MUTLIPOLARITY, MULTIPROGRAMMIBILITY, MULTIPOLES with CRT

האם נפתרה בעיית הגירוי הסרעפתי והספים הגבוהים ?

דר. רון סלע

היחידה לאלקטרופיזיולוגיה וקוצבים

המחלקה הקרדיולוגית

בית החולים לגליל המערבי –נהריה.

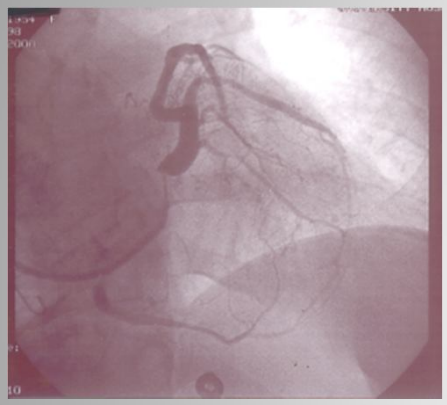
הפקולטה לרפואה – אוניברסיטת בר-אילן

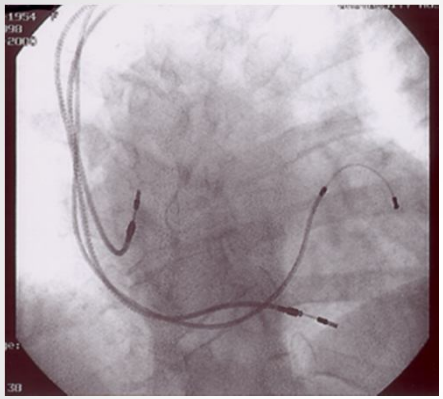
10-12 , ינואר 2013 , כפר בלום

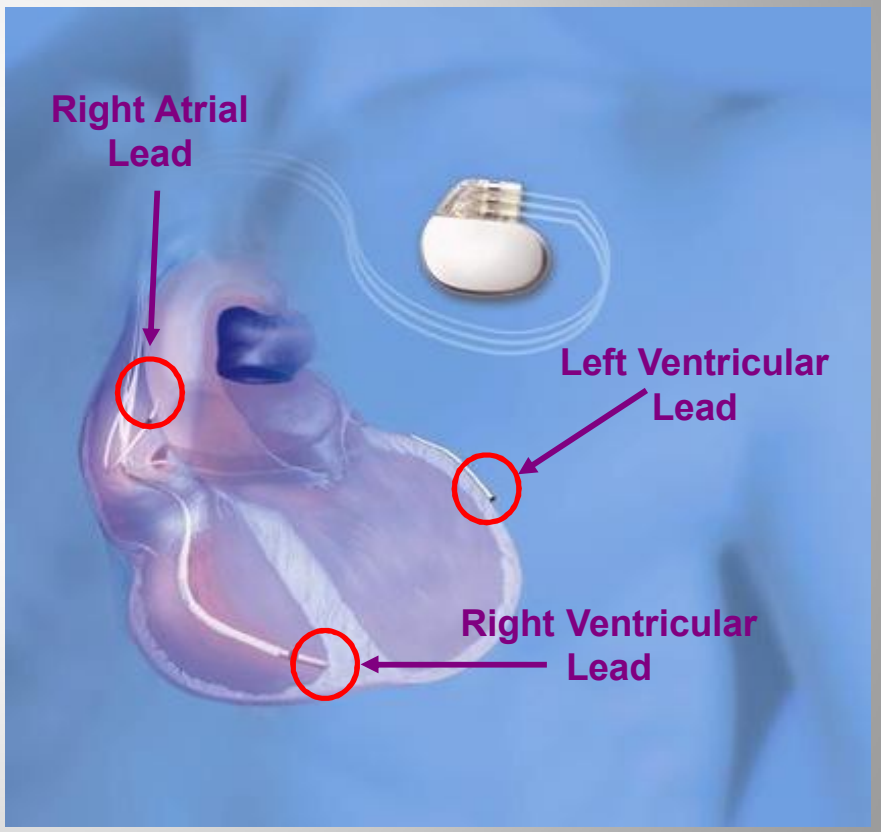
Bar-Ilan University
Faculty of Medicine

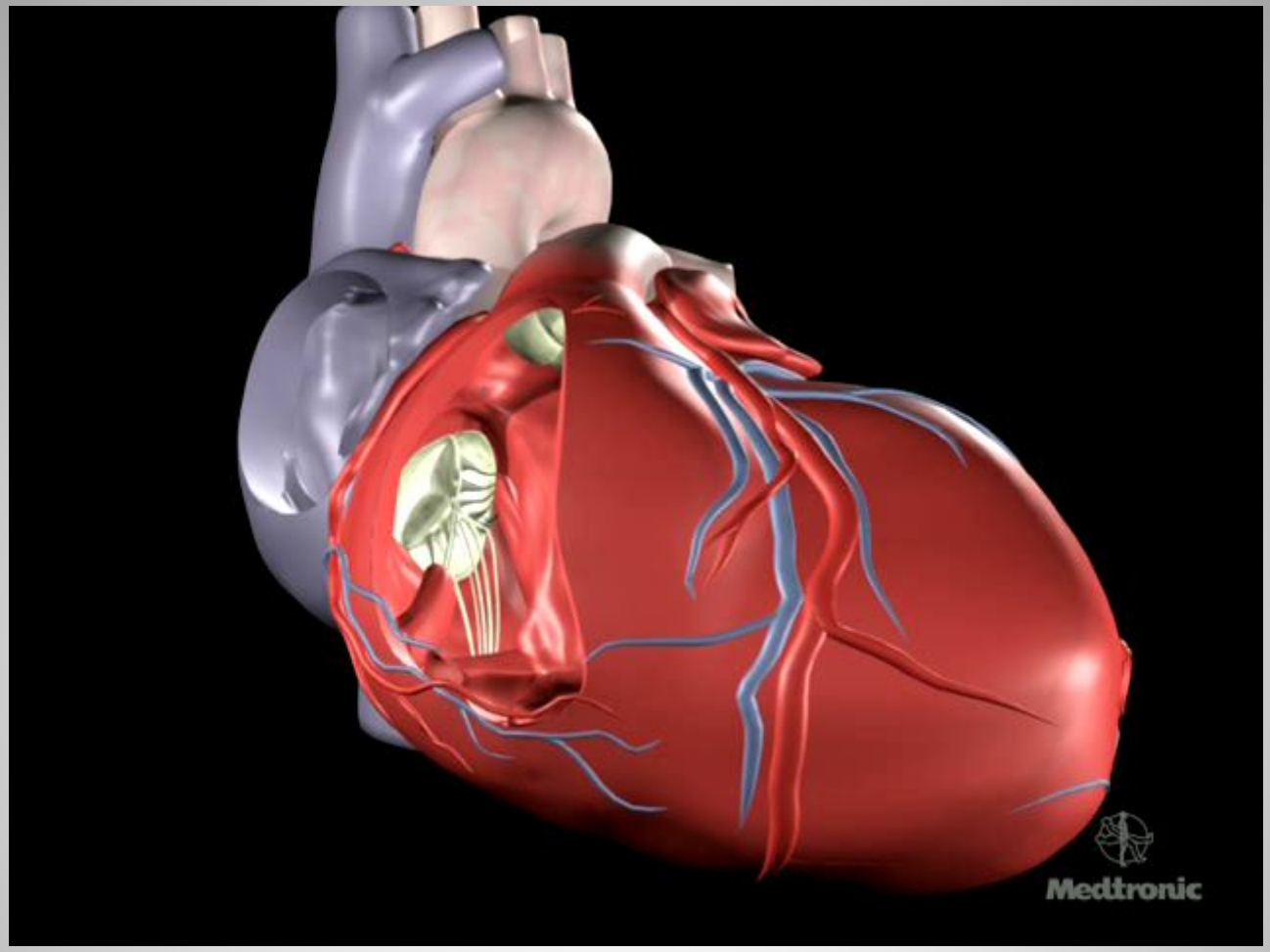
אוניברסיטת בר-אילן
הפקולטה לרפואה

Cardiac resynchronization therapy (CRT) is well established as a treatment for heart failure in patients with severely impaired left ventricular (LV) systolic function and evidence of ventricular dyssynchrony.









The placement of a coronary sinus (CS) lead is a technically challenging procedure owing to variable vein anatomies, lead stability and Phrenic nerve stimulation(PNS)

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FOCUS ISSUE: CARDIAC RESYNCHRONIZATION THERAPY

Safety of Transvenous Cardiac Resynchronization System Implantation in Patients With Chronic Heart Failure

Combined Results of Over 2,000 Patients From a Multicenter Study Program

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Atlanta, Georgia; Lexington, Kentucky; Columbus, Ohio; Gainesville, Florida; Rochester, New York; Evanston, Illinois; Rochester, Minnesota; Minneapolis, Minnesota; and Dallas, Texas

2,000 patients from a multicenter study showed need for reoperation in 8% of patients during a 6-month follow-up period:

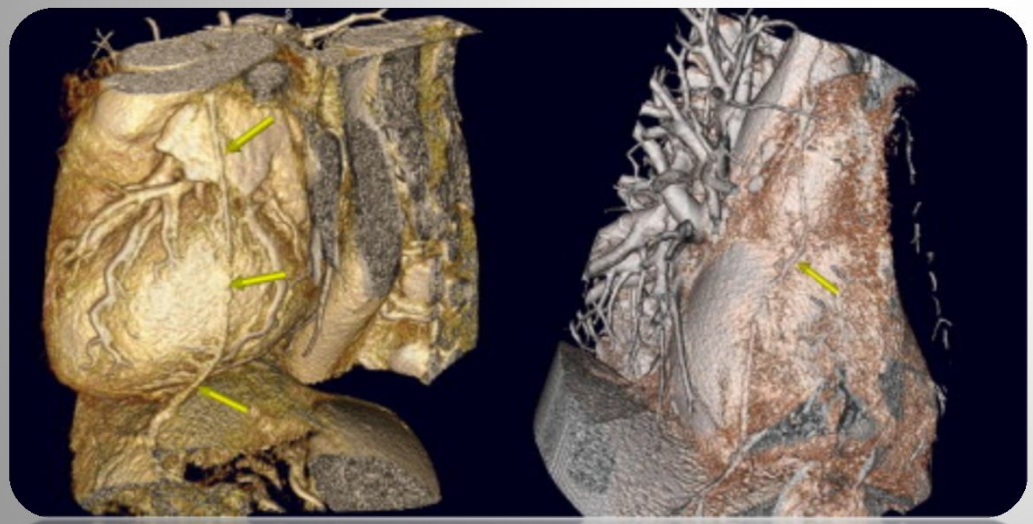
The reasons for revision included mainly:

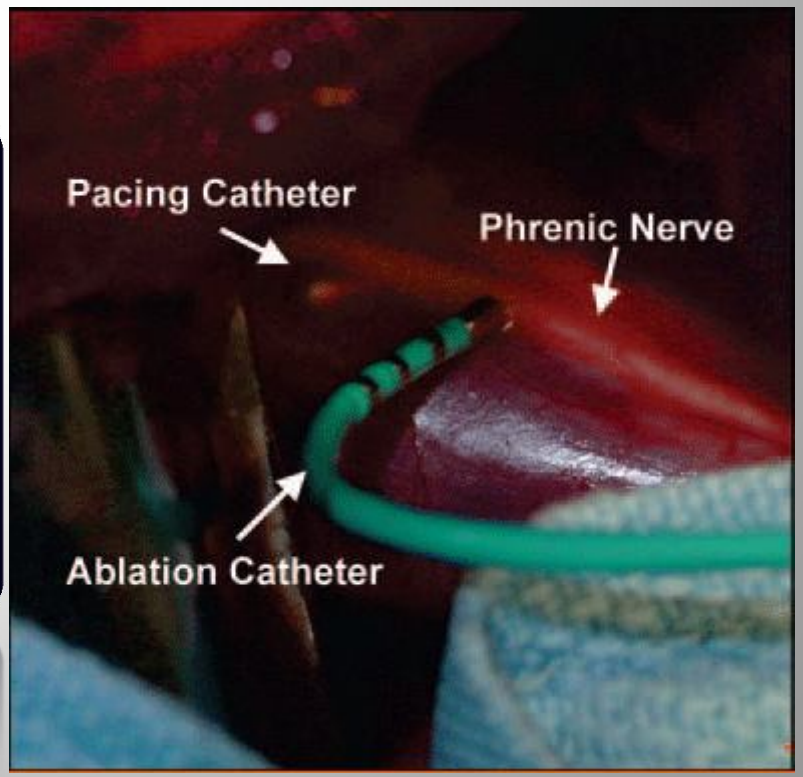
- LV lead dislodgment with loss of capture
- Phrenic nerve stimulation (PNS)
- Increased LV pacing threshold without obvious lead dislocation

J Am Coll Cardiol 2005;46:2348 –2356.

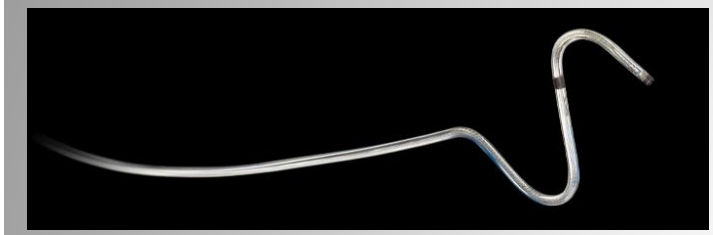
The principal obstacles to the successful implementation of CRT:

- limited anatomic choices for the placement of the LV lead
- Difficulties in obtaining a stable pacing site free of PNS.

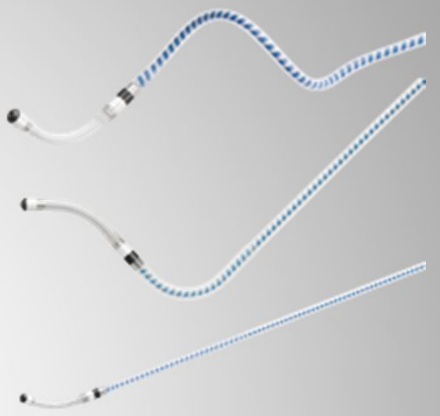




Most LV leads are preshaped and curved in one or multiple dimensions to ensure passive fixation in the target vein

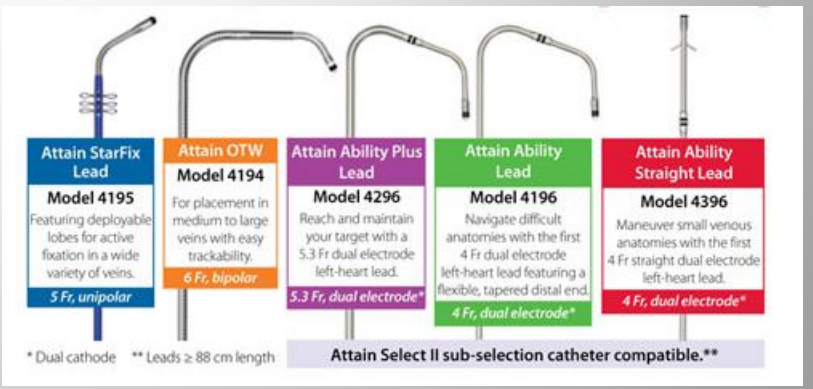


QuickFlex™ µ LV Lead



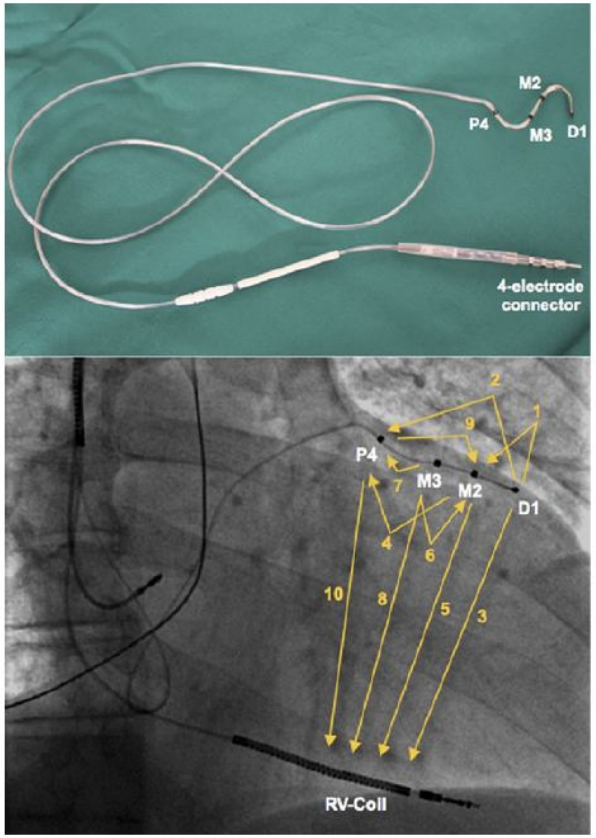
Corox ™OTW BP

ACUITY™ Spiral LV Lead

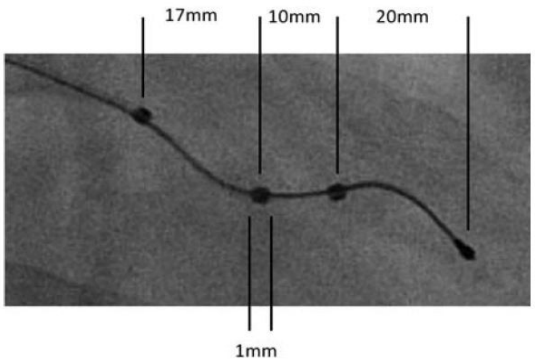


Attain® Family of LV Leads

A quadripolar CS lead (Quartet 1458Q, St Jude Medical, Sylmar, CA) has been designed to provide more options for LV pacing.
The goal of this design, which integrates multiple pacing options, was to minimize the effects of lead dislodgment and give the implanter more choices in implantation location.



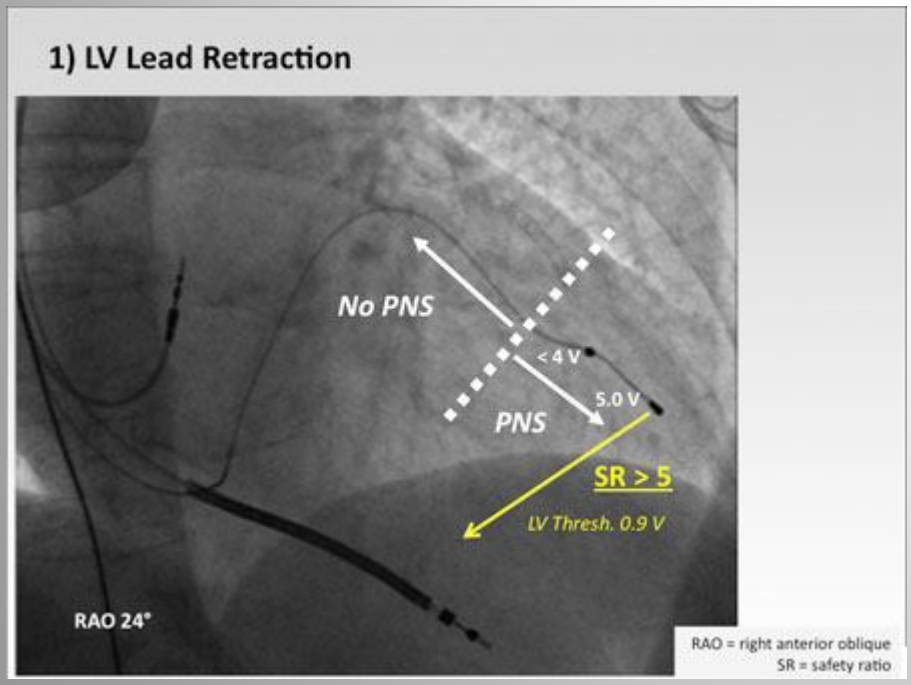
VECTOR	DESCRIPTION	CATHODE	ANODE
1	Distal-Tip to Mid-2	D1	M2
2	Distal-Tip to Proximal-4	D1	P4
3	Distal-Tip to RV-Coil	D1	RV-Coil
4	Mid-2 to Proximal-4	M2	P4
5	Mid-2 to RV-Coil	M2	RV-Coil
6	Mid-3 to Mid-2	M3	M2
7	Mid-3 to Proximal-4	M3	P4
8	Mid-3 to RV-Coil	M3	RV-Coil
9	Proximal-4 to Mid-2	P4	M2
10	Proximal-4 to RV-Coil	P4	RV-Coil

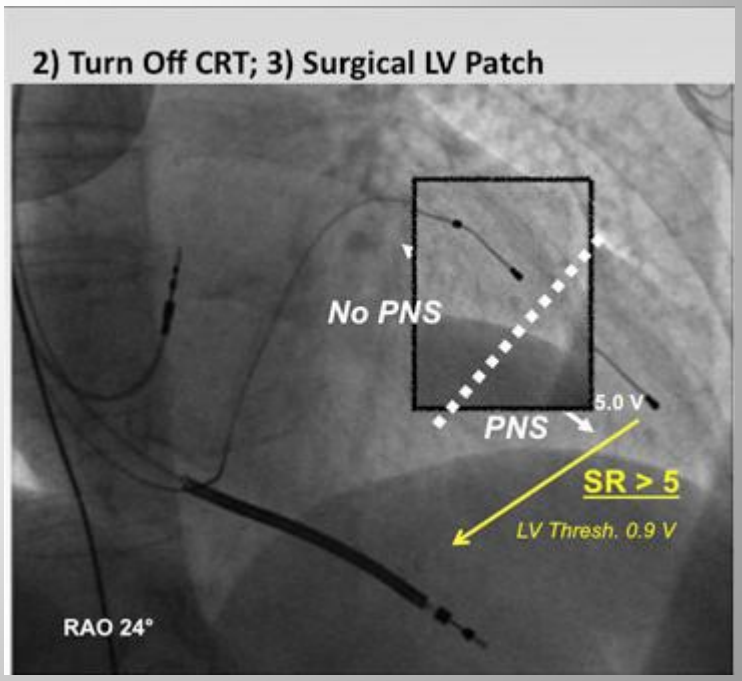


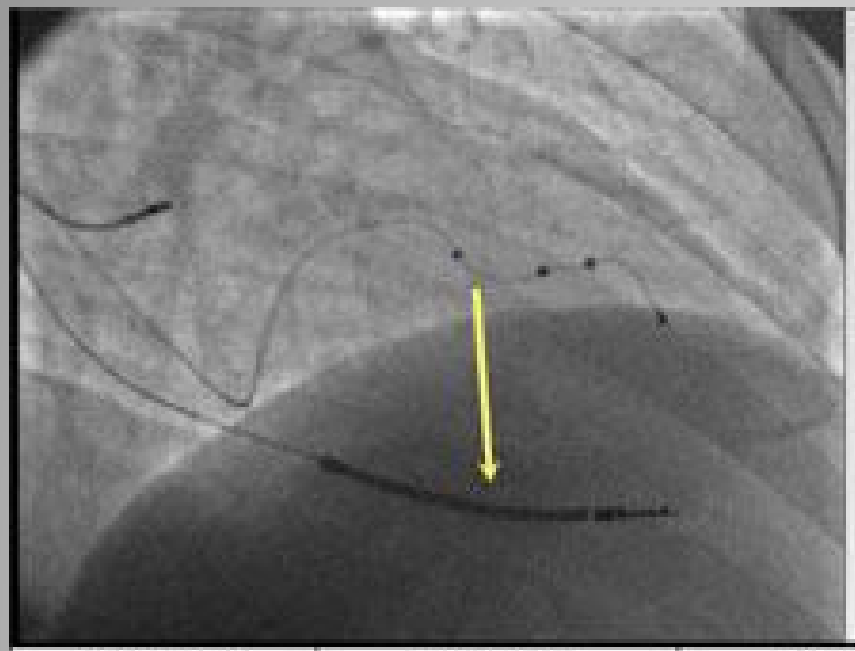
Close-up of the lead with electrode distances

Figure 1 View of the quadripolar left ventricular lead with a detailed representation of the multiple pacing vectors. The 3-ring electrodes (M2, M3, P4) are located 20, 30, and 47 mm from the 4.0-F–tip electrode (D1). Maximum lead body diameter is 4.7-F. In conjunction with an appropriate device, it enables delivery of pacing stimuli using any of the 4 electrodes in 10 pacing configurations. **Bottom:** final lead location at implantation from the right anterior oblique projection. RV = right ventricular.

- The most important goal when implanting a CRT system is to reach a stable LV lead position in a suitable CS tributary associated with a low capture threshold and no PNS.
- A lead with multiple pacing electrodes is a potential alternative to physical adjustment of the lead or discontinuing CRT when PNS occurs
- Detection of PNS has a poor sensitivity.

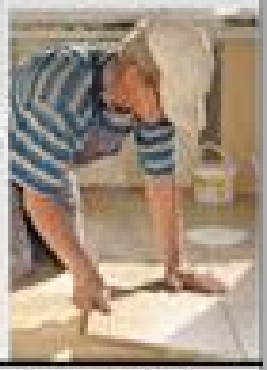






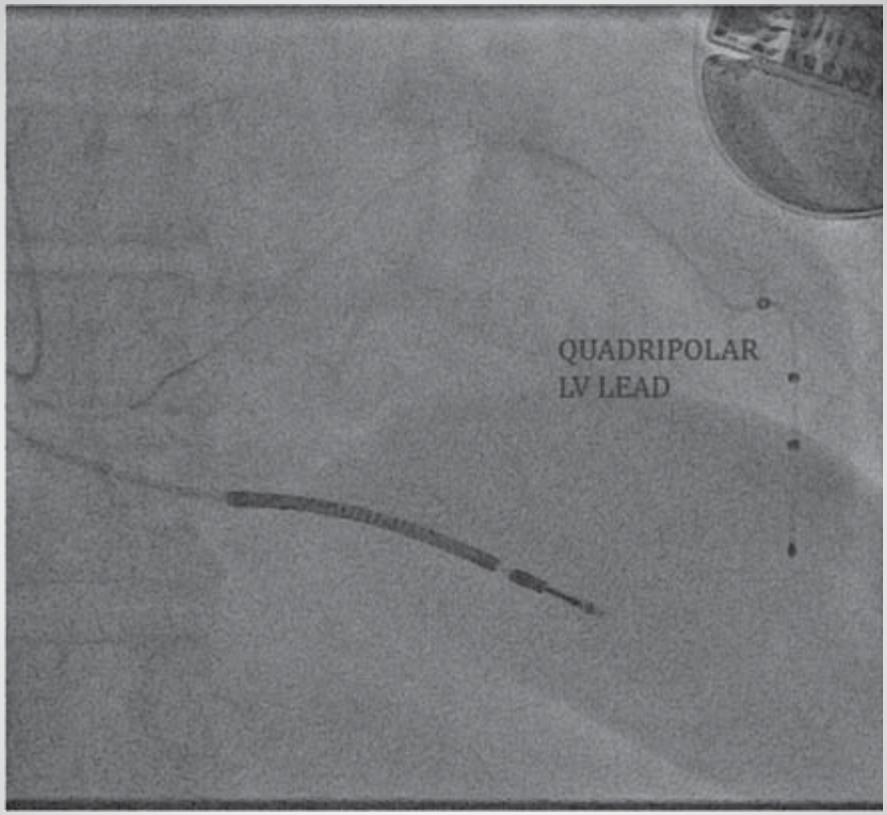
Program Flexibility

- Man, 62-years-old, dilated cardiomyopathy, EF 35%, left bundle branch block
- CRT-D, quadripolar lead
- PNS during work hours (tiler)



VECTOR			IMPLANT		1 MONTH		3 MONTHS		6 MONTHS	
			PACING (V/0.5 ms)	PNS (7.5 V/0.5 ms)	PACING (V/0.5 ms)	PNS (7.5 V/0.5 ms)	PACING (V/0.5 ms)	PNS (7.5 V/0.5 ms)	PACING (V/0.5 ms)	PNS (7.5 V/0.5 ms)
1	D1	M2	0.75	NO	1.25	NO	2.25	YES	1.25	NO
2	D1	P4	0.25	NO	4.25	YES	2.5	NO	1.25	NO
3	D1	RV COIL	0.5	NO	0.75	YES	1.5	NO	2	YES
4	M2	P4	0.5	YES	0.5	YES		YES	1.25	YES
5	M2	RV COIL	0.5	YES	0.75	YES		YES	0.75	YES
6	M3	M2	0.75	YES	5	YES	2.25	YES	1.25	YES
7	M3	P4	0.75	YES	5.5	YES	3.75	YES	1.25	NO
8	M3	RV COIL	0.75	YES	1	YES		YES	0.5	YES
9	P4	M2	1	YES	2.75	YES	2.5	YES	1.75	NO
10	P4	RV COIL	0.75	NO	2.25	NO	4.25	NO	1.25	NO

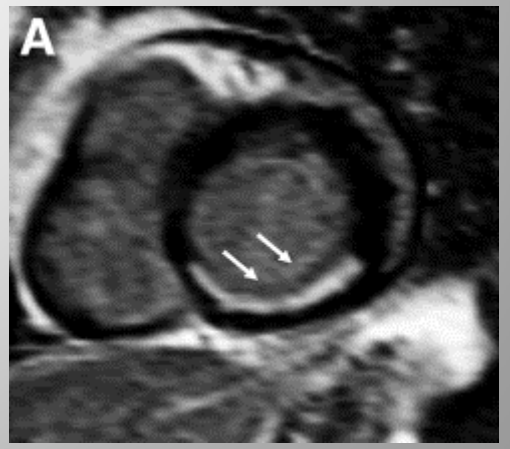
The quadripolar lead may facilitate targeting of more proximal coronary venous branches (avoiding apical pacing)



Because of the relatively small diameter and electrode choices of the Quartet lead, it is possible to advance the distal tip (4.0-F) more toward the apex to ensure lead stability, while retaining the ability to program the lead to pace from middle or proximal electrodes in a mid-basal location

- The pacing site is crucial for improving ventricular mechanics. Non-responder patients might be paced at a suboptimal site. Therefore, the quadripolar lead and the programming flexibility might theoretically improve CRT outcomes while maintaining a more distal and stable final lead position

- Avoiding pacing within scar area by having more options of pacing from near-site stimulation.



J Interv Card Electrophysiol
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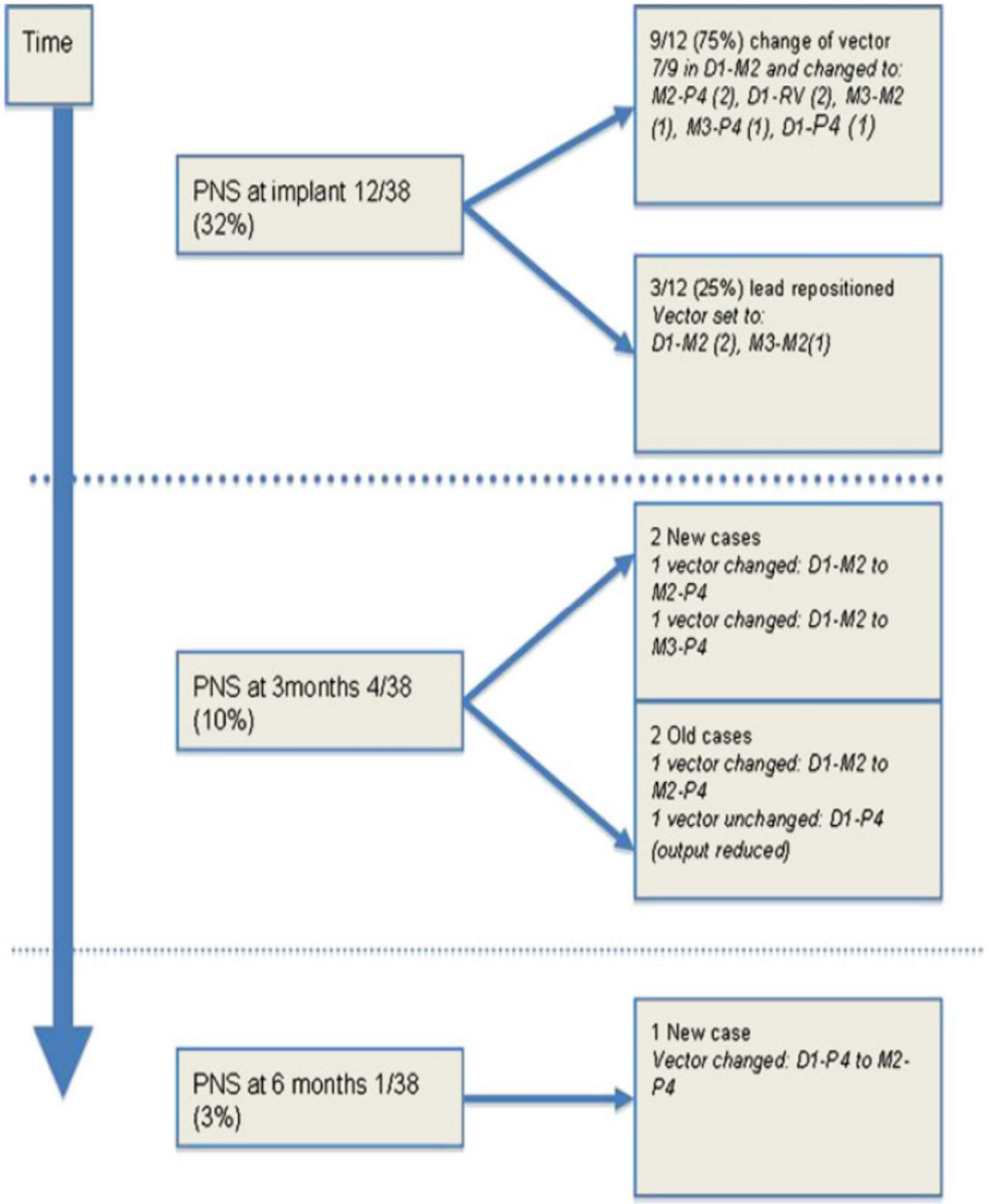
Elimination of phrenic nerve stimulation occurring during CRT

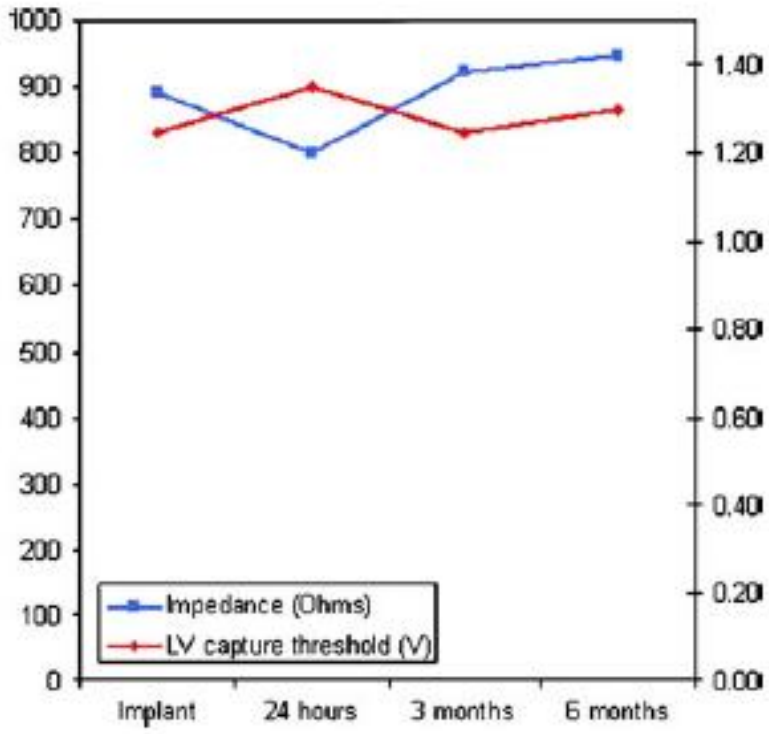
Follow-up in patients implanted with a novel quadripolar pacing lead

Paresh A. Mehta · Anoop K. Shetty · Mark Squirrel · Julian Bostock · C. Aldo Rinaldi

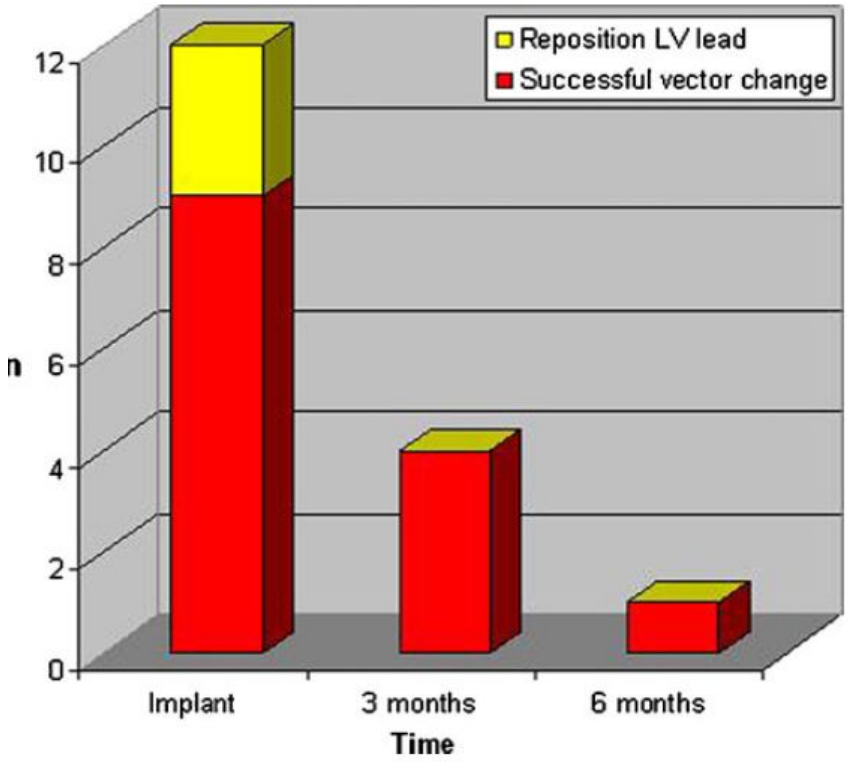
- 40 patients underwent attempted CRT-D implantation with the Quartet lead.
- Pacing parameters, lead position, complications, presence of PNS were collected for 6 month since the implantation.

Fig. 3 Flow diagram showing the occurrence of PNS and subsequent pacing vector programming changes with the Quartet lead (*n*)





LV capture threshold(V) and impedance trends(ohms) with the Quartet lead during the first 6 months after implant



Incidence of patients with successful pacing vector change for PNS and unsuccessful initial reprogramming requiring LV lead

J Interv Card Electrophysiol 21 July 2011

Left ventricular pacing with a new quadripolar transvenous lead for CRT: Early results of a prospective comparison with conventional implant outcomes

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*From the *University of Rome Tor Vergata, Department of Internal Medicine, Division of Cardiology, Rome, Italy, and the †National Research Council, Institute of Clinical Physiology, Section of Rome, Rome, Italy.*

45 underwent implantation: 22 quadripolar group ; 23 bipolar group

Primary outcome: LV lead failure - lead revision or reprogramming during the first 3 months after implantation.

Operative and follow-up data were prospectively noted and checked for significance between groups.

Heart Rhythm 2011;8:31–37

Table 1 Baseline characteristics, procedural data, and outcomes

	Overall	Quadripolar group	Bipolar group	*P* value
Variable				
Patients	45	22	23	–
Age, yrs	70.2 ± 10	1 69.1 ± 10.1	71.2 ± 10.3	NS
Male, n (%)	34 (75.5)	16 (72.7)	18 (78.2)	NS
LV ejection fraction (%)	26.0 ± 8.4	26.2 ± 6.3	25.9 ± 10.0	NS
QRS duration, ms	152 ± 26	152 ± 29	151 ± 22	NS
Comorbidities				
Hypertension, n (%)	44 (97.8)	22 (100)	22 (95.6)	NS
History of AF, n (%)	6 (13.3)	4 (18.1)	2 (8.7)	NS
Diabetes, n (%)	14 (31.1)	7 (31.8)	7 (30.4)	NS
Coronary artery disease, n (%)	24 (53.3)	11 (50.0)	13 (56.5)	NS
Procedural data				
Procedural time, min	107.8 ± 23.0	106.3 ± 23.5	109.5 ± 23.0	NS
Fluoroscopy time, min	15.9 ± 6.7	15.1 ± 5.8	16.6 ± 7.4	NS
LV lead implant time, min	16.1 ± 13.9	14.0 ± 11.5	17.9 ± 15.7	NS
LV pacing threshold, V*	1.09 ± 0.55	0.99 ± 0.57	1.17 ± 0.54	NS
Outcome				
CS lead failure	7 (15.6)	1 (4.5)	6 (26.1)	.037
PNS	5 (11.1)	1 (4.5)	4 (17.4)	NS
CS lead dislodgment	2 (4.4)	0 (0.0)	2 (8.7)	NS
CS lead failure requiring repositioning	2 (4.4)	0 (0.0)	2 (8.7)	NS

Values are mean ± SD unless otherwise specified.

CS lead failure was defined as the need for lead revision or reprogramming.

*At the optimal pacing configuration.

AF = atrial fibrillation; CS = coronary sinus; LV = left ventricular; NS = not significant; NYHA = New York Heart Association; PNS = phrenic nerve stimulation.

Heart Rhythm 2011;8:31–37

Rate of Left ventricular lead failure

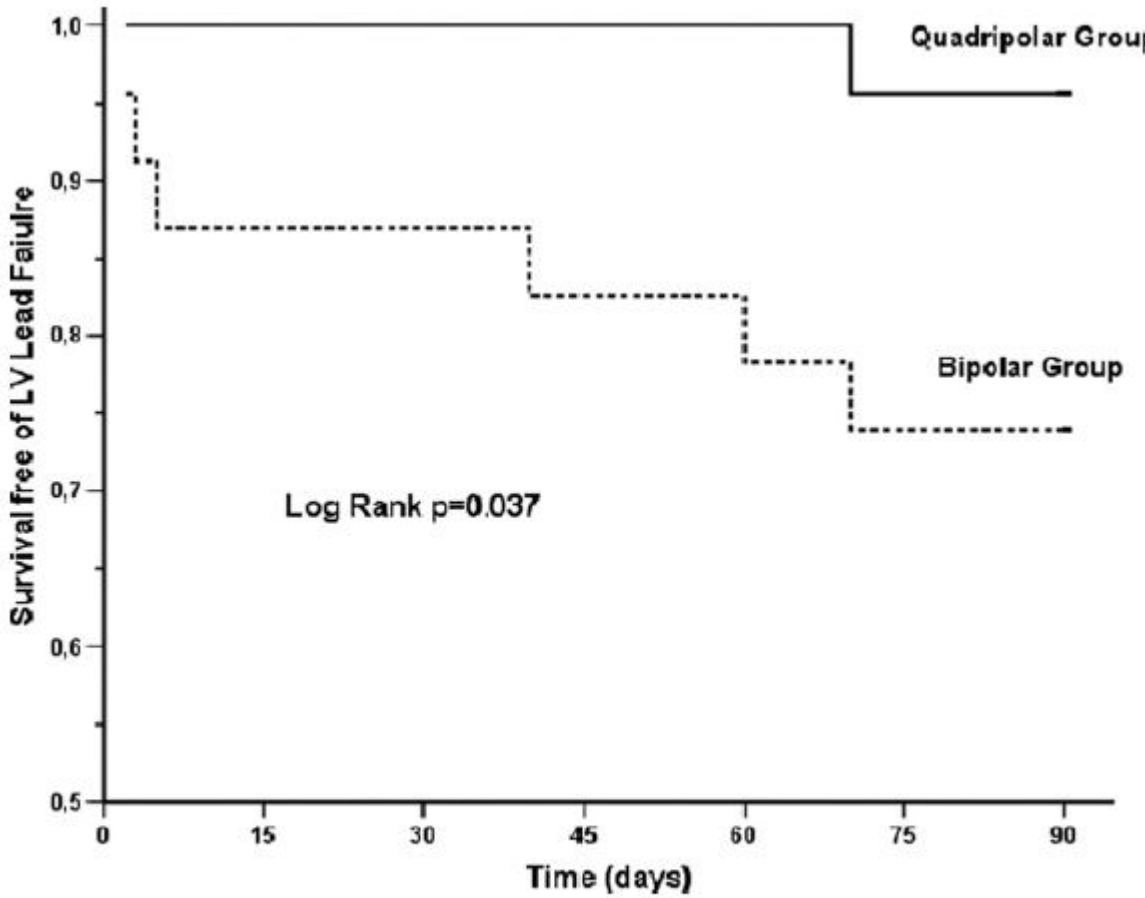

Figure 2 A Kaplan-Meier estimate of the rate of left ventricular (LV) lead failure (revision or reprogramming). After 3 months, freedom from LV lead failure was significantly higher in the quadripolar group.

Heart Rhythm 2011;8:31–37

Cons:

- Cost –more expensive system . Although in the long run might be more cost effective.
- The quadripolar lead is Less flexible than the bipolar leads.
- Long term lead performance ?
- Not recommended for very short branches.

CASE REPORT

doi:10.1093/europace/eur355

Phrenic nerve stimulation with the quadripolar left ventricular lead not overcome by 'electronic repositioning'

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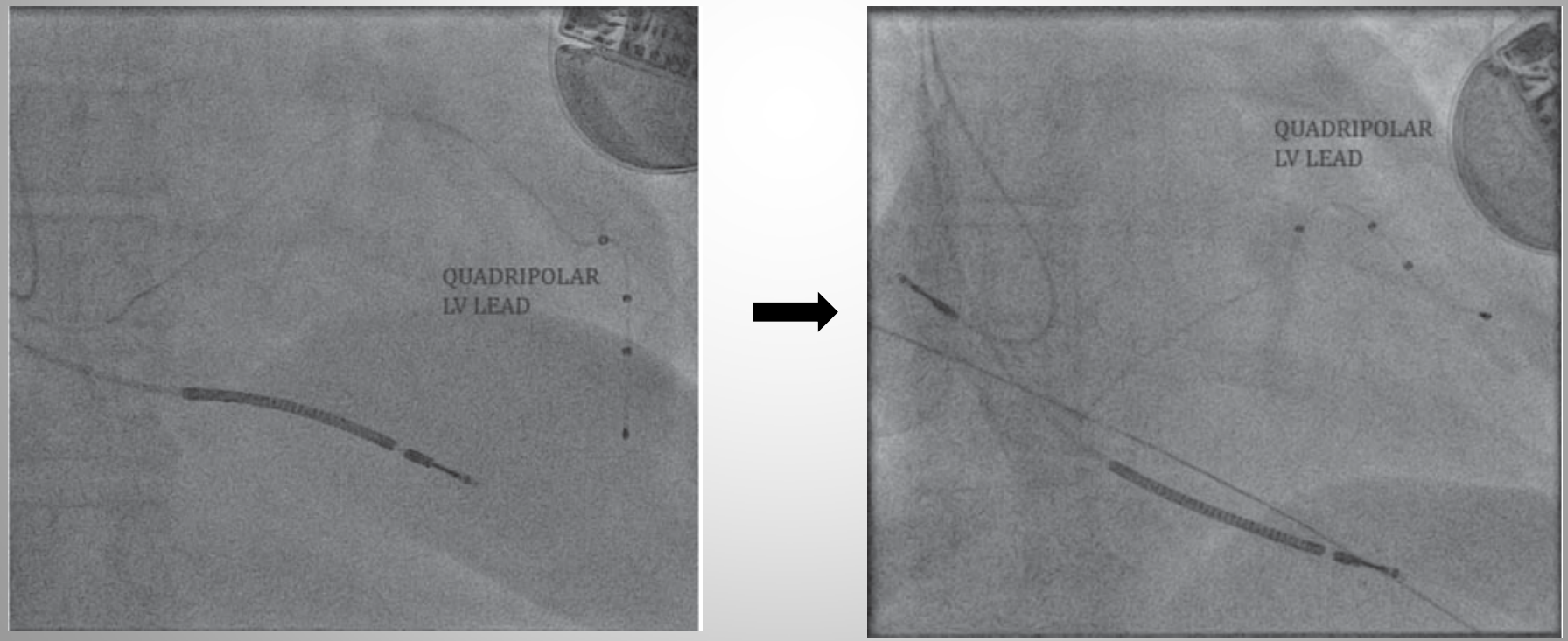

Europace, Nov 16, 2011

Conclusion

- *A new era of pacing?*
  As bipolar leads have largely replace unipolar leads,
  Perhaps quadripolar leads will replace bipolar leads.

- Multipolar leads are emerging as an option for:
  - reducing common CRT complication.
  - improved CRT outcome

- Additional supporting clinical studies with longer surveillance data will be needed to establish the long-term performance and hemodynamic effects of this newly designed LV lead.