PLACE 2026
PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

CONGRESSO
ROMA, 25 - 27 Giugno 2026

CSP AVANZATA, POPOLAZIONI SPECIALI E SCENARI FUTURI

HOT/LOT-CRT: Quando? Come?

Mario Volpicelli

New CSP Clinical Consensus Statement EHRA

CSP for heart failure without bradycardia pacing indication

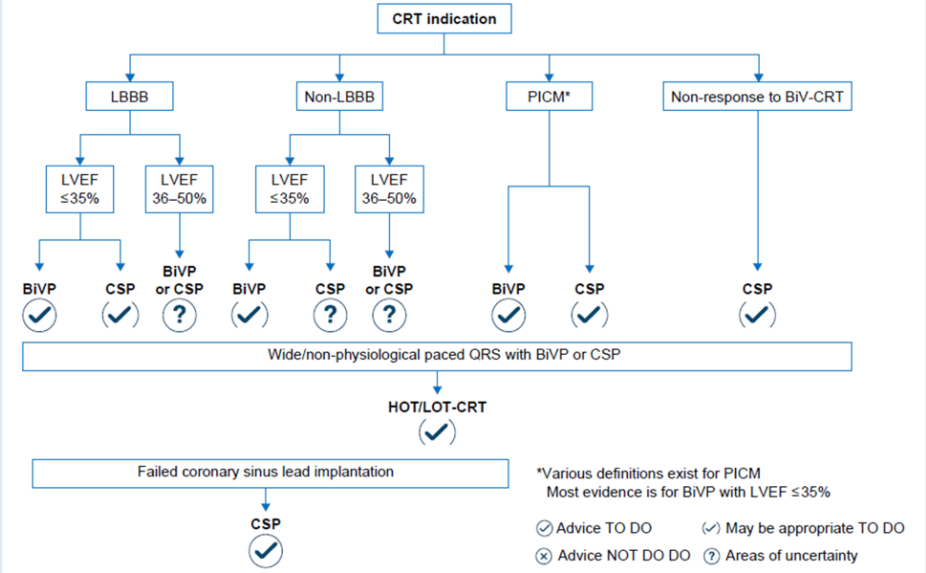
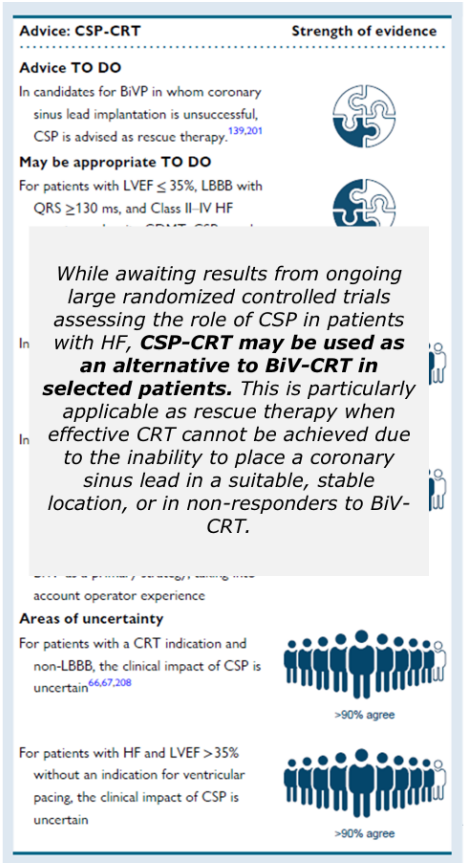


Figure 8 Indication for CSP-CRT. BiV-CRT, biventricular pacing cardiac resynchronization therapy; BiVP, biventricular pacing; CSP, conduction system pacing; HOT/LOT-CRT, His-optimized or left bundle-optimized cardiac resynchronization therapy; LBBB, left bundle branch block; LVEF, left ventricular ejection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



New CSP Clinical Consensus Statement EHRA

His-optimized and left bundle branch pacing-optimized cardiac resynchronization therapy

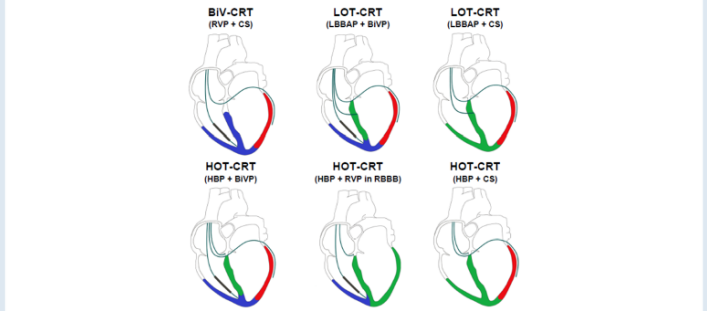


Figure 9 Schematic illustration of ventricular activation wavefronts BiV-CRT, HOT-CRT, and LOT-CRT. Approximate activation by the right ventricular lead is indicated in blue, by the conduction system pacing lead in green, and by the coronary sinus lead in red. Adapted with permission from Zweerink *et al.*[225] BiV-CRT, biventricular pacing cardiac resynchronization therapy; BiVP, biventricular pacing; CS, coronary sinus pacing; HBP, His bundle pacing; HOT-CRT, His bundle pacing-optimized cardiac resynchronization therapy; LOT-CRT, left bundle branch-optimized cardiac resynchronization therapy; RBBB, right bundle branch block; RVP, right ventricular pacing.

Two hybrid pacing modalities combining CSP and coronary sinus pacing were recently introduced: His bundle-optimized CRT (HOT-CRT) and left bundle branch-optimized CRT (LOT-CRT). ***Delayed activation of the LV lateral wall in patients with HF may result*** *not only from a discrete lesion in the left bundle branch that can be bypassed/corrected by CSP, but* ***also from widespread delay, distal focal lesion(s) in the conduction system, electrical uncoupling, myocardial scar, and functional conduction block****. In patients with wider QRS, non-typical LBBB and more advanced HF, both mechanisms (focal proximal lesion and distal delay) often coexist. Analysis of V6RWPT—an electrocardiographic marker of LV lateral wall activation time, indicates that such conduction delay cannot be corrected by CSP alone. On the contrary, conventional BiV-CRT is also limited in its ability to fully restore physiological LV activation. This is due to several factors: potentially desynchronizing effects of myocardial pacing with the RV lead, localized non-physiological epicardial LV pacing, latency, and suboptimal LV lead position (paraseptal/apical) due to unfavourable cardiac venous anatomy and/or LV scar. Failure of BiV-CRT to restore physiologic activation may manifest as QRS prolongation rather than narrowing.*

Furthermore, ***His-optimized and left bundle branch pacing-optimized cardiac resynchronization therapy (HOT/LOT-CRT) is an option in patients who do not respond clinically to BiV-CRT or to CSP-CRT and in whom the paced QRS is considered suboptimal.***

New CSP Clinical Consensus Statement EHRA

His-optimized and left bundle branch pacing-optimized cardiac resynchronization therapy

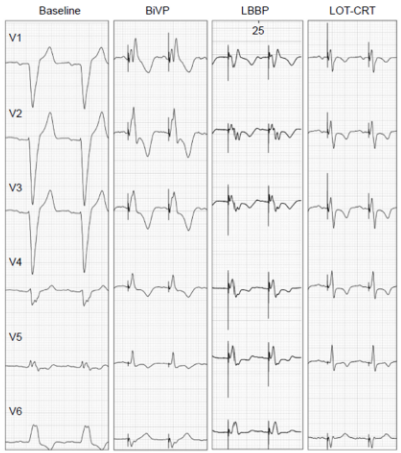


Figure 10 Superior electrical resynchronization with LOT-CRT compared with BiVP. Note the presence of QRS notching with BiVP and LBBP, which disappears with LOT-CRT. BiVP, biventricular pacing; LBBP, left bundle branch pacing; LOT-CRT, left bundle branch-optimized cardiac resynchronization therapy.

The prevailing expert opinion is that there is no necessity to add a coronary sinus lead to a CSP-based CRT system if the obtained paced QRS already indicates a physiological, i.e. fast and synchronous LV activation.

If the paced QRS is not deemed satisfactory (based on criteria outlined in Table 4), there may be benefit from the HOT/LOT-CRT approach.

Advice: HOT/LOT-CRT	Strength of evidence
May be appropriate TO DO	
It may be appropriate to propose HOT/LOT-CRT at implantation in case of suboptimal electrocardiographic results of CSP or BiVP, taking into account operator experience and patient risk.	
It may be appropriate to propose HOT/LOT-CRT as an upgrade procedure in selected CRT candidates in case of suboptimal clinical and electrocardiographic result with CSP-CRT or BiV-CRT, especially in the setting of non-specific intra-ventricular conduction delay or mixed conduction disease,[a,99,212,213,221,222,226,227] taking into account operator experience and patient risk.	

[a]Mixed conduction disease refers to association of bundle branch/fascicular conduction delay with peripheral conduction disease and/or intra-myocardial propagation delay, which cannot be corrected by CSP alone.

Table 4 Criteria used to determine whether HOT/LOT-CRT may be required after having implanted a CSP lead

Paced QRS width
Presence of conduction system capture
V_6 or aVL RWPT
V_6V_1 interpeak interval
Paced QRS notching
QRS axis (normal vs. axis deviation)
Anatomical position of LBBAP lead (basal, mid, or apical)
Absence or minimal acute haemodynamic response to pacing

LBBAP, left bundle branch area pacing; RWPT, R-wave peak time.

New CSP Clinical Consensus Statement EHRA

His-optimized and left bundle branch pacing-optimized cardiac resynchronization therapy

The selection of LOT-CRT over HOT-CRT or vice versa is currently based on the operator's preference, experience, and ability to implement HBP and LBBP, as well as on case-dependent anatomical and physiological factors that influence the feasibility of HBP and LBBAP. It is important to note, however, that ***LOT-CRT usually offers superior pacing parameters and normal sensing without compromising arrhythmia detection in cardiac resynchronization therapy defibrillator (CRT-D) systems****, while* ***HOT-CRT may provide superior QRS narrowing due to the direct recruitment of the right bundle branch in the setting of LBBB.***

Patients with permanent AF *cannot benefit from algorithms which adjust AV delays to promote fusion between intrinsic conduction and ventricular pacing, used in BiV-CRT. In these patients,* ***HOT-CRT with HBP (usually using the off-label configuration of connecting the lead to the unused atrial channel of the generator)*** *combined with coronary sinus and/or RV pacing may be used to deliver controlled and constant fusion pacing by adjusting AV delay, even in patients in whom bundle branch block remains uncorrected by HBP.*

Although there are no dedicated randomized studies on HOT/LOT-CRT, it is pertinent to note that, unlike CSP-CRT, these pacing modalities do not deviate too much from conventional BiV-CRT as they also include a coronary sinus lead and a septal pacing lead. In contrast to CSP-CRT, the HOT/LOT-CRT approach does not replace key BiV-CRT components, but builds on them. Therefore, it is anticipated that favourable major endpoint results from CRT trials will be maintained with HOT/LOT-CRT.

Nevertheless, operator experience and patient risk need to be carefully taken into account, particularly when evaluating upgrade procedures.

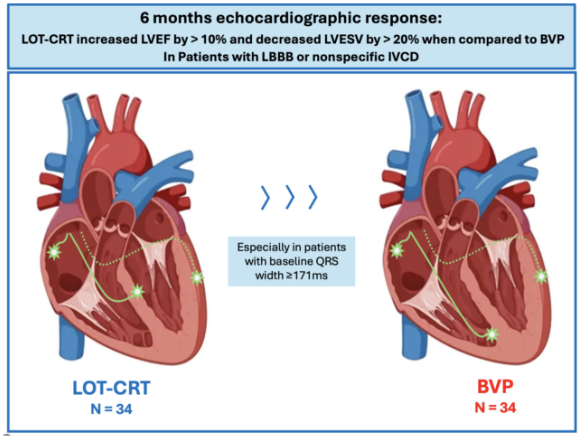
Randomized clinical trials are still needed to determine the safety of a more complex procedure and whether the superior electrical resynchronization translates into hard outcomes such as mortality and hospitalization for HF.

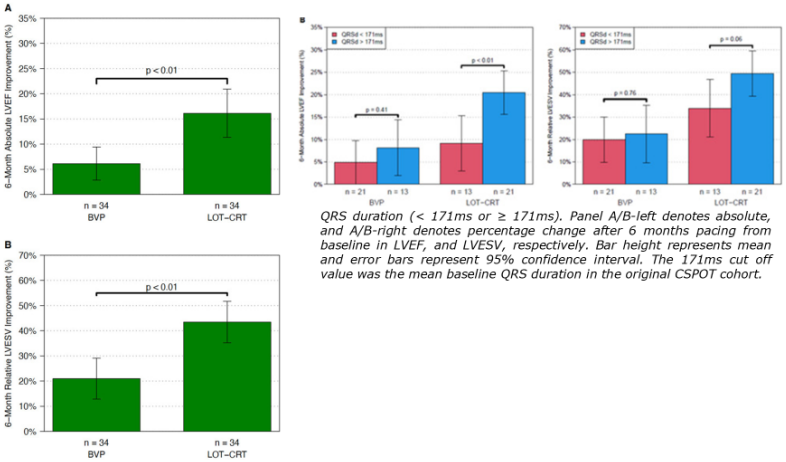
LOT-CRT versus traditional CRT
Left ventricular dysfunction

2025

Echocardiographic response from Left Bundle Branch Area Pacing Optimized Cardiac Resynchronization Therapy (LOT-CRT) versus traditional CRT.

Gaurav A. Upadhyay, MD [1] · Marek Jastrzębski, MD, PhD [2] · Paul Foley, MB ChB, MD Res, FRCP [3] · ... · Jonathan Lyne, MD [10] · Bengt Herweg, MD [11] · Pugazhendhi Vijayaraman, MD. [12] ... Show more





QRS duration (< 171ms or ≥ 171ms). Panel A/B-left denotes absolute, and A/B-right denotes percentage change after 6 months pacing from baseline in LVEF, and LVESV, respectively. Bar height represents mean and error bars represent 95% confidence interval. The 171ms cut off value was the mean baseline QRS duration in the original CSPOT cohort.

This study suggests that LOT-CRT may be especially beneficial in patients with longer QRS duration (i.e. ≥171ms), which has been shown to be a strong predictor of BVP echocardiographic response by other investigators.
The larger improvements observed in our LOT-CRT recipients are impressive (both low non-response and high super-response rates). Longer QRS duration may reflect greater electrical dyssynchrony, scarred or delayed activated regions, resulting in mechanical dyssynchrony.
Multi-site LV pacing (similar to that found in the present study) has been shown to be particularly effective in these patient cohorts perhaps by increasing the probability of stimulating the viable and late contracting myocardium and/or **optimizing LV filling by more effective AV timing of the LV.**

https://doi.org/10.1016/j.hrthm.2025.04.026

LOT-CRT versus traditional CRT

A Review

2025

Journal of Clinical Medicine
MDPI

Review

Understanding LOT-CRT: Current Insights, Limitations, and Our Center's Experience

Georgios Leventopoulos [1,*], Kassiani-Maria Nastouli [1], Maria Bozika [1], Eleni Papastavrou [1], Anastasios Apostolos [2], Rafail Koros [1], Angelos Perperis [1], Ioanna Koniari [1,3], Niki Vlassopoulou [1], Panagiotis Chronopoulos [1], Christoforos K. Travlos [4], Athanasios Moulias [1] and Periklis Davlouros [1]

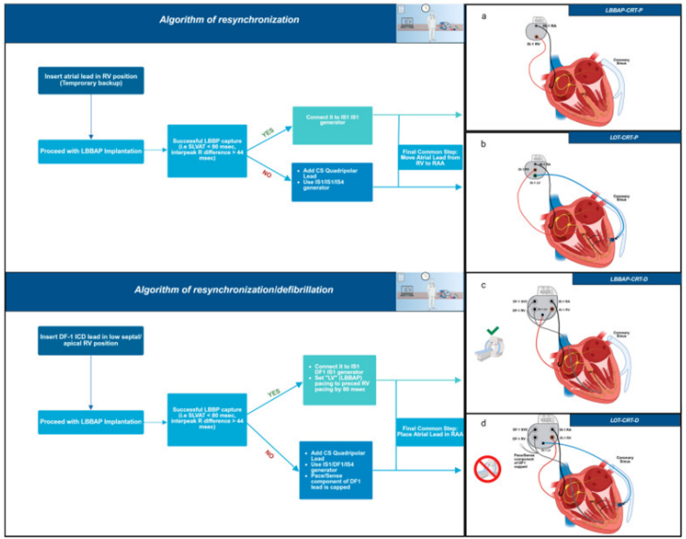
This review evaluates the feasibility, advantages, disadvantages, and clinical outcomes of LOT-CRT;

10 clinical studies ON LOT-CRT;

WHEN
LOT-CRT is a promising modality that can be applied in clinical settings where the use of Conventional Biventricular Pacing is unsuccessful and when LBBAP alone does not deliver the expected outcomes as in atypical LBBB patterns or when LBB capture is not unsuccessful.

PROs
The technique, provides **enhanced QRS shortening**, an **increase in the percentage of the LVEF** in the patients, **an improvement in NYHA class**, and most studies reported a **reduction in NT-pro-BNP levels**.

CONs
When **a defibrillator** is needed (LOT CRTD), the device is rendered **not compatible with MRI** due to the capped DF 1 lead.
The **procedural complexity** and required expertise limit the widespread use of LOT-CRT in routine clinical practice.



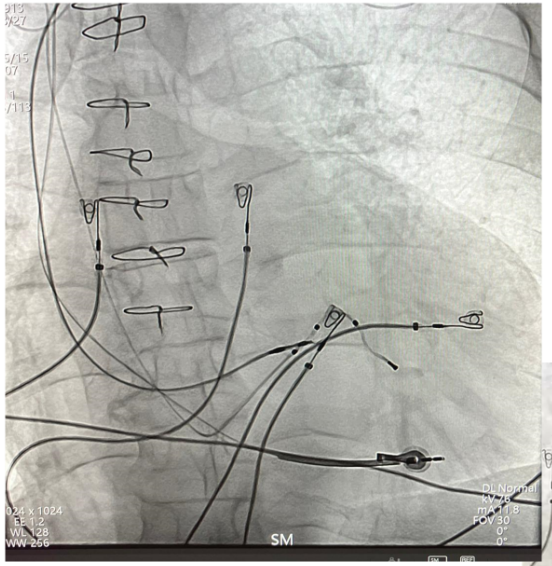
• DOI: 10.3390/jcm14093025

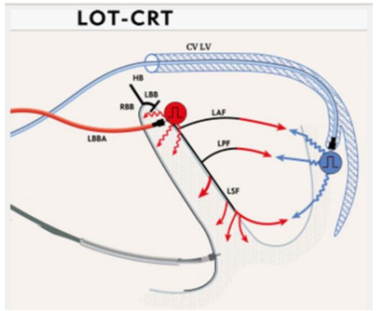
Medical Case

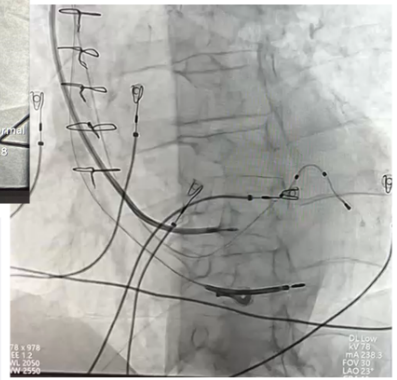
66 year old patient

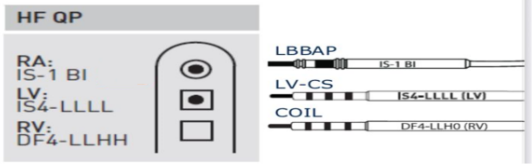
Hypokinetic valvular dilated cardiomyopathy (aortic valve replacement and mitral valvuloplasty). Permanent atrial fibrillation with ICD-CRT.

Non-Responder undergoes upgrade with LOT-CRT









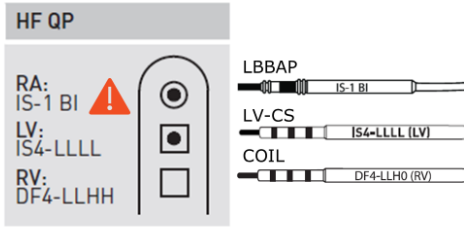
OUT OF LABEL

LOT-CRT

Negli ICD – CRT-D DF4

LOT-CRT: CRT come combinazione di LV-CS e LBBAP ⊕ Terapia antitachicardica — AF permanente

CRT-D



BRADY

Modalità: DDI(R)

Autocatture: OFF su tutti i canali

Soglia minima di sensing canale atriale: almeno 1.5 mV

Cambio modo: OFF di default in DDI

Frequenza massima atriale: OFF

Ritardo AV: $AV_{prog} = AV_{desid} - 20$ ms

Sincronizzazione: OFF

CRTAA: OFF

La programmazione in questi casi particolari andrebbe fatta tramite ottimizzazione ecocardiografica o all'ECG andando a modificare e scegliere:

- **Ritardo AV, che funge da ulteriore VV** (non più lungo di 100 ms per evitare pacing su T)
- **BIV o LV-only**, e quale camera stimolare per prima, scegliendo se il coil contribuisce o meno alla stimolazione
- **Ritardo VV**

TACHY

Discriminanti tachy:

- **Stability**: ON
- **SVT, onset e Morfologici**: OFF

Terapie atriali automatiche: OFF

Episodi per registrazioni TA/FA: OFF

Medical Case | ECG

66 year old patient

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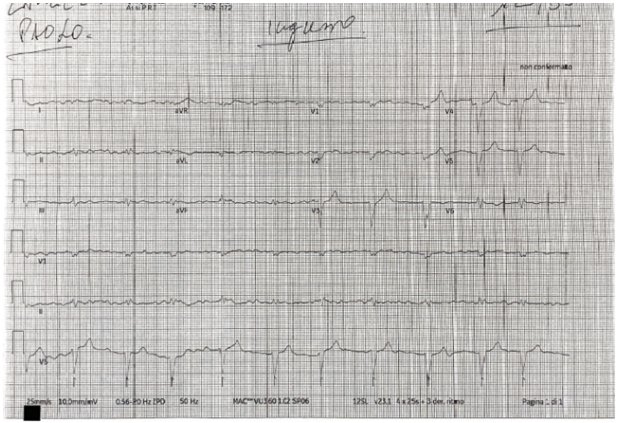
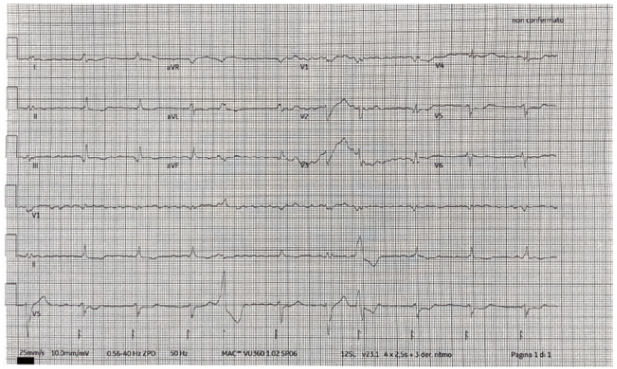
Start



Final



Medical Case | Eco 1M

66 year old patient

Hypokinetic valvular dilated cardiomyopathy (aortic valve replacement and mitral valvuloplasty). Permanent atrial fibrillation with ICD-CRT.

Non-Responder undergoes upgrade with LOT-CRT

Start

Peso: 96 Altezza: 185 BMI: 28.05 Alt.2,7: 5.26 BSA: 2.21
PAS mmhg: PAD mmhg: qualità: sufficiente

Atrio Sinistro mm: 60 ml: 116 ml/m²: 52.49

Aorta Anulus: 36 Aorta ascendente: 42 Arco :

Sezioni Destre V.cava in esp.: 22 V.cava in insp.: 0.6 PAPs (mmHg): 42+5 Vdx: TAPSE: 19

Ventricolo Sinistro
Diametro telediastolico (mm): 72 Diametro telesistolico (mm): 65 Setto interventricolare (mm): 12
Parete posteriore (mm) : 10 Massa (gr/m 2,7): 72.45 Massa (gr/m ²) : 172.44
Frazione di accorciamento (%): 9.72 Volume telediastolico (ml) : Volume telesistolico (ml) :
Frazione di eiezione Vol (%): RWT : 0.31

Valvola Mitrale
E (cm/s) : 0.79 A (cm/s) : E/A : E Dec (ms) :
PHT (ms) : Area 2d (cm²) : Grad. Max (mmHg) : Grad. Medio (mmHg) :
Insuf. (+) : ++/+++ Ero mm² : V-RIG (ml) :
E' Laterale : E' Settale : E/E' : 17.5

Valvola Aortica
Velocità Max (m/s) : Grad Max (mmHg) : Grad Medio (mmHg) : 4.7
Area 2d (cm2) : IRT (ms) : 470 Area Valvolare Stimata :

	Setto		Parete			
	Ant	Post	Ant	PI	PLA	PLP
Basale	4	4	1	3	3	1
Medio	4	4	2	3	3	2
Apicale	4		3	3		3

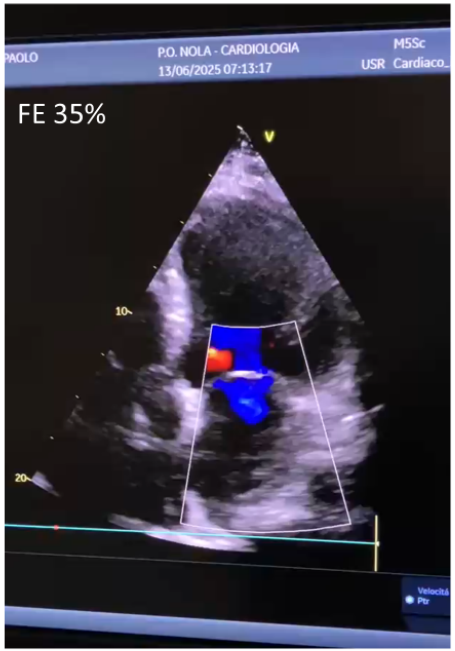
WMSI : 2.94

Conclusioni: Ipertrofia eccentrica con dissincronia settale ed apical rocking del ventricolo sinistro con severa riduzione della funzione sistolica globale (FE Biplana 19%, FE GS derived 19%) e longitudinale (GS -3.0 %), con cinesi segmentaria come da schema. Radice aortica normodilatata e tratto ascendente dilatato, in assenza di chiari flap ai tratti esplorabili. Valvola biologica in sede aortica normofunzionante con residua insufficienza aortica di grado lieve-moderato. Atrio sinistro dilatato. Insufficienza mitralica moderata da duplice componente (thetering lembo posteriore e funzionale), con pattern monofasico ed aumentate pressioni di riempimento. Ventricolo destro nei limiti con normale cinesi longitudinale, con elettrocatetere in situ. IT moderato-severa (da verosimile impingement dell'elettrocatetere) con PAPs stimata aumentata. Atrio destro dilatato. VCI ai limiti alti e normocollassante con insprio. Assenza di versamento pericardico.

Data: 15/05/2025 **Ora:** 08:49 **L'operatore** Dr Orlando Munciguerra

Firmato dal dr.: ORLANDO MUNCIGUERRA [Matricola: 956729]

Final



Medical Case | ECG 1M

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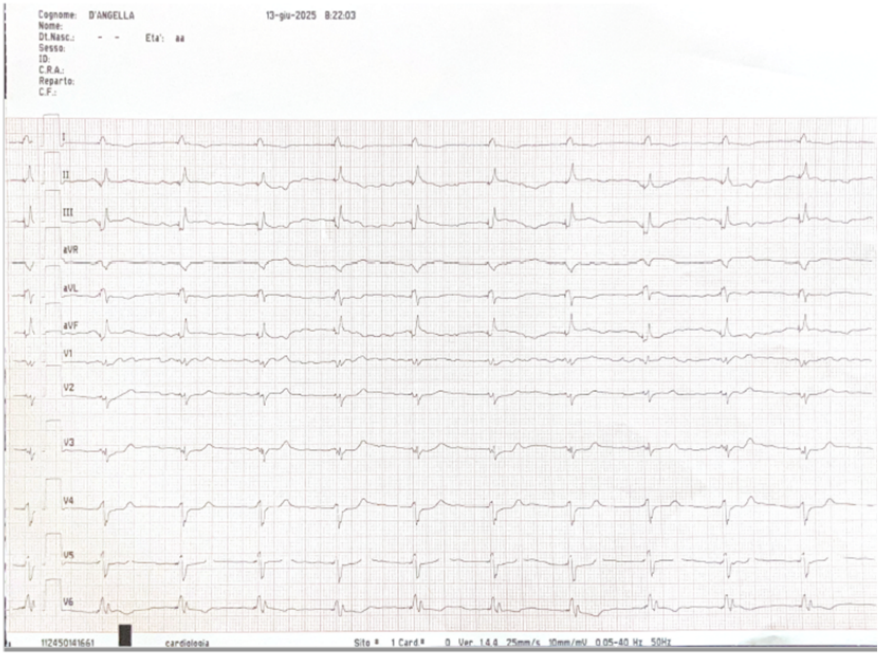

Grazie