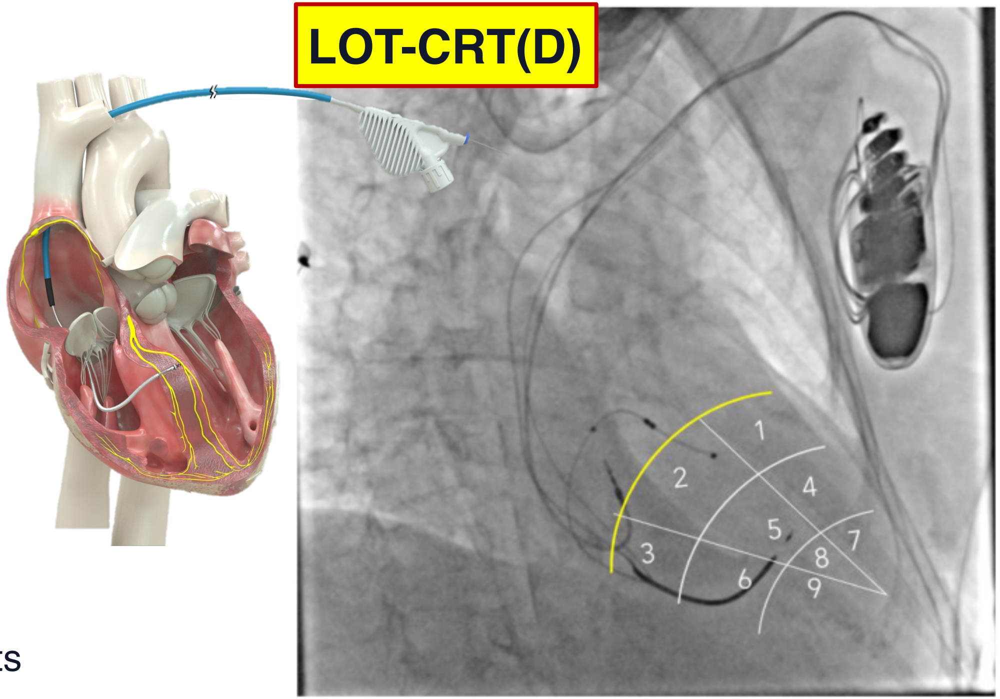
1. **RV ICD DF-1** → RVcoil DF1 port
2. **LBBa lead** → RV port IS-1 BIP
3. **LV (CS) lead** → LV port IS-1/IS-4



Jastrzebski M. Heart Rhythm 2021

- **CRT pacing mode** (VVI / DDD)
- **VV delay:** fusion **LBBap** w distal **LVp**
- AV delay: to be optimized in SR / parox AF pts
- **VT/VF detection through a LBBa / deep IVS RV lead !!!**
- Be careful with **arrhythmia discrimination criteria** (PARAD, PR Logic, SmartAV, etc)

LBBaP (w/o back-up) : choice of device (4/4)



Lead implant steps:

1. RA lead → RA port IS-1
2. RV ICD DF-4 → RVcoil DF4 port
3. LV (CS) lead → LV port IS-4

- **CRT pacing mode** (VVI / DDD)
- **VV delay:** fusion **LBBap** w distal **LVp**
- AV delay: to be optimized in SR / parox AF pts

LBBaP settings → Pacing/Sensing POLARITY

- **PACING POLARITY**

Bipolar (lower current drain due to higher impedance; anodal capture may narrow the QRS)

Unipolar if anodal capture is not desirable

LBBaP settings → Pacing/Sensing POLARITY

PACING POLARITY	Bipolar (lower current drain due to higher impedance; anodal capture may narrow the QRS) Unipolar if anodal capture is not desirable
SENSING POLARITY	Bipolar
SENSITIVITY	Usually, not an issue as R waves are of high amplitude

LBBaP → RA port
REDUCE / ELIMINATE RA sensing

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LBBaP settings → Pacing ENERGY

PACING OUTPUT

2 × threshold voltage

Pacing threshold →
S ⇦ NS ⇨ Myo
Anodal Pacing Thx in BIP?

LBBaP settings → Pacing ENERGY

Pacing threshold →
S ⇐ NS ⇒ Myo
Anodal Pacing Thx in BIP?

PACING OUTPUT	2 × threshold voltage
PULSE WIDTH	0.4 ms (capture threshold is rarely an issue)

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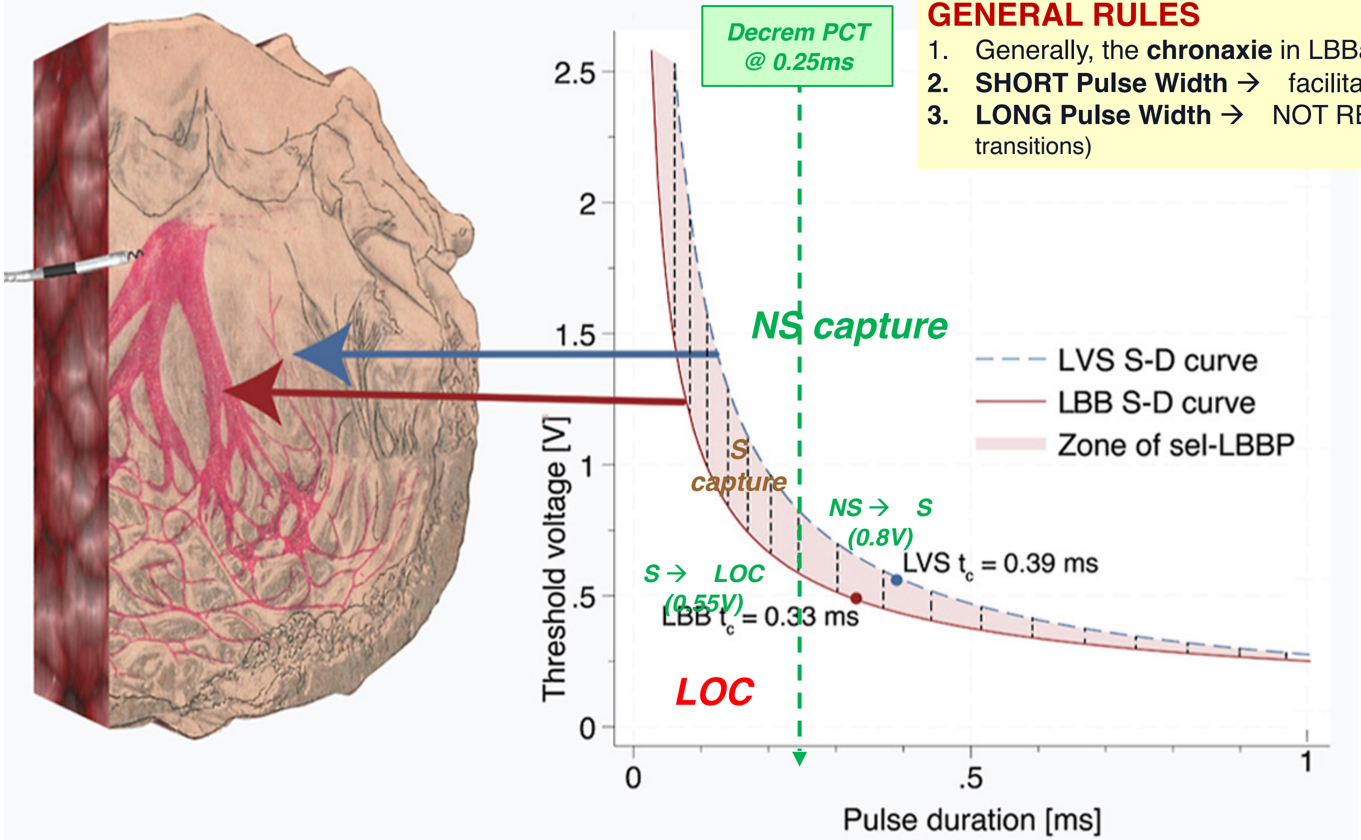
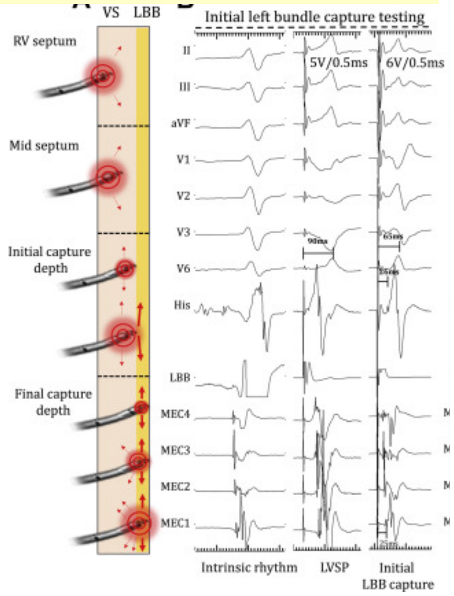
GENERAL RULES

1. Generally, the **chronaxie** in LBBaP is ~ **0.25ms** (→ **Energy minimization**)
2. **SHORT Pulse Width →** facilitate **S-LBB** pacing capture
3. **LONG Pulse Width →** NOT RECOMMENDED (reduce delta between transitions)





NS: non-selective capture
S: selective capture
MYOC: myocardial capture
LOC: loss of capture

Cardiac Resynchronization/Physiologic Pacing; ***Heart Rhythm 365 - Nov 2024;*** *21:11:2262-9.*
Strength–duration curves for LBBaP. *Kiełbasa G, Jastrzebski M et al.*

LBBaP settings → Pacing ENERGY

Pacing threshold →
S ⇐ NS ⇒ Myo
Anodal Pacing Thx in BIP?

PACING OUTPUT	2 × threshold voltage
PULSE WIDTH	0.4 ms (capture threshold is rarely an issue)
AUTOTHRESHOLD AUTOCAPTURE	Set to monitor or automatic once the accuracy has been confirmed in the patient

RV AutoThreshold / AutoCapture:

1. OFF → No advantage
2. **MONITOR → BEST CHOICE in Pre-Hosp. Disch.**
3. ON → Only if individ. tested

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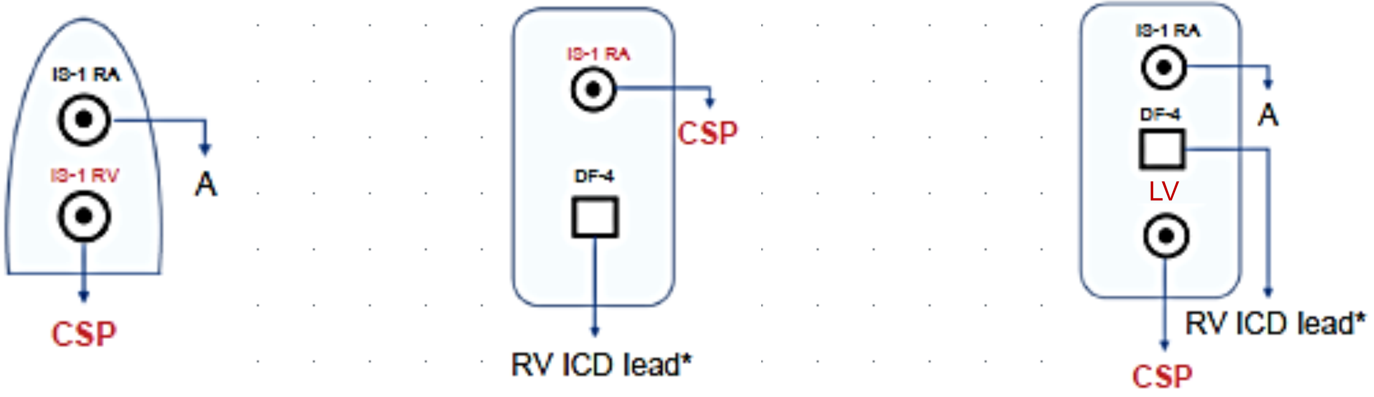
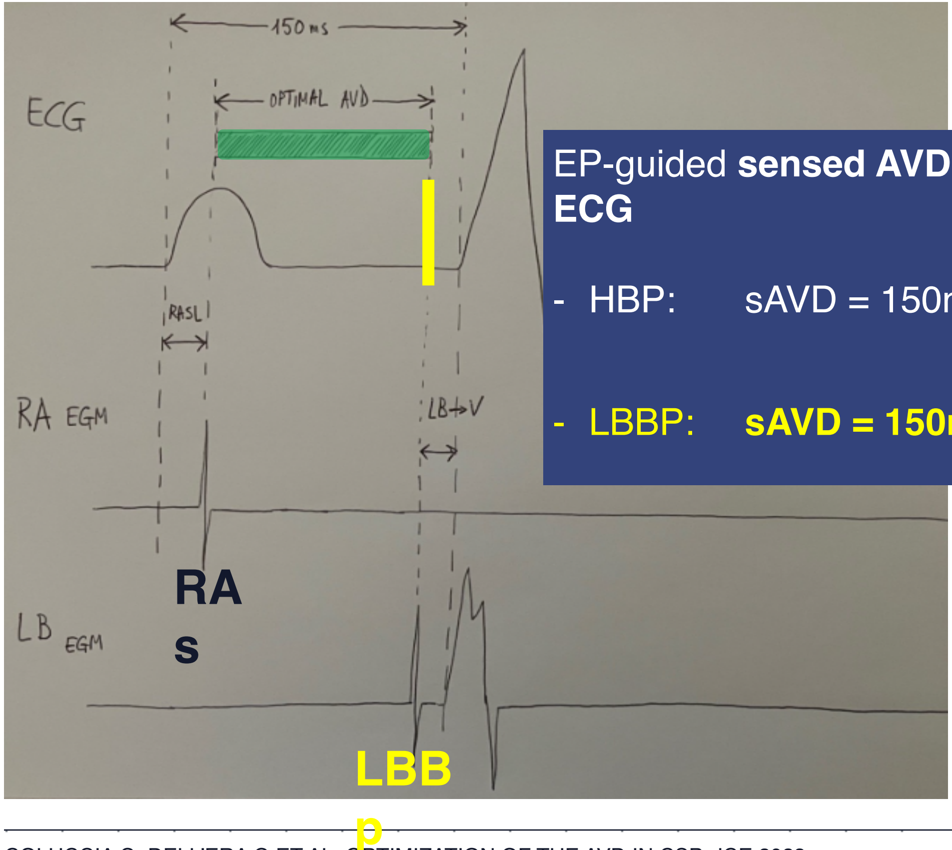
Optimization of the AV Delay in CSP

- ➢Pre-implantation AV interval duration **known**
- ➢LBB lead **connection port**



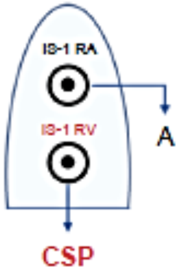
Optimization of the AV Delay in CSP   Pre AV Known



EP-guided **sensed AVD →**   value **leading to PR = 150 ms on surface ECG**

- HBP: sAVD = 150ms – [P(ecg) – RAs(egm)] – [H(egm) - V(egm)]
  RASL (RA sensing latency)   *HV interval*

- LBBP: **sAVD = 150ms – [P(ecg) – RAs(egm)]**
  RASL (RA sensing latency)



COLUCCIA G, DELL'ERA G ET AL. OPTIMIZATION OF THE AVD IN CSP. JCE 2023

Optimization of the AV Delay in CSP Pre AV Unknown

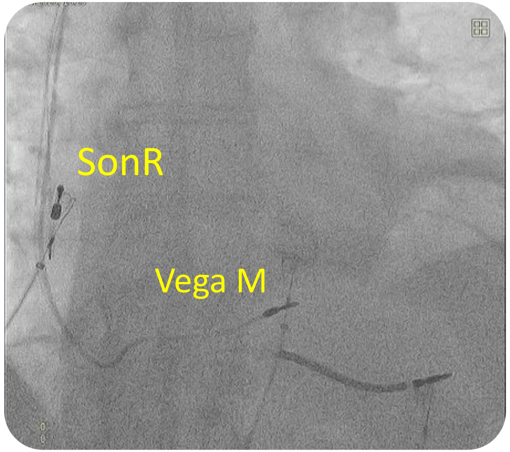
Empiric

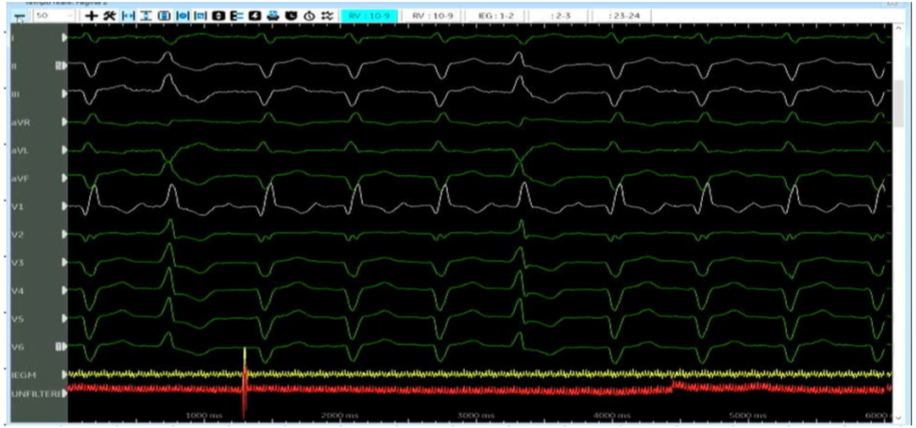
VTI-
ECHO

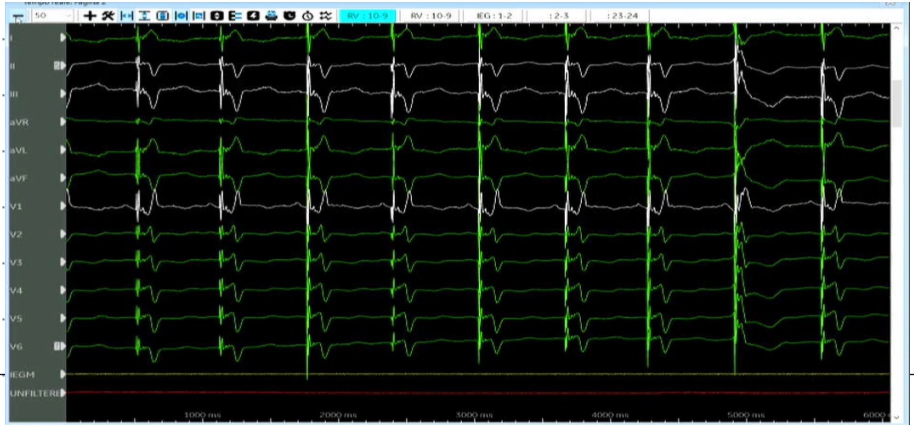
dP/dT- ECHO

Optimization of the AV Delay in CSP   Pre AV Unknown

Case series







M pt, 80 yrs old

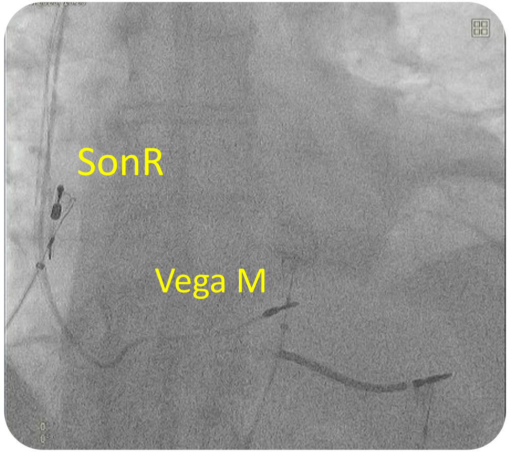
HFrEF pt with LVEF 30% (May 2026)

Ischemic Dilated CMP, NYHA II/III

MI Y2014

Optimization of the AV Delay in CSP   Pre AV Unknown

Case series



LBBaP (LVp only); Optimal sAVD 125ms (SonR based) @ HR 97bpm

Marinaccio L. – Piove di Sacco (Padua), Italy – May 2026

Optimization of the AV Delay in CSP   Pre AV Unknown

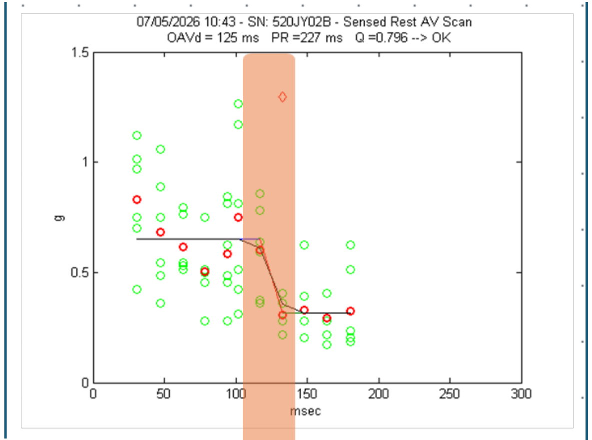
Case series

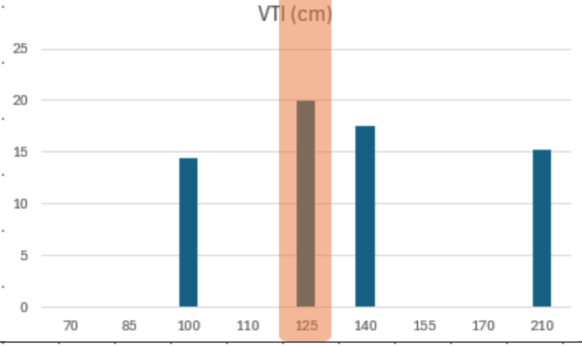
SonR AVD MANUAL OPTIMIZATION
LBBaP (LVp only)

OUTCOMES:

Sensed AVD

- HR 97bpm (real conditions): 125ms
- By interpolating:
  - Optimal sAVD @   60bpm: 140ms (+4ms/10bpm)
  - Optimal sAVD @ 130bpm: 70ms (empiric)





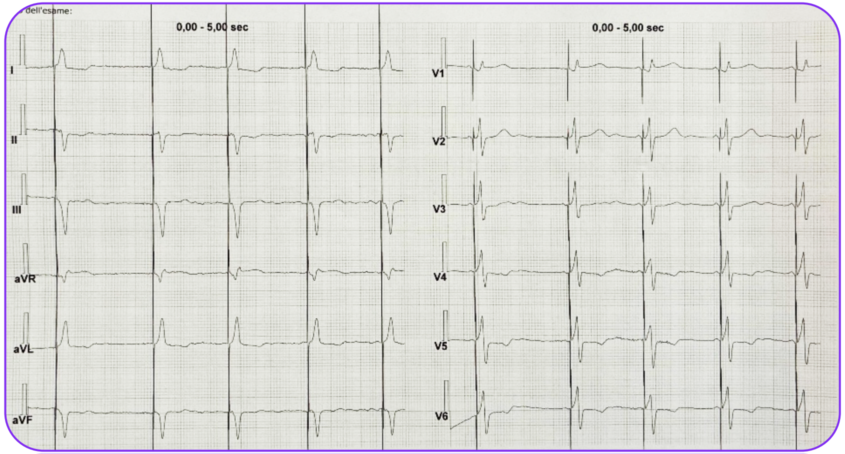
dP/dT-Echo:
Mitral regurgitation

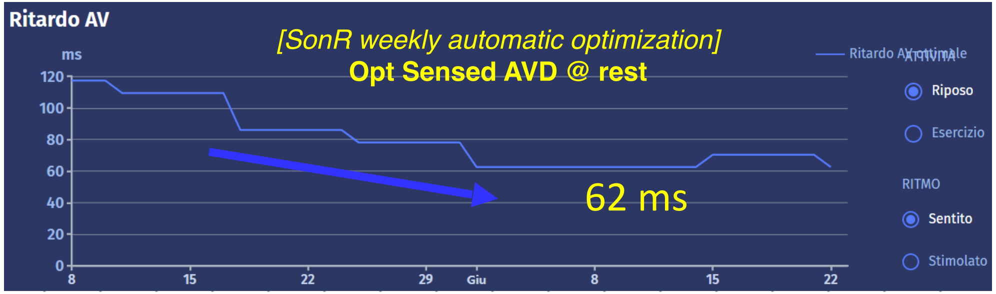
Optimization of the AV Delay in CSP: 6W FU Visit

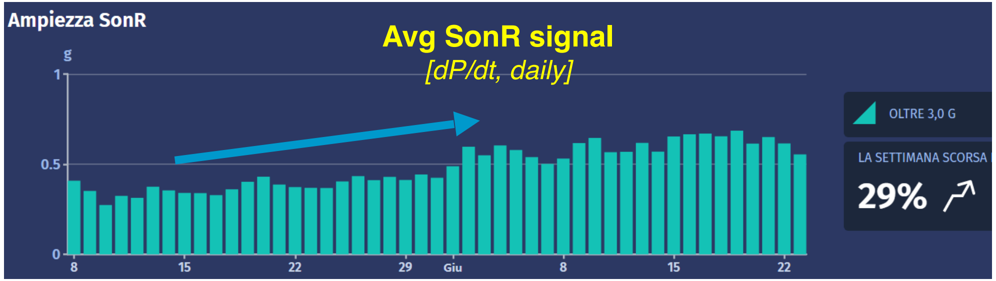
Case series

dP/dT-Echo: 62 ms

Mitral regurgitation

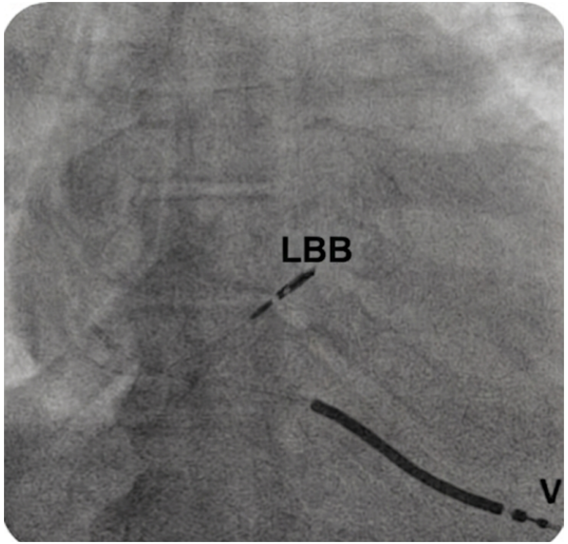


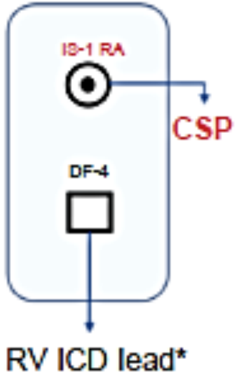




Optimization of the AV Delay in CSP

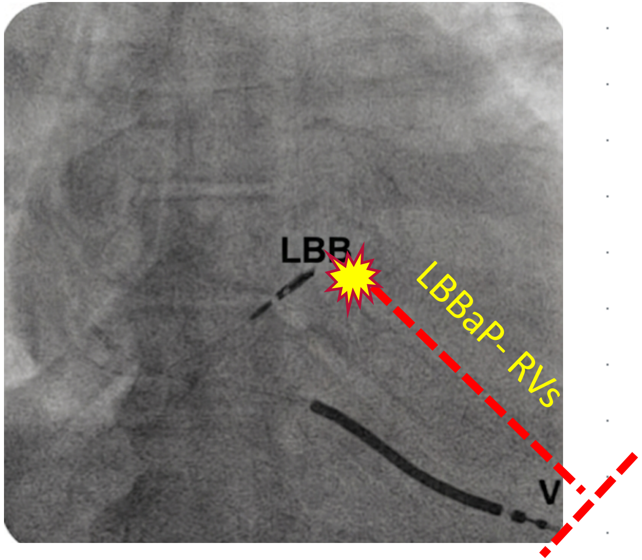
LBB lead **in atrial port**

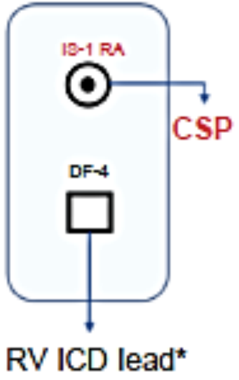




Optimization of the AV Delay in CSP

LBB lead **in atrial port**





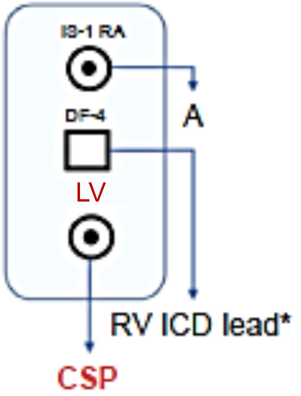
LB lead → RA port :

AVD > LBBaP-RVs interval

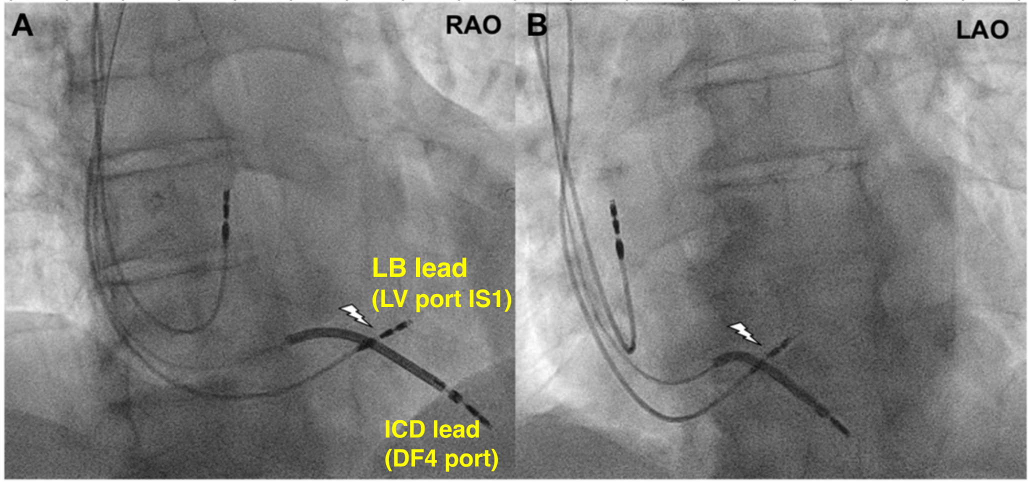
If not possible, subthreshold output

LBBaP settings → VV Delay

LBB lead **in LV port**



With backup RV pacing (e.g. with ICD lead): program maximum LV channel pre-excitation (e.g 80 ms)



LB lead → 1st to pace
RV lead (ICD) → 2nd to pace (max VVD)

Example:

Mode: DDD-CRT
V pacing: L + R
A V: narrowest QRS
V V: 80-100 ms

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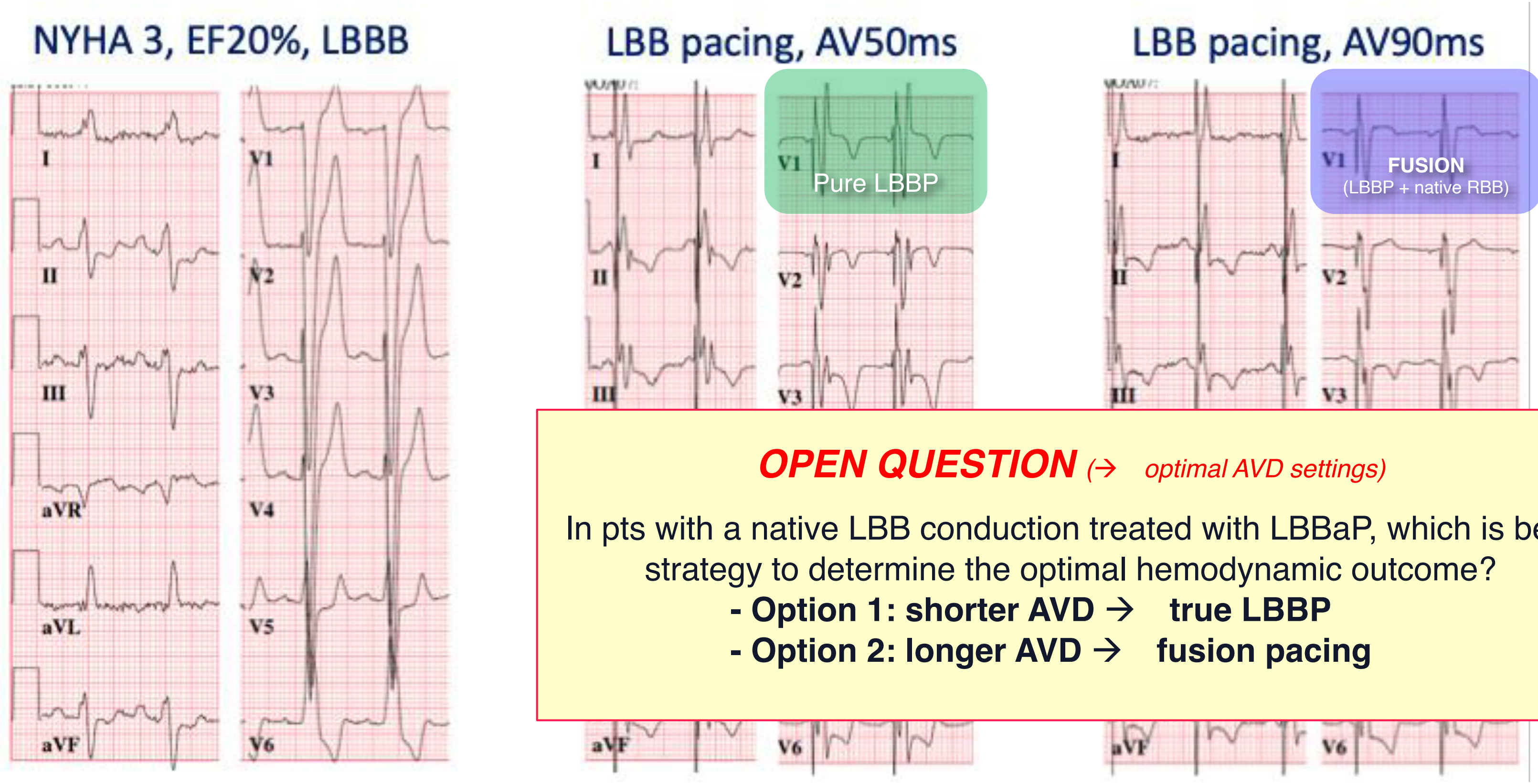


OPEN QUESTION *(→ optimal AVD settings)*

In pts with a native LBB conduction treated with LBBaP, which is best strategy to determine the optimal hemodynamic outcome?

- Option 1: shorter AVD → true LBBP

- Option 2: longer AVD → fusion pacing

Different programmed AVDs during LBBP in a patient with baseline LBBB,
exhibiting fusion with intrinsic RBB

Joza J et al. ***Europace 2025 Jul***
LBBP in Pts with ***STRUCTURAL Heart Disease****: Personalizing CRT*

LBBB pts: how to set an optimal AVD

scientific reports

Fusion with PROXIMAL LVp (i.e. LBBaP)

Opt AVD (sensed) = 0.66 * [RAs-RVs]

LBBaP at 2/3 of the PR interval guarantees optimal fusion native RBB + LBBaP

Check for updates

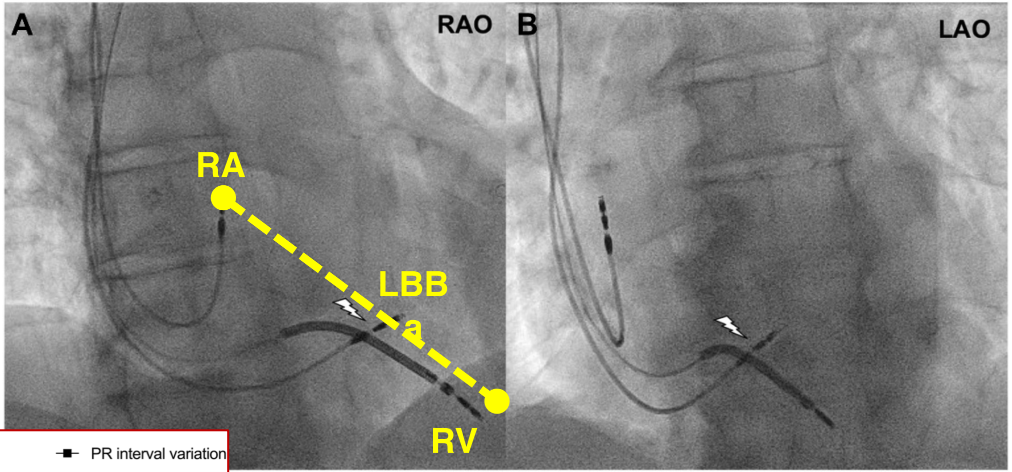
OPEN **Feasibility study on cardiac resynchronization in the treatment of heart failure by single left bundle branch pacing**

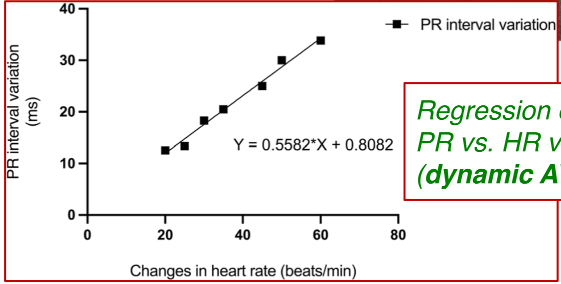
Yadong Du[1], Lijin Pu[1], Baotong Hua[1], Yanzhou Lu[2], Xiuli Wang[3] & Ling Zhao[1]

n = 21 CRT LBBB pts implanted with CRTP and S-LBBaP (uniV pacing from the LBBa)

AVD optim with echo methods (VTI/MR-area) vs. QRSd, cardiac function, echo parameters:

- RAs–RVs (PR) 156 ± 33 ms
- AVD opt 102 ± 10 ms
- ***optimal coefficient*** ***0.66 ± 0.06***



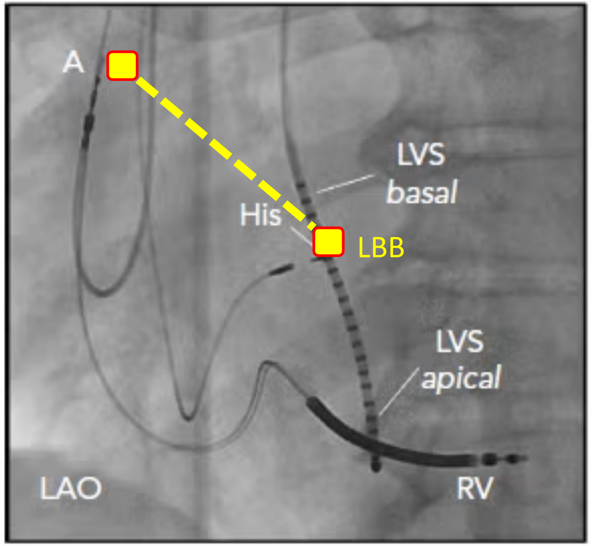


*Regression equation PR vs. HR variations (**dynamic AVD optim**)*

Du Y et al. Scientific Reports 2023
https://doi.org/10.1038/s41598-023-48820-z
(www.nature.com/scientificreports)

Fusion model: AVD optim in Brady / CRTP pts *(treated with LBBaP)*

To investigate **acute impact of AVD** on cardiac electrical characteristics and identify an **optimal range of AVDs for LBBaP** to achieve electrical AV/VV synch.



Optimal AVD by ECG criteria:

- **QRS duration**
- reduced V1R’
- reduced notching or slurring in lat. leads
- more desirable precordial QRS trans.

N = 38 pts (68.7±10.3 yrs; 42% M);

- n = 18 DC PM
- n = 20 CRT devices

Fusion LBBaP + intrinsic RV conduction **in 21 pts** with corresponding optimal AVD determined:
~85% of **Opt AVDs** ranged from **50% to 80% of the observed RAs-to-LBBs intervals**

Optimal AVD was linearly correlated with the corresponding RAs-LBBs interval:
Opt AVD = 0.84 * [RAs-LBBs interval] – 36 ms

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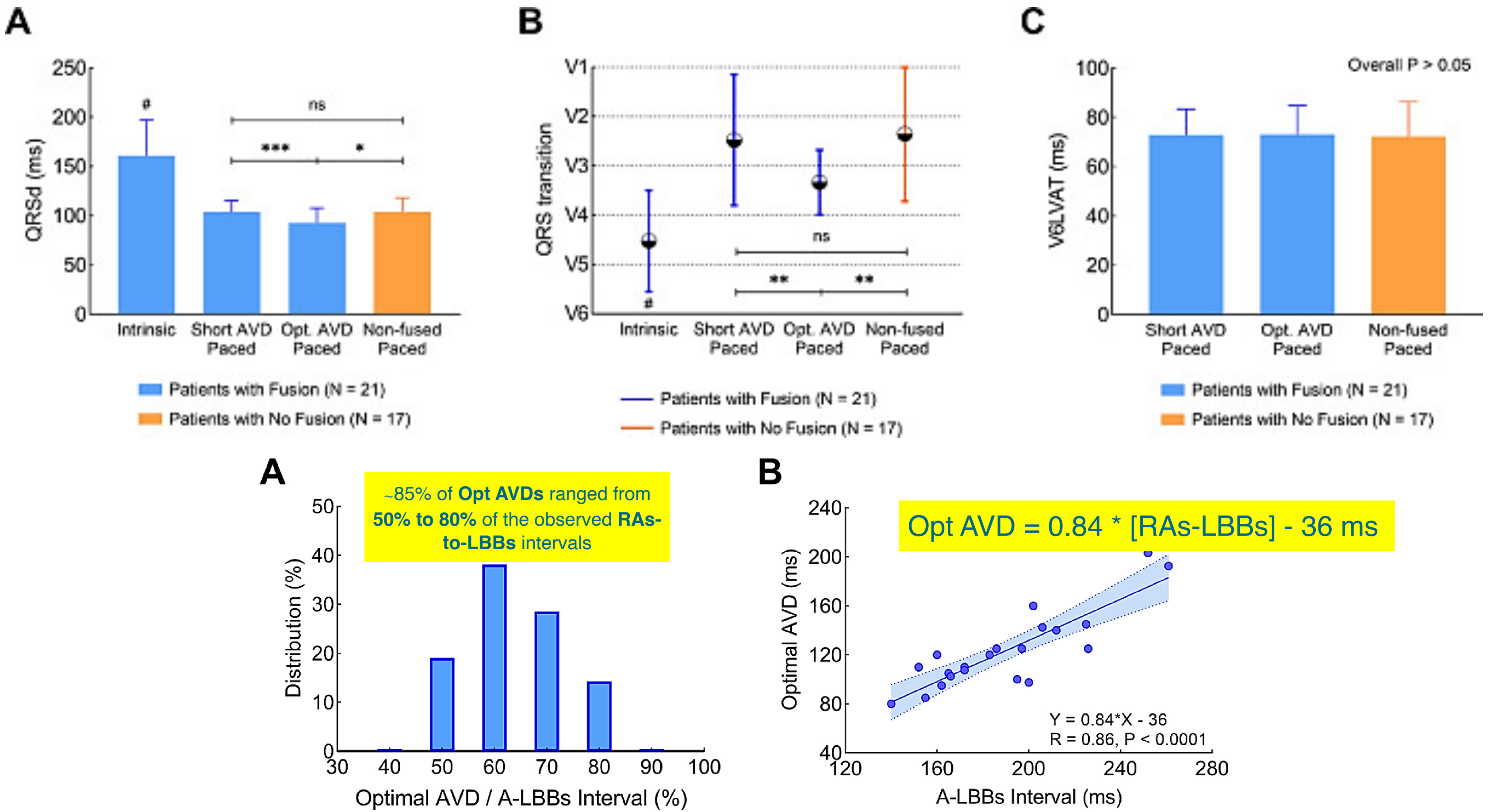
Fusion model: AVD optim in Brady / CRTP pts *(treated with LBBaP)*



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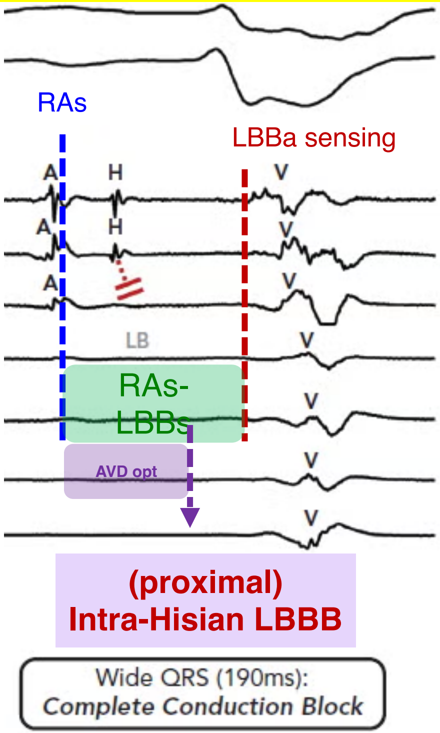
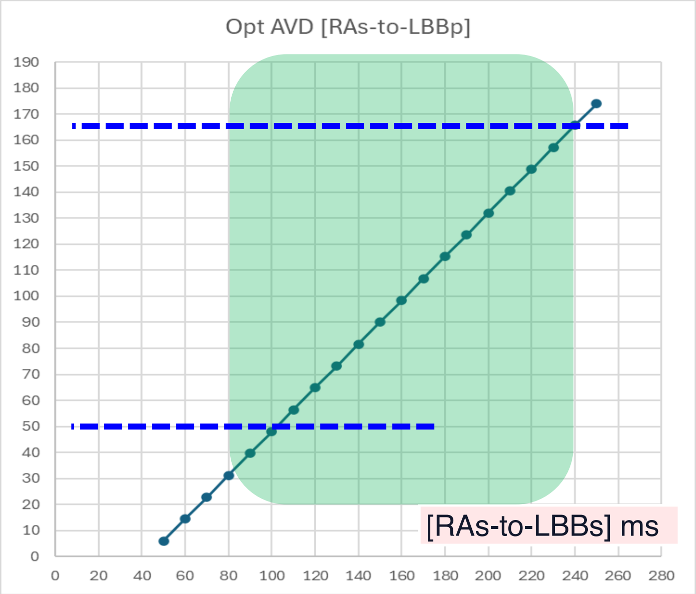
LBBB pts → optimal AVD *(using RA and **LBBa** sensing)*

Fusion with PROXIMAL LVp (i.e. LBBaP)
based upon LBBa sensing …





Formula for optimal AVD (RAs-LBBp):

Opt AVD (sensed) = 0.84 * [RAs-LBBs] - 36ms

Example:
if time to LBB sensing [RAs-LBBs] = 200ms
then Opt AVD = [168 – 36] = 132ms

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Grazie…

Leonardo MARINACCIO, MD

Cardiology Dptm
AULSS 6 - Ospedale Piove di Sacco

PIOVE di SACCO (Padua), Italy