



Venice Arrhythmias 2105



October 16 - 18
14th EDITION 2015

CONTEMPORARY AND CONTROVERSIAL ISSUES IN CARDIAC PACING

Upgrade from Conventional PM to CRT: When and How (CRT-P vs CRT-D)

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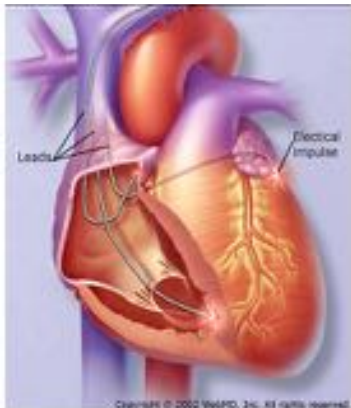
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Hong Kong





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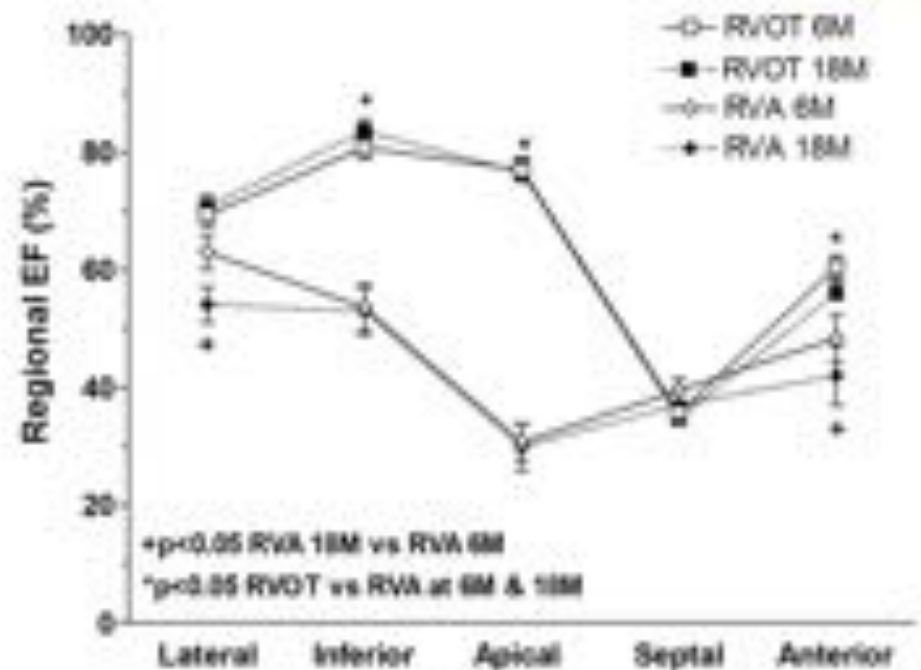
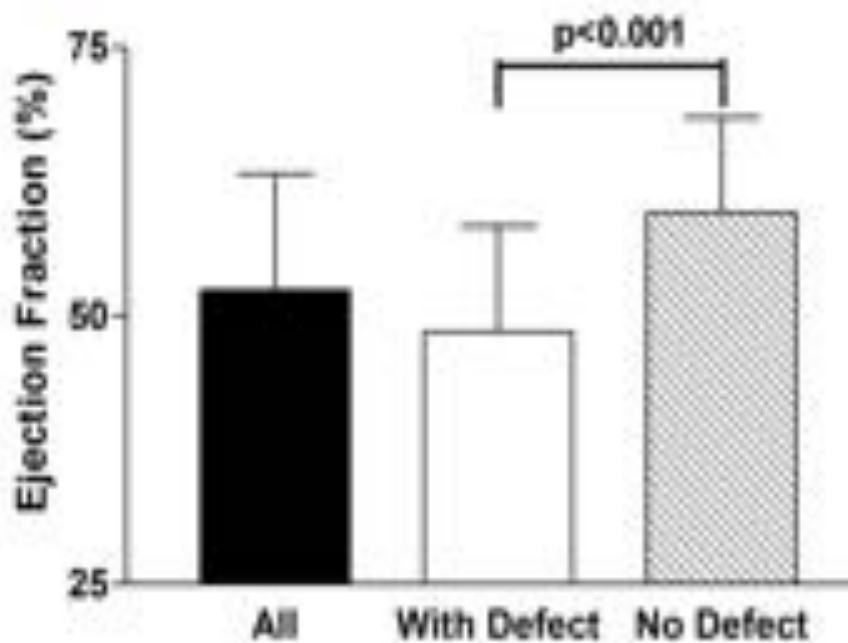


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MY CONFLICTS OF INTEREST ARE

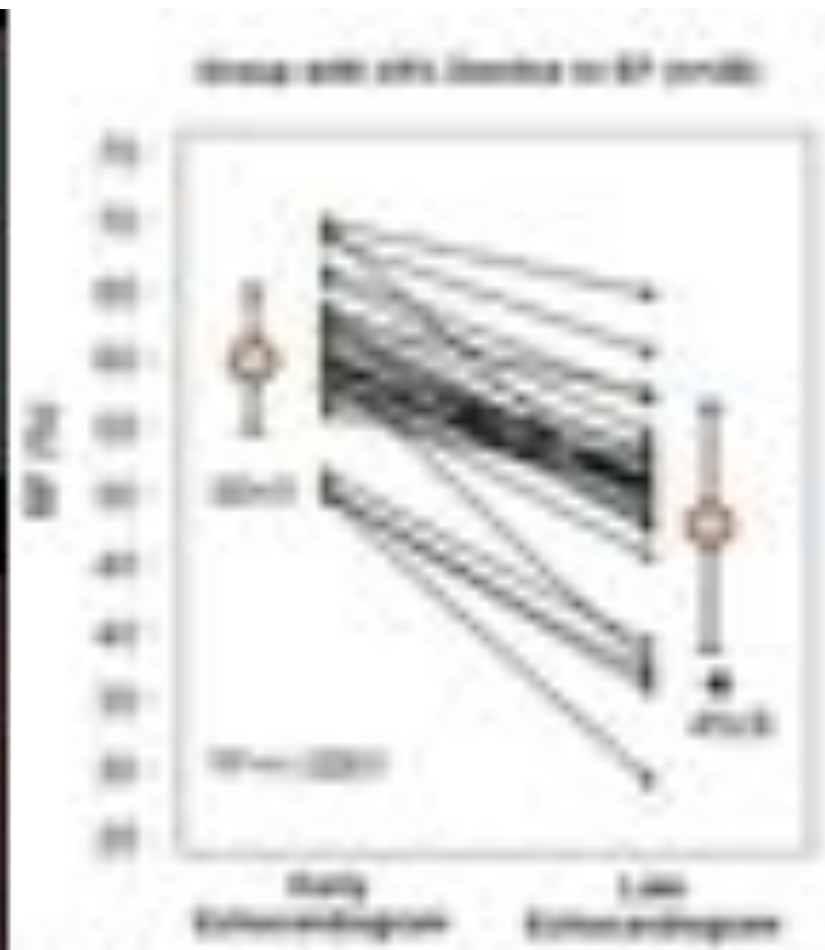
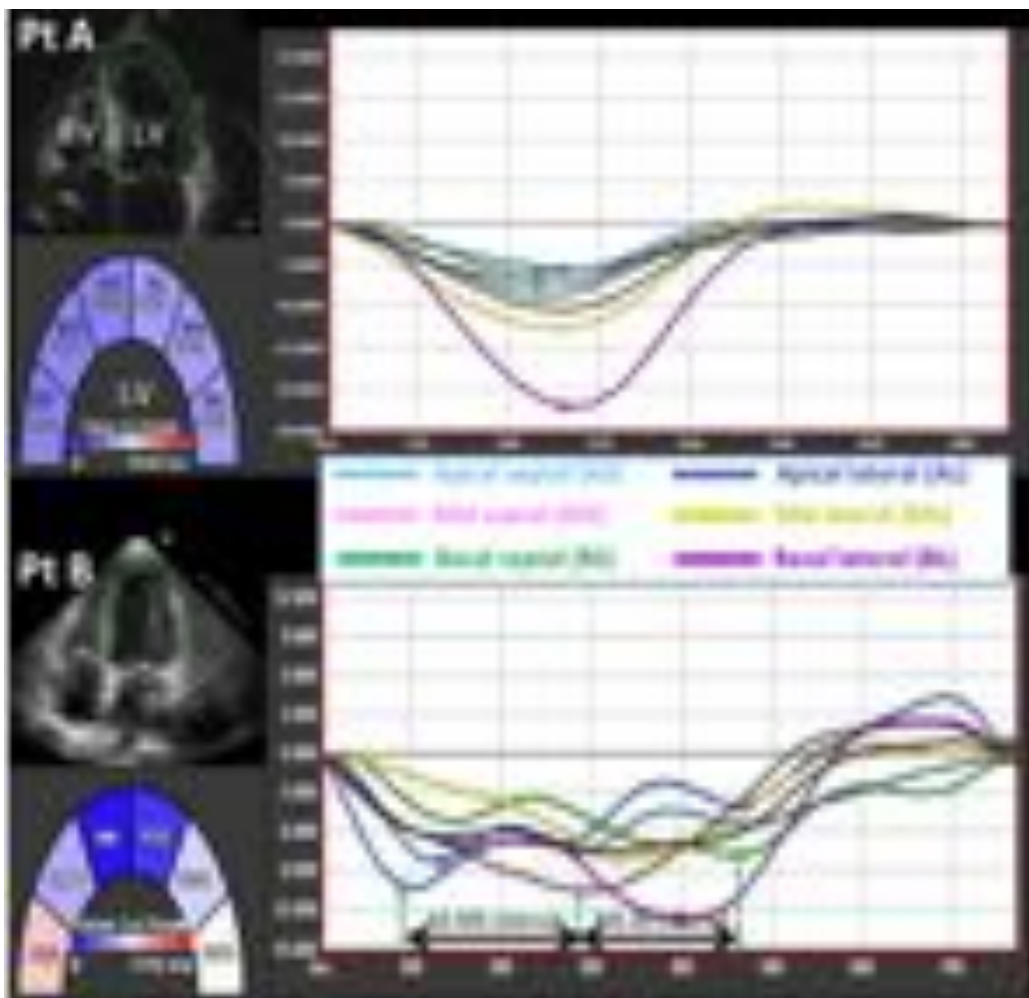
- **Scientific Advisory Board: St. Jude Medical, Boston Scientific; Medtronic**
- **Scientific Research: St. Jude Medical, Boehringer Ingelheim; MSD, Bayer; Sanofi; GSK; BMS Pfizer; Boston Scientific; Medtronic**
- **Speaker's Bureau: St. Jude Medical, Boehringer Ingelheim; MSD, Bayer; Sanofi; GSK; BMS Pfizer; Boston Scientific; Medtronic, Daiichi**

Long-term Effect of RVA Pacing

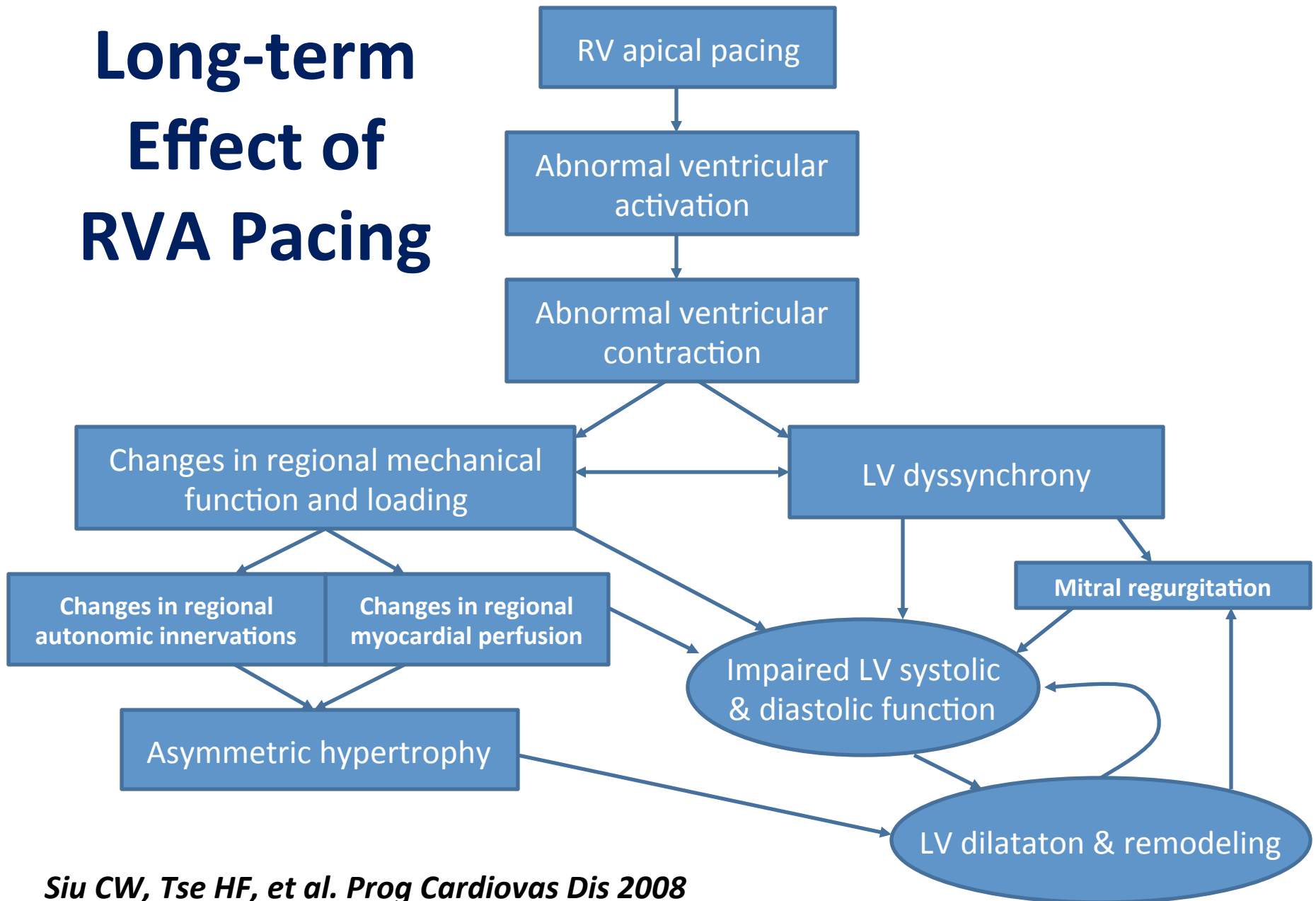


- Permanent RVA pacing → ↑ myocardial perfusion abnormalities
- Myocardial perfusion abnormalities → regional wall dyskinesia and impair LVEF

Worsening of LV Function with Chronic RVA Pacing Induced Dyssynchrony



Long-term Effect of RVA Pacing

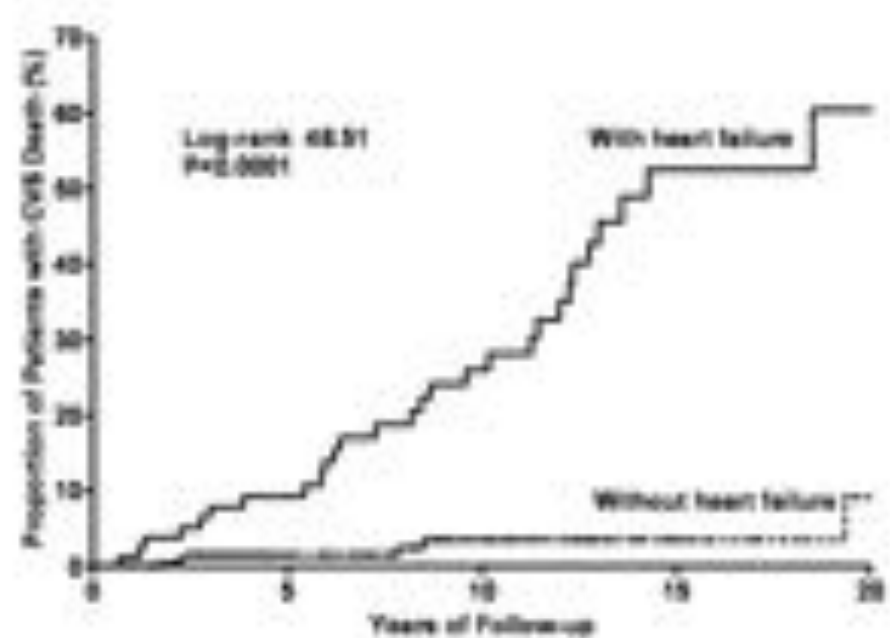
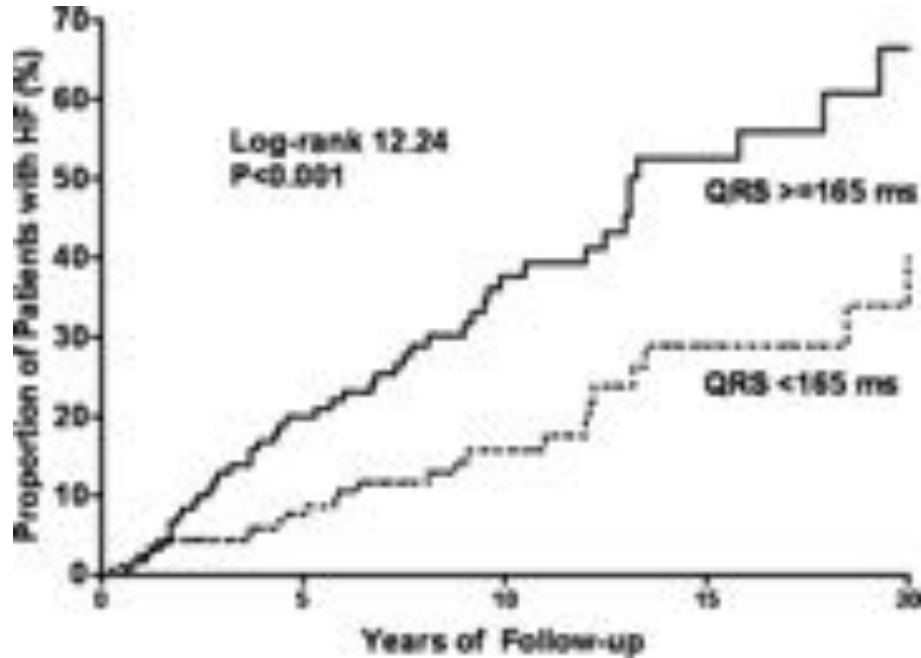


RV Pacing-Induced CMP

Table 1
Observational studies of pacing-induced cardiomyopathy

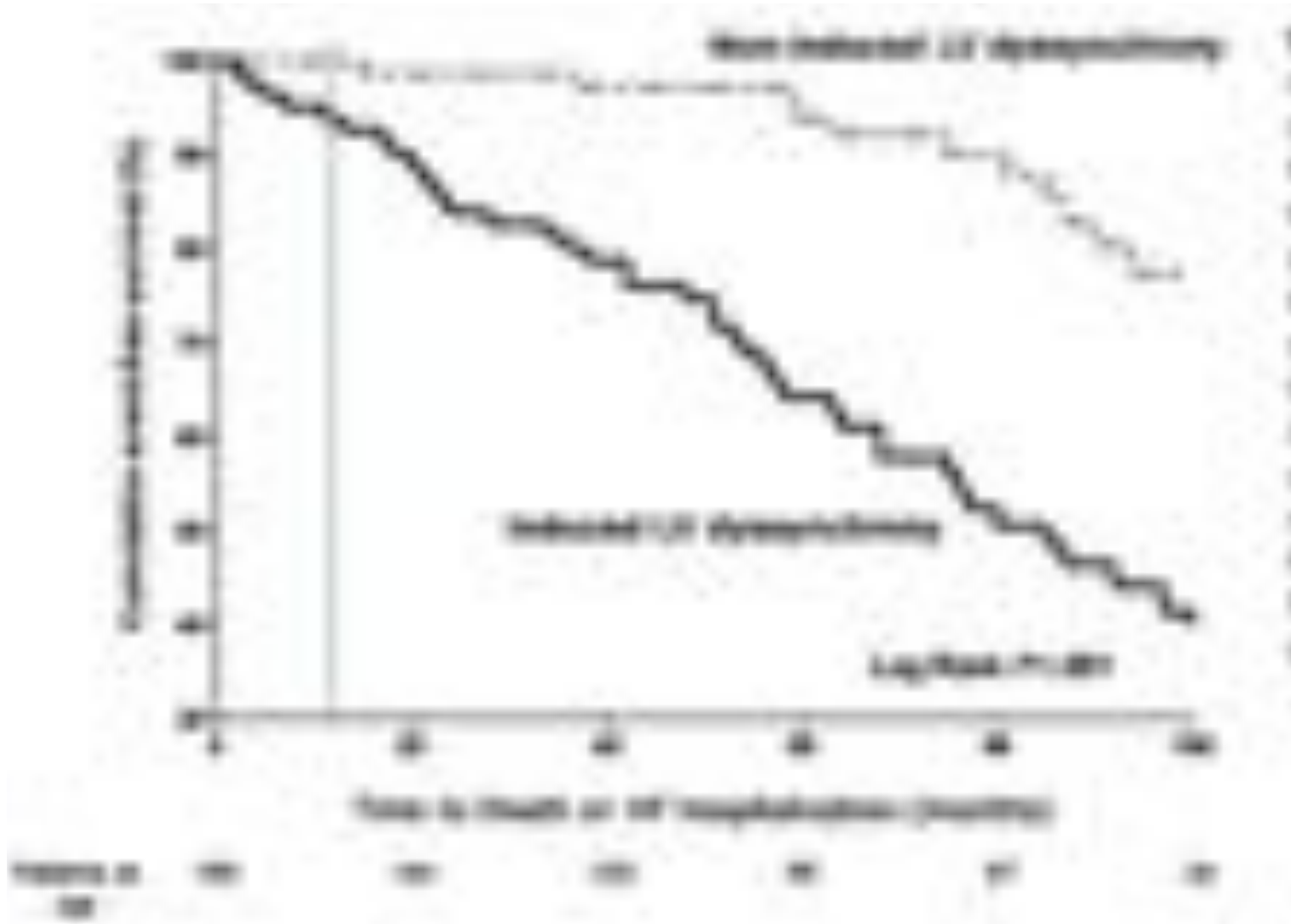
Authors, Year	No. of Patients	Follow-up (mo)	Baseline QRS	% Pacing	AVL QRS	Incidence of PNCM	Heart Failure Hospitalization	Comments
Sharma et al., 2007	18	87 ± 10	18 patients: 58 ± 3.7% 13 patients: >90%	Complete AV block Spontaneous sinus rhythm	18 patients: 28.2%	Isolated patients with PNCM only	66.2 ± 4.2y	Mean QRS at baseline
Zhang et al., 2006	88	60	68 ± 8.7	80%	47 ± 8.11	30%	HF 76.28% 87% were hospitalized	CI mortality was higher in patients with HF (38.7% vs 2.7%, P<0.01) despite
Sharma et al., 2012	26	>12y	No structural heart disease	>80%	4 patients: QRS 41.9 ± 4.1% in 20 patients: QRS 51.2 ± 3.8%	15.4%	—	PNCM defined as QRS of <40%
Khalaf et al., 2014	27	Mean 11.2y	>90%	Variable	27 patients: unchanged 41.1% 16 patients: PNCM (QRS 54.7%–59.7%)	11.1%	—	PNCM defined as QRS drop of >10% with QRS of <40%. 28 patients were excluded for an arrhythmic explanation
Kim et al., 2013	50	111 ± 66	58.4 ± 11.3	>80% in all patients	HF group: 58.8 ± 11.3 vs 65.1 ± 10.2 in the non-HF group	9%	64 (34%)	No symptoms
Sharma et al., 2014	51	AVL activation for AV start at a median of 4 ms after implantation. Late HV: >28 ms median after implantation Group 1: no decline QRS at 1y (5% 28 patients) vs 5y Group 2: decline QRS >15% (28 patients) vs 1y	Group 1: 58 ± 3% 5% 28 patients Group 2: 50 ± 3% 9% 28 patients 17% QRS < 40% included	100%	Group 1: unchanged Group 2: decline to 48 ± 9%	4%	—	Group 1: QRS 58 ± 12 28 ± 12–68 ± 21

New Onset HF after Permanent RV Pacing



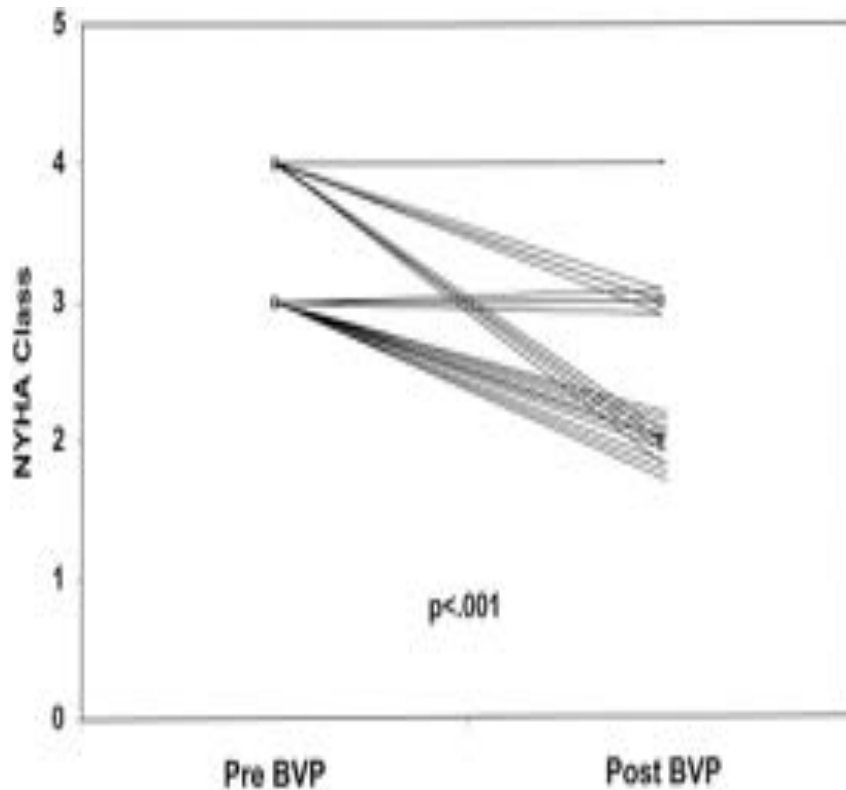
- After 7.8 yrs FU, permanent RV apical pacing (>90%) was associated with new-onset HF in 26% of patients (3.3% per yr)
- Predictors for HF: Elderly age at the time of implant, a wider paced QRS duration and the presence of CAD independently predicted new-onset HF
- HF after RV apical pacing was associated with a higher cardiovascular mortality

Adverse Outcomes with RV Pacing-Induced Cardiomyopathy

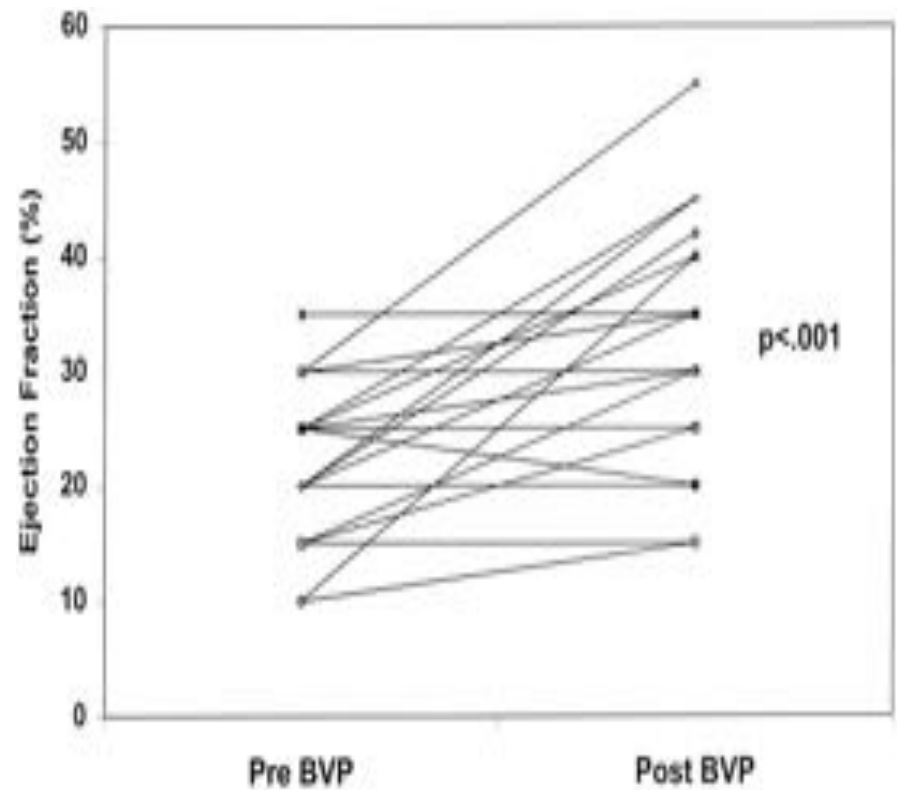


Effect of Upgrading to CRT after Chronic RVA Pacing

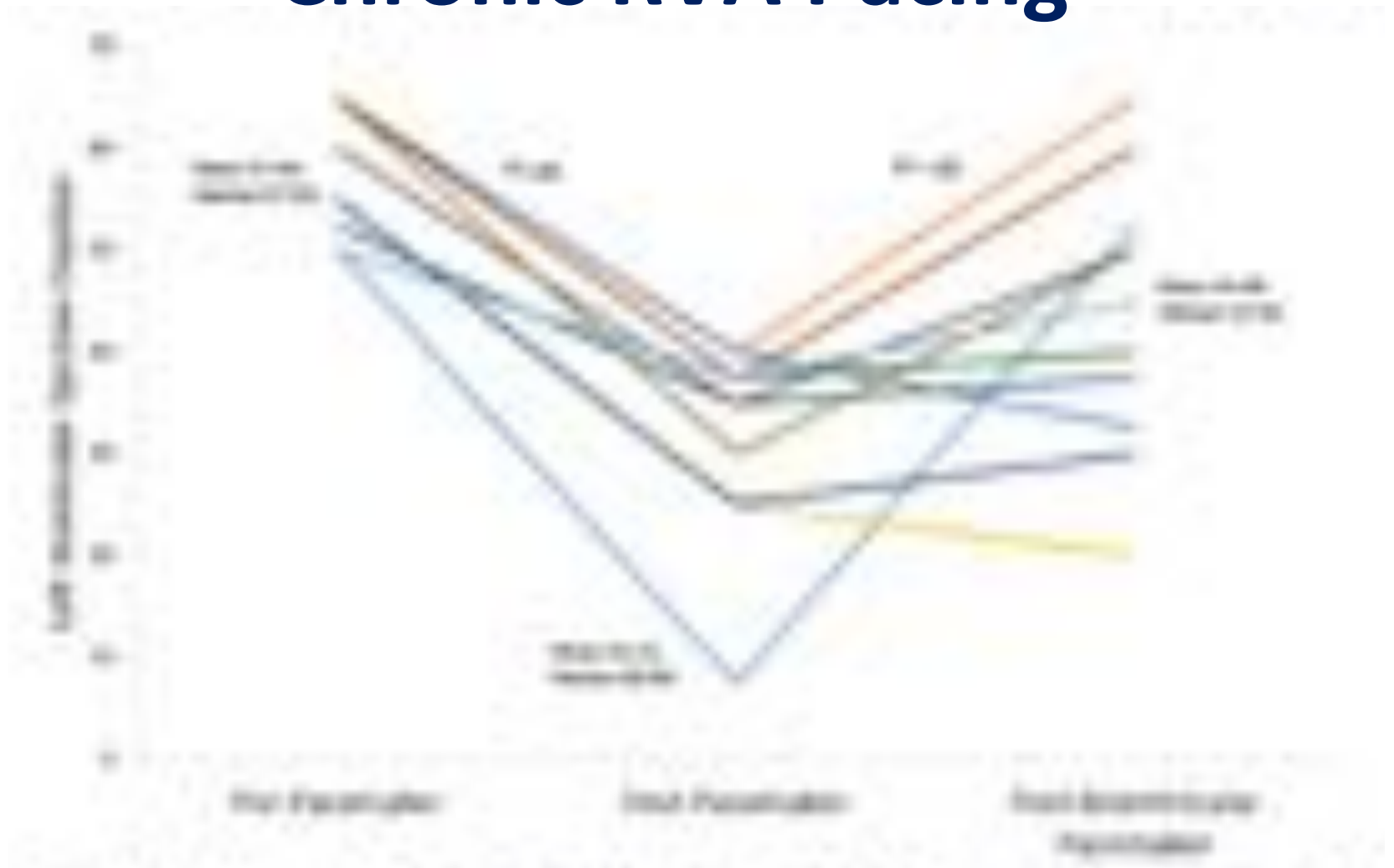
NYHA



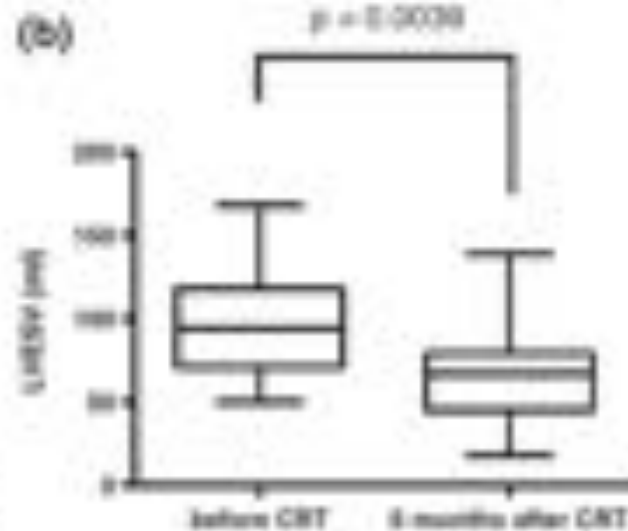
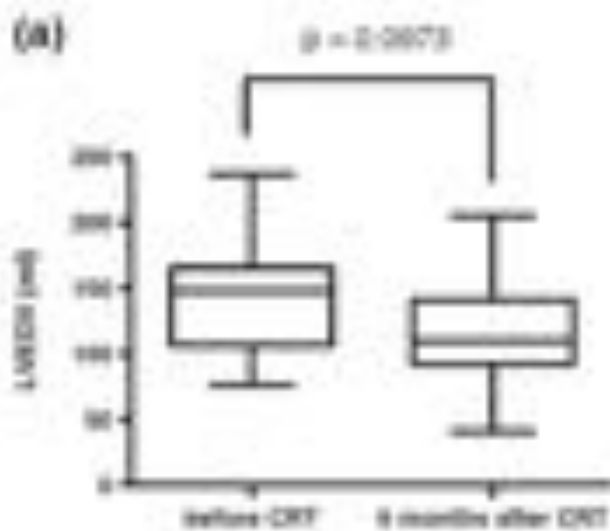
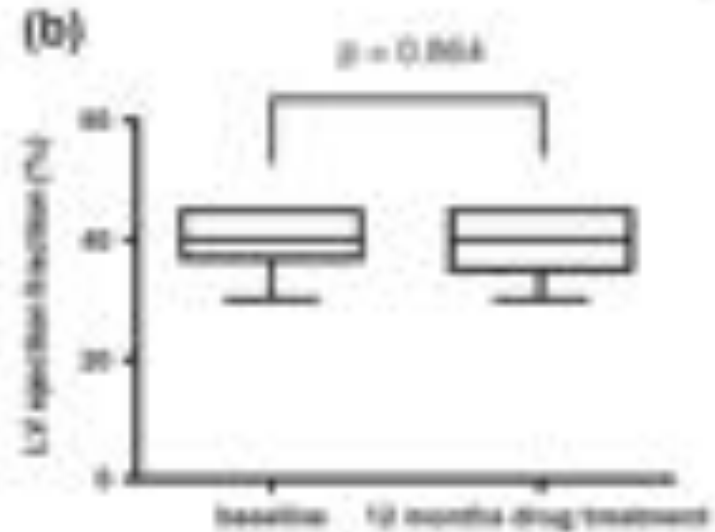
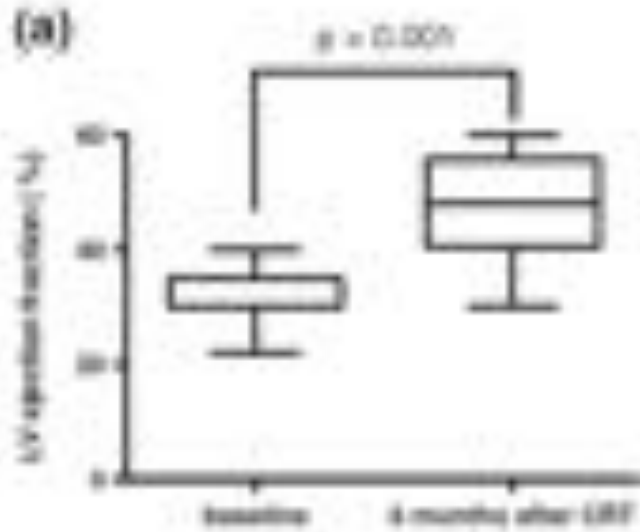
LVEF



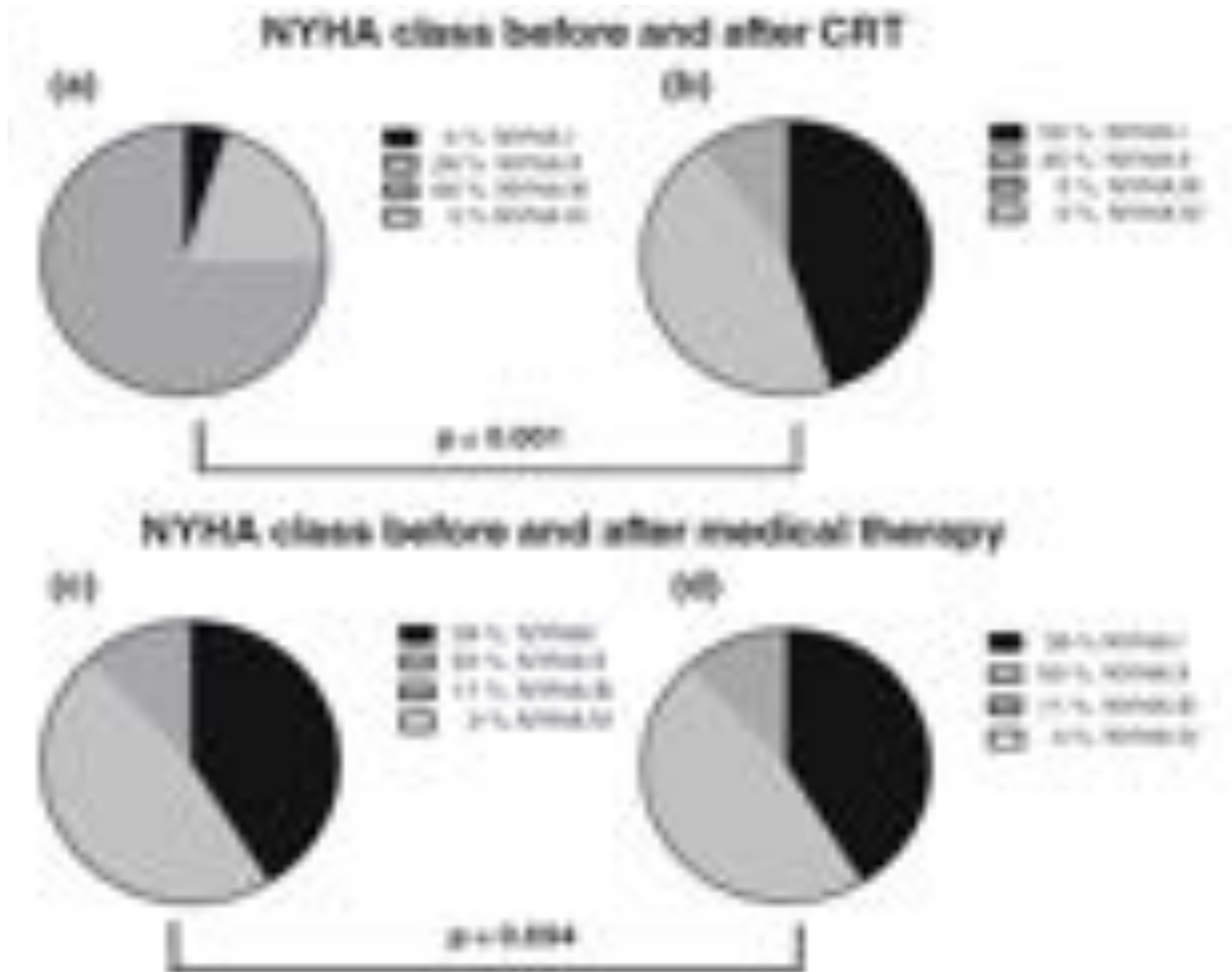
Effect of Upgrading to CRT after Chronic RVA Pacing



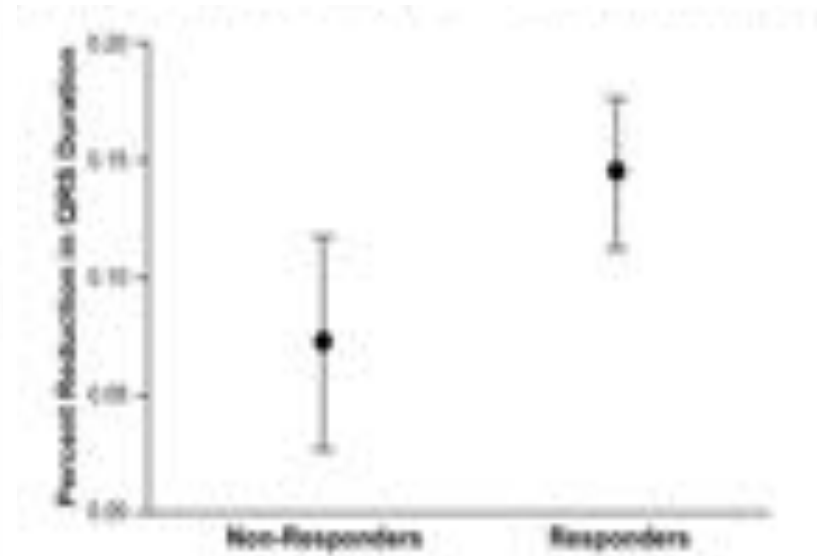
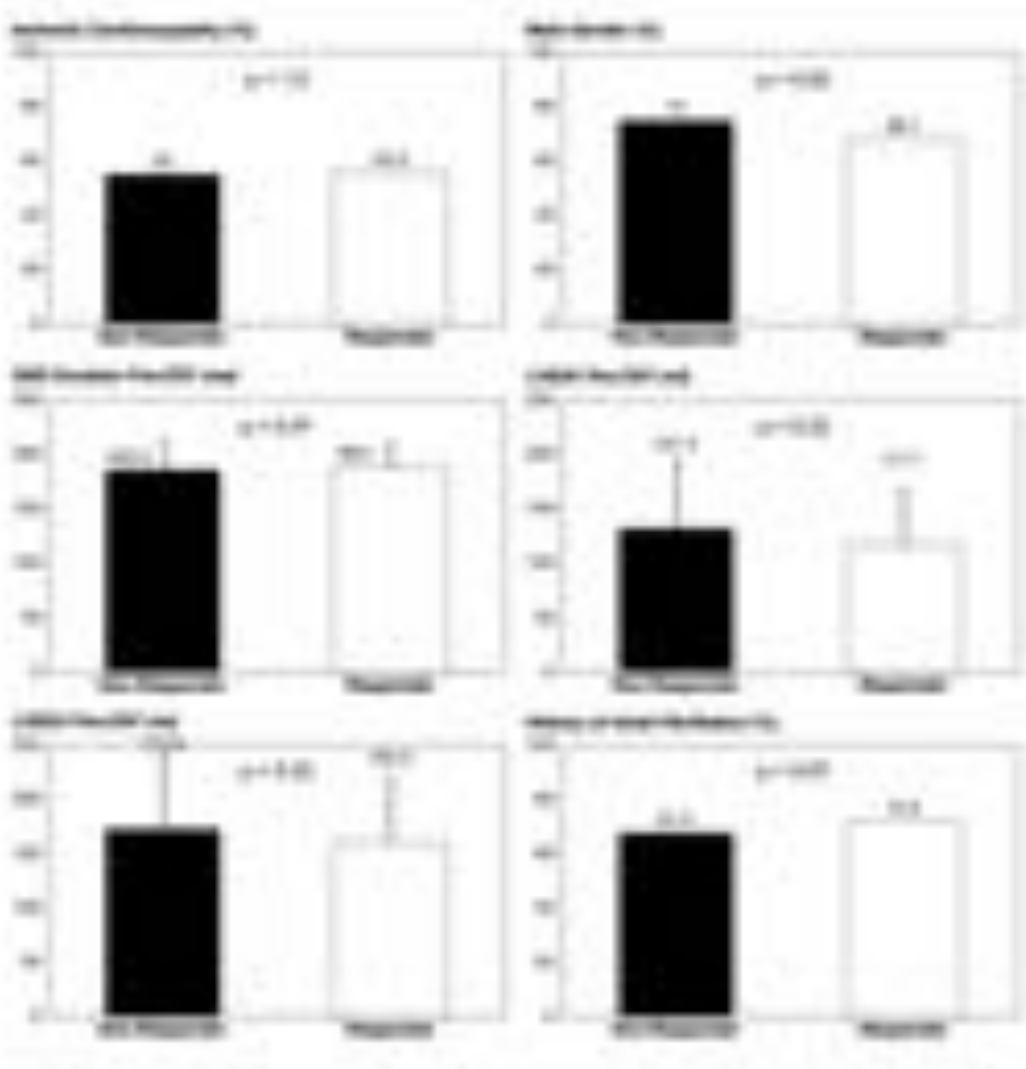
OMT vs CRT Upgrade in Pacemaker Induced Cardiomyopathy



OMT vs CRT Upgrade in Pacemaker Induced Cardiomyopathy



Predictors for Response: CRT Upgrade in Pacemaker Induced Cardiomyopathy



- Reversal of electrical dyssynchrony predicts response to CRT upgrade.
- Traditional factors associated with a favorable response to CRT in de novo implants are not predictors for CRT upgrade response

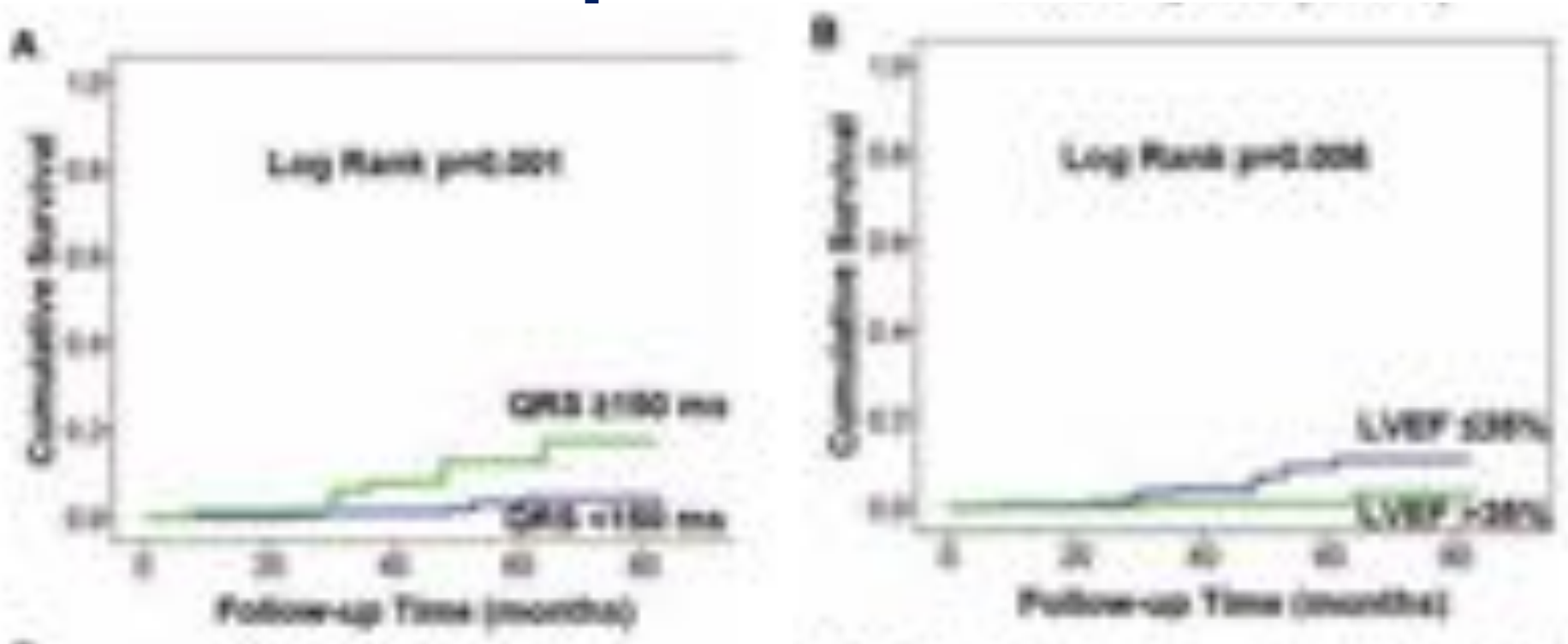
Potential Candidates for CRT-D Upgrade in ICD Recipients

Percentage of ICD Recipients Meeting CRT Criteria (n = 545)

Criteria		All Patients Irrespective of Implant Rhythm	Excluding Patients with Atrial Fibrillation on Implant ECG
Contemporary guidelines* ACC/AHA/HRS CRT guidelines (2005-2006)	LVEF $\leq 35\%$	28.8 (100)	—
HCF guidelines† (2007)	QRS ≥ 130 ms LVEF $\leq 35\%$ QRS ≥ 130 ms and LVEF $\leq 35\%$	27.3 (100)	—
Actual CRT utilization in Cohort		44.3 (100)	44.3 (100)
Manual criteria A	LVEF $\leq 35\%$ QRS ≥ 130 ms Normal LV	42.3 (100)	40.3 (91)
Manual criteria B	LVEF $\leq 35\%$ QRS ≥ 130 ms Normal LV	37.3 (100)	35.3 (95)
Manual criteria C	LVEF $\leq 35\%$ QRS ≥ 130 ms Normal LV	34.7 (100)	34.3 (99)
Manual criteria D	LVEF $\leq 35\%$ QRS ≥ 130 ms Normal LV	34.1 (100)	33.3 (98)

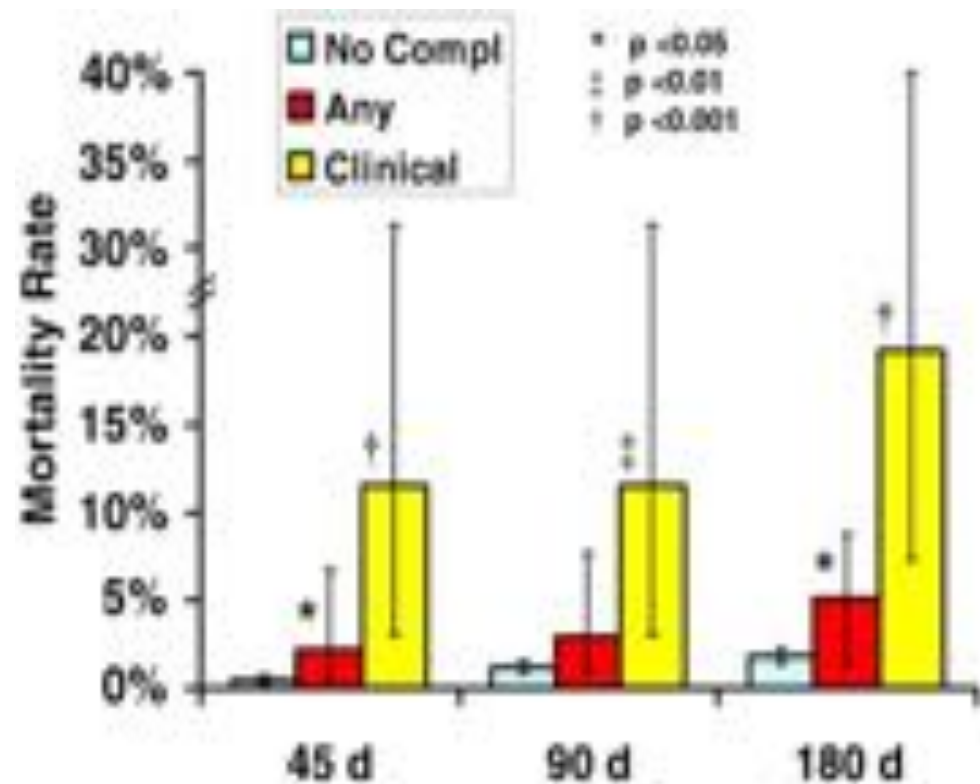
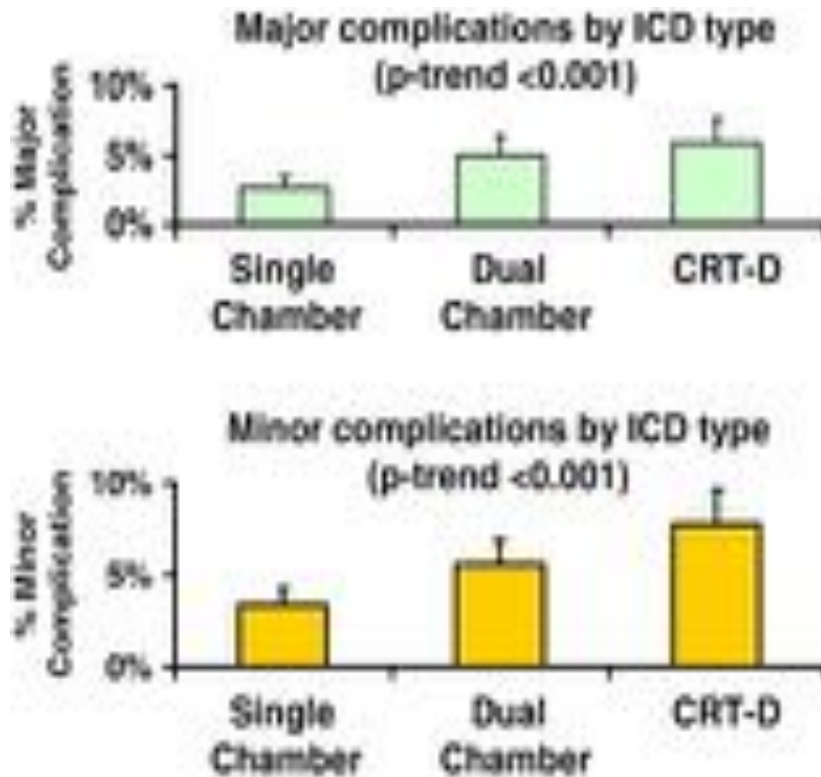
Up to 35-50% of ICD recipients are potential candidates of CRT upgrade based on current guidelines for CRT

Rates of Upgrade of ICD Recipients to CRT

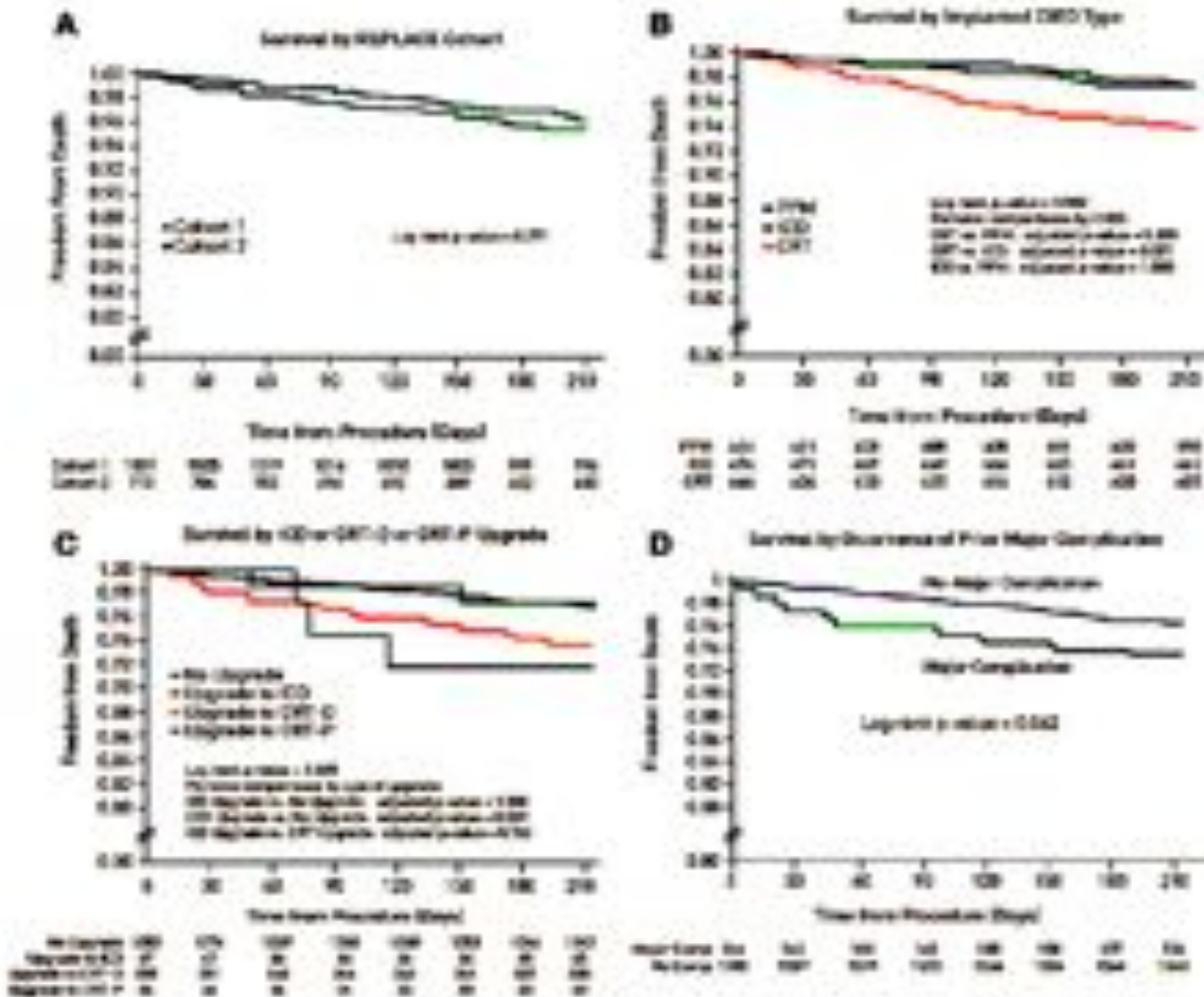


Upgrade rates at 1, 3, and 5 years were 0.03%, 2.4%, and 5.1%, respectively

Early Complications of de Novo ICD Implantation



REPLACE DARE study



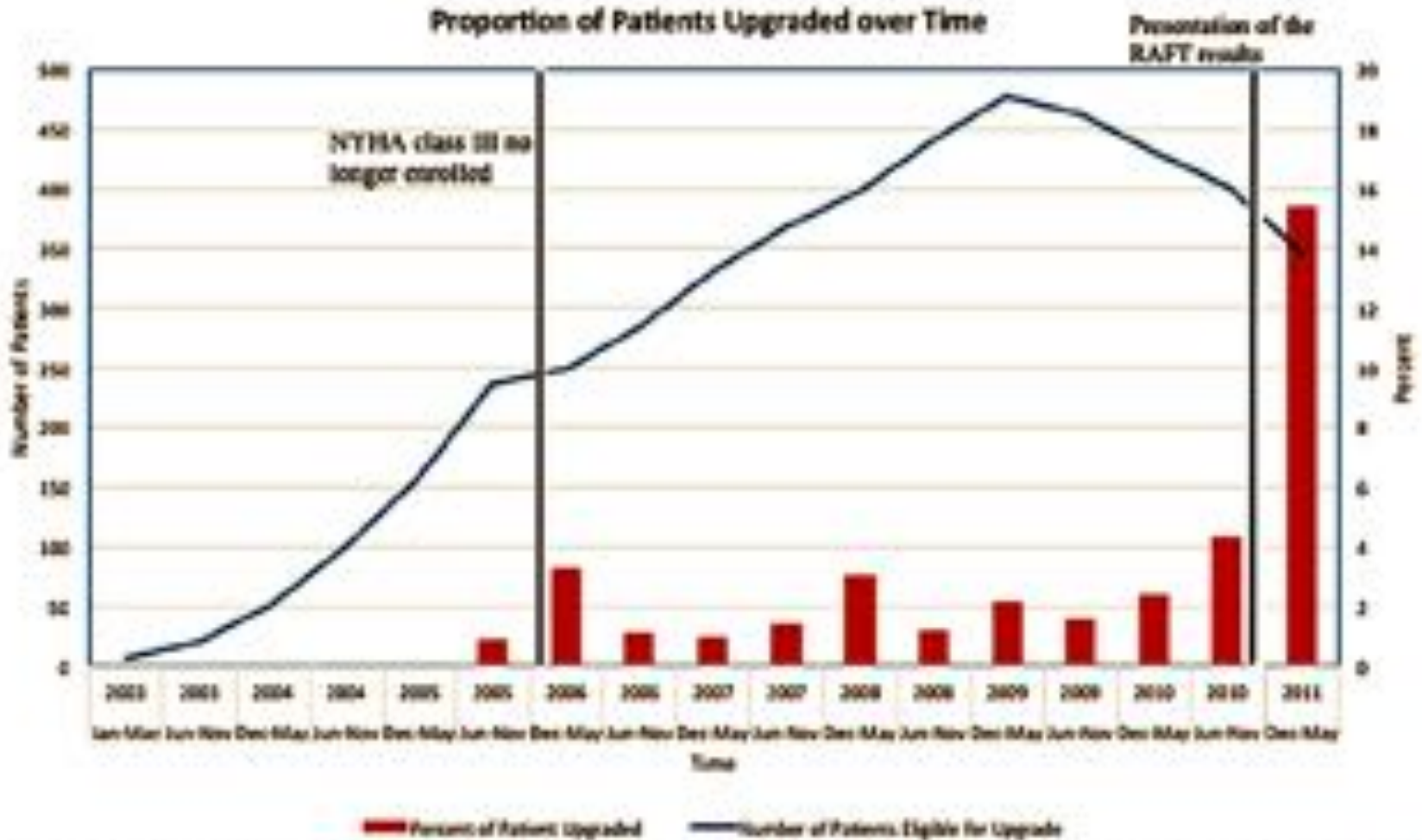
RAFT Upgrade Substudy

Reasons for Unsuccessful Upgrade

	De Novo CRT-D Implant in RAFT (1st attempt), n=644	Upgrade During RAFT (1st attempt), n=80	Upgrade After Presentation of RAFT Results, n=60
Successful initial CRT implant, n, % (95% CI)	586, 91.0 (88.8-93.3)	74, 92.5 (84.3-96.8)	54, 90.0 (79.5-95.7)
Reasons for unsuccessful upgrade	n=58*	n=6†	n=6‡
Inability to cannulate coronary sinus	20 (44.8)	1 (16.7)	4 (66.7)
Inability to place LV lead	15 (25.9)	1 (16.7)	1 (16.7)
Coronary sinus dissection	7 (12.1)	0	0
LV lead dislodgement	3 (5.2)	1 (16.7)	0
Occlusion of left subclavian vein	0	2 (33.3)	1 (16.7)
Clinically unstable patient	1 (1.7)	1 (16.7)	0
Other§	6 (10.3)	0	0

	De Novo CRT-D Implant in RAFT, n=644	Upgrade During RAFT, n=80	Upgrade After Presentation of RAFT Results, n=60
Patients with adverse events at 30 days, n, % (95% CI)	169, 26.2 (23.0, 29.4)	15, 18.8 (11.6, 28.8)	3, 5.0 (0.3, 12.0)
Adverse events at 30 days	180	15	2
Hemo/pneumothorax	12 (1.9)	2 (2.5)	0
Requiring chest tube	7 (1.1)	0	
Pocket hematomas (requiring intervention)	8 (1.2)	0	0
Requiring surgery	3 (0.5)		
Requiring hosp.	5 (0.8)		
Pocket infection (requiring intervention)	10 (1.5)	0	0
Requiring surgery	4 (0.6)		
Requiring IV antibiotics	3 (0.5)		
Requiring oral antibiotics	11 (1.7)		
Tamponade	1 (0.2)	0	0
Lead dislodgement (requiring intervention)	16 (2.5)	4 (5.0)	1 (1.7)
Coronary sinus dissection	0 (0.0)	0	0
Conductive heat before excavation (requiring longer hospitalization)	1 (0.2)	2 (2.5)	1 (1.7)
Other¶	83 (12.8)	7 (8.8)	0

RAFT Upgrade Substudy



CRT-P Vs. CRT-D Upgrade

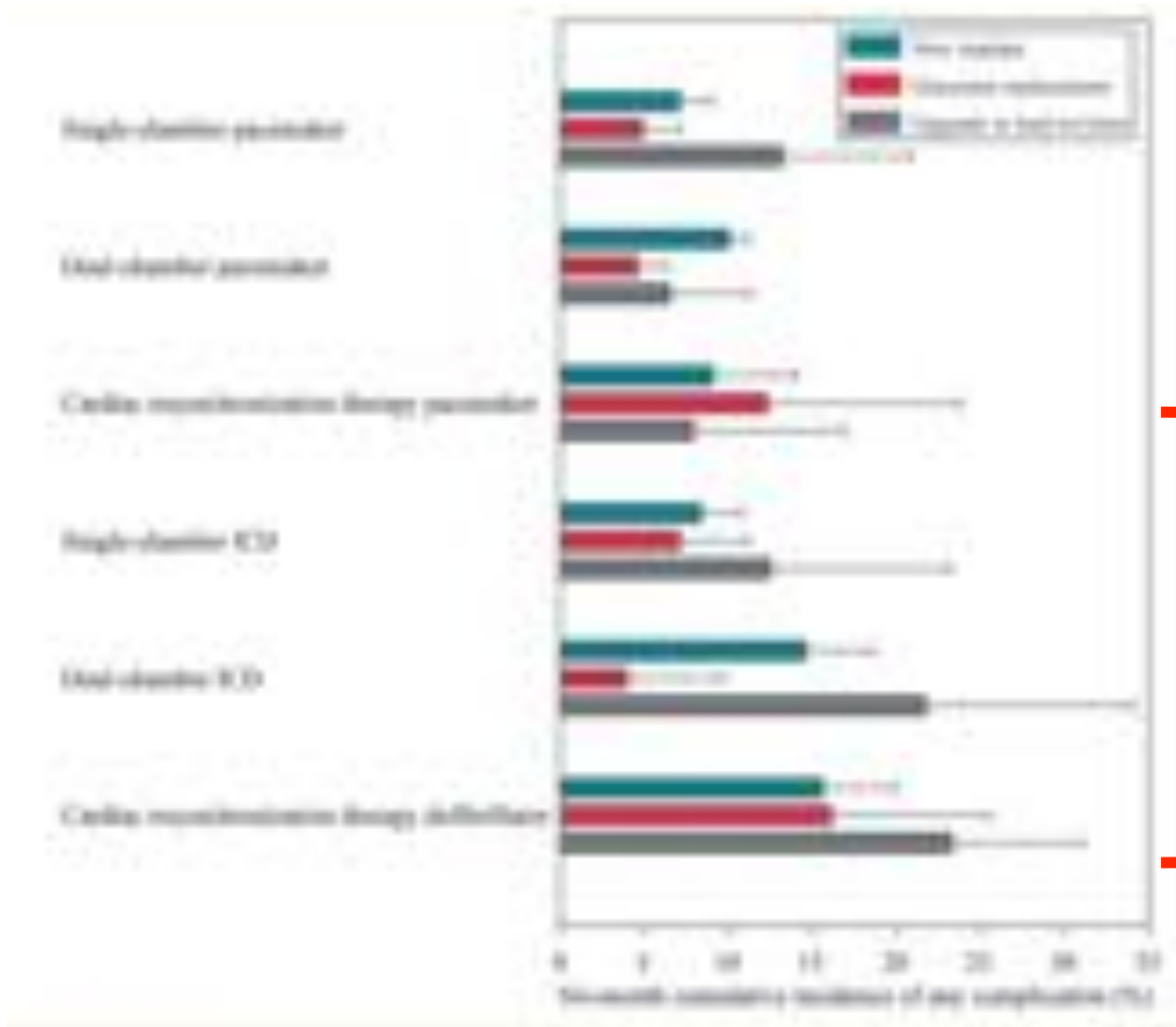
A flowchart illustrating the upgrade pathways for CRT devices. It starts with 'CRT-P' and branches into 'CRT-D' and 'CRT-P to CRT-D'. The 'CRT-D' path further branches into 'CRT-D to CRT-P' and 'CRT-D to CRT-D'. The 'CRT-P to CRT-D' path branches into 'CRT-P to CRT-D' and 'CRT-P to CRT-D'. The flowchart includes various clinical scenarios and outcomes, with three red boxes highlighting specific areas.

Device	Number of Patients	Number of Deaths	Number of Hospitalizations
CRT-P	100	10	100
CRT-D	100	10	100
CRT-P to CRT-D	100	10	100
CRT-D to CRT-P	100	10	100
CRT-D to CRT-D	100	10	100

A table comparing clinical outcomes for CRT-P and CRT-D. The table includes columns for 'CRT-P', 'CRT-D', 'CRT-P to CRT-D', and 'CRT-D to CRT-D'. The table lists various clinical outcomes and their corresponding values for each device type. A red box highlights a specific section of the table.

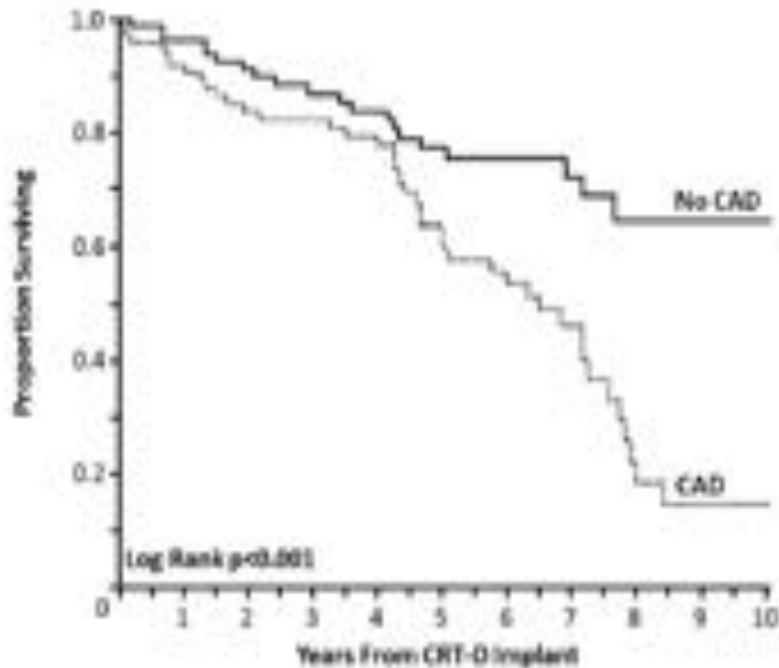
Outcome	CRT-P	CRT-D	CRT-P to CRT-D	CRT-D to CRT-D
Primary endpoint	100	100	100	100
Secondary endpoint	100	100	100	100
Number of patients	100	100	100	100
Number of deaths	10	10	10	10
Number of hospitalizations	100	100	100	100

CRT-P Vs. CRT-D Upgrade

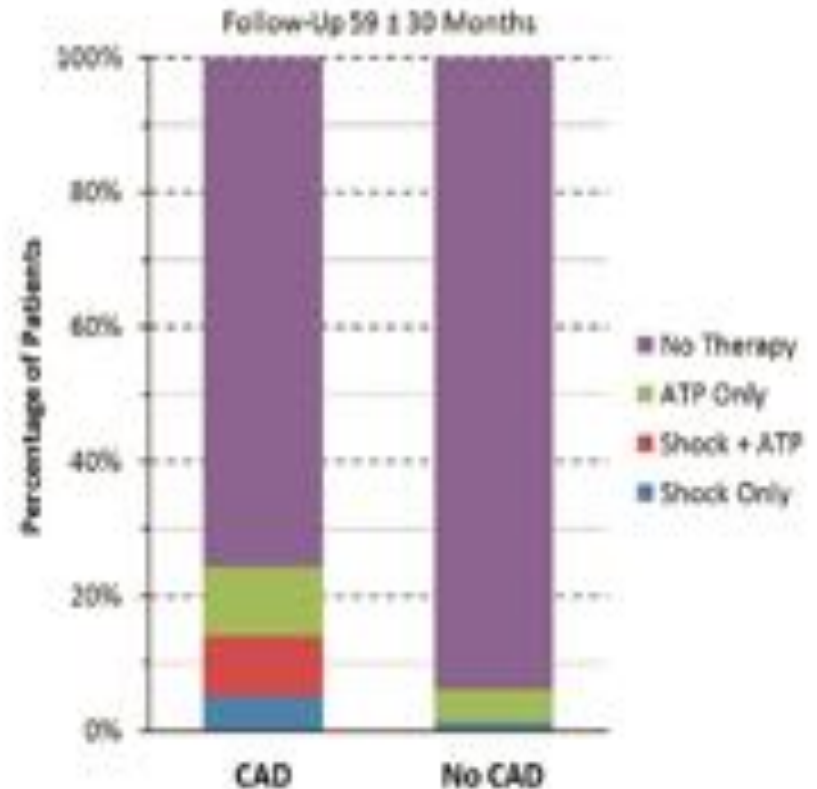


Higher complication rates with CRT-D upgrade vs CRT-P upgrade

CRT-P Vs. CRT-D Upgrade



No CAD	82	76	69	61	53	40	28	23	13	3	2
CAD	75	67	61	56	49	30	24	16	5	1	1



- Among pacemaker-dependent patients with no prior ventricular arrhythmias upgraded from a pacemaker to a CRT-defibrillator, patients without significant CAD have fewer comorbidities, longer survival, and low risk of appropriate shocks than do patients with CAD.
- CRT-pacemakers may be appropriate in such patients without CAD.

Contralateral Approach for Device Upgrade



Lateral Infraclavicular Puncture for Device Upgrade

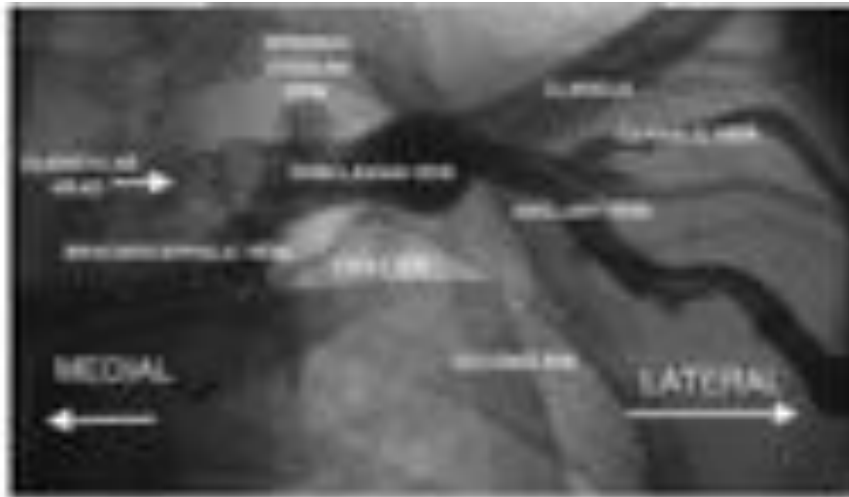
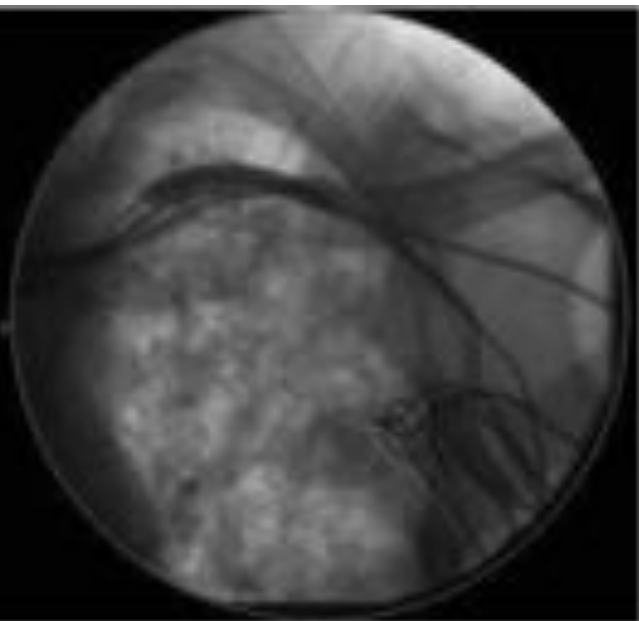
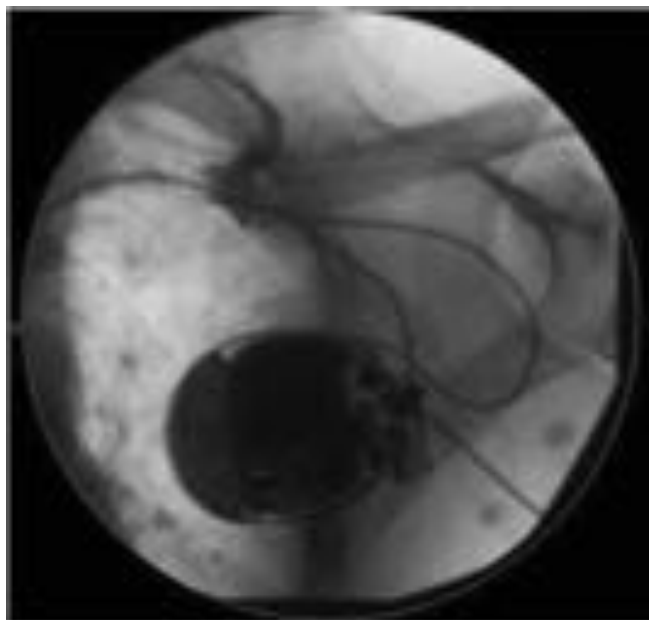


Figure 1. The normal anatomy of the supraclavicular and infraclavicular left venous system.

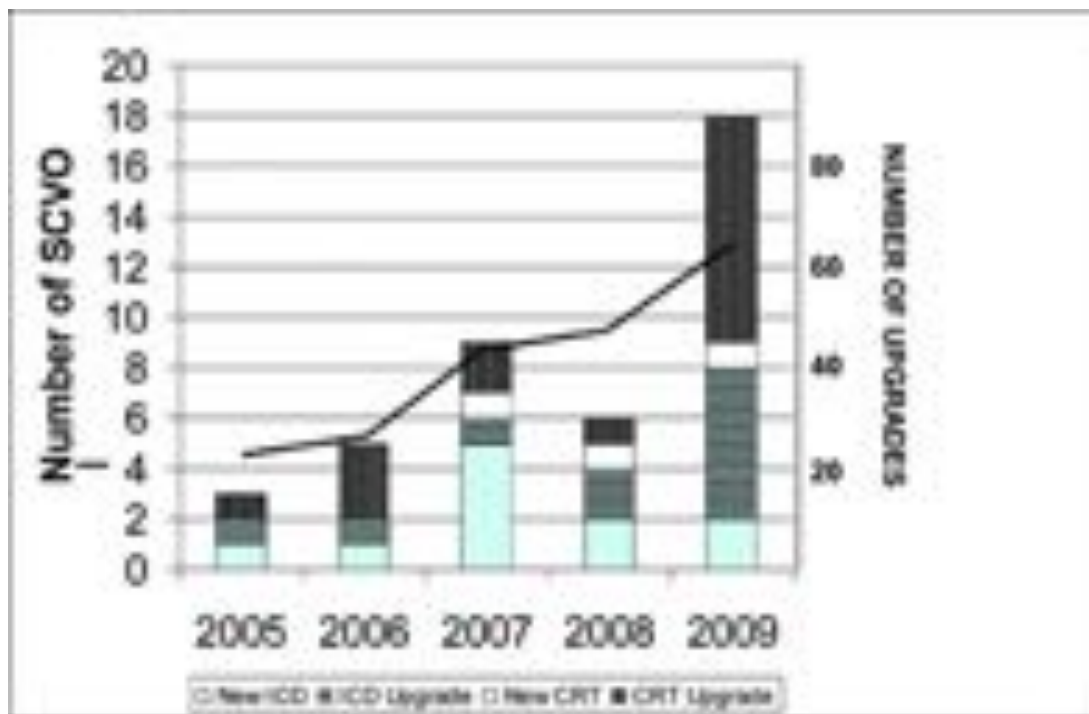


Figure 2. The puncture is performed from a lateral position, with pressure applied to the left shoulder to allow the needle to slide underneath the clavicle at a horizontal plane.

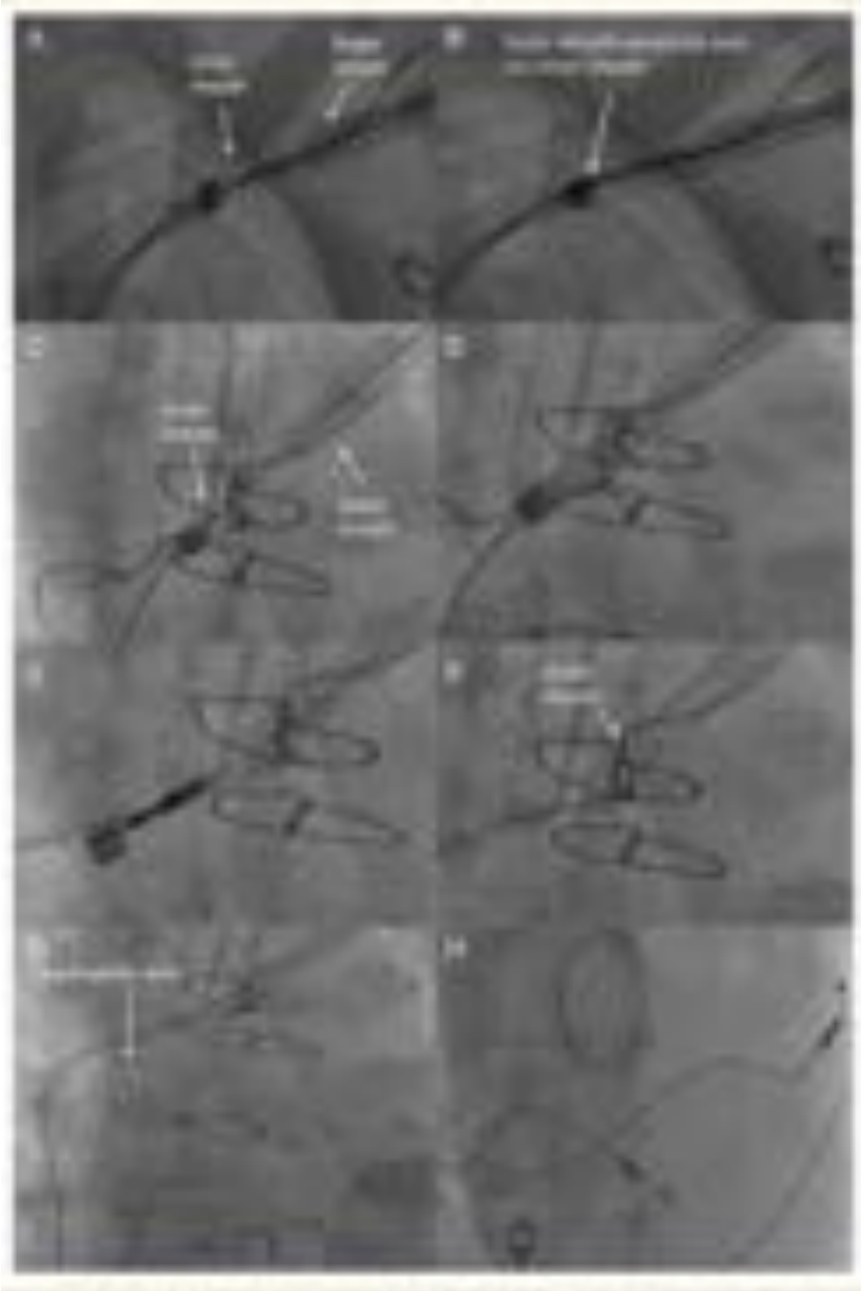




Subclavian Venoplasty May Reduce Implant Times and Implant Failures in the Era of Increasing Device Upgrades



Lead Extraction for Device Upgrade



Conclusions

In pts with RV pacing induced CMP:

- CRT upgrade improves symptoms and LV function
- Under utilization of CRT upgrade in RV pacing induced CMP
- CRT upgrade, especially with CRT-D is associated with increased risk of complications
- Various techniques can facilitate successful CRT upgrade