PLACE 2026
PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

CONGRESSO
ROMA, 25 - 27 Giugno 2026

LBBAP: tecniche e nuove tecnologie

LBBAP e ottimizzazione della stimolazione con sensore emodinamico: prime esperienze

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Background (1/2): CSP as an alternative to BiVP

According to the **existing GLs** (2021 ESC GLs for pacing/CRT), **BiVP is today first choice** approach in pts with **indications for CRT**, given the **proven clear clinical/functional benefits given by BiVP.**

CSP has been recently proposed *(HBP first, then LBBaP, 2025 EHRA Consensus)* as **potential alternatives to BiVP** in pts in whom we need to:

- correct a BBB when present
- pace physiologically to prevent PI-CMP

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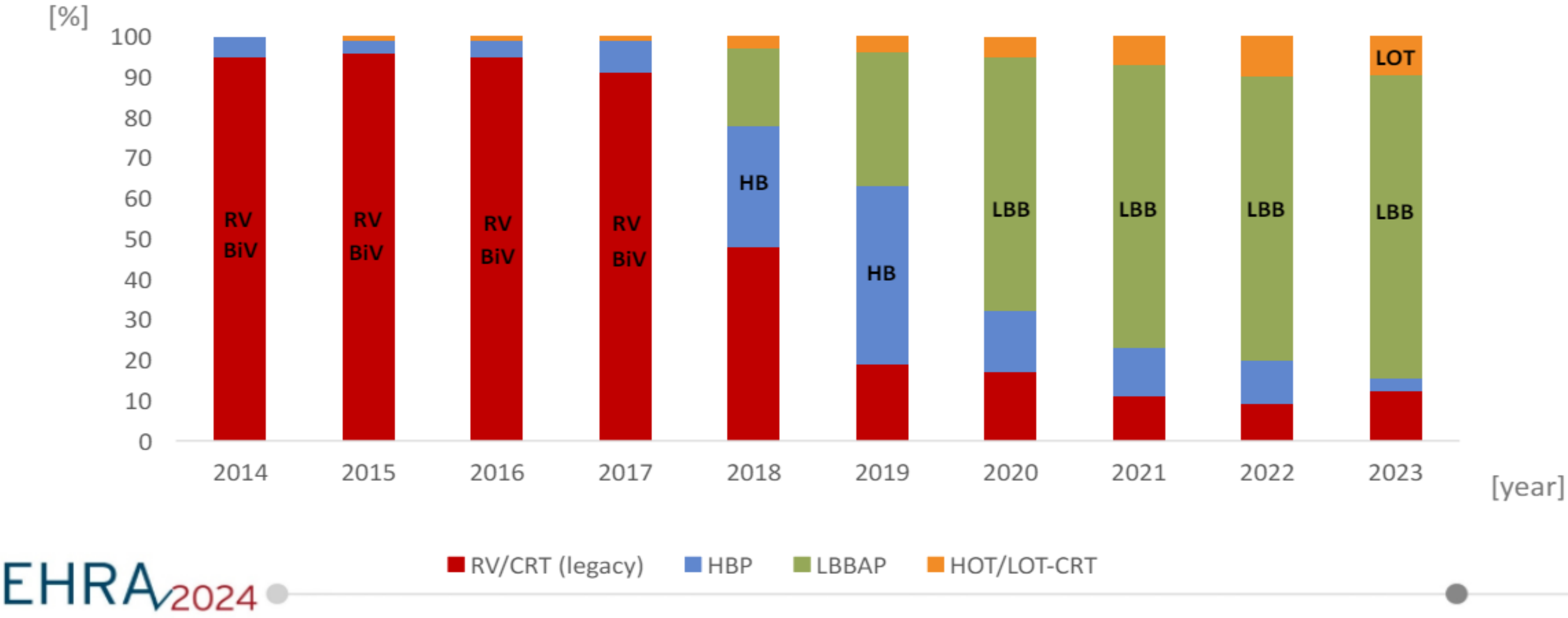
- correct a BBB when present
- pace physiologically to prevent PI-CMP

Background (2/2): CSP goes faster than evidence …

Transition from legacy pacing to conduction system pacing for all-comers

2500 conduction system devices implanted in Jagiellonian University Hospital EP Laboratory.



*M. Jastrzebski (Krakov, Poland) – **EHRA 2024 Berlin** [Controversy: CSP vs. BiVP in CRT indications]*

EHRA consensus 2025

CSP-CRT is an **indication/alternative** in several conditions

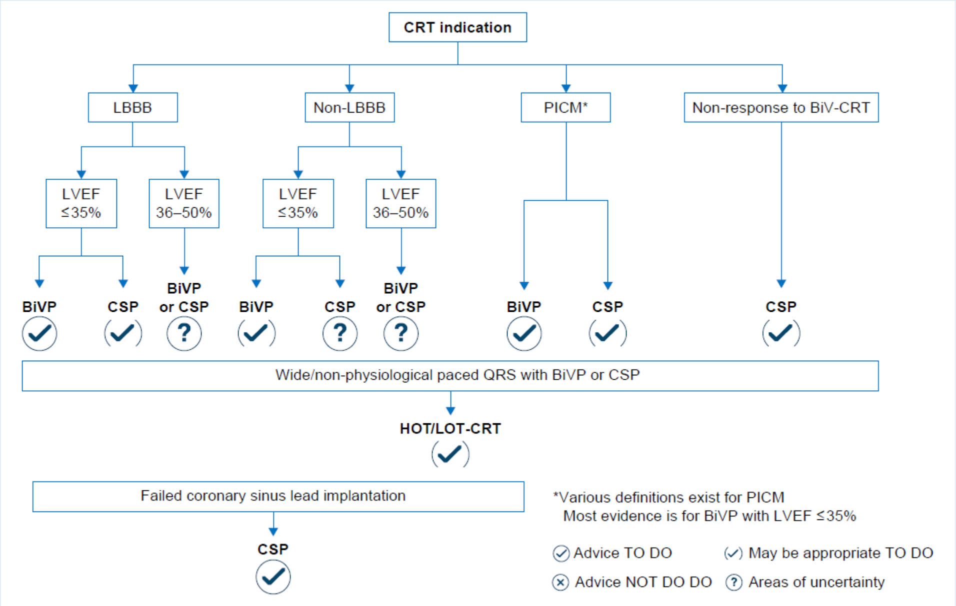


Figure 8 Indication for CSP-CRT. BiV-CRT, biventricular pacing cardiac resynchronization therapy; BiVP, biventricular pacing; CSP, conduction system pacing; HOT/LOT-CRT, His-optimized or left bundle-optimized cardiac resynchronization therapy; LBBB, left bundle branch block; LVEF, left ventricular ejection fraction; PICM, pacing-induced cardiomyopathy.

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

How to program an LBBAP-CRT?

- **Pure LBBAP**
  - Device setting with DDD-VSonly (LBBAP)

- **LBBAP + fusion**
  - Device setting with DDD-VS+VD

How to program optimal AV / VV delays?

Europace (2026) 28, euag103
https://doi.org/10.1093/europace/euag103

CLINICAL RESEARCH

Optimal pace timing for left bundle branch area pacing with or without an additional LV lead: results from the CSPOT study

Robert D. Schaller [1*], Paul Foley [2], Badrinathan Chandrasekaran [2], Jonathan Lyne [3], Marek Jastrzębski [4], Pugazhendhi Vijayaraman [5], Gaurav A. Upadhyay [6], Rafał Gardas [7], Travis Richardson [8], D'Anne Kudlik [9], Robert W. Stadler[9], Patrick Zimmerman [9], James Burrell [9], Robert Waxman [9], Richard N. Cornelussen [10], Bengt Herweg [11], and Zachary Whinnett [12]

[1]Section of Cardiac Electrophysiology, Cardiovascular Division, Department of Medicine, Hospital of the University of Pennsylvania, 3400 Civic Center Boulevard, Philadelphia, PA 19104, USA; [2]Wiltshire Cardiac Center, Great Western Hospital, Swindon, UK; [3]Division of Cardiac Electrophysiology, Beacon Hospital, Dublin, Ireland; [4]First Department of Cardiology, Interventional Electrocardiology and Hypertension, Jagiellonian University, Medical College, Krakow, Poland; [5]Geisinger Heart Institute, Geisinger Commonwealth School of Medicine, Wilkes-Barre, PA, USA; [6]Center for Arrhythmia Care, Section of Cardiology, University of Chicago, Pritzker School of Medicine, Chicago, IL, USA; [7]Department of Electrocardiology and Heart Failure, Medical University of Silesia, Katowice, Poland; [8]Division of Cardiovascular Medicine, Vanderbilt University Medical Center, Nashville, TN, USA; [9]Medtronic, Mounds View, MN, USA; [10]Medtronic, Bakken Research Center, Maastricht, Netherlands; [11]Division of Cardiology, University of South Florida Morsani College of Medicine and Tampa General Hospital, Tampa, FL, USA; and [12]National Heart and Lung Institute, Imperial College, London, UK

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Methods

- **48 pts underwent standard CRT implantation with the addition of an LBBAP lead.**
- **LV pressure acutely recorded**
- Evaluation of **acute haemodynamic response** to **three resynchronization strategies**:
  - LBBAP (uni)
  - LOT-CRT
  - BVP.
- For each approach, **five AV delays were tested**:
  - 70% of the interval between Ap and the earliest QRS activation on 12-lead ECG (AV70%),
  - AV70% +/−30 ms
  - AV70% +/− 60 ms.
- This approach mostly fit a parabolic model -> optimal AV is the vertex

Endpoints: optimal AV delay considering
-> acute haemodynamic (LV dP/dtmax)
-> electrical (QRS duration)

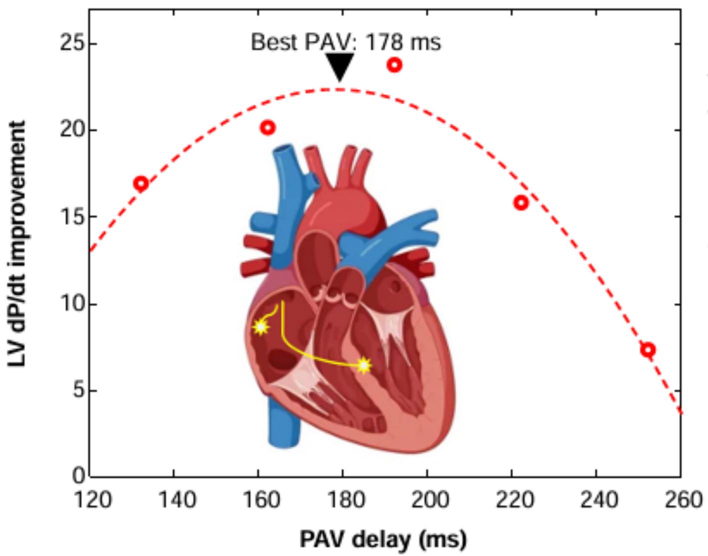
Graphical Abstract

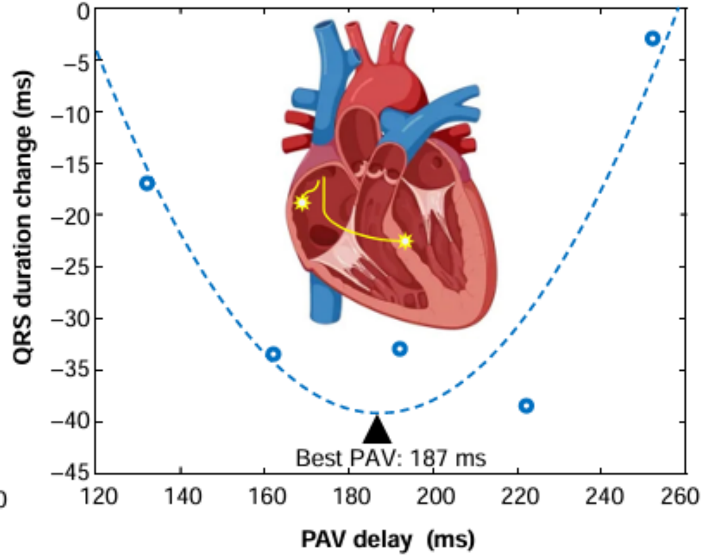
Optimal pace timing for left bundle branch area pacing with or without an additional LV lead: results from the CSPOT study

LBBAP-only

Measured (Ap–LBBs) interval: 308 ms

How does this relate to the best paced AV (PAV) for the patient?





Summarized Over 48 pts	LBBAP-only:	Best PAV = 0.54*(Ap-LBBs) + 3.8 ms
	LOT-CRT:	Best PAV = 0.56*(Ap-LBBs) + 7.7 ms
	BVP:	Best PAV = 0.48*(Ap-RVs) + 28.0 ms

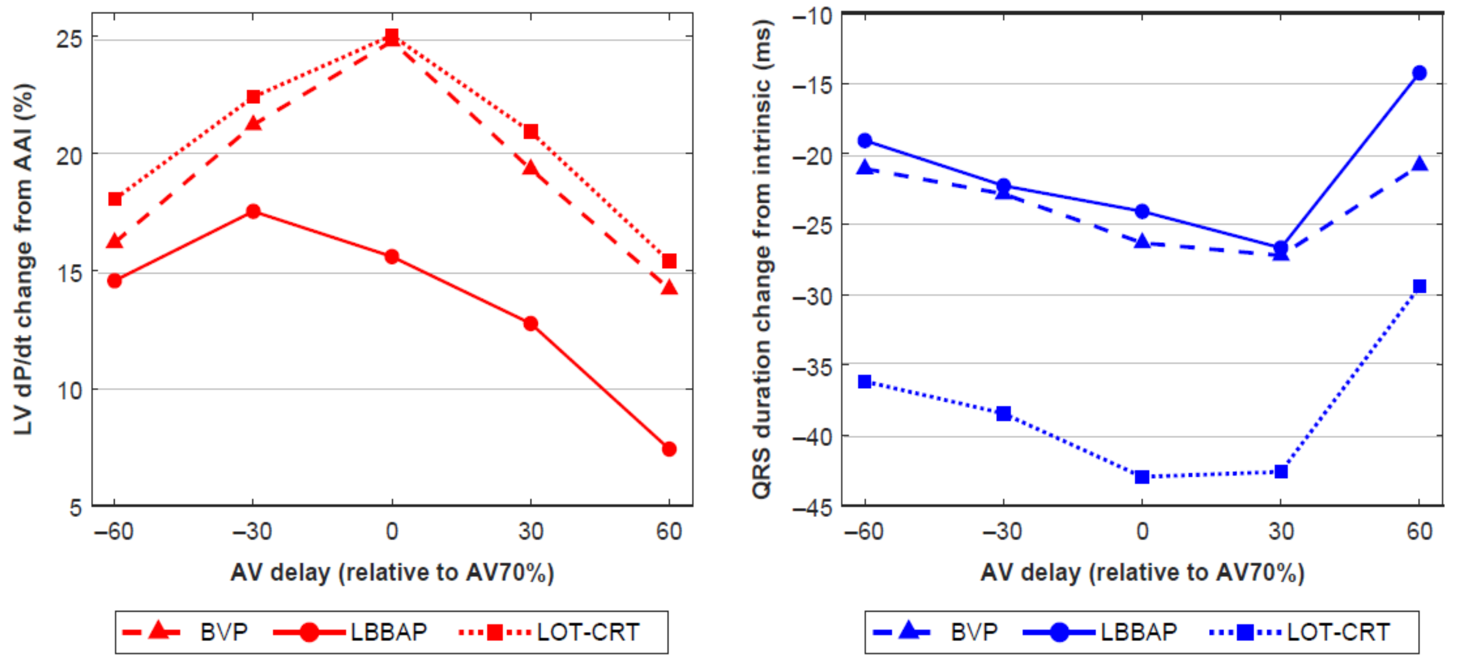


Figure 2 Left: the relationship between LV dP/dt and AV delay, averaged over all patients. Right: The relationship between QRS duration and AV delay, averaged over all patients.

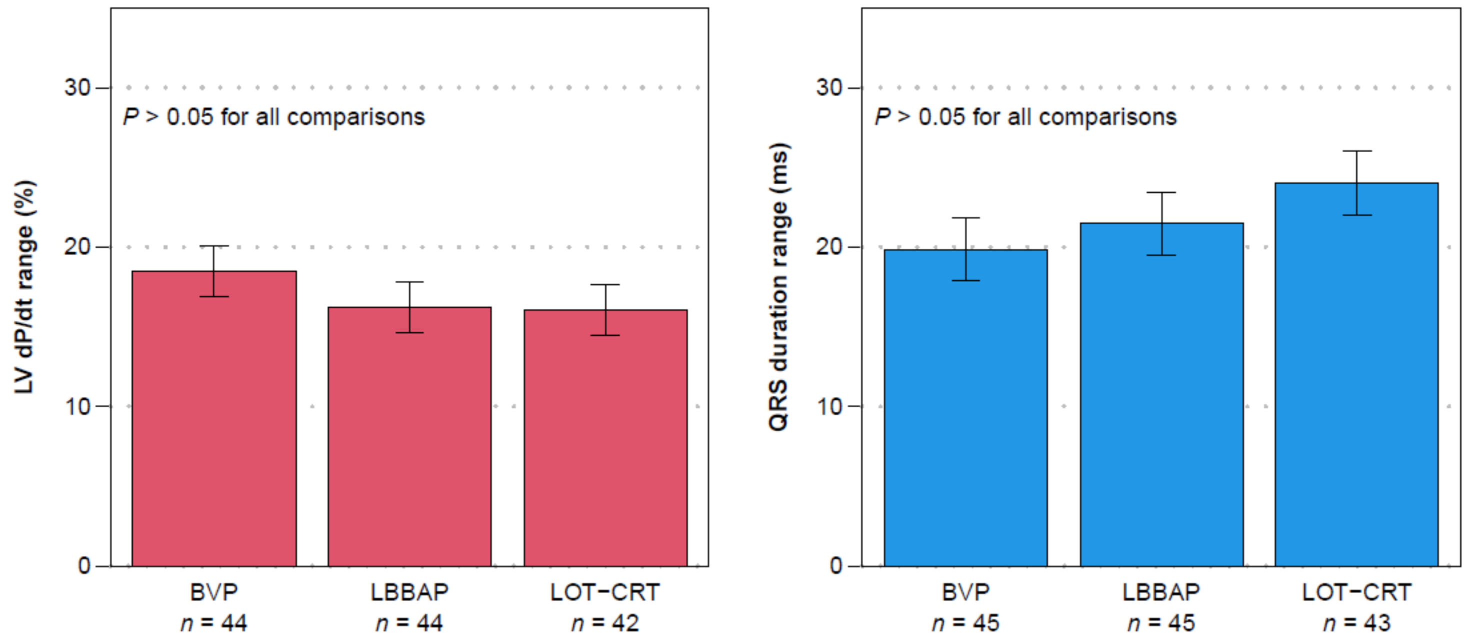


Figure 3 The three resynchronization methods (BVP, LBBAP, and LOT-CRT) produced similar ranges of LV dP/dt improvement (% change from AAI pacing) and QRS duration (ms reduction from intrinsic) during 120 ms sweeps in AV delay, suggesting similar sensitivity to selection of AV delay. Error bars represent the model-based estimate of the standard error of the mean.

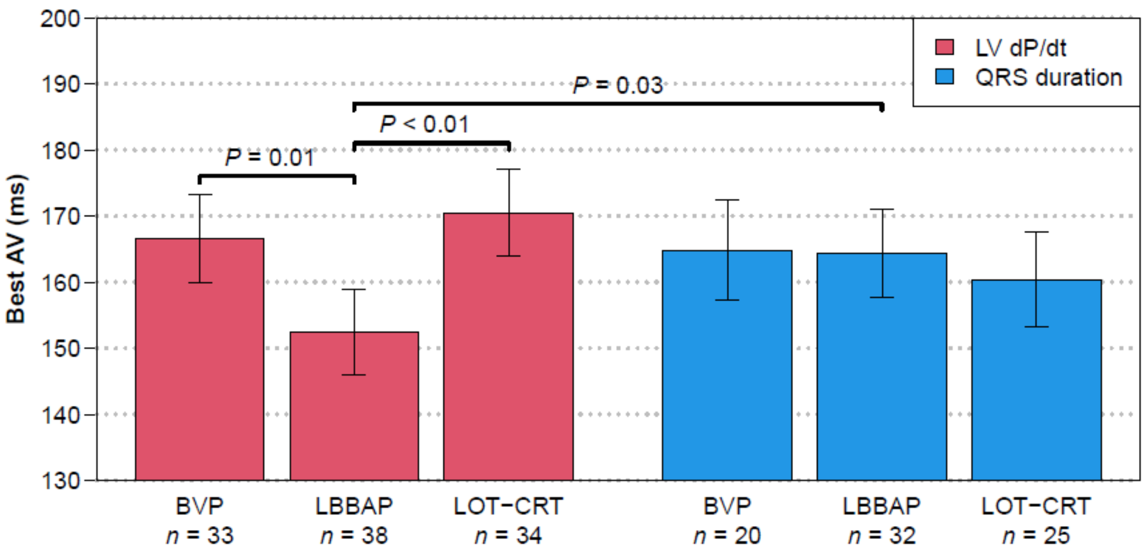


Figure 4 The best AV delay during atrial pacing, averaged over patients. For each patient, the best AV was obtained as the vertex of the best quadratic fit to the sequence of 5 tested AV delays. Error bars represent the standard error of the mean.

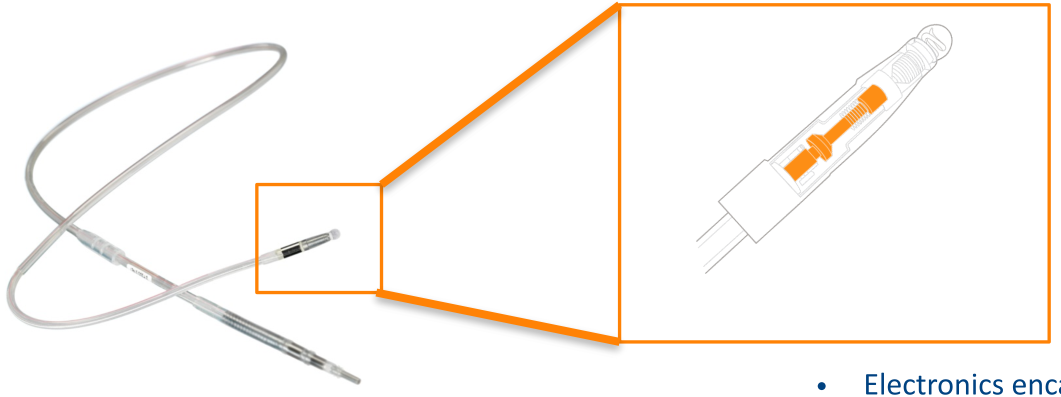
Possible limitations

- Acute, manual measurements
- Time consuming
- No tracking of possible patient condition changes

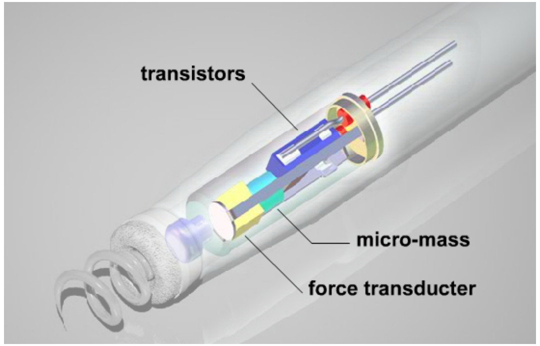
Is there any automatic LBBAP algorythm?

The SonR sensor technology

The SonR sensor is embedded in the **tip of the RA lead** (SonRtip™), designed to **detect cardiac muscle vibrations related to S1** (first Heart Sound) without any soft deformable part in contact with blood



The SonRtip™ atrial lead



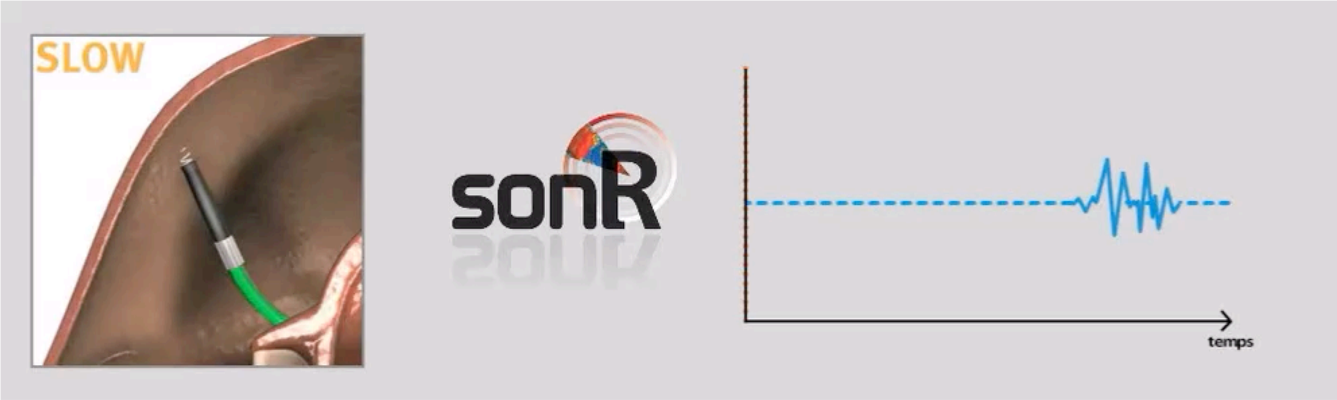
- Electronics encapsulated in a sealed titanium can are:
  - resistant to mechanical stress
  - insensitive to fibrosis development

SonR detects vibrations mirroring the **GLOBAL contractility**, not just local cardiac wall movements

The SonR sensor signal

SonR detects **vibrations** in a **specific range of frequencies**:

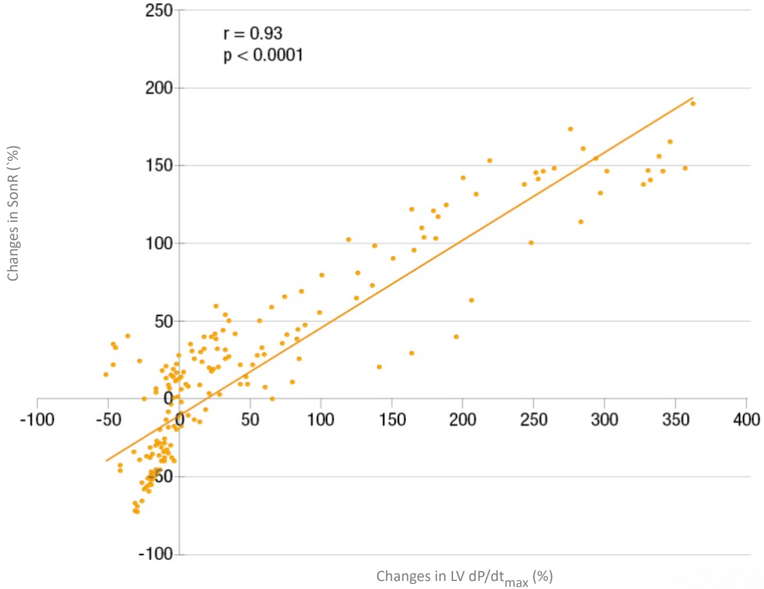
- infra-sounds in the range 10-70Hz (non audible components)
- atrial contractions → lower frequency band (max 5 Hz or 300bpm)
- external sounds → filtered by the chest, they do not alter the SonR signal



The SonR sensor signal

The amplitude of the SonR signal is correlated with LV dP/dt_{max}

Correlation between the SonR signal and LV dP/dt_{max}



Changes in the SonR signal are very closely related to changes in contractility (r=0.93; p<0.0001)

Bordachar P , Garrigue S, Ritter P et al. Contributions of a hemodyamic sensor embedded in an atrial lead in a porcine model.

J Cardiovasc Electrophysiol;2011*; May vol 22 :579-583*

SonR as a cardiac contractility sensor

SonR signal "mirrors" the global LV contractility despite the SonRtip lead positioning in the right side of the heart *(usually RA Appendage)*

Pulmonary artery occlusion experiment:

- Prevents any filling into LV
  - Causes decrease of LV dP/dt_{max}
- Prevents any ejection from RV
  - Causes increase of RV dP/dt_{max}

SonR tracks the variations of the LV dP/dt_{max}

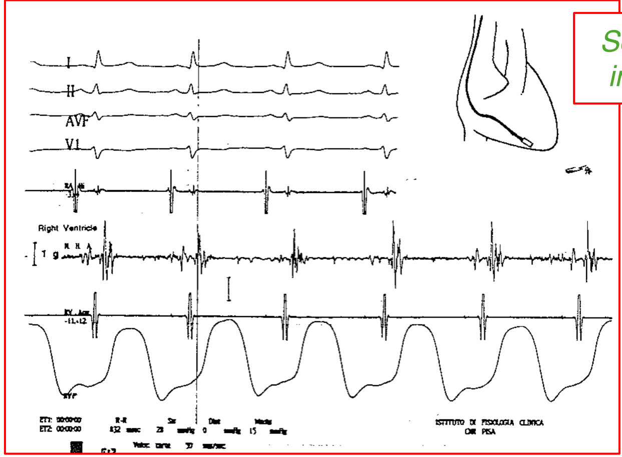
Rickards AF et al. An implantable intracardiac accelerometer for monitoring myocardial contractility. The Multicenter PEA Study group. ***Pacing Clin Electrophysiol. 1996*** *Dec;19(12 Pt 1):2066-71.*

SonR as a cardiac contractility sensor

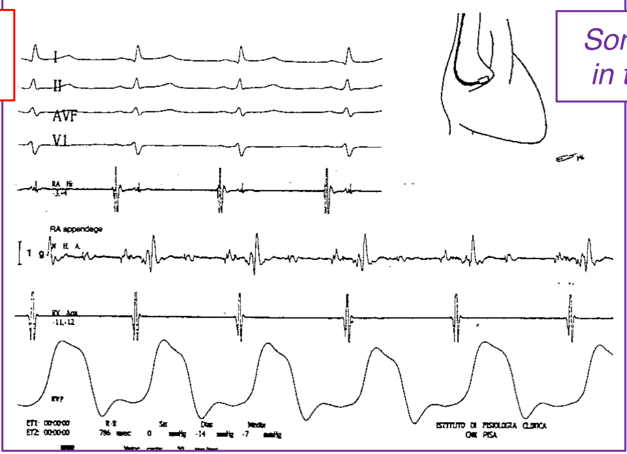
SonR signal “mirrors” the global LV contractility:

1. in pts with AF or Sinus Rhythm
2. **irrespective of the site of implant**

Is Local Myocardial Contractility Related to Endocardial Acceleration Signals Detected by a Transvenous Pacing Lead?



SonR lead in the RV



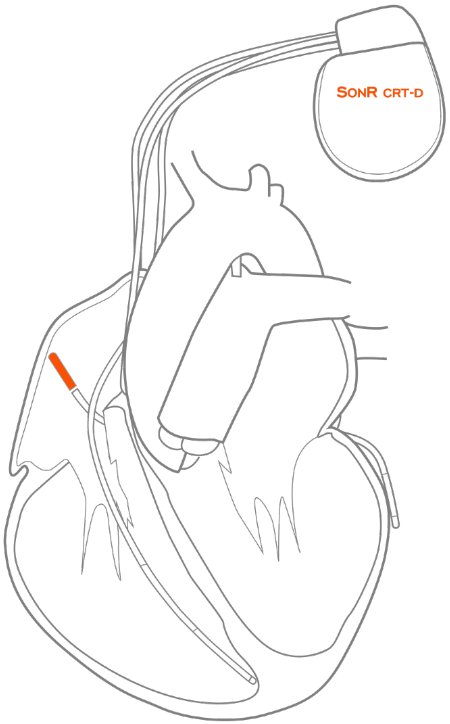
SonR lead in the RA

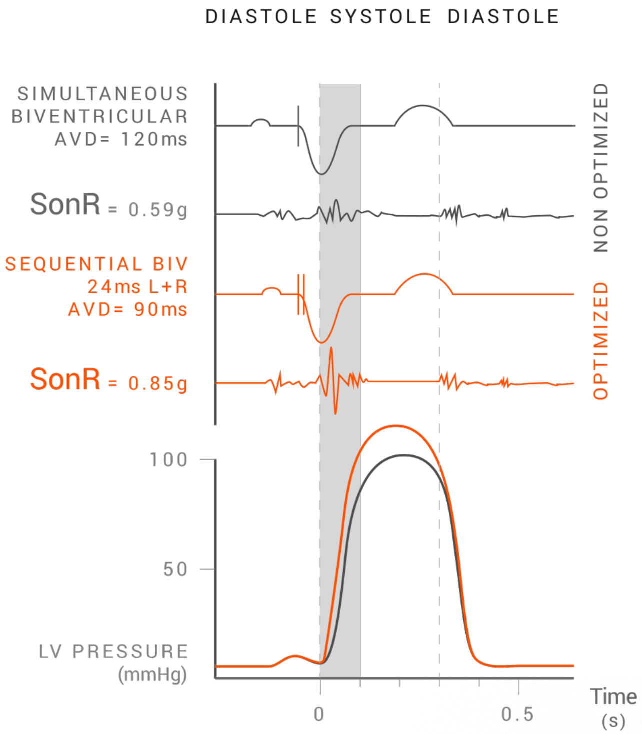
The amplitude and the timing of the PEA signals detected by the BEST accelerometer were independent of the recording site and atrial rhythm; they appeared to be strictly related to the global ventricular contractility. These results suggest that the BEST could be used either as an effective sensor in closed loop pacing systems, or primarily as a diagnostic hemodynamic sensor. (PACE 1996; 19[Pt. II]:1682–1688)

et al. ***Pacing Clin Electrophysiol. 1996****;19(12 Pt 2):1682-8*

SonR as a cardiac contractility sensor

The SonR signal* immediately tracks changes in contractility

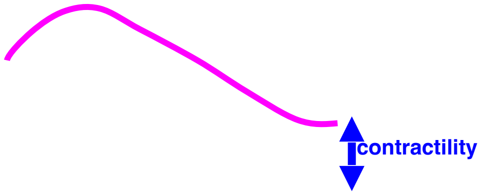




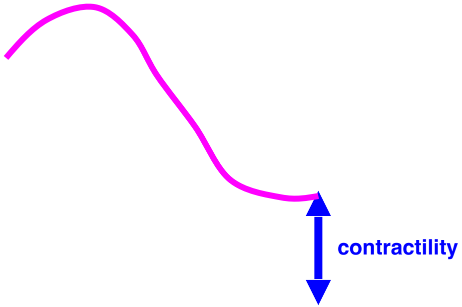
* Brugada J, Brachmann J, Delnoy PP et al. Automatic optimizartion of cardiac resynchroization therapy using SonR-rationale and design of the Clinical trial of the SonRtip lead and Automatic AV-VV optimization Algorithm in the Paradym RF SonR CRT-D (**RESPOND CRT**) trial. ***Am Heart J , 2014*** ; Vol 167 (4):429-435

SonR - Contractility vs. AV Interval

SonR1 (g) **at rest**



SonR1 (g) **under effort**

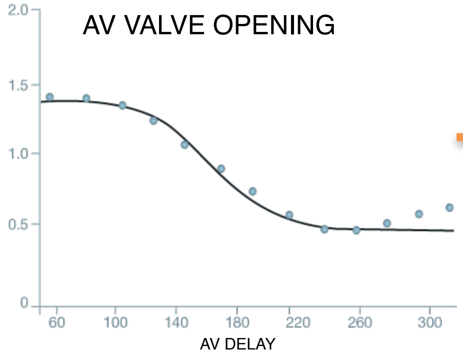


During the AV scanning, the SonR signal is affected by both:

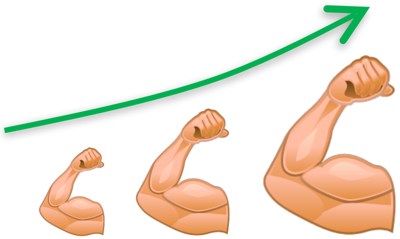
1. contractility variations
2. opening of the mitral valve leaflets

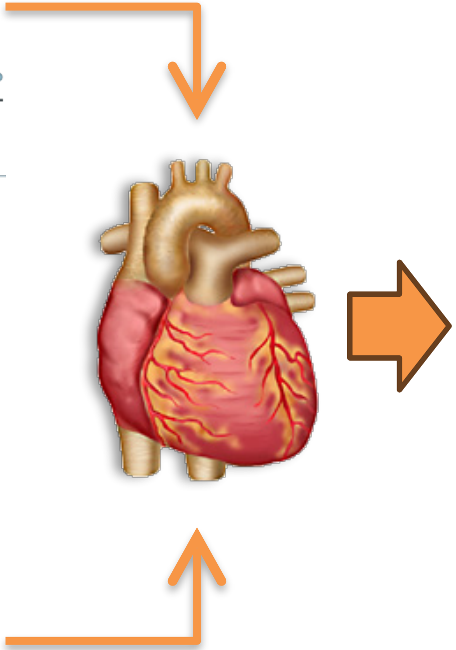
Ritter P et al., NASPE 2000

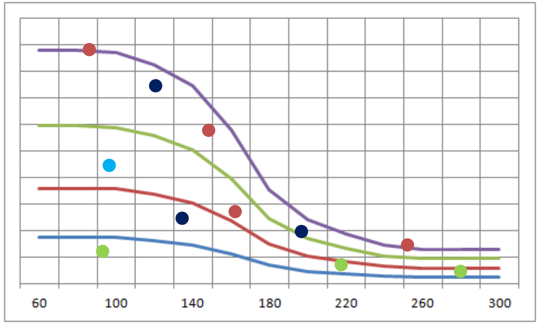
SonR - Contractility vs. AV Interval



“CONTRACTILITY”

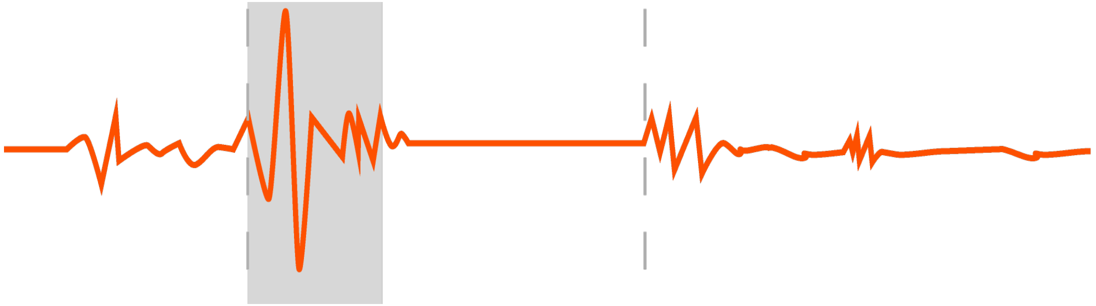






SonR System optimization at rest and exercise

REAL-TIME SONR SIGNAL



SonR performs automatic optimization on a weekly basis.

At rest
Evaluation of 64 AVD/VVD combinations

At exercise
Evaluation of 5 AVD/VVD combinations

Optimized timings

VVD
Paced AVD
Sensed AVD

Paced AVD
Sensed AVD

Respond CRT study

Landmark study considering SonR in BiV-CRT pts

The objective of the RESPOND-CRT study was to demonstrate that

- **SonRtip atrial lead safety**

- **Automatic optimization with SonR as effective as** AV and VV delay optimization using **echocardiography** to improve the rate of CRT responders.

Study Design

DESIGN

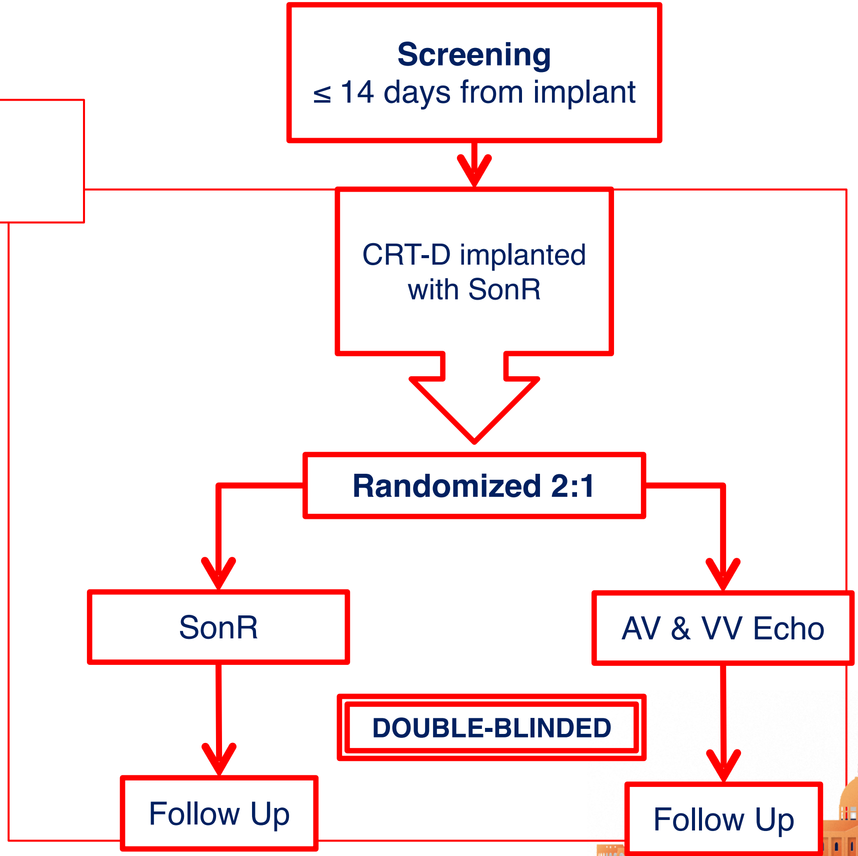
International, Multicenter, Randomized (2:1), Prospective, non-inferiority study

PATIENTS

- → LVEF ≤ 35%
- → QRS ≥ 120 ms in LBBB or QRS ≥ 150 ms in non-LBBB
- → NYHA III or IV
- → Without permanent AF

ENROLLMENT

- → 125 sites in Europe, USA, Australia
- → Jan 2012 – Oct 2014
- → Long term follow up (2 years)



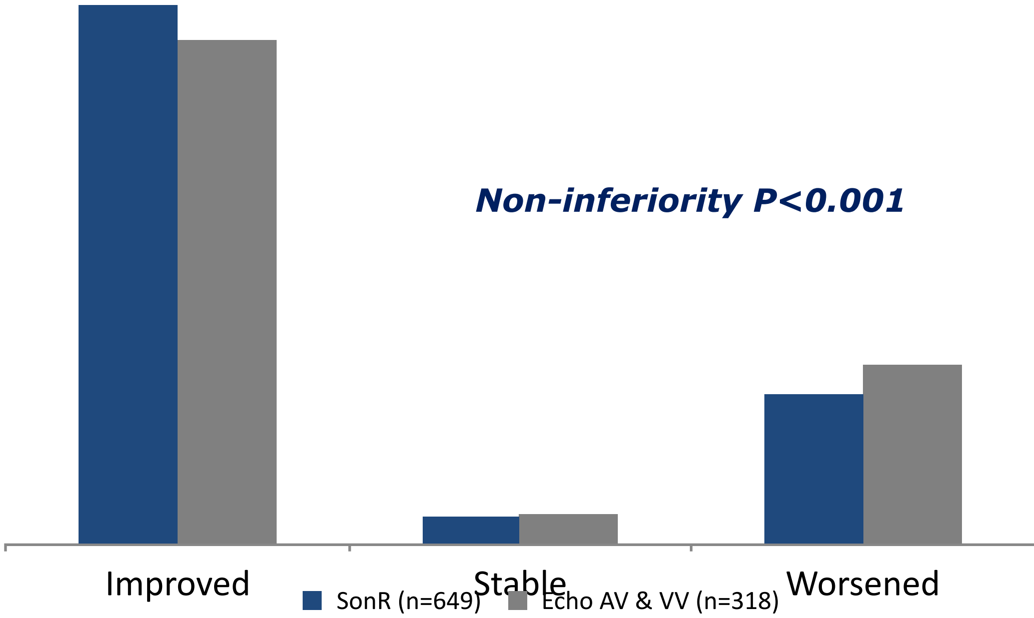
Safety / efficacy end point at 12 months

SonRtip
Complication free rate
from 4 to 12 months

99.8%

vs 94% (objective)
p<0.001

Primary safety endpoints met



Primary efficacy end point met

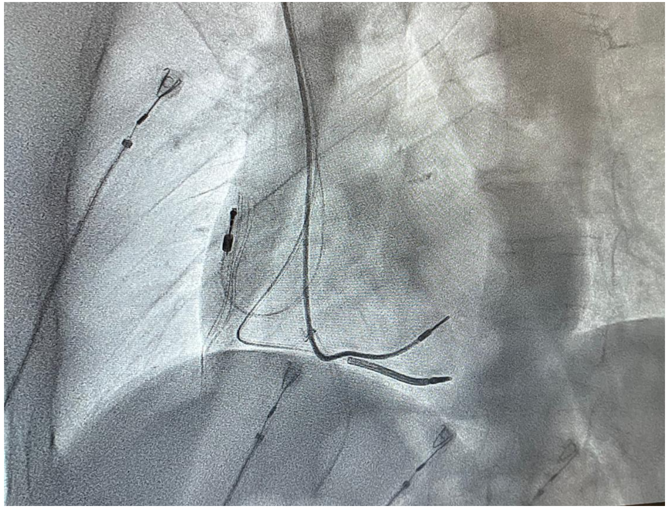
Our SonR-LBBAP experience

10 SonR-LBBAP implanted in 1 year according to current GDLs

- Talentia 3841 + SonRtip + InVicta + VeGa M58
- LBBAP confirmed via OR ECG monitoring
- DDD-LVonly (LBBAP) + SonR AV optimization

Proof of concept

SonR works **even** in LBBAP configuration



Parametri di base

Modo	Frequenza base / Frequenza ...	Ritardo AV a riposo / Ritardo ...	Camera ventricolare
DDD	60 bpm / 120 bpm	95 ms / 70 ms	Sx

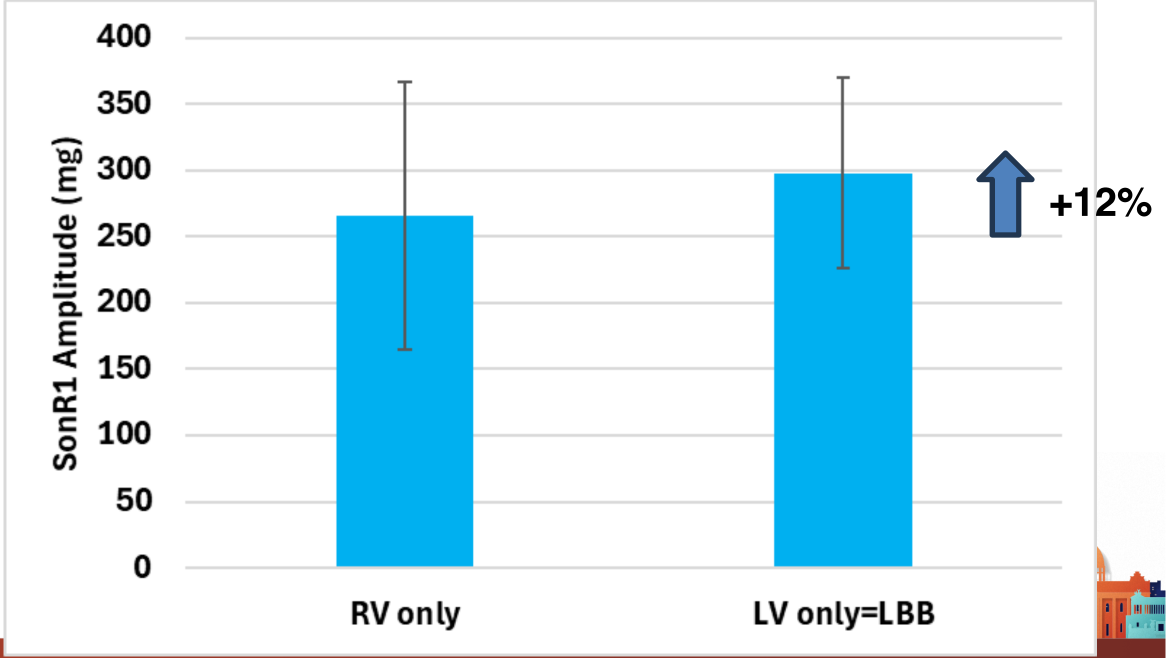
Modalità Rate Response	Ottimizz. CRT SonR
No	AV

Our SonR-LBBAP experience

SonR signal recorded in 2 pacing configurations:

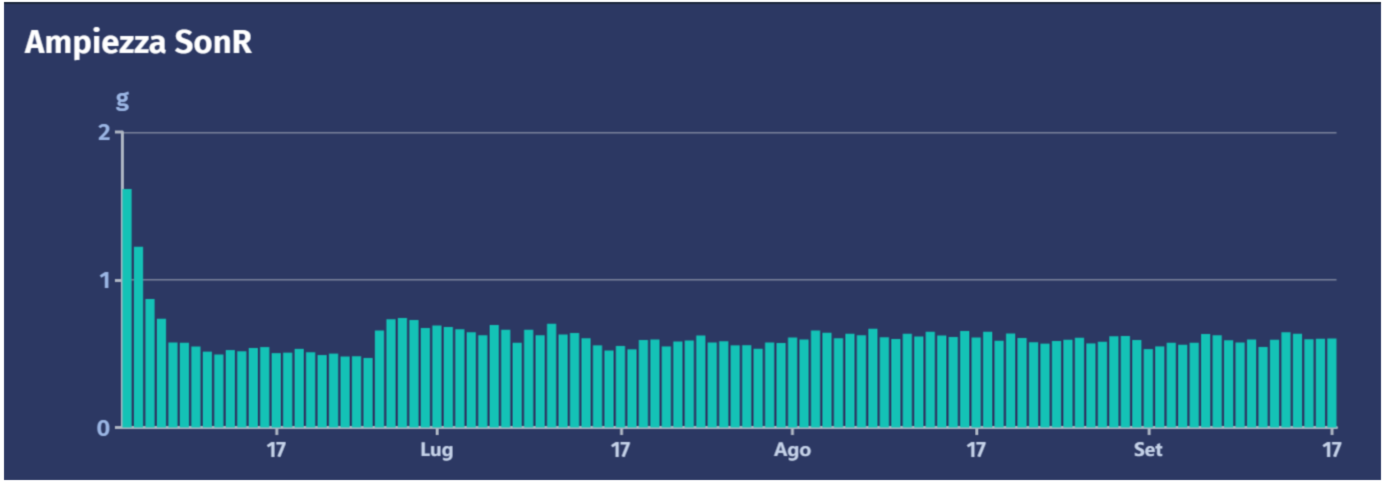
- RV only → RV Septal Pacing (**RVSP**)
- LV only → LBBa Pacing (**LBBaP**)

SonR contractility sensor detects an improved hemodynamics during LBBaP vs. RVSP



Our SonR-LBBAP experience

Long term SonR evaluation



The amplitude of SonR signal is <u>good</u> and tracks daily variations

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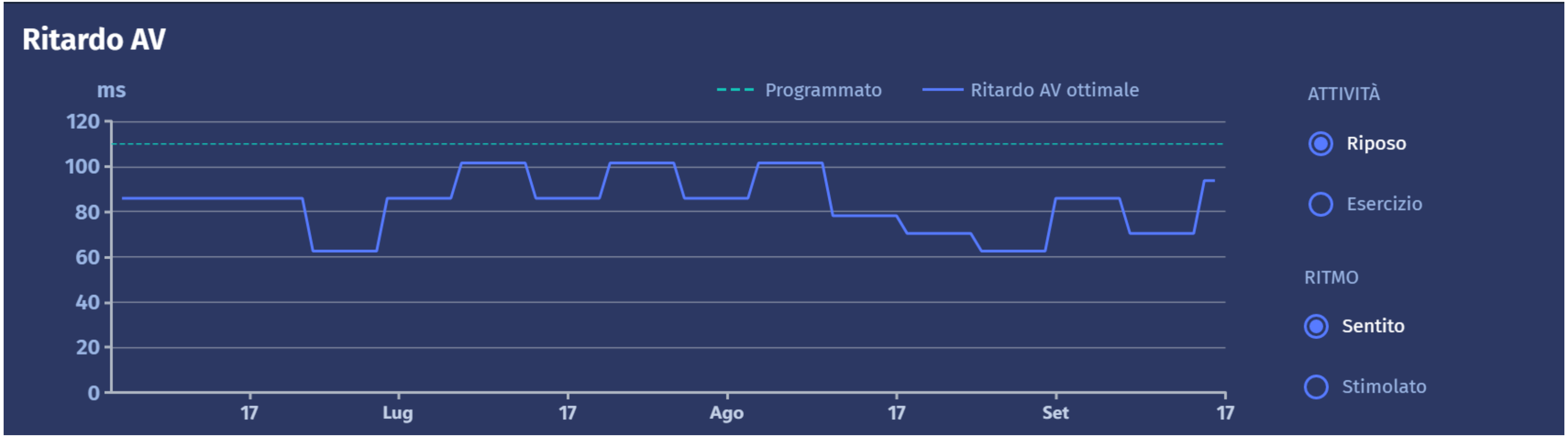
Our SonR-LBBAP experience

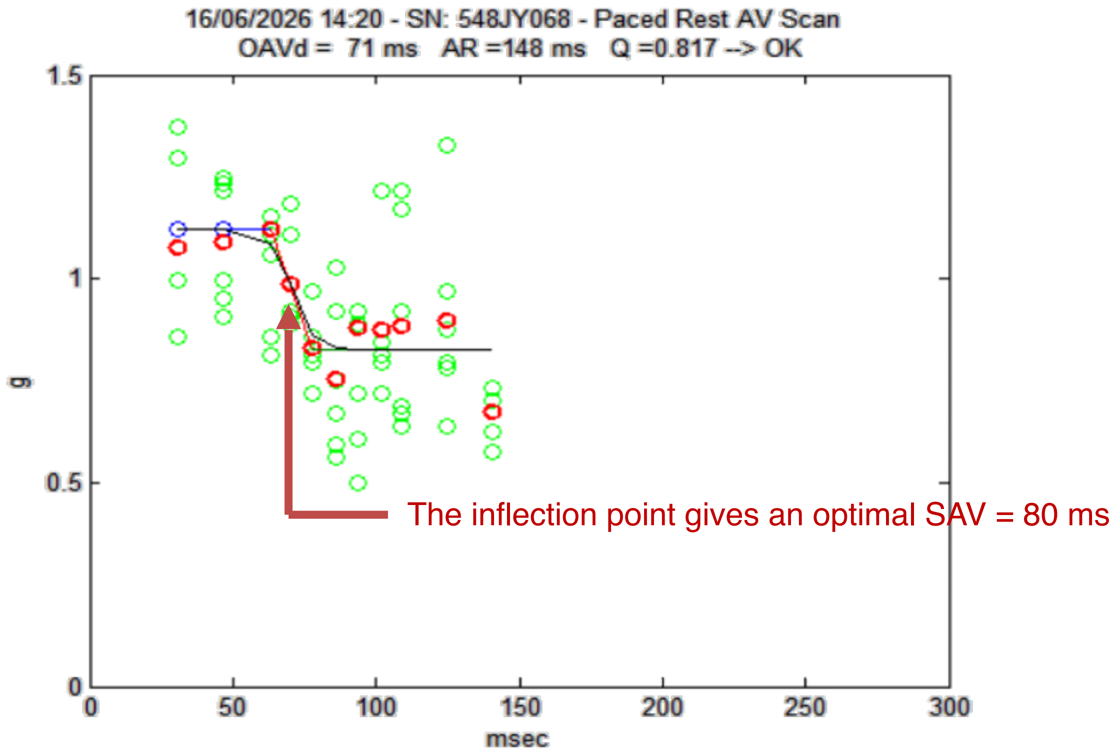
Long term SonR evaluation



Good SonR amplitude -> effective weekly AV changes

Our SonR-LBBAP experience

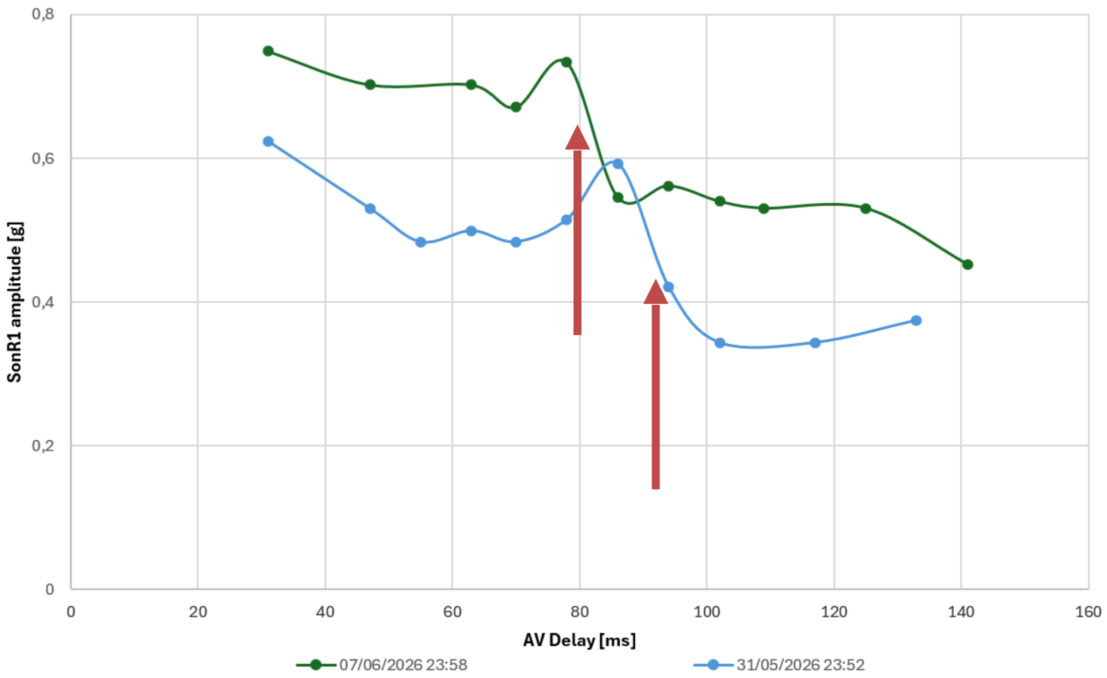
SonR variation Vs AV delay changes



The amplitude of the SonR signal tracks the usual AV dynamics related to the degree of mitral valve opening

Our SonR-LBBAP experience

SonR variation Vs AV delay changes in different weeks



The weekly curve variation is coherent with changing patient conditions

Different inflection points give different AV delay values

Conclusions

- **SonR** may **perform well** even in **LBBAP setting**

- Very preliminary data indicate that in **LBBAP implant configuration** the **SonR** sensor **tracks the expected dynamics** related to:
  - **monitoring** the degree of avg global **cardiac contractility**
  - the degree of valve opening (**AV interval optimization**)

- Further investigations are ongoing to test the same dynamics and clinical effects in multiple patient settings