Possiamo ottenere una resincronizzazione con la stimolazione di branca sinistra con un numero minore di cateteri? La prima esperienza multicentrica italiana

PLACE 26 Giugno 2026

- Dr Luca Rossi -

CRT

	QRS Morphology	QRS Duration	Class of Recommendation	Level of Evidence
Sinus Rhythm, LVEF ≤ 35%, symptomatic despite Optimal Medical Therapy (OMT)	**LBBB**	**≥ 150 ms**	**I**	**A**
Sinus Rhythm, LVEF ≤ 35%, symptomatic despite OMT	**LBBB**	**130–149 ms**	**IIa**	**B**
Sinus Rhythm, LVEF ≤ 35%, symptomatic despite OMT	**Non-LBBB**	**≥ 150 ms**	**IIa**	**B**
Sinus Rhythm, LVEF ≤ 35%, symptomatic despite OMT	**Non-LBBB**	**130–149 ms**	**IIb**	**B**
Atrial Fibrillation, LVEF ≤ 35%, NYHA Class III/IV, with biventricular capture strategy	**Any**	**≥ 130 ms**	**IIa**	**C**
Conventional Pacemaker Upgrade with high percentage of RV pacing and worsening heart failure	**Any**	**N/A**	**I**	**B**
AV Junction Ablation Candidates with LVEF < 50% requiring ventricular pacing	**Any**	**N/A**	**I**	**B**

CRT

≈ 30% non responders
≈ 5% implantation failure
≈ 10% lead related complications

Atrial Lead in CRT

Circulation
Volume 116, Issue 12, 18 September 2007; Pages 1349-1355
https://doi.org/10.1161/CIRCULATIONAHA.106.678664

ARRHYTHMIA/ELECTROPHYSIOLOGY

Risk Factors Related to Infections of Implanted Pacemakers and Cardioverter-Defibrillators

Results of a Large Prospective Study

	All, n (%)	Requiring Reintervention, n (%)
Hematoma	328 (5.34)	26 (0.42)
Lead dislodgment	112 (1.82)	102 (1.66)
Pacing threshold elevation	59 (0.96)	1 (0.01)
Impending erosion	34 (0.55)	31 (0.50)
Erosion	15 (0.24)	15 (0.24)
Overall	548 (8.93)	175 (2.85)

Circulation
Volume 116, Issue 12, 18 September 2007; Pages 1349-1355
https://doi.org/10.1161/CIRCULATIONAHA.106.678664

ARRHYTHMIA/ELECTROPHYSIOLOGY

Risk Factors Related to Infections of Implanted Pacemakers and Cardioverter-Defibrillators

Results of a Large Prospective Study

Infectious complications rate: 1.19 per 100 patients (95% CI, 0.92 to 1.46)

Were positively correlated with:

- fever within 24 hours before system implantation (OR, 4.8; 95% CI, 1.6 to 14.5; *P*0.01)
- early reintervention (OR, 55.3; 95% CI, 33.1 to 92.6; *P*0.0001)

Were negatively correlated with:

- de novo implantation (OR, 0.4; 95% CI, 0.2 to 0.7; *P* 0.0001)
- antibiotic prophylaxis (OR, 0.37; 95% CI, 0.20 to 0.70; *P*0.01)

Journal of the American College of Cardiology
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Vol. 56, No. 20, 2010
ISSN 0735-1097/$36.00
doi:10.1016/j.jacc.2010.06.037

Acute Lead Dislodgements and In-Hospital Mortality in Patients Enrolled in the National Cardiovascular Data Registry Implantable Cardioverter Defibrillator Registry

Variable	Acute Dislodgement	No Acute Dislodgement	p Value
Age, yrs	68.6 ± 12.7	67.5 ± 13.0	<0.0001
Female	31.9%	27.0%	<0.0001
Race			0.005
White	81.5%	78.7%	
Black	11.5%	12.8%	
Hispanic	3.8%	5.4%	
Other	3.2%	3.1%	
NYHA functional class			<0.0001
I	9.0%	12.4%	
II	26.4%	35.8%	
III	58.4%	47.4%	
IV	6.2%	4.4%	
Atrial fibrillation	35.3%	31.3%	<0.0001
Cardiac transplantation	0.2%	0.2%	0.4755
Ischemic cardiomyopathy	61.8%	68.0%	<0.0001
Prior pacemaker	14.0%	11.2%	<0.0001
ICD type			<0.0001
Single-chamber	11.6%	24.2%	
Dual-chamber	34.0%	40.6%	
CRT-D	54.3%	35.0%	

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Acute Lead Dislodgements and In-Hospital Mortality in Patients Enrolled in the National Cardiovascular Data Registry Implantable Cardioverter Defibrillator Registry

Variable	Acute Dislodgements	No Acute Dislodgements	p Value
Length of stay	6.9 days	4.6 days	<0.0001
Drug reaction	0.34%	0.09%	<0.0001
Phlebitis, superficial	0.15%	0.04%	0.006
Hematoma	4.15%	0.97%	<0.0001
Infection	0.23%	0.02%	<0.0001
Peripheral embolus	0.19%	0.03%	<0.0001
Cardiac arrest	1.45%	0.31%	<0.0001
Cardiac perforation	7.04%	0.00%	<0.0001
Pneumothorax	1.56%	0.47%	<0.0001
Hemothorax	0.42%	0.09%	<0.0001
In-hospital death	1.29%	0.41%	<0.0001

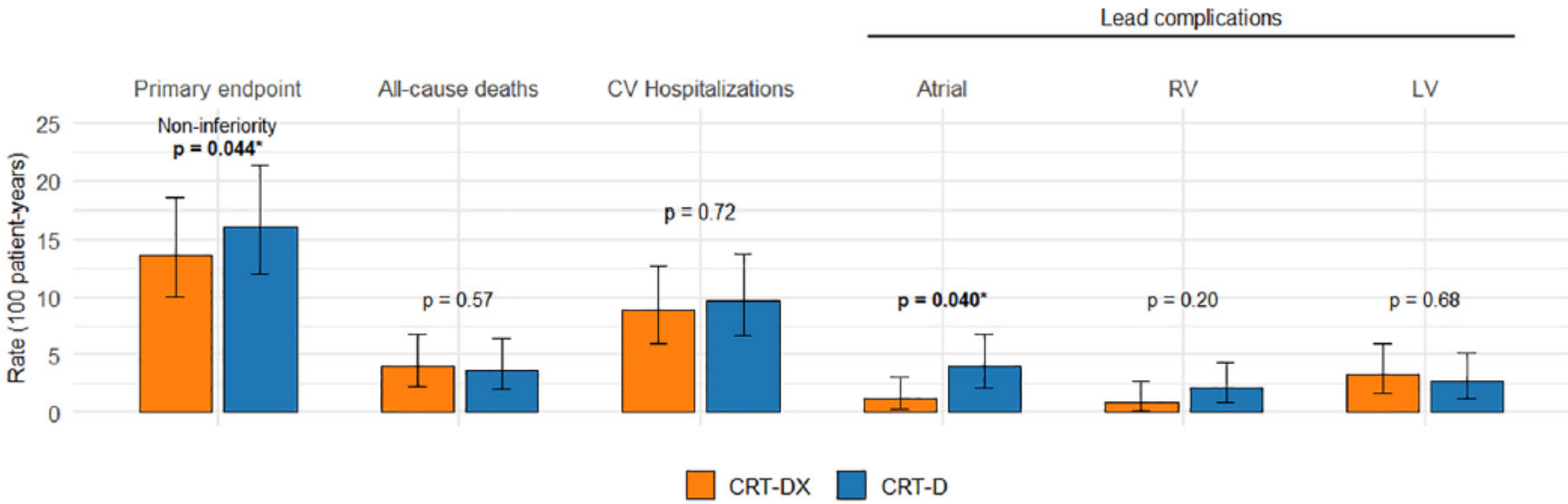
Circulation

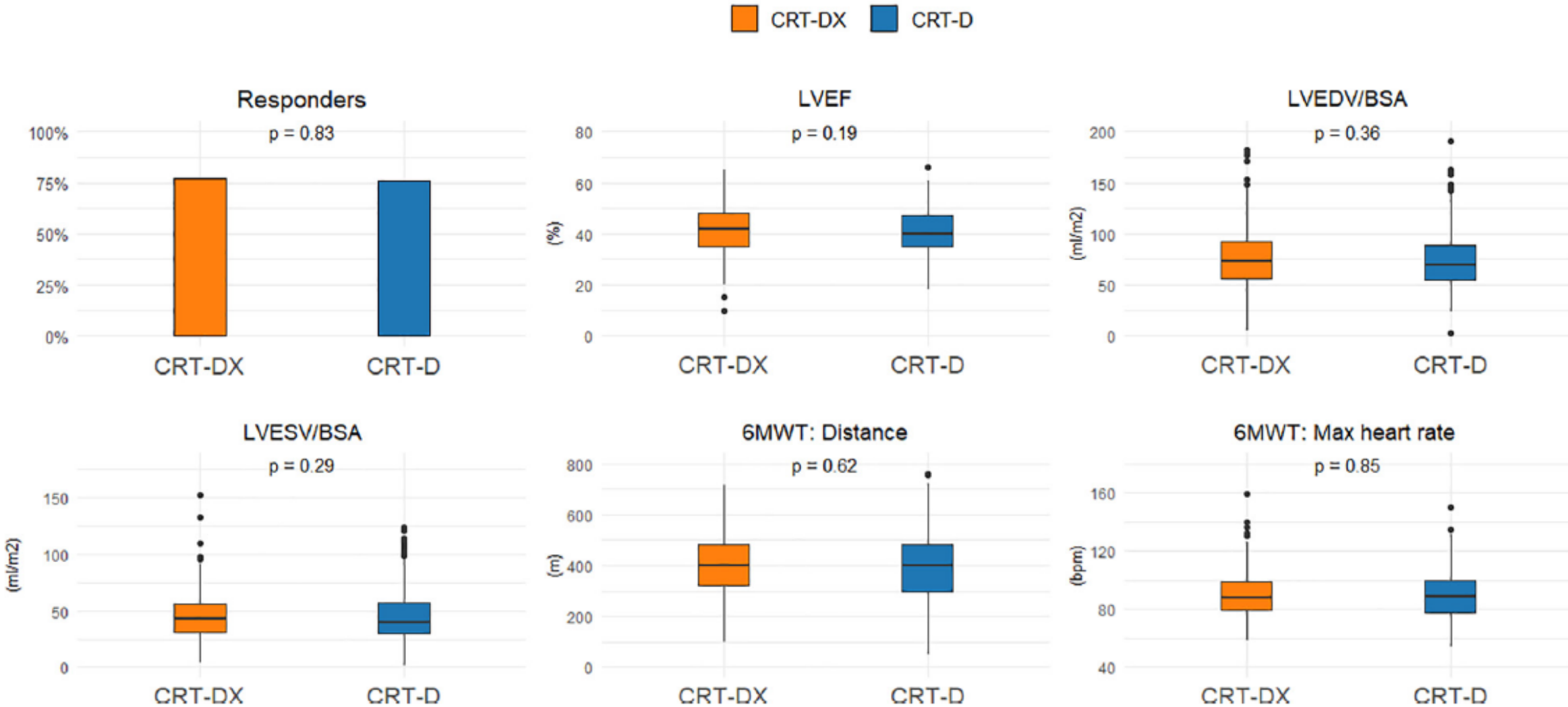
ORIGINAL RESEARCH ARTICLE

Role of Atrial Pacing Support in Cardiac Resynchronization Therapy: A Noninferiority Randomized Trial

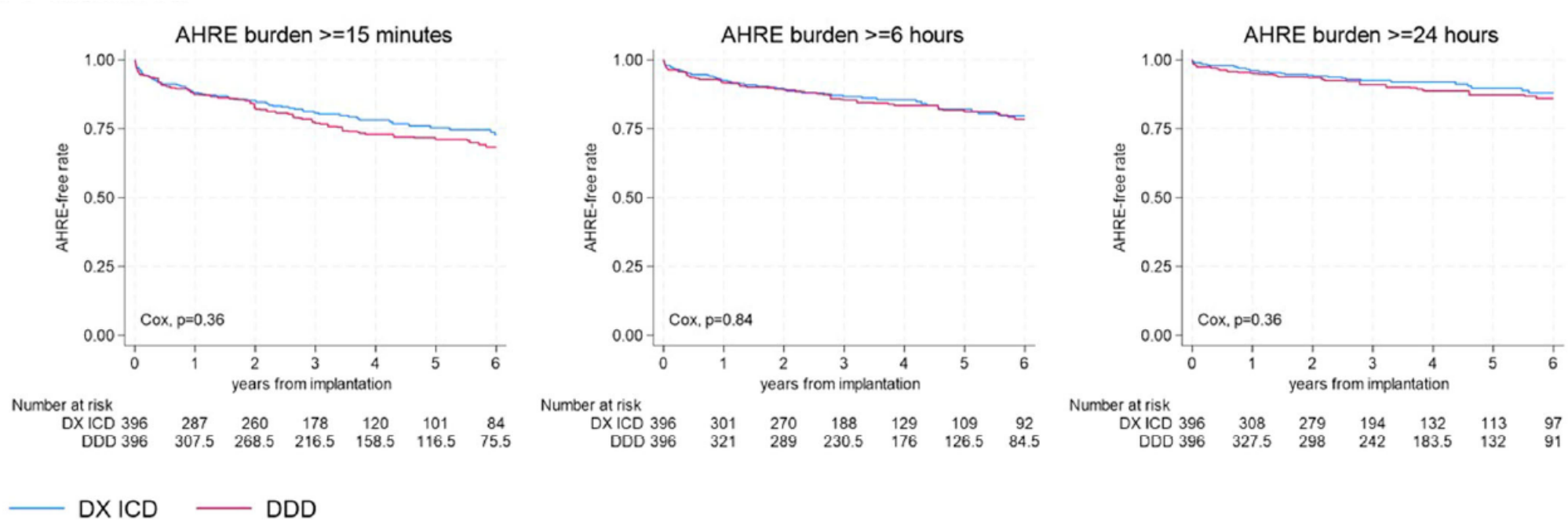
Mauro Biffi, MD; Giovanni Rovaris, MD; Ennio Carmine Luigi Pisanò, MD; Valeria Calvi, MD; Antonio Rapacciuolo, MD, PhD; Matteo Santamaria, MD, PhD; Giampiero Maglia, MD; Gabriele Zanotto, MD; Emanuele Bertaglia, MD, PhD; Gerardo Nigro, MD, PhD; Andrea Giomi, MD; Francesca Notarangelo, MD; Patrizia Pepi, MD; Giuliano D'Alterio, MD; Davide Castagno, MD, PhD; Antonio Dello Russo, MD, PhD; Antonino Nicosia, MD; Massimo Zecchin, MD; Matteo Bertini, MD, PhD; Antonio Duca, MD; Daniele Giacopelli, PhD; Alessio Gargaro, MSc; Giovanni Luca Botto, MD; on behalf of the CRT-NEXT Study Group*

Circulation. 2026;153:1707–1718


Lead complications
Primary endpoint
All-cause deaths
CV Hospitalizations
Atrial
RV
LV
Rate (100 patient-years)
25
20
15
10
5
0
Non-inferiority
p = 0.044*
p = 0.57
p = 0.72
p = 0.040*
p = 0.20
p = 0.68
CRT-DX
CRT-D

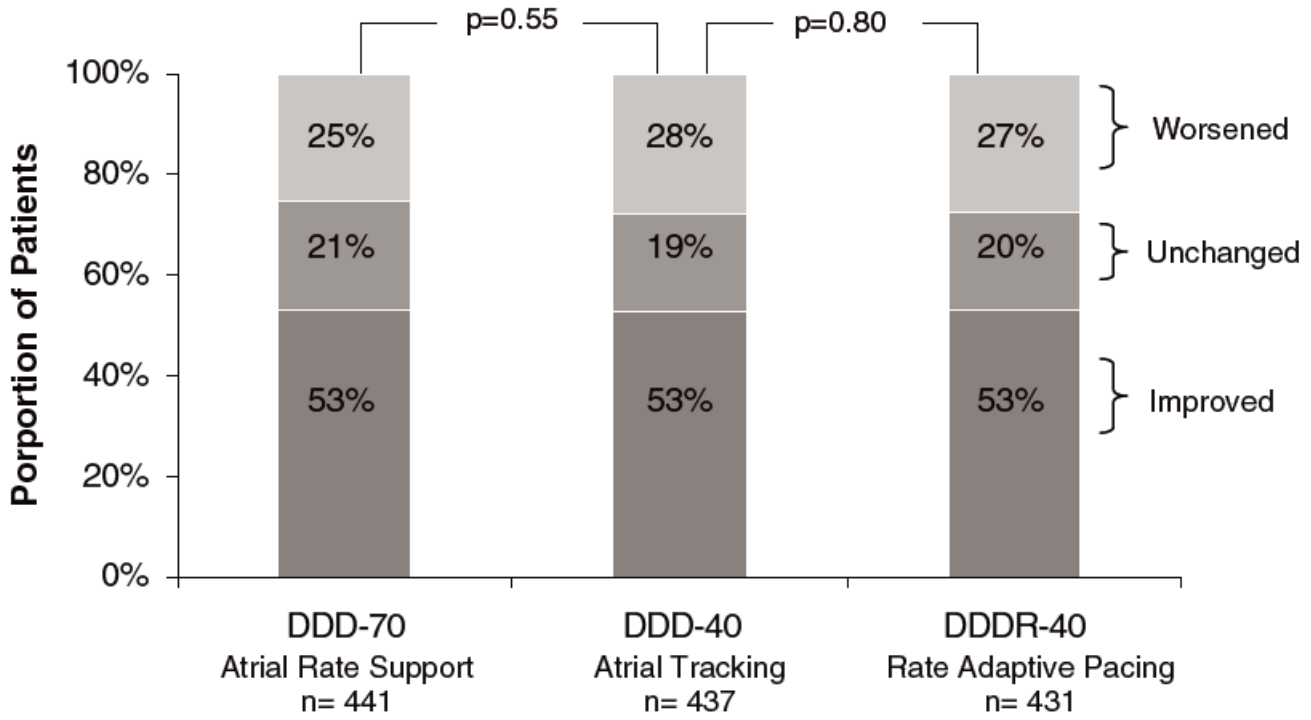

CRT-DX
CRT-D
Responders
p = 0.83
100%
75%
50%
25%
0%
CRT-DX
CRT-D
LVEF
p = 0.19
(%)
80
60
40
20
0
CRT-DX
CRT-D
LVEDV/BSA
p = 0.36
(ml/m2)
200
150
100
50
0
CRT-DX
CRT-D
LVESV/BSA
p = 0.29
(ml/m2)
150
100
50
0
CRT-DX
CRT-D
6MWT: Distance
p = 0.62
(m)
800
600
400
200
0
CRT-DX
CRT-D
6MWT: Max heart rate
p = 0.85
(bpm)
160
120
80
40
CRT-DX
CRT-D

New-Onset Device-Detected Atrial Fibrillation in Patients With Atrial Floating Dipole Implantable Cardioverter- Defibrillators: A Propensity Score-Matched Comparison
With Conventional Dual-Chamber Systems



Mitacchione G. et al Journal of Cardiovascular Electrophysiology, 2025; 36:1303–1313

In advanced heart failure patients treated with CRT, atrial support pacing did not improve clinical outcomes compared to atrial tracking.
However, atrial pacing did not adversely affect mortality or heart failure events.



Martin D. et al. J Cardiovasc Electrophysiol 2012 Dec;23(12):1317-25

CRT
Biventricular Pacing vs Conduction System Pacing

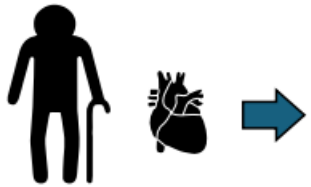
ESC Europace (2026) 28, euag122
https://doi.org/10.1093/europace/euag122

STATE OF THE ART REVIEW

Conduction system pacing for cardiac resynchronization therapy: a systematic review

Georgios Fotos [1,2†], Nikolaos Ktenopoulos [3*†], Konstantinos Vlachos [4,5], Apostolos Christou[1], Maria Agelaki [1], Anastasios Apostolos [3,6], Athanasios Samaras [7], Justin Luermans [8], Kevin Vernooy [8], Konstantinos Tsioufis [3], Konstantinos Toutouzas [3], Dominik Linz [8,9], and Serge Boveda [10,11]

In pooled analyses, overall complication rates with LBBAP are approximately 2%, significantly lower than those reported with HBP. Lead-related complications, including lead failure or deactivation, appear less frequently, while reported lead dislodgement rates remain low, typically 1–2%



CRT candidate
(LVEF ≤ 35%, QRS ≥130 ms, NYHA II-III

LBBB	RBBB/IVCD (non-LBBB)	PICM High pacing burden > 20%	AVNA (pace and ablate strategy in persistent AF)	Failed BVP
BVP* Class I with QRS ≥ 150 ms Class IIa with QRS 130–149 ms	BVP* Class IIa with QRS ≥ 150 ms Class IIb with QRS 130–149 ms	BVP* Upgrade Class IIa in Patients with EF 35%	BVP* Class I with LVEF < 40% Class IIa with 40% ≤ EF < 50%	Rescue with CSP*^
LBBAP preferred CSP^ HBP only if LBBAP fails	Consider CSP^ as a promising alternative	Consider upgrade to CSP^ (LBBAP/HBP)	Consider CSP^ (HBP with Class IIb)*	
• Greater QRS narrowing • Better LVEF improvement	• Greater QRS narrowing • Better LVEF improvement	• Prevents PICM • Reverses LV dysfunction	• Physiological ventricular activation • LVEF improvement • Reduce HF events	

In BVP/CSP non-responders think hybrid strategy: **HOT/LOT - CRT**

* Based on 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy
^Evidence-free area, additional studies are needed

Author/year	Number of patients	Study type	Group/CRT type	Key findings	Safety/complications
Liang Y. *et al.*, 2022[48]	21	Multicentre/ crossover	LBBAP vs. BVP	Greater reduction in paced QRS, haemodynamic improvement	No major events
Pujol-Lopez M. *et al.*, 2022[51]	70	**RCT**	CSP (mainly LBBAP) vs. BVP	Change in LVAT at 6 months: CSP similar to BVP	No major events
Chen X. *et al.*, 2022[66]	85	Observational prospective	LBBAP vs. BVP	Greater QRS reduction and LVEF improvement; reduced composite endpoint (HF/death)	No major events
Wang *et al.*, 2022[47]	40	**RCT**	LBBAP vs. BVP	ΔLVEF at 6 months: 5.6% (significant)	No major events
Vijayaraman P. *et al.*, 2023[38]	1778	Observational retrospective	LBBAP vs. BVP	26% reduction in composite death/ HF admissions	No major events
Diaz J. C. *et al.*, 2023[58]	371	Observational prospective	LBBAP vs. BVP	38% reduction in composite endpoint	No major events
Diaz J. C. *et al.*, 2024[57]	415	Observational prospective	LBBAP vs. LVSP vs. BVP	LBAAP reduced significantly composite outcomes; LVSP comparable to BVP	No major events
Palmisano P. *et al.*, 2024[60]	668	Observational comparative	LBBAP vs. BVP	LBBAP associated with similar CRT efficacy, lower complications vs. BVP	Device-related complications lower in LBBAP (4.3% vs. 12.9%); BVP independently associated with higher complication risk

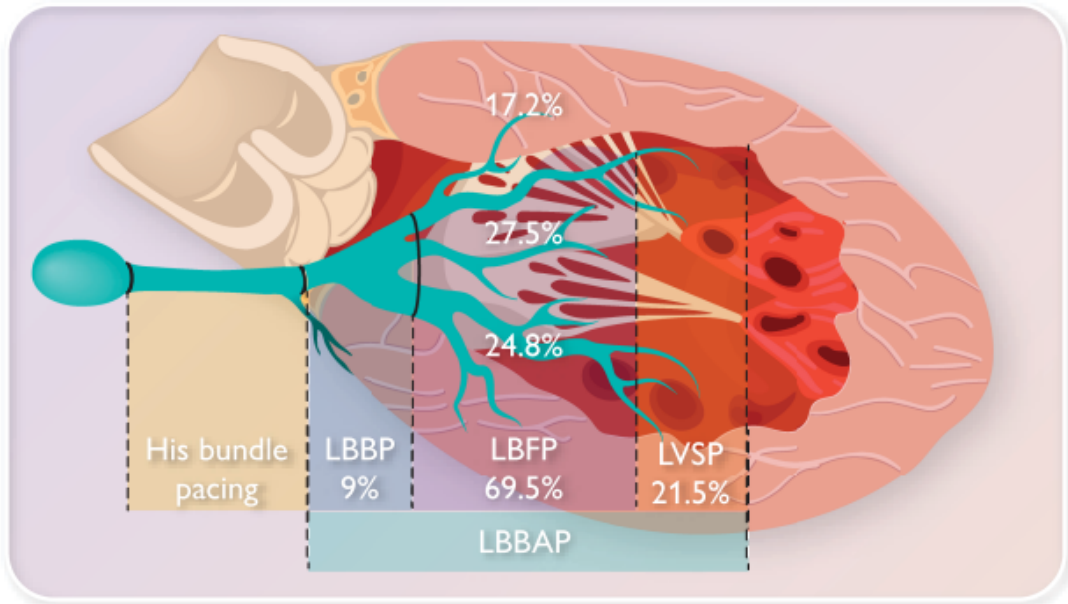
Zhu H. *et al.*, 2024[61]	259	Observational prospective	LBBAP vs. BVP	LBBAP achieved better clinical outcomes (death/HF hospitalizations)	No major events
Schroff P.J. *et al.*, 2024	101	Observational comparative	LBBAP vs. BVP	Similar with CRT response but with significant lower pacing thresholds; better electrical synchrony	No major events
Zizek *et al.*, 2025	270	**RCT**	LBBAP vs. BVP	LBBAP reduced HF admissions; improved LVEF and QRS width	No major events
Pujol-Lopez *et al.*, 2025[51]	134	**RCT**	CSP (mainly LBBAP) vs. BVP	Non-inferior to BVP for composite death/HF/ΔLVEF; QRS shortening, NYHA improvement	No major events
Morcos R. *et al.*, 2025[63]	2579	Observational prospective	LBBAP vs. BVP	LBBAP: shorter paced QRS; lower risk of the composite endpoint (death/HF); lower HF admissions	Lower complications in LBBAP arm, lower arrhythmic risk
Zimerman A. *et al.*, 2026[55]	173	**RCT**	LBBAP vs. BVP	Inferior to BVP for composite death/HFH/ΔLVEF; comparable improvement in QRS duration and functional capacity	More complications in LBBAP arm (10 vs. 7); 3 deaths in the same arm
Chen X. *et al.*, 2026[56]	200	**RCT**	LBBAP vs. BVP	LBBAP superior to BVP for composite death/HFH; similar echocardiographic response; better functional capacity in LBBAP arm	No major complications in LBBAP arm; one lead dislodgement and one increase in pacing threshold in BVP arm
Jastrzebski *et al.*, 2022[67]	91	Observational prospective	LOT-CRT vs. BVP	Narrower QRS vs. BVP and LBBAP, improved LVEF > 3 months, improved NYHA	No major events

MELOS — MULTICENTER EUROPEAN LEFT BUNDLE BRANCH AREA PACING OUTCOMES STUDY

Prospective, multicenter, registry-based observational study

2533 Participants

14 European centres



Independent predictors of LBBAP lead implantation failure

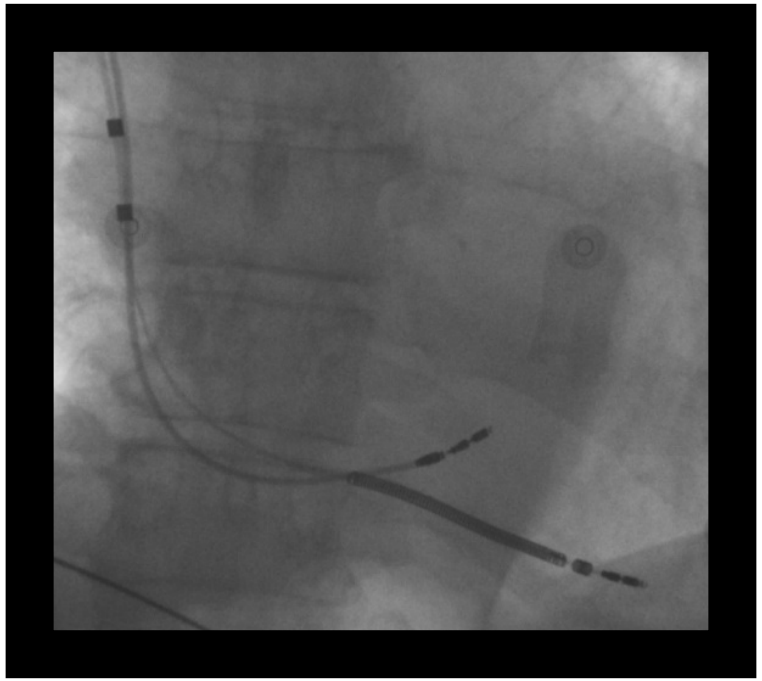
Heart failure indication	**OR 1.49**, 95% CI 1.01–2.21
Baseline QRS duration, per 10 ms	**OR 1.08**, 95% CI 1.03–1.14
LVEDD, per 10 mm increase	**OR 1.53**, 95% CI 1.26–1.86

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%

CRT-DX LBBAP



CRT(DX)-LBBAP

Two-lead CRT-DX system with a LBBAP lead:

- Atrial sensing is achieved via a floating atrial dipole integrated into the implantable cardioverter-defibrillator lead
- CRT delivered with a left bundle branch area pacing lead

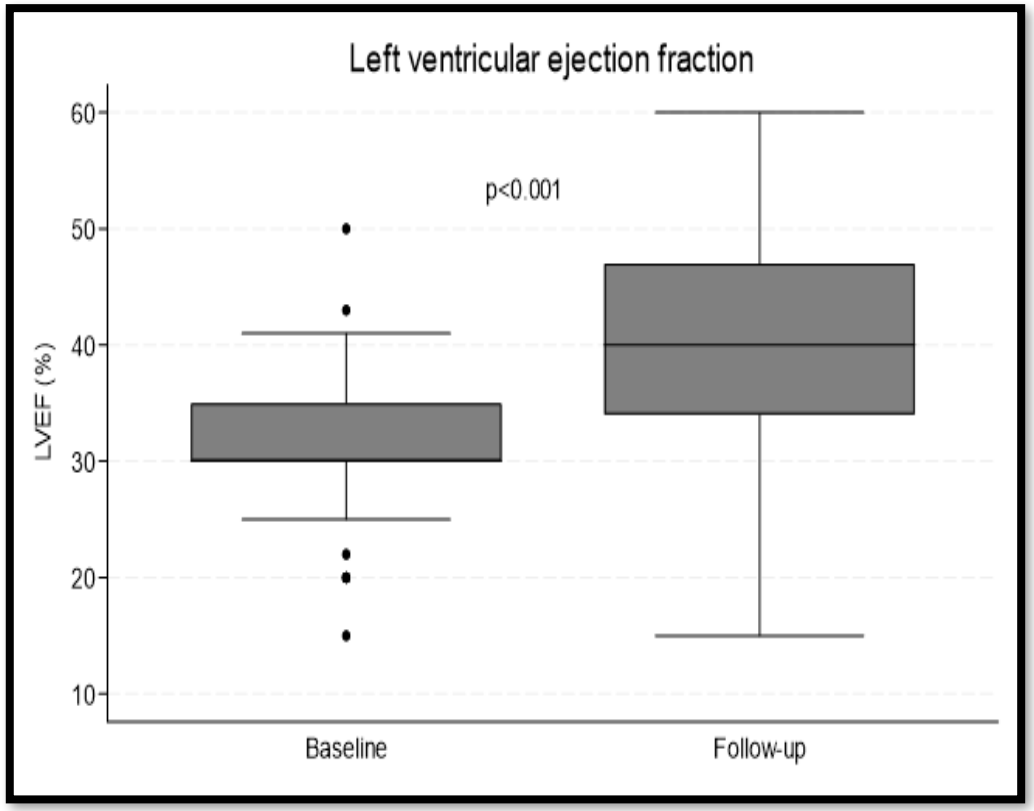
CRT(DX)-LBBAP è uno studio no-profit, osservazionale, retrospettivo, multicentrico sui pazienti sottoposti a resincronizzazione ventricolare con stimolazione LBBAP

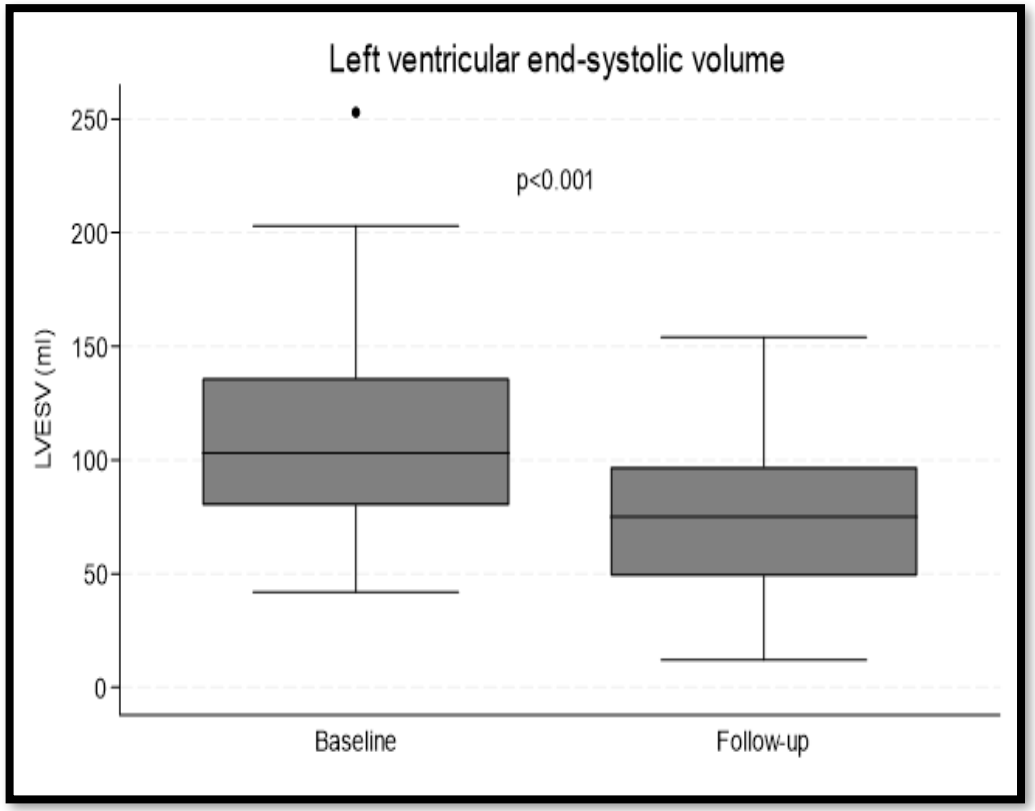
	All patients (N=40)
Age (years)	72 (67-77)
Sex, male	31 (78%)
Hypertension	24 (60%)
Diabetes	15 (38%)
Coronary heart disease	16 (41%)
Dilated cardiomyopathy	27 (69%)
Primary valvular heart disease	7 (18%)
Chronic kidney disease	10 (25%)
Previous TIA/stroke	6 (15%)
Pulmonary disease	2 (5%)
History of AF	10 (25%)
Echocardiography	
Left ventricular Ejection fraction (%)	30 (30-35)
Left ventricular end-diastolic volume (mL)	157 (120-179)
Left ventricular end-systolic volume (mL)	103 (80-136)

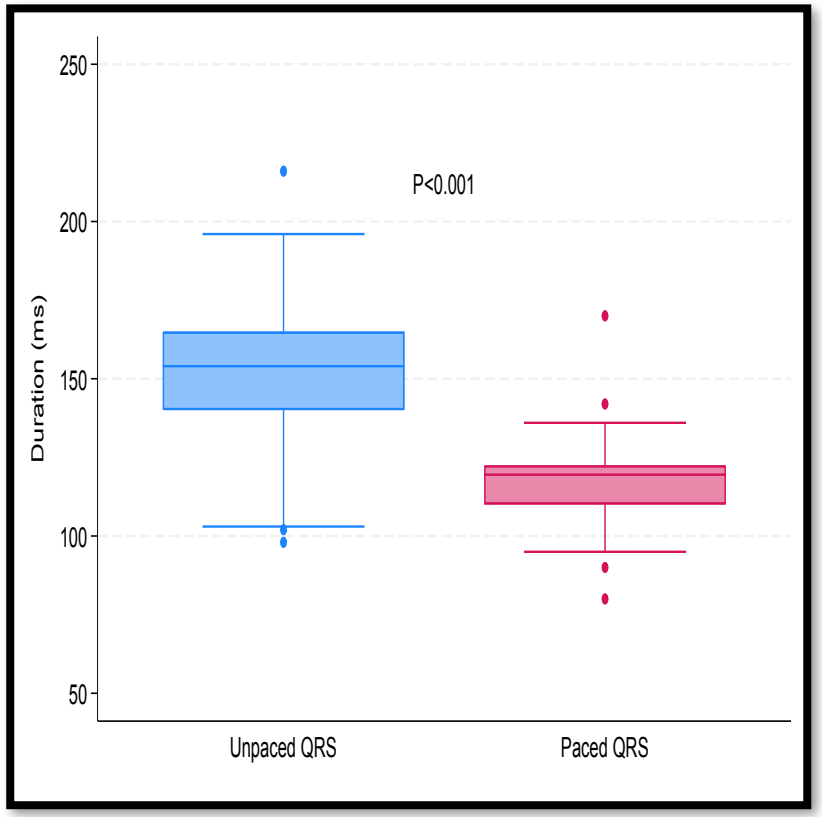
Sinus rhythm	35 (88.0%)
AF	5 (12.0%)
Rest heart rate (bpm)	65 (57-74)
AV Block	
No	22 (55%)
I°	14 (35%)
II°-III°	4 (10%)
Spontaneous QRS duration (ms)	154 (140-165)
QRS morphology	
LBBB	21 (53%)
RBBB	7 (18%)
Left Anterior Fascicular Block	5 (12%)
Nonspecific IVCD	3 (7%)
Normal	4 (10%)

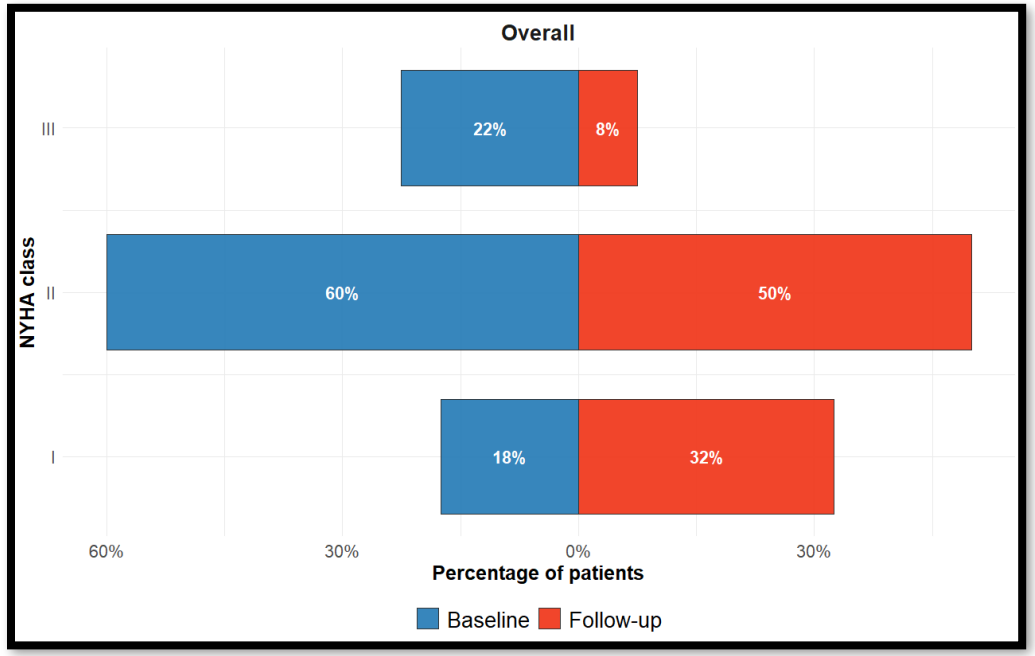
	All patients (N=40)
LBBAP lead used as	
First-line	11 (28%)
Bailout strategy	29 (72%)
CS not accessible	18 (45%)
Unsatisfactory electrical parameters/phrenic nerve stimulation of CS lead	6 (15%)
Stability concern of CS lead	3 (8%)
Unfavorable anatomical location of CS branches	2 (5%)
Fluoroscopy time (minutes)	9.6 (5.8-11.9)
Procedural time (minutes)	70 (60-80)
LBBAP lead	
Type	
Stylet-driven	39 (98%)
Lumenless	1 (2%)
LBBAP capture subtypes	
LBBP	11 (28%)
LFP	19 (48%)
LVSP	6 (15%)
Unknown	4 (10%)
Stimulus to V6 R wave peak (ms)	80 (74-88)
V6-V1 interpeak interval (ms)	42 (35-48)

	Baseline (N=40)	Follow-up (N=37)	P value
DX ICD lead			
Atrial sensing with atrial floating dipole (mV)	4.0 (1.9-5.7)	3.6 (1.7-6.2)	0.257
LBBAP lead			
Sensing amplitude (V)	8.1 (6.6-10.0)	8.6 (6.3-19.7)	0.021
Pacing threshold @0.4 ms (V)	0.8 (0.6-1.1)	0.6 (0.5-0.8)	0.006
Pacing impedance (Ohm)	599 (463-715)	404 (360-630)	<0.001
LABBAP pacing percentage (%)	-	98 (95-99)	-
Paced QRS duration (ms)	128 (116-133)	120 (110-123)	0.245


Left ventricular ejection fraction
LVEF (%)
60
50
40
30
20
10
p<0.001
Baseline
Follow-up


Left ventricular end-systolic volume
LVESV (ml)
250
200
150
100
50
0
p<0.001
Baseline
Follow-up


250
200
150
100
50
Duration (ms)
P<0.001
Unpaced QRS
Paced QRS


Overall
III
II
I
NYHA class
22%
8%
60%
50%
18%
32%
60%
30%
0%
30%
Percentage of patients
Baseline
Follow-up

CONCLUSIONS

- Biventricular pacing remains the gold standard for cardiac resynchronization therapy
- CRT using a floating dipole lead is both feasible and effective.
- Conduction system pacing is emerging as a physiologically appealing alternative for cardiac resynchronization.
- In our study, CRT-DX with LBBAP was shown to be both feasible and effective.
- Larger, multicentre, prospective randomized controlled trials with longer follow-up are needed.