



Arrhythmias & Heart Failure
New Insights & Technological Advances

March 2-3

9th Congress Edition
Novotel PARIS Tour Eiffel

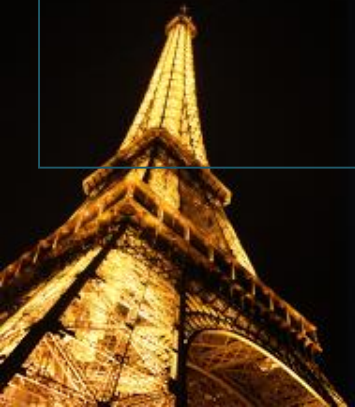
Last Updates in Cardiac Resynchronization Therapy

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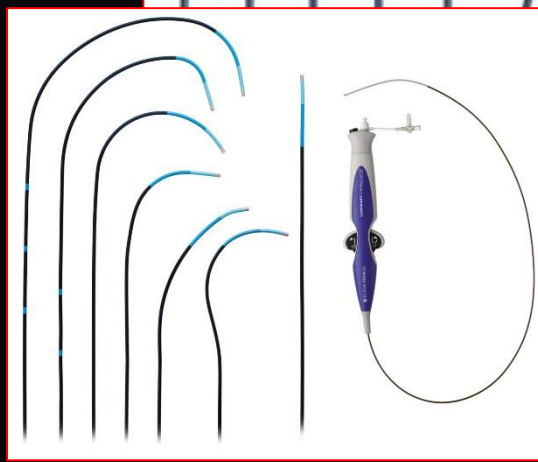
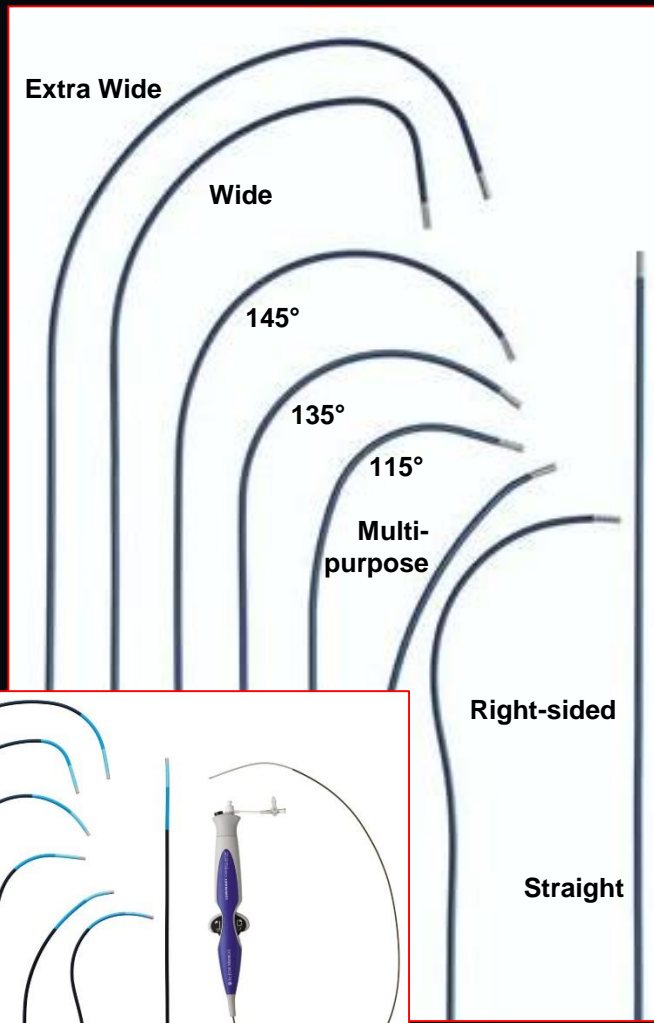
Potential conflicts of interest

Consulting	Biotronik, Boston-Scientific, LivaNova, Medtronic, St. Jude Medical/Abbott
Employment in industry	None
Shareholder in a healthcare company	None
Owner of a healthcare company	None
Honoraria/speaker's bureau	Biotronik, Boston-Scientific, LivaNova Medtronic, St. Jude Medical/Abbott
Travel/congress reimbursement	Biotronik, Boston-Scientific, LivaNova, Medtronic, St. Jude Medical/Abbott
Participation in sponsored trials	Biotronik, Boston-Scientific, LivaNova, Medtronic, St. Jude Medical/Abbott

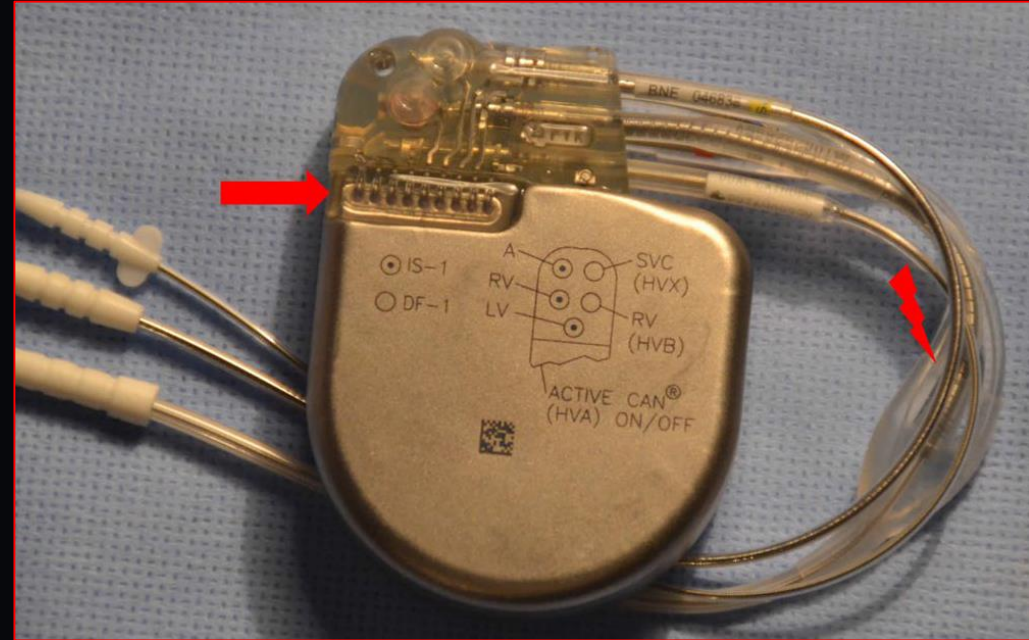
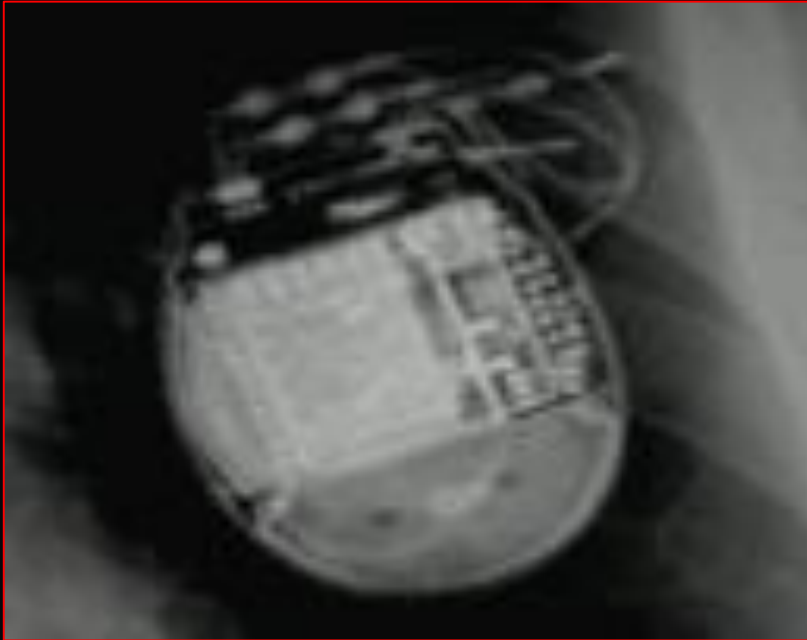


New Delivery Systems and Materials

Right Ventricle/Atrium		Coronary Sinus Cannulation				Subselection	
SelectSite™ Catheters CR181 CR191	Attain™ Deflectable Catheter R2005	Attain™ Fixed Shape Catheters		Attain™ Preval™ Sheath Catheter E220190	Attain Select™ Guiding Catheters		Attain Select™ II Lead Delivery Subselection Catheters
		Scraper R218190 R218195 R218199	Extended Hook R218192	Amplatz Hook R218193	Multi-purpose R218194	VR1 R218195	VR2 R218196



IS4 and DF4 Connector



Device (Remote) Monitoring of HF

Algorithms

Fluid Index ≥ 60

Fluid Index ≥ 80

Fluid Index ≥ 100

1 Criterion (excluding fluid)

≥ 2 Criterion (excluding fluid)

Combined Algorithm

P-Value

<0.0001

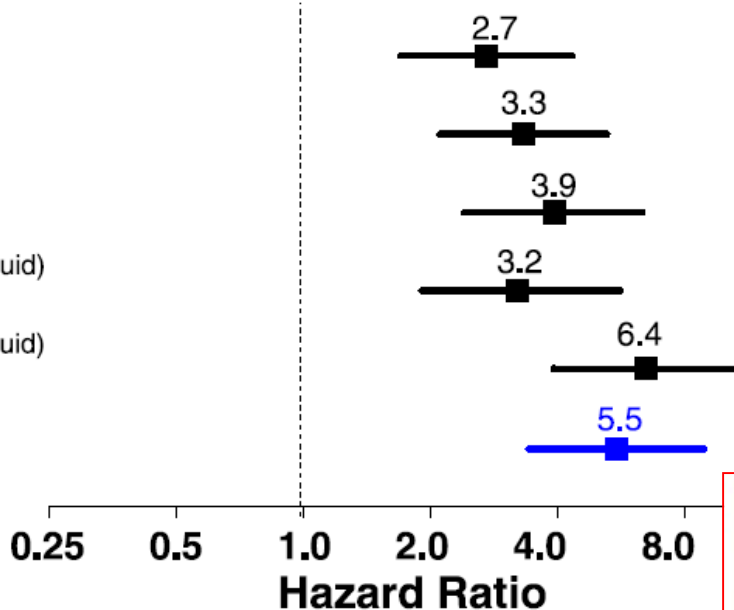
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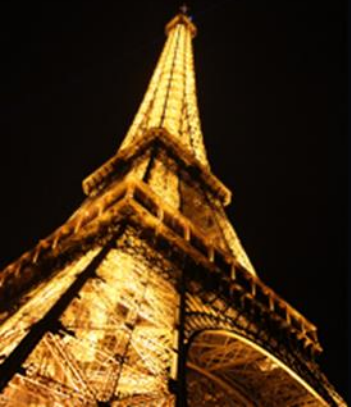
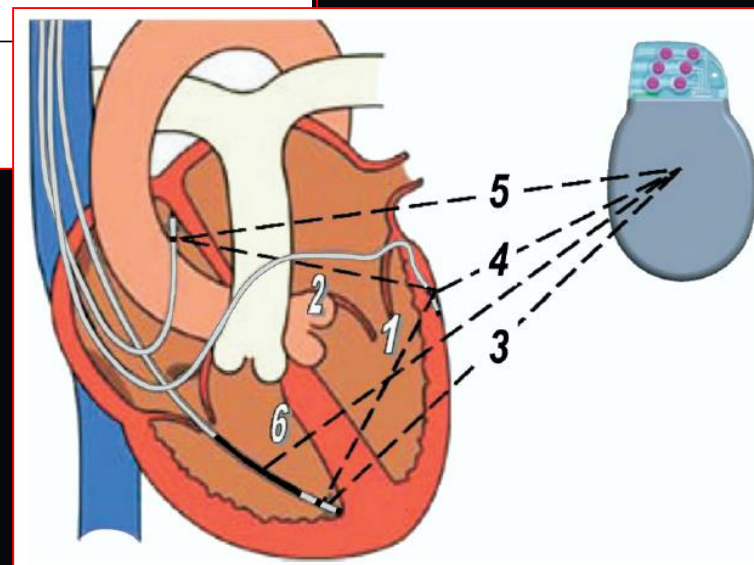
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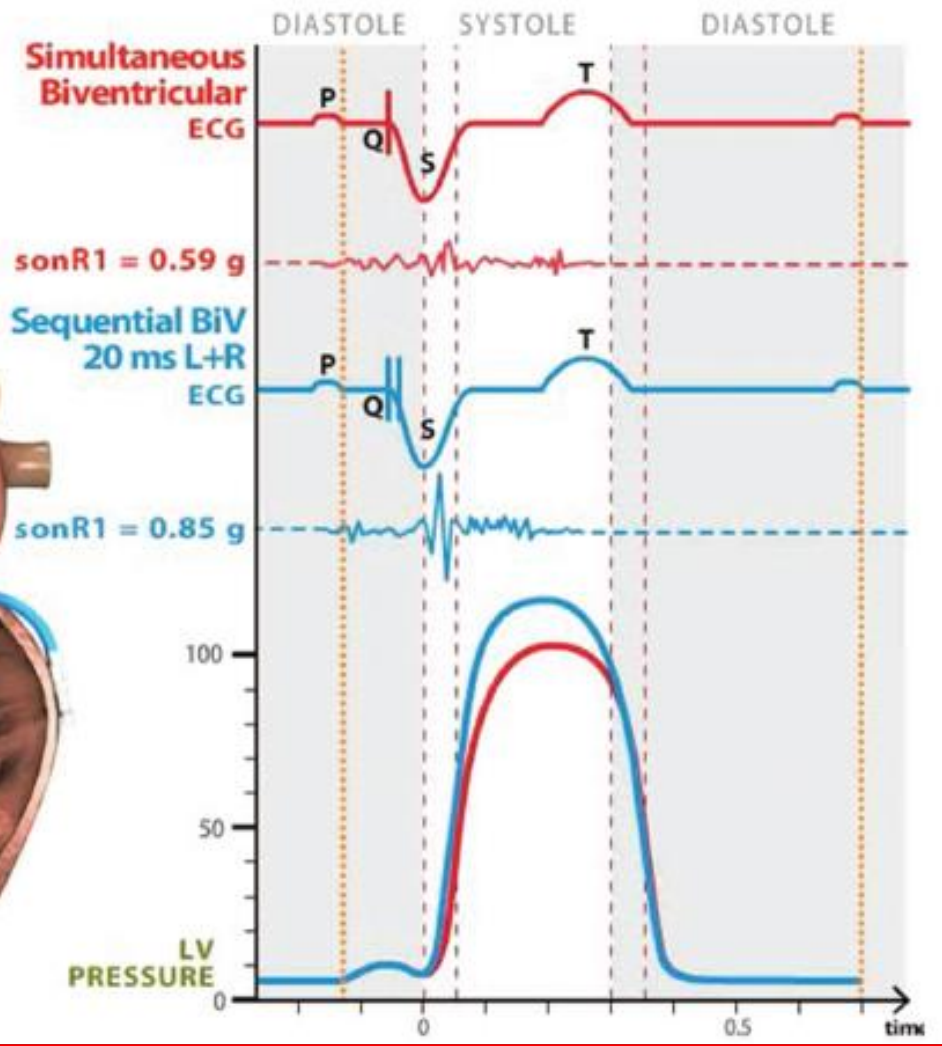
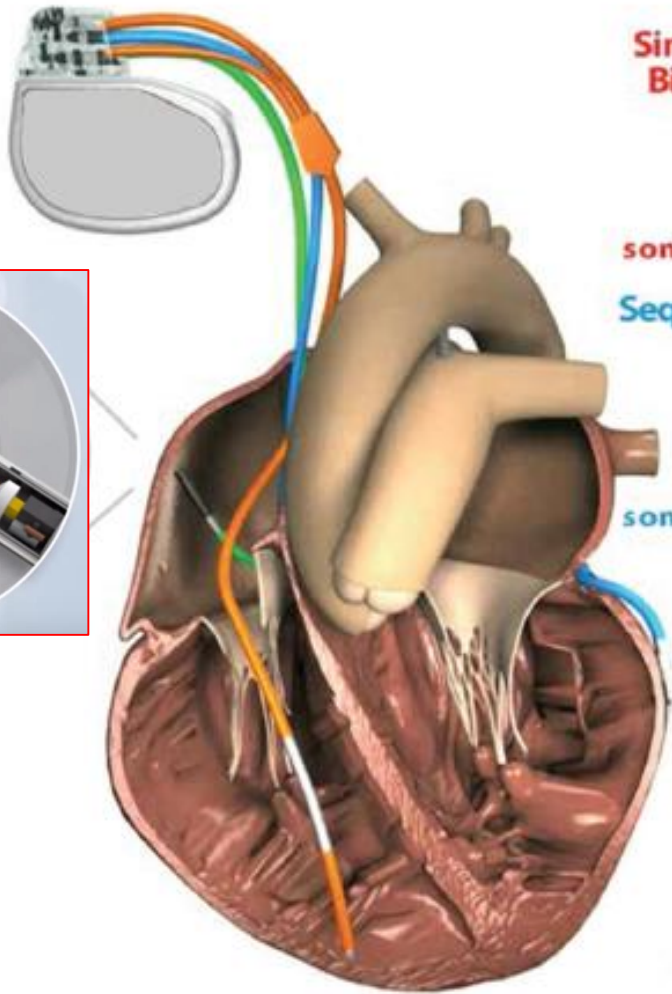
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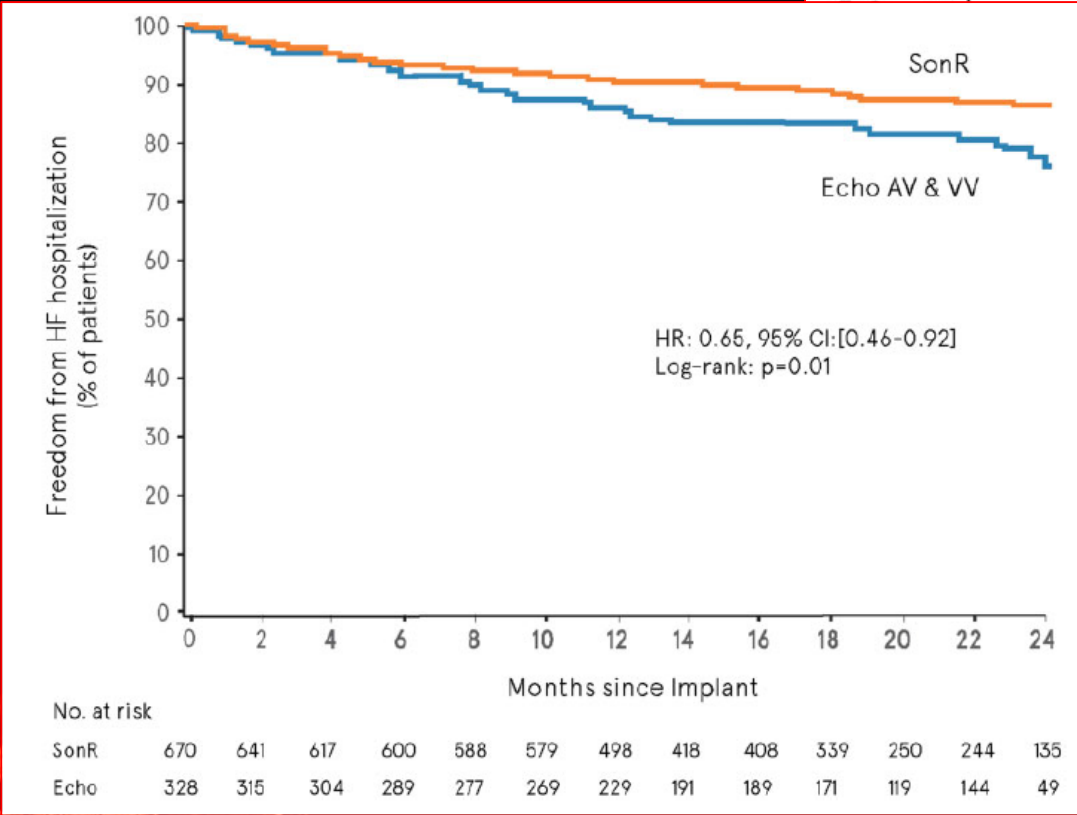
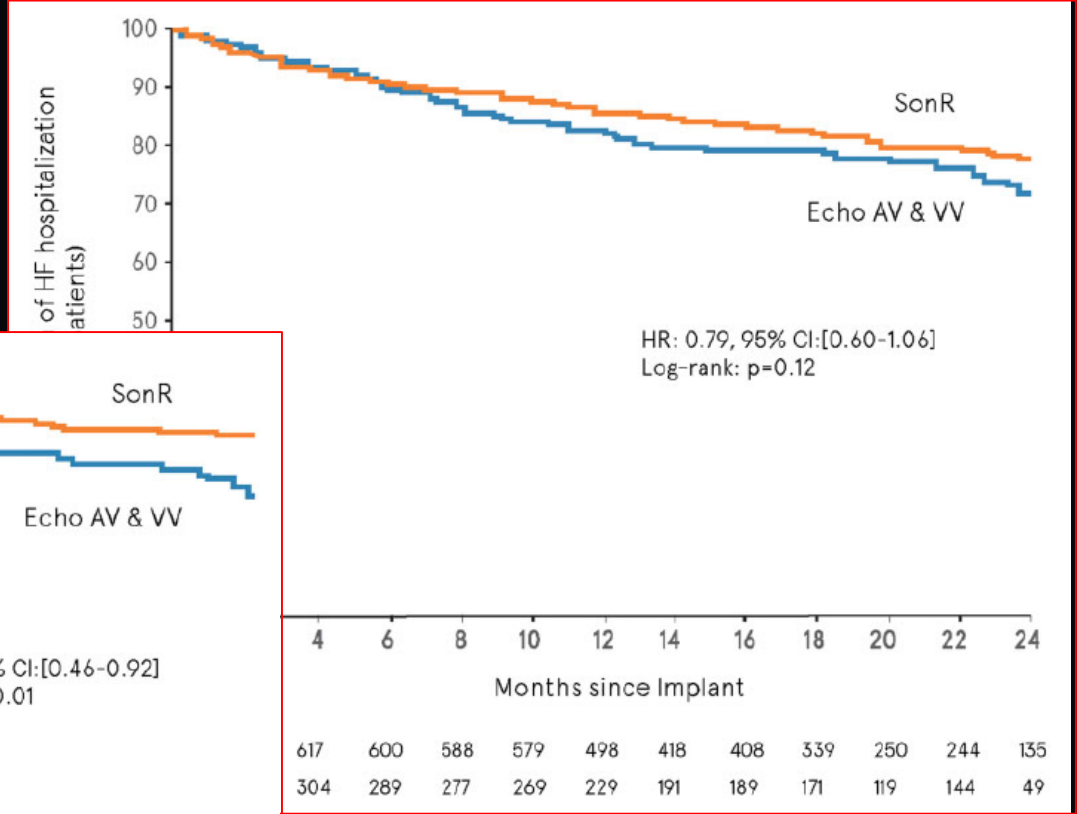
Whellan, J Am Coll Cardiol 2010;55:1803-10



Peak Endocardial Acceleration (PEA)

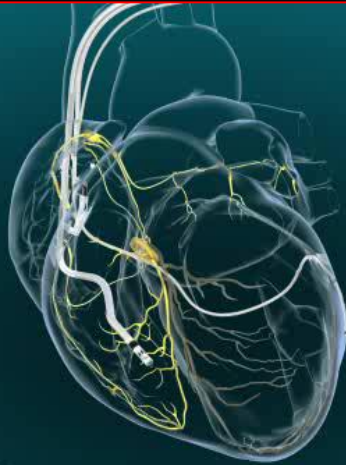


RESPOND-CRT

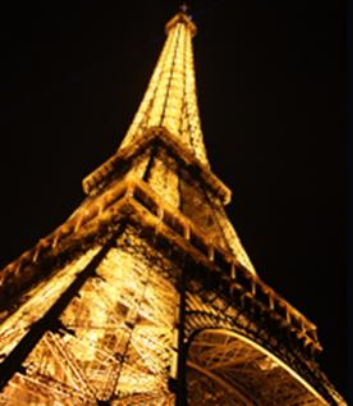
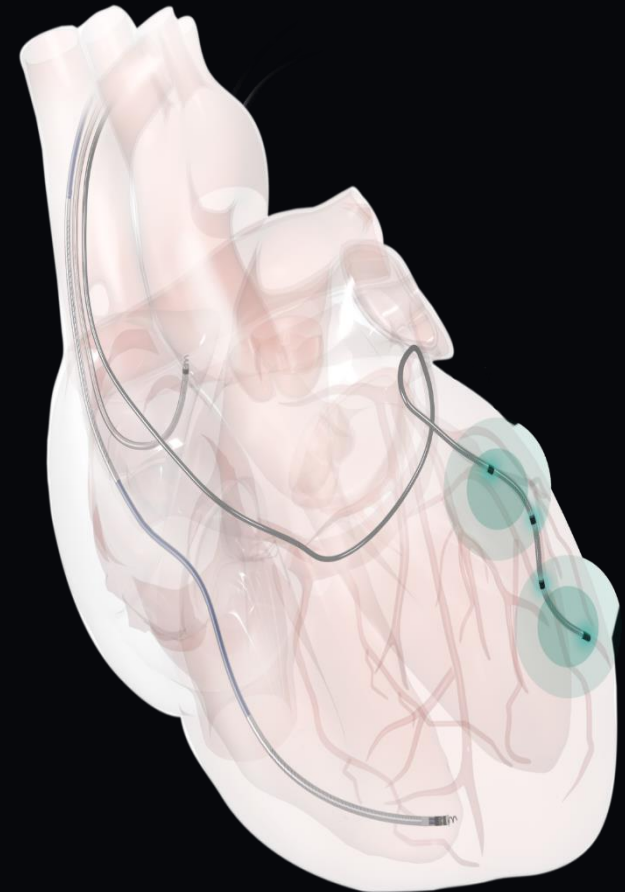


RV-LV Adaptive Fusion

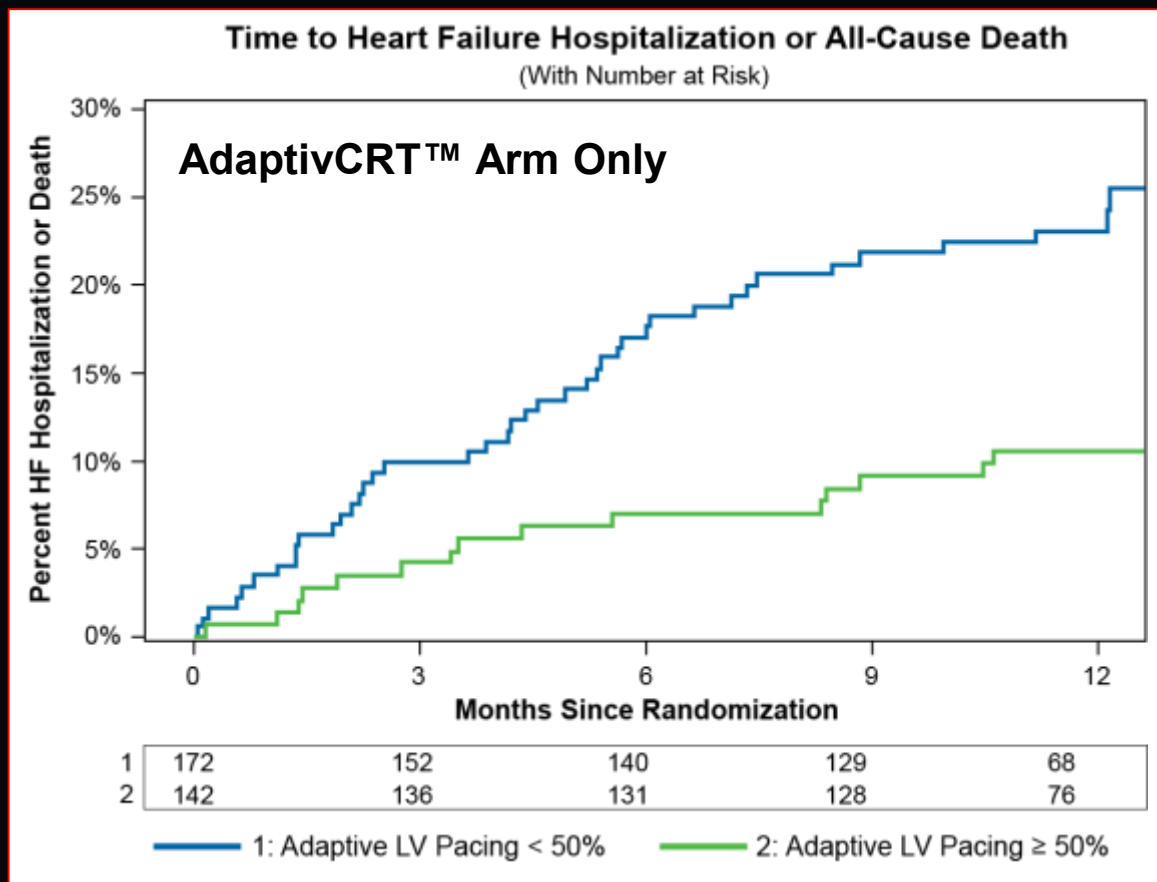
Adaption of LV Pacing to Changes in Intrinsic AV Conduction



Adaptive LV



ADAPTIVE Trial: Death and Hospitalization



Patients with higher percentage adaptive LV pacing in the AdaptivCRT arm
⇒ lower rate of death and HF hospitalizations

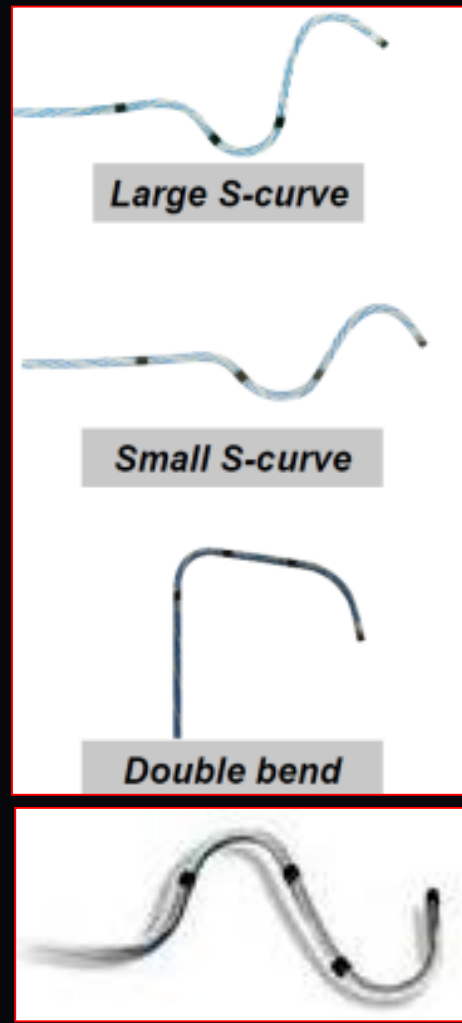
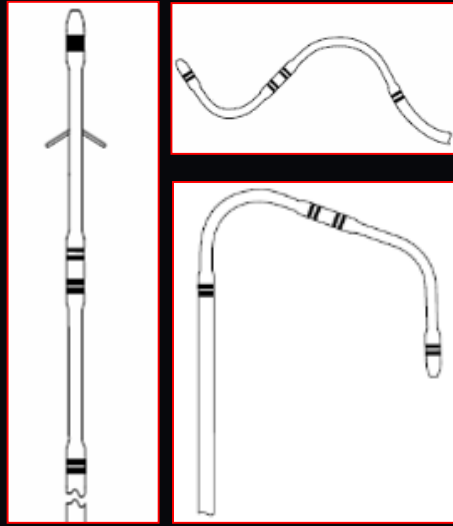
Quadripolar Leads

Biotronik Sentus QP

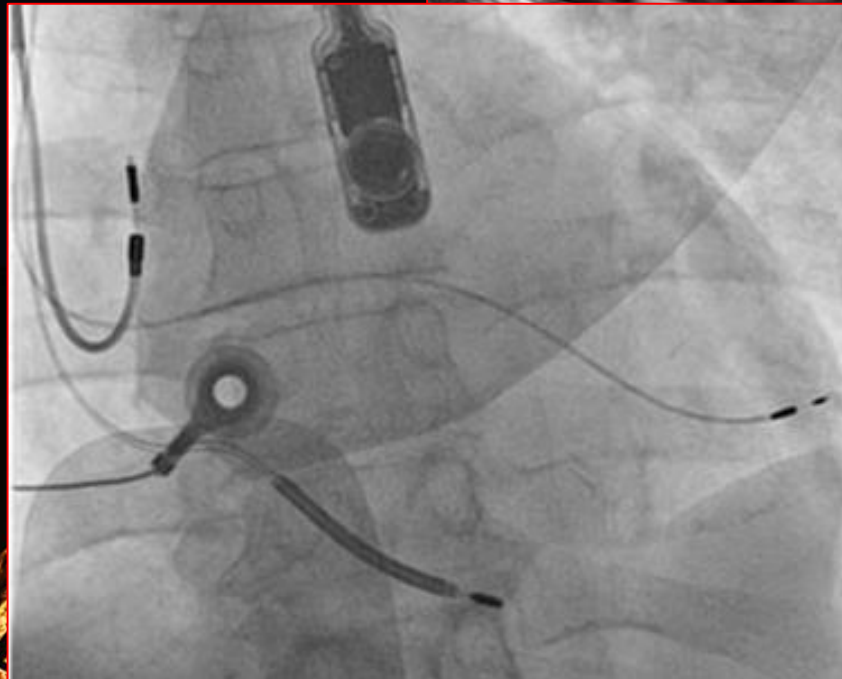
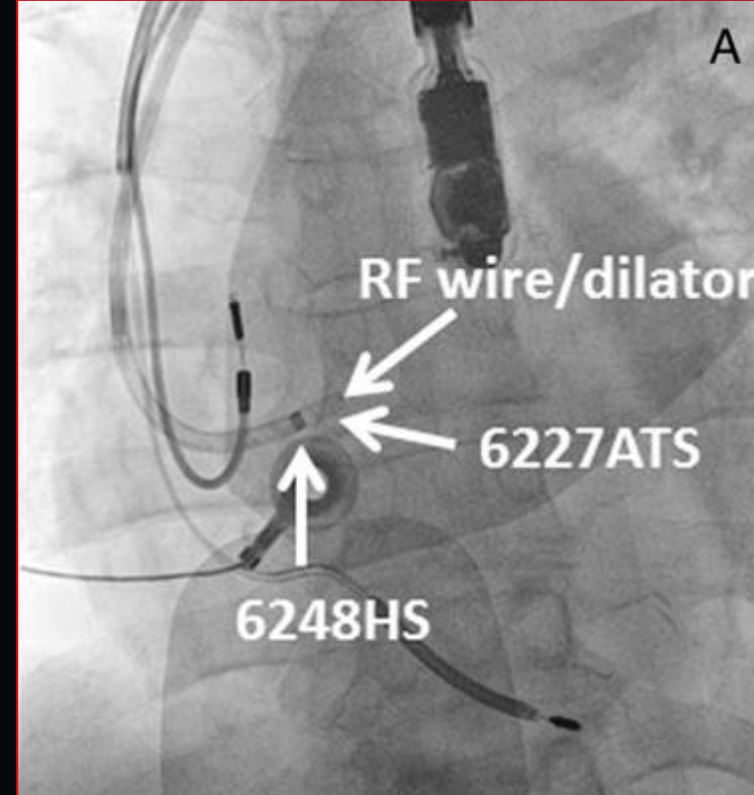
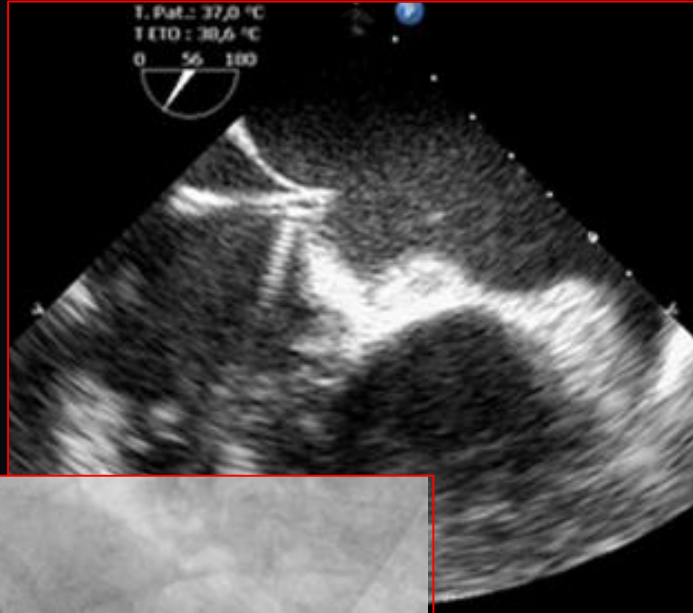
Medtronic
Attain
Performa

Boston Scientific
Acuity X4

SJM Quartet



Endocardial LV Pacing

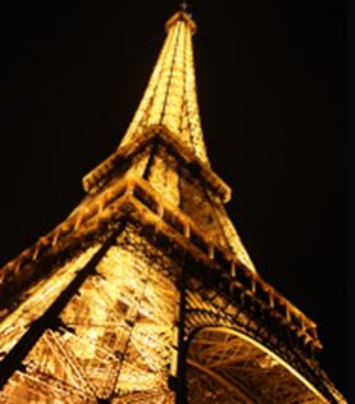


ALSYNC

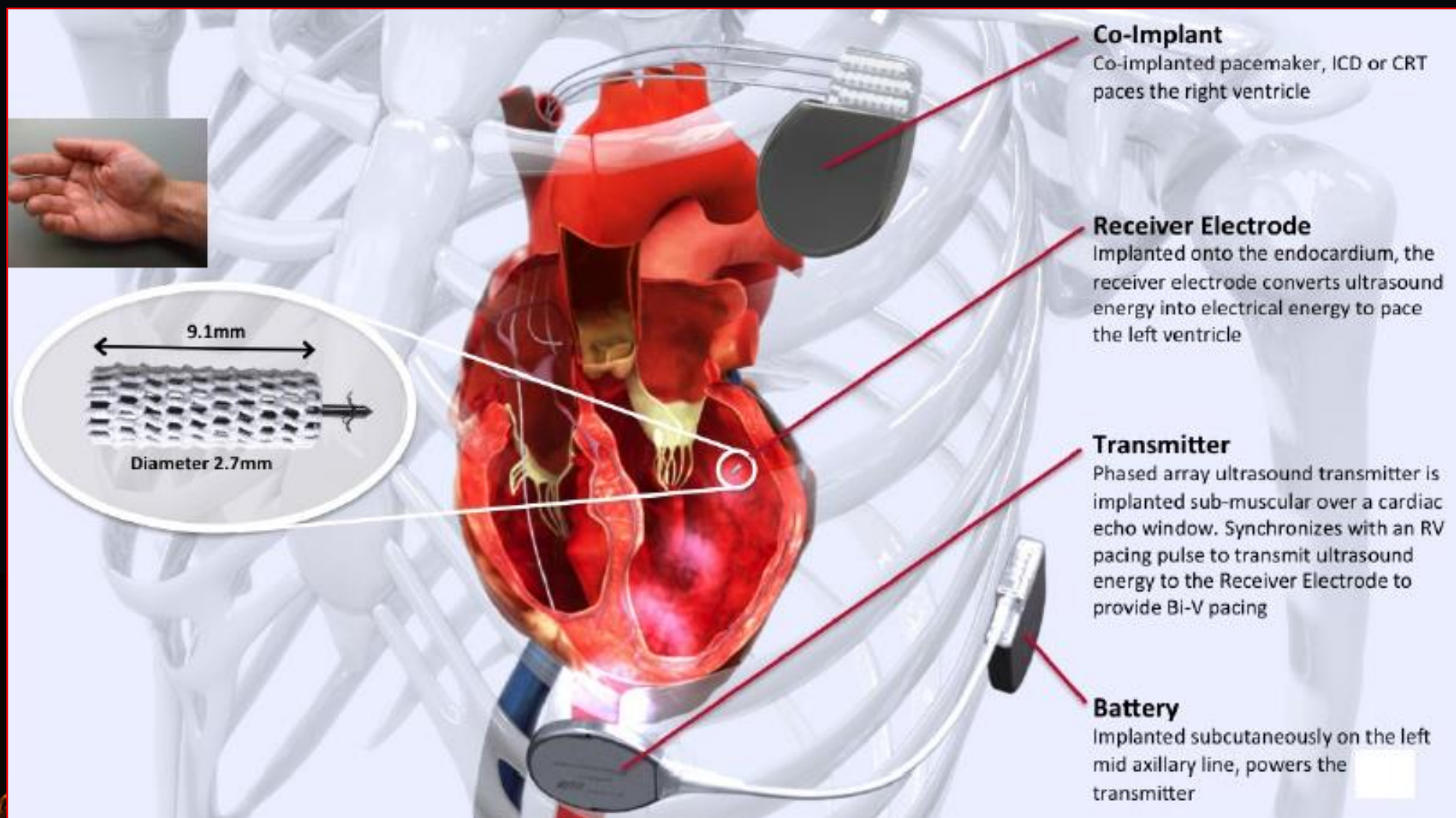
	Baseline (n = 118)	6 months (n = 105)	Change	P-value*	Response definition	Response rate for all patients (n = 118)	Response rate for non-responders with prior CRT (n = 31)
LVESV	149 ± 79 mL	121 ± 74 mL	29 ± 60 mL reduction	<0.0001	≥15% relative reduction ≥30% relative reduction	55% 33%	47% 5%
LVEF	29 ± 10%	36 ± 12%	7 ± 10% increase	<0.0001	≥5% absolute increase	64%	61%
Mitral regurgitation	Moderate/severe: 41%	Moderate/severe: 30%		0.035	≥1 class	33%	43%
NYHA class	I/II/III/IV: 3%/20%/69%/7%	I/II/III/IV: 19%/51%/28%/2%					
Six-minute walking test	332 ± 117 m	388 ± 135 m					

Morgan, Eur Heart J 2016;37:2118-27

Cohort Time frame (n patients at risk)	Implant failed Implant (14)		Implant success		All patients Total (132)		
	Implant (118)	PHD (118)	6 months (105)	>6 months (94)			
Procedure complication					6		
Intracardiac thrombus	3						
Aorta puncture	1						
Pericardial effusion			1				
Pneumothorax	1						
Bleeding					7		
Pocket haematoma			2	3			
Nose bleeding			1				
Retroperitoneal haematoma				1			
Lead dislodgement			1	3	2	6	
Confirmed stroke						5	
Stroke	1				1	2	
Retinal artery thrombus						1	
Transient ischaemic attack*					1	1	4
Infection					1	1	2
Total	6		6	6	7	5	30



WiSE-CRT



Co-Implant

Co-implanted pacemaker, ICD or CRT paces the right ventricle

Receiver Electrode

Implanted onto the endocardium, the receiver electrode converts ultrasound energy into electrical energy to pace the left ventricle

Transmitter

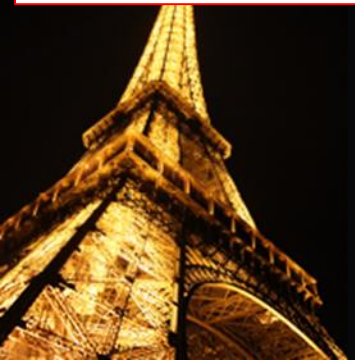
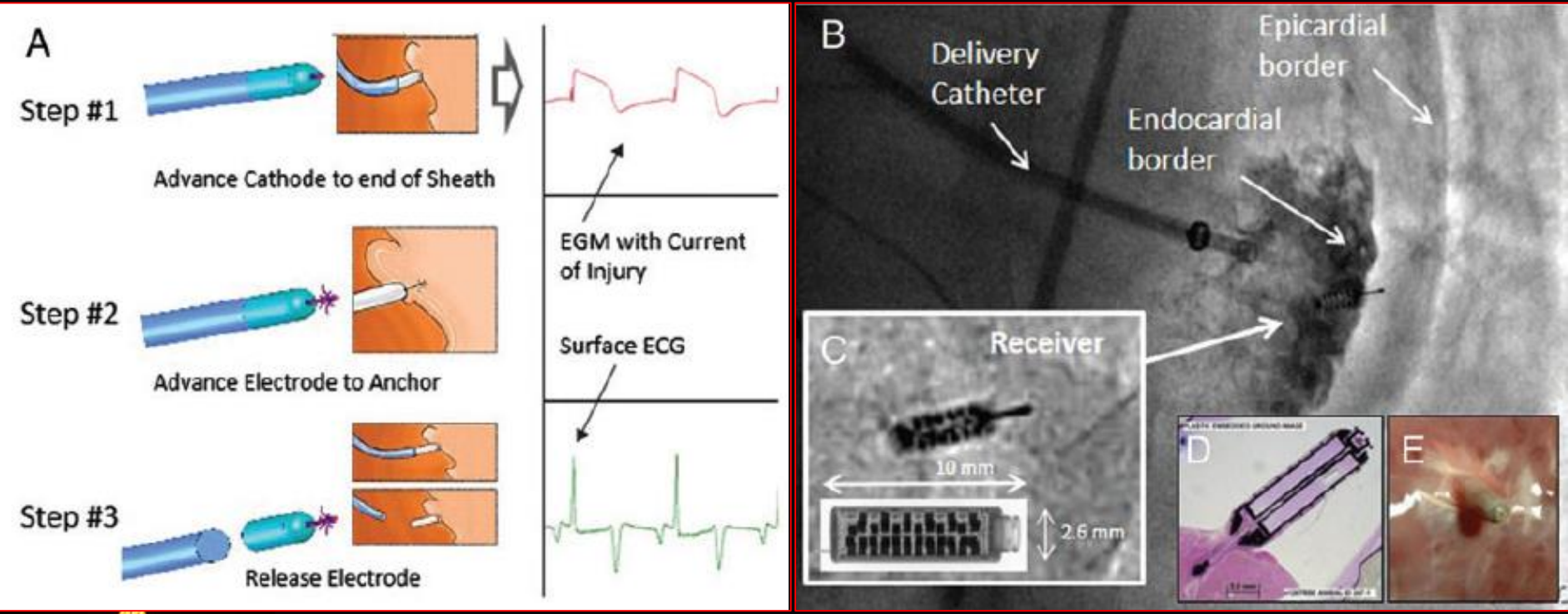
Phased array ultrasound transmitter is implanted sub-muscular over a cardiac echo window. Synchronizes with an RV pacing pulse to transmit ultrasound energy to the Receiver Electrode to provide Bi-V pacing

Battery

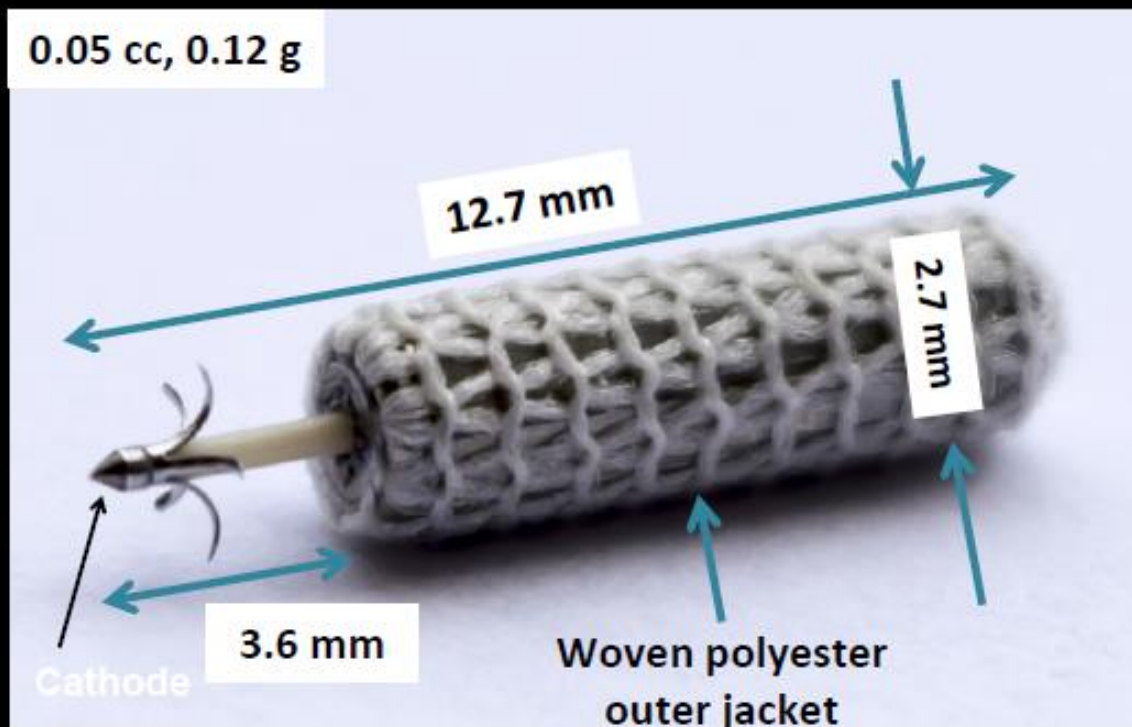
Implanted subcutaneously on the left mid axillary line, powers the transmitter



WiSE-CRT

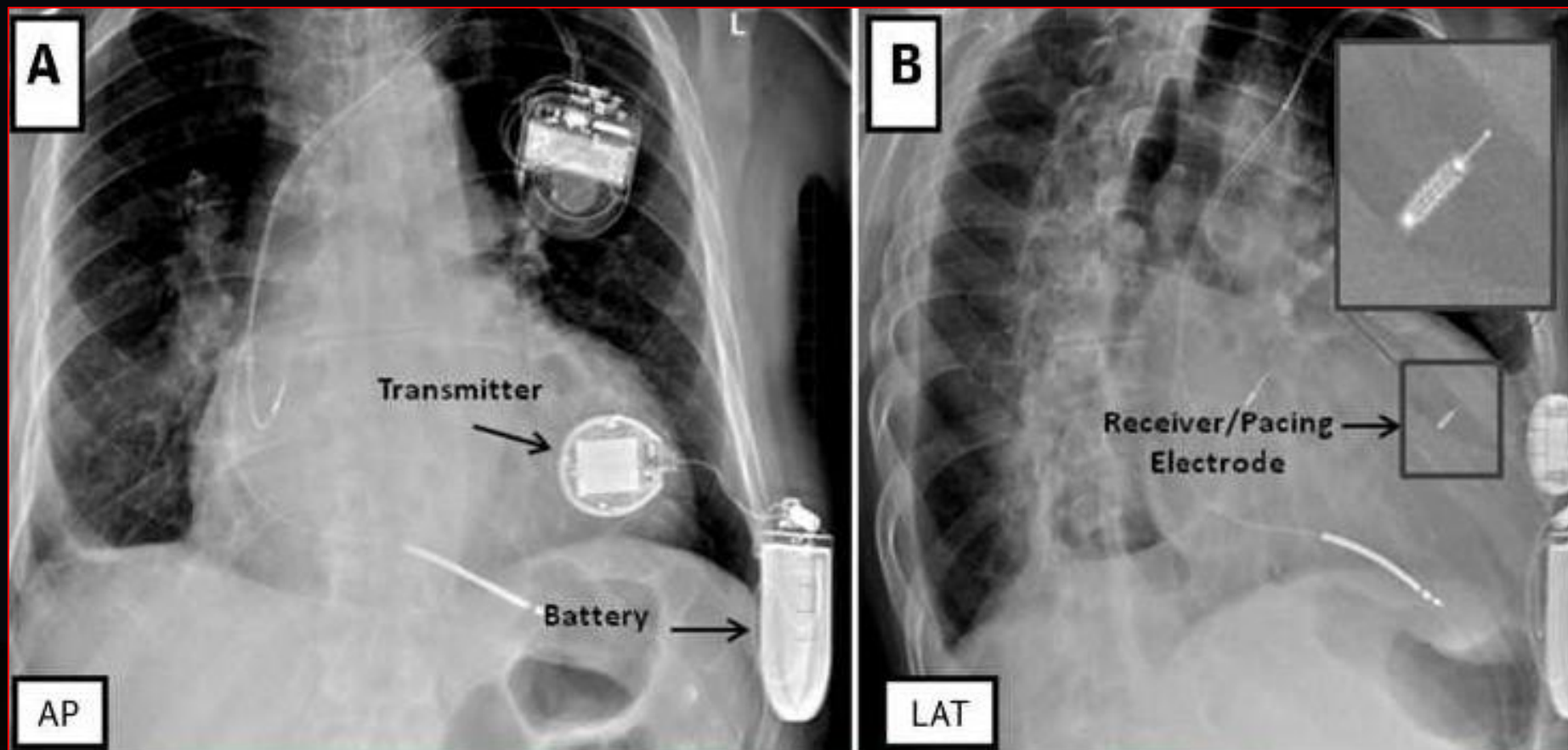


WiSE-CRT



- Attached to LV endocardium with 5 barb fixation anchor
- Woven polyester outer jacket
 - Enhanced endothelialisation
 - Minimised risk of thromboembolic events

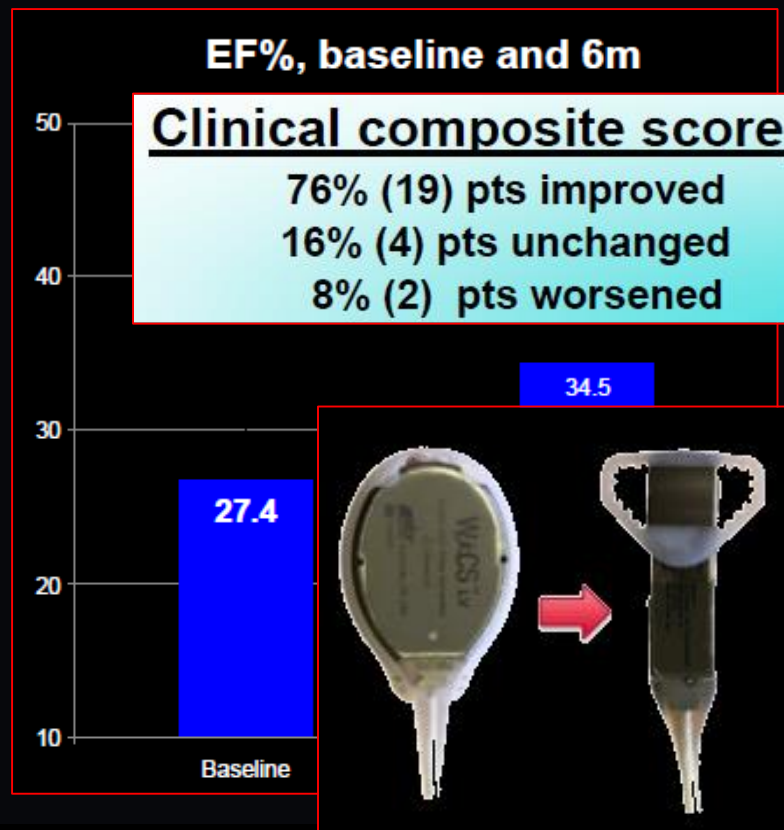
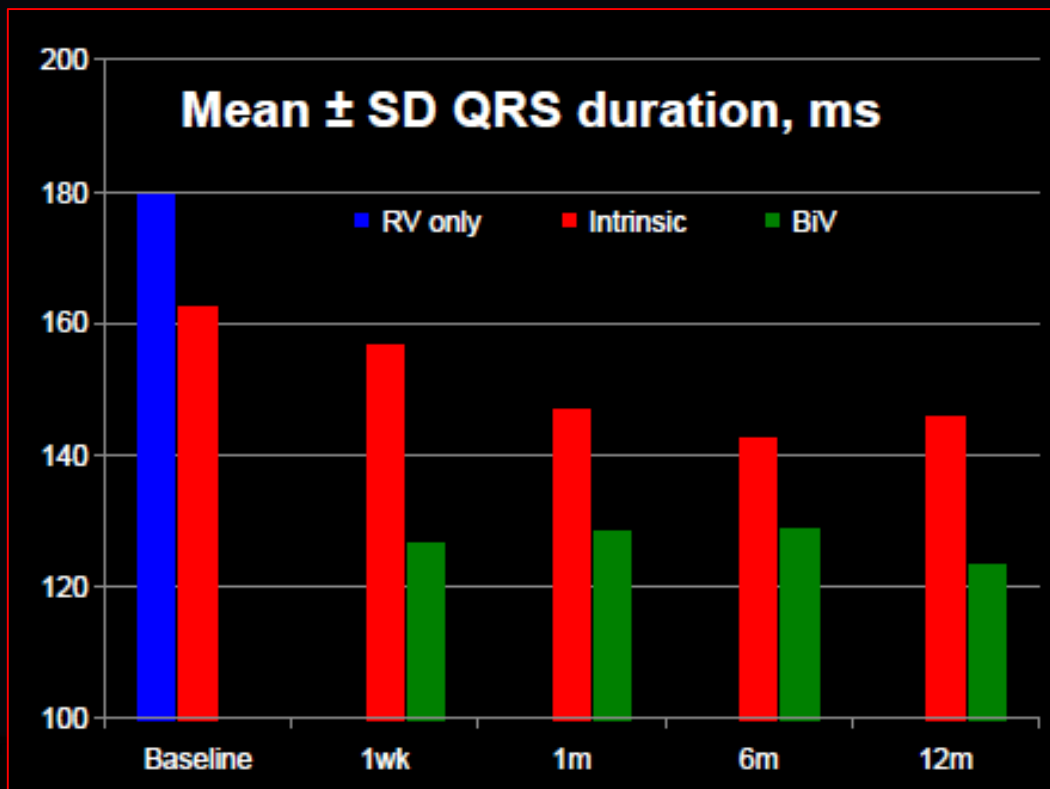
WiSE-CRT



- successful implant in only 13/17 (76%) of pts
- 3 pts (18%) pericardial effusion
- 2 pts (11%) revision of transmitter (loss of communication)
- 1 pt unexpected battery depletion

n = 17

WiSE-CRT



- 3/39 patients no sufficient ultrasound window
- 34/35 implantations successful
- 33 patients with 6 month data (25 pts with 12 months)

CRT and Atrial Fibrillation

Recommendations	Class ^a	Level ^b
<p>I) Patients with HF, wide QRS and reduced LVEF:</p> <p>IA) CRT should be considered in chronic HF patients, intrinsic QRS ≥ 120 ms and LVEF $\leq 35\%$ who remain in NYHA functional class III and ambulatory IV despite adequate medical treatment^d, provided that a BiV pacing as close to 100% as possible can be achieved.</p>	IIa	B

Why?

<p>IB) AV junction ablation should be added in case of incomplete BiV pacing.</p>	IIa	B
<p>2) Patients with uncontrolled heart rate who are candidates for AV junction ablation. CRT should be considered in patients with reduced LVEF who are candidates for AV junction ablation for rate control.</p>	IIa	B

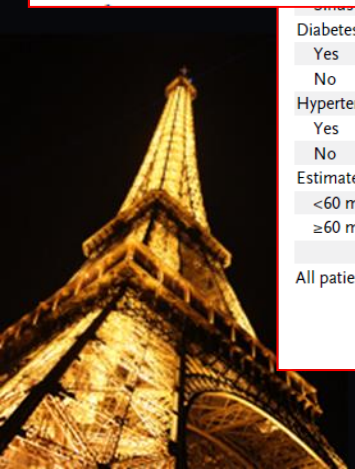
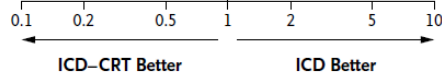
In contrast to SR, CRT in permanent AF only (at best) class IIa indication

CRT and AF: RAFT

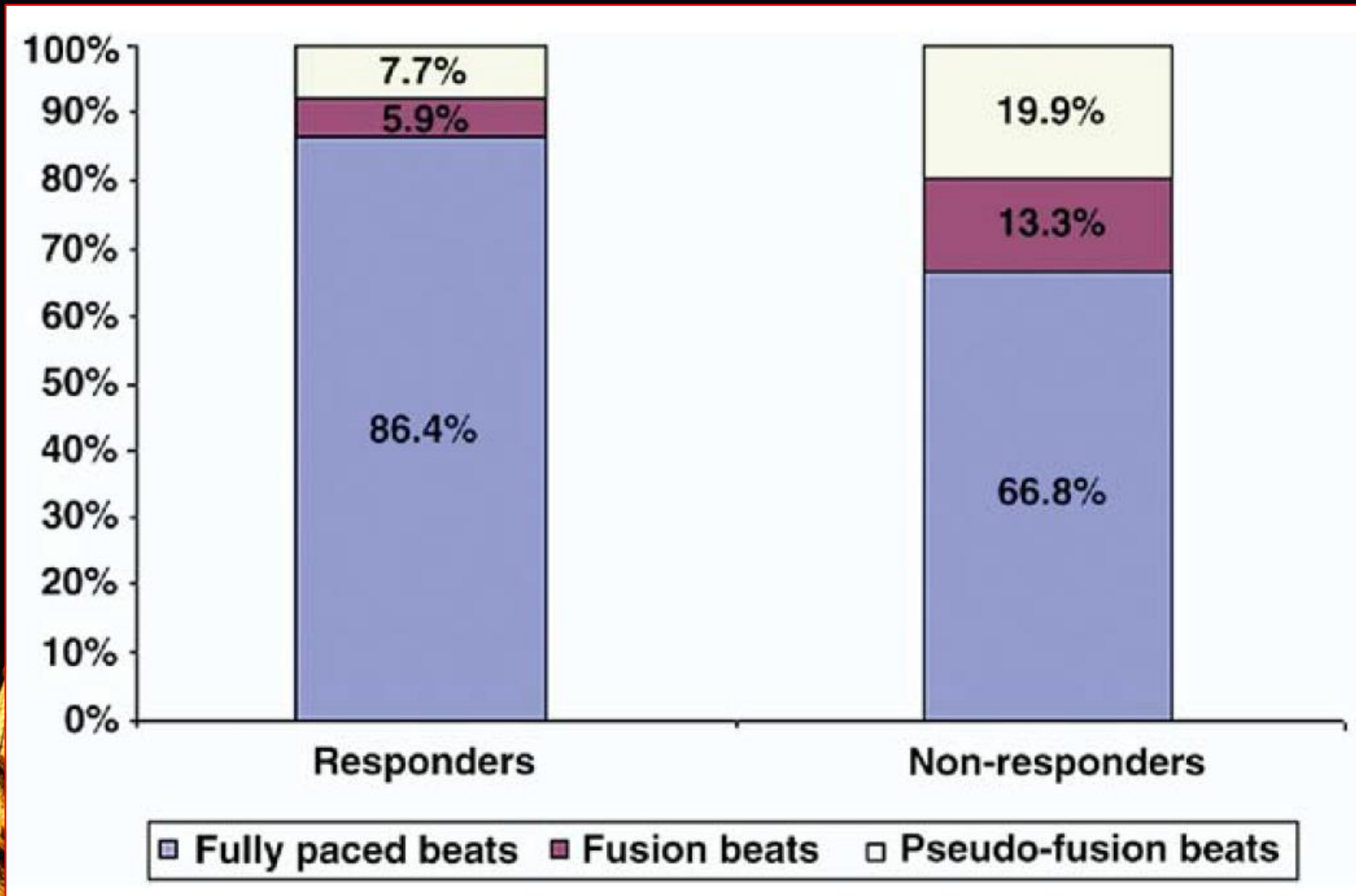
Subgroup	No./Total No.	Hazard Ratio (95% CI)	P Value for Interaction
Age			0.75
<65 yr	24/763		
≥65 yr	420/1035		
Sex			0.09
Male	573/1490		
Female	88/308		
NYHA class			0.91
II	446/1438		
III	215/360		
Underlying heart disease			0.90
Ischemic	498/1201		
Nonischemic	163/597		
QRS duration			0.003
Intrinsic QRS <150 msec	248/627		
Intrinsic QRS ≥150 msec	359/1036		
Paced QRS ≥200 msec	54/135		
Left ventricular ejection fraction			0.05
<20%	175/431		
≥20%	486/1367		

Atrial rhythm	No./Total No.	Hazard Ratio (95% CI)
Permanent atrial fibrillation or flutter	104/229	
Sinus or atrial paced	557/1569	

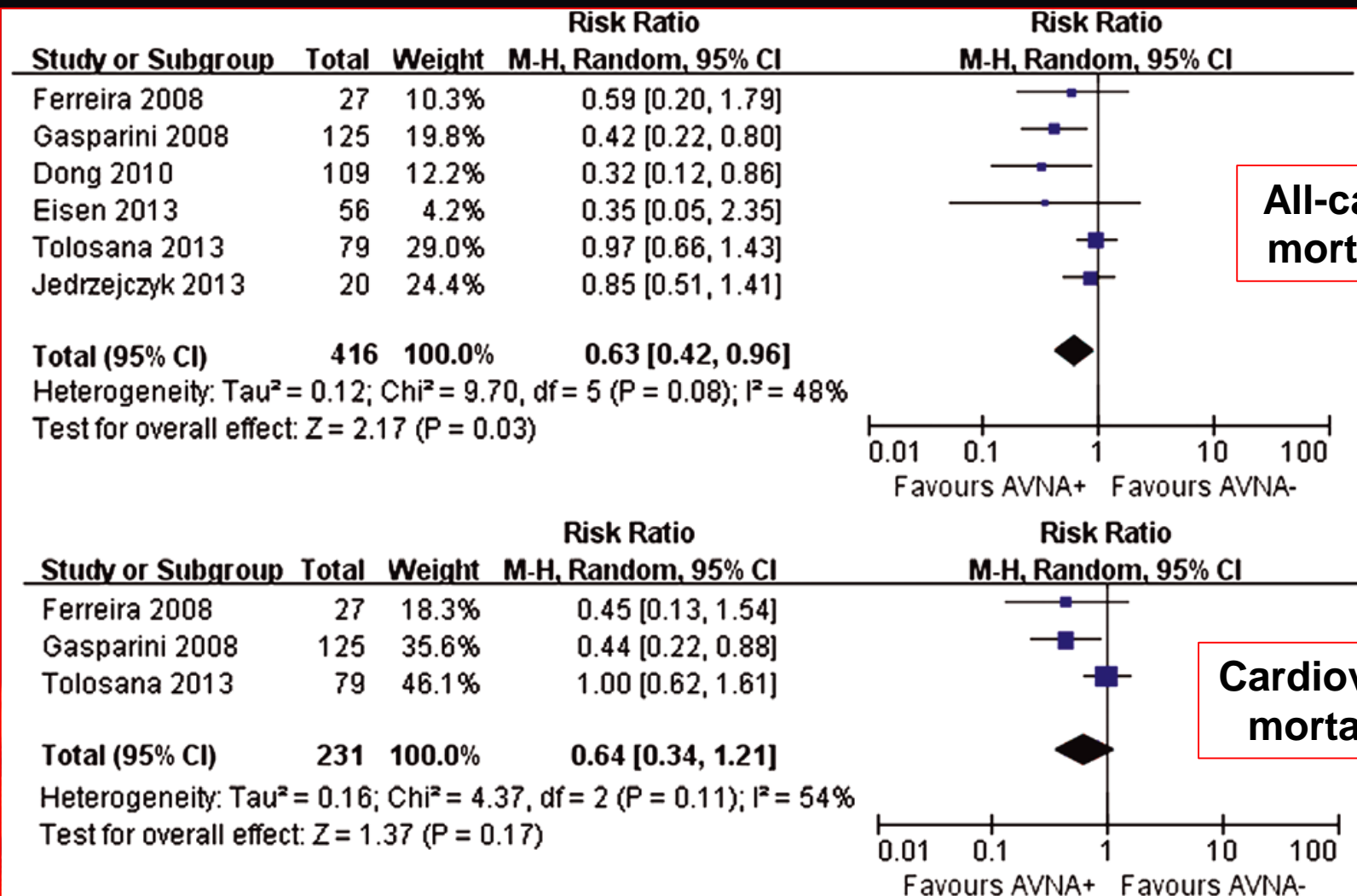
Diabetes			0.22
Yes	258/606		
No	403/1192		
Hypertension			0.84
Yes	292/799		
No	369/999		
Estimated GFR			0.70
<60 ml/min/1.73 m ²	407/900		
≥60 ml/min/1.73 m ²	250/882		
All patients			



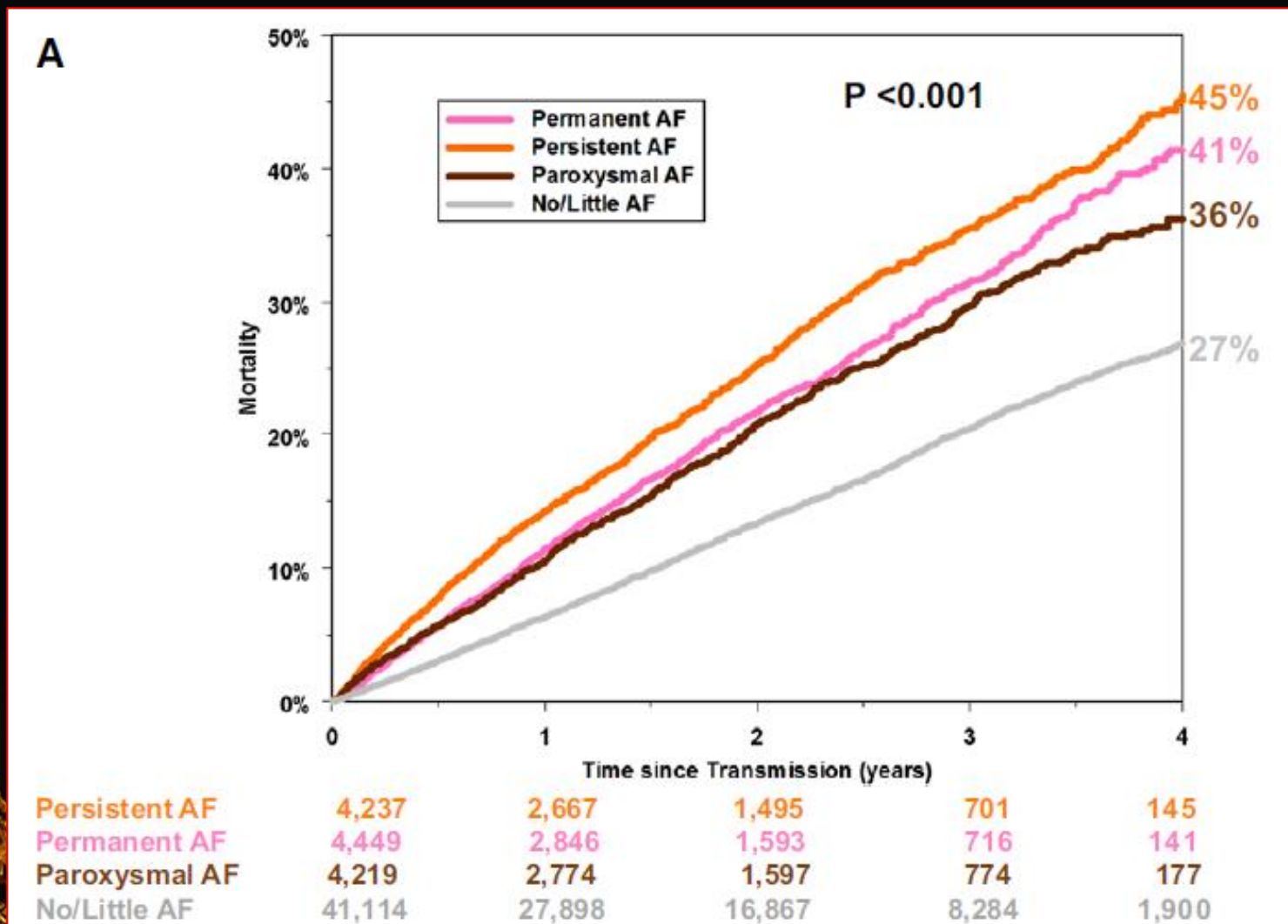
Pseudofusion, AF and CRT: 24h Holter



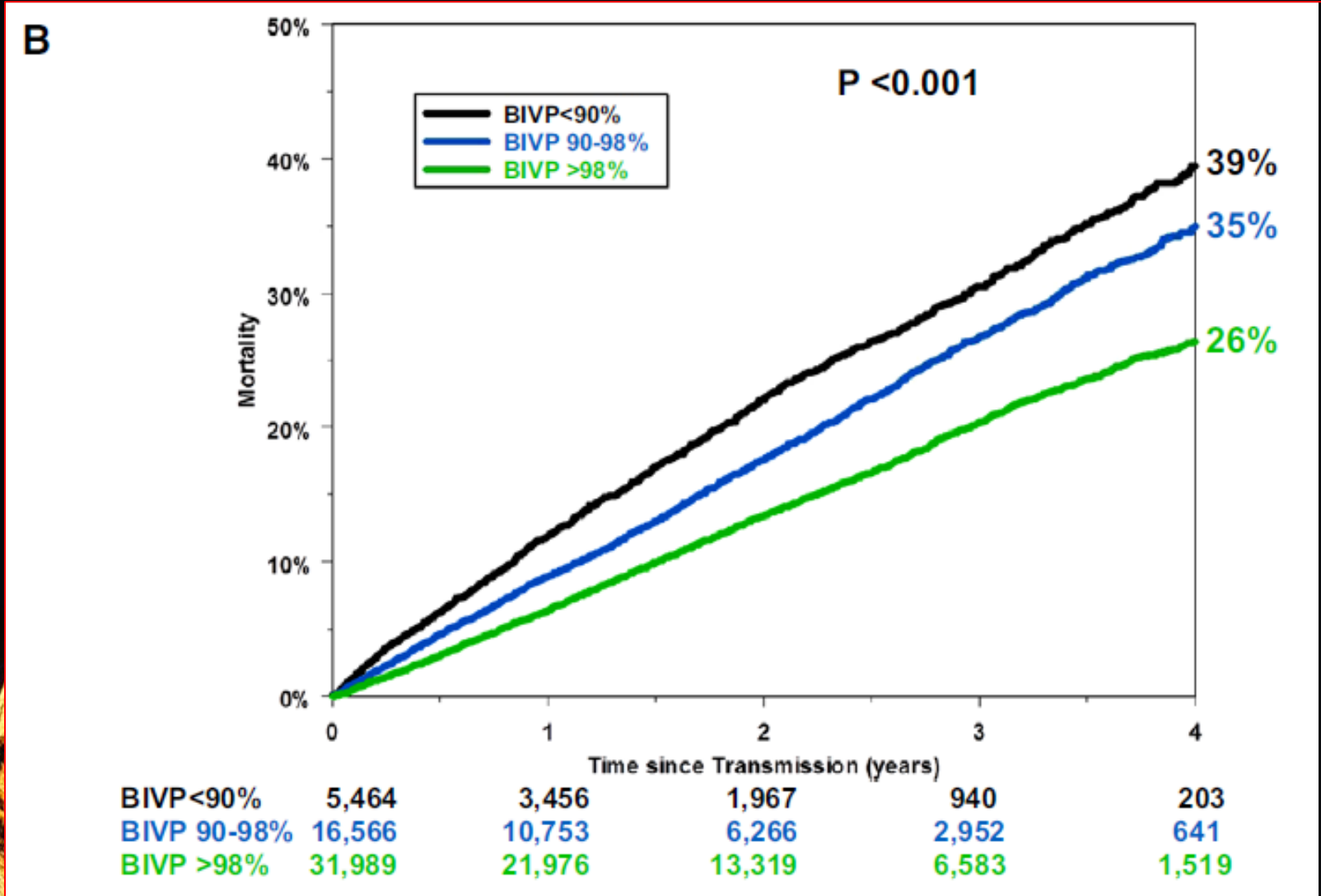
AVNA, AF and CRT: Metaanalysis



Epidemic of Insufficient CRT



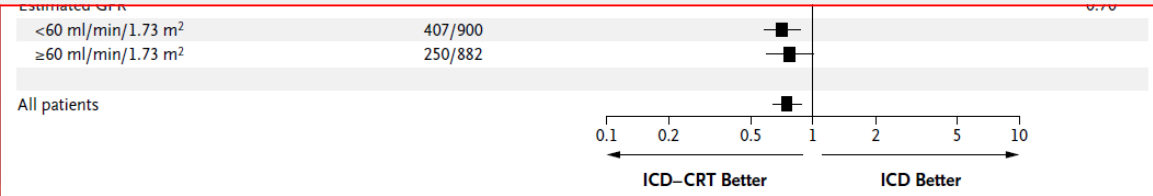
Epidemic of Insufficient CRT



RAFT: BBB Type Subgroups

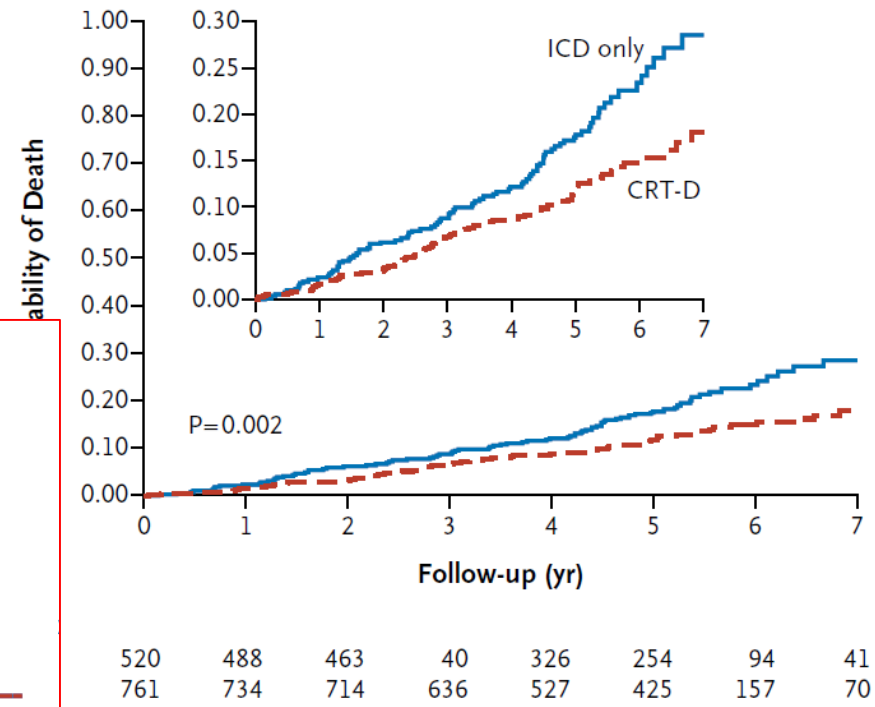
Subgroup	No./Total No.	Hazard Ratio (95% CI)	P Value for Interaction
Age			
<65 yr	24/763	~0.8	0.75
≥65 yr	420/1035	~0.8	
Sex			
Male	573/1490	~0.8	0.09
Female	88/308	~0.5	
NYHA class			
II	446/1438	~0.8	0.91
III	215/360	~0.8	
Underlying heart disease			
Ischemic	498/1201	~0.8	0.90
Nonischemic	163/597	~0.8	
QRS duration			
Intrinsic QRS <150 msec	248/627	~0.8	0.003
Intrinsic QRS ≥150 msec	359/1036	~0.5	
Paced QRS ≥200 msec	54/135	~1.0	
Left ventricular ejection fraction			
<20%	175/431	~0.5	0.05
≥20%	486/1367	~0.8	
QRS morphologic features			
Right bundle-branch block	70/161	~1.0	0.046
Left bundle-branch block	449/1295	~0.5	
NIVCD	88/207	~1.0	

QRS morphologic features		
Right bundle-branch block	70/161	~1.0
Left bundle-branch block	449/1295	~0.5
NIVCD	88/207	~1.0
Paced	54/135	~1.0

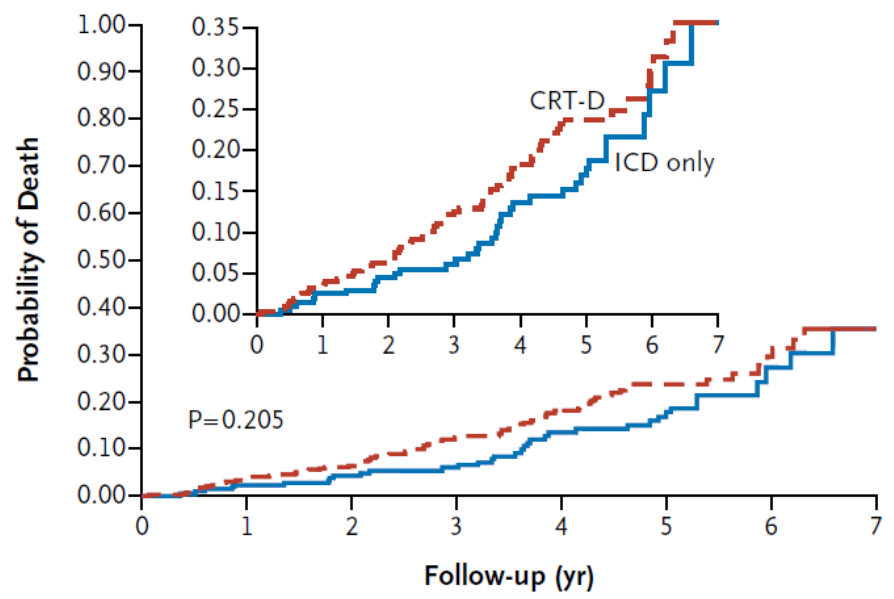


MADIT-CRT: BBB Type Subgroups

A Patients with Left Bundle-Branch Block



B Patients without Left Bundle-Branch Block



No. at Risk

ICD only	209	197	189	156	115	95	24	10
CRT-D	328	312	292	240	182	136	39	13

REVERSE: BBB Type Subgroups

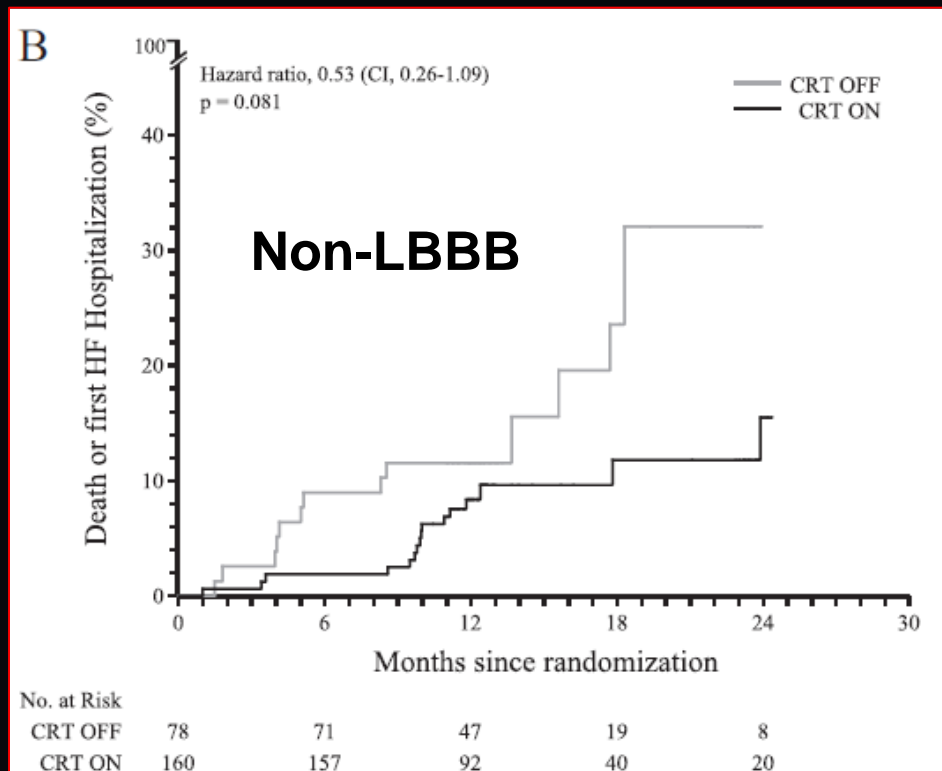
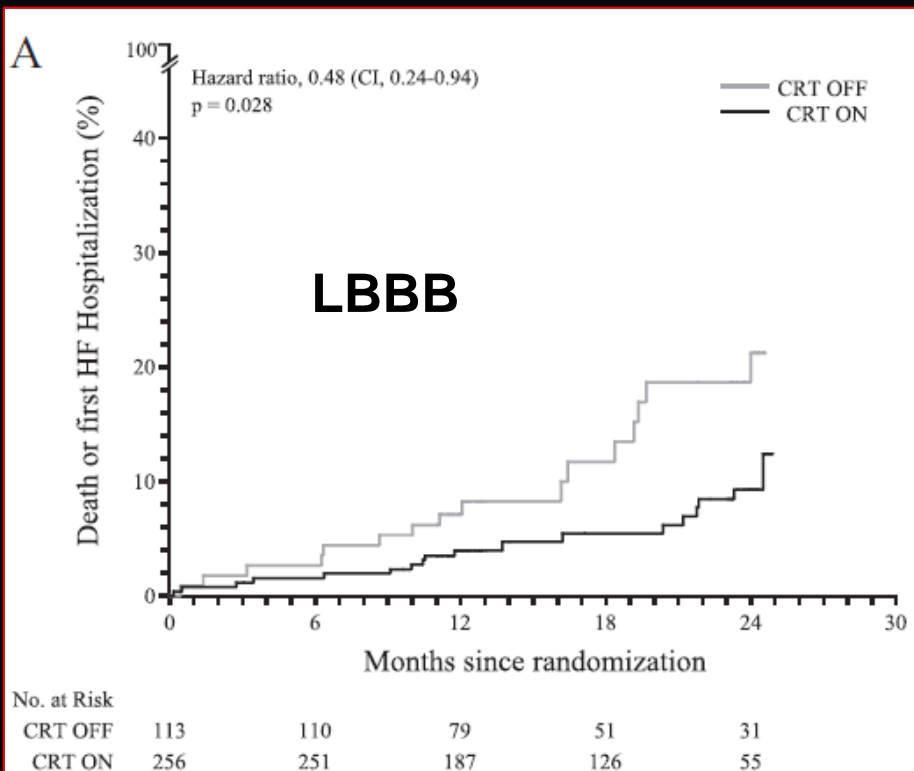
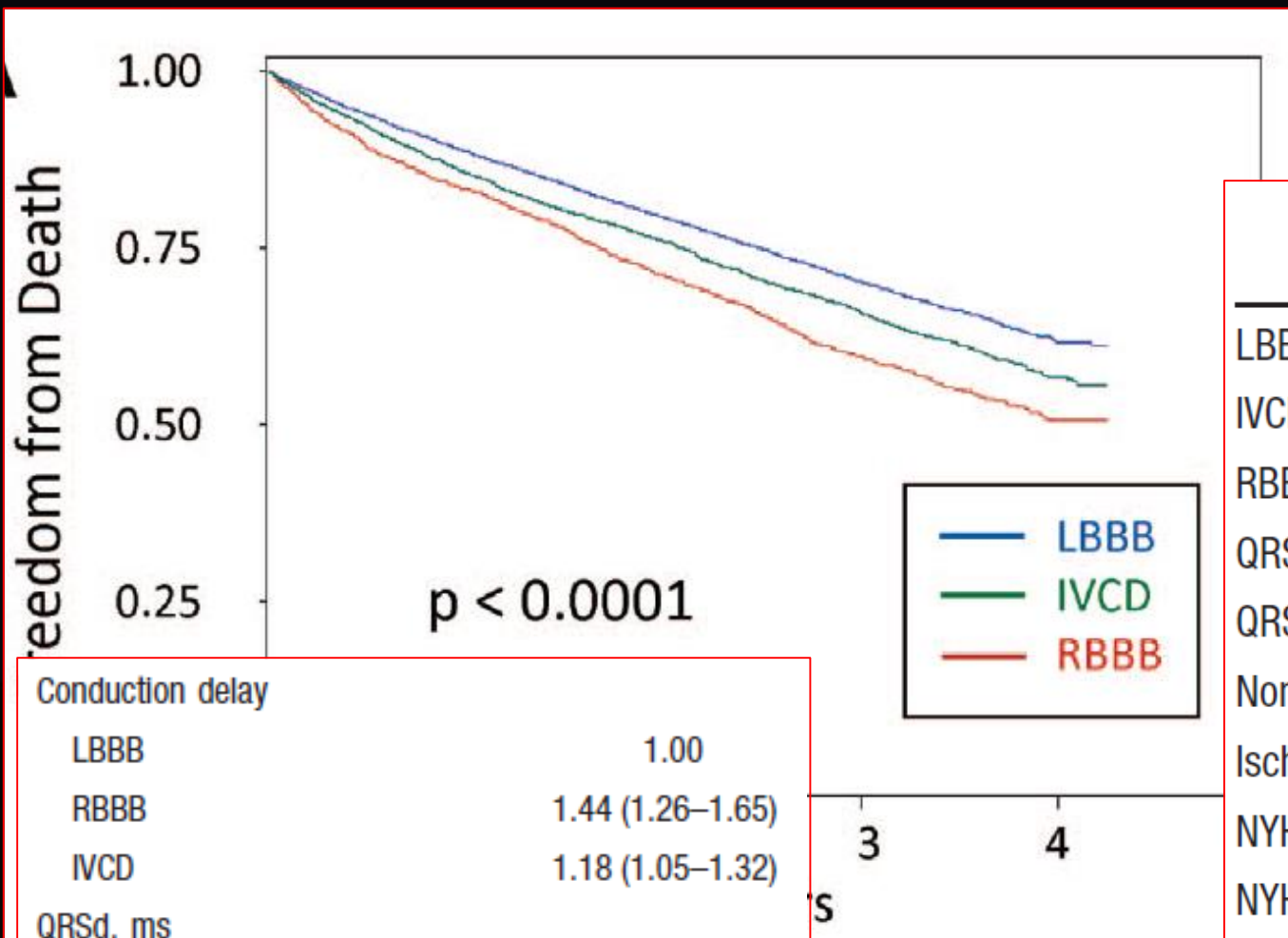


Table 2. Effect of QRS Morphology on Changes in Echocardiographic Parameters at 12 Months

	LBBB			Non-LBBB			P for Interaction*
	CRT OFF (n=99)	CRT ON (n=211)	P	CRT OFF (n=66)	CRT ON (n=131)	P	
LVESVi, mL/m ²	-1.7±25.8	-25.3±28.5	<0.0001	-1.5±19.7	-6.7±25.8	0.18	0.0003
LVEDVi, mL/m ²	-1.8±30.0	-25.7±31.5	<0.0001	-1.2±24.7	-8.5±30.5	0.11	0.0043
LVEF, %	0.8±6.9	6.9±9.7	<0.0001	0.7±6.3	0.9±7.2	0.88	0.0002

Gold,
 Circulation
 2012;126:822-9

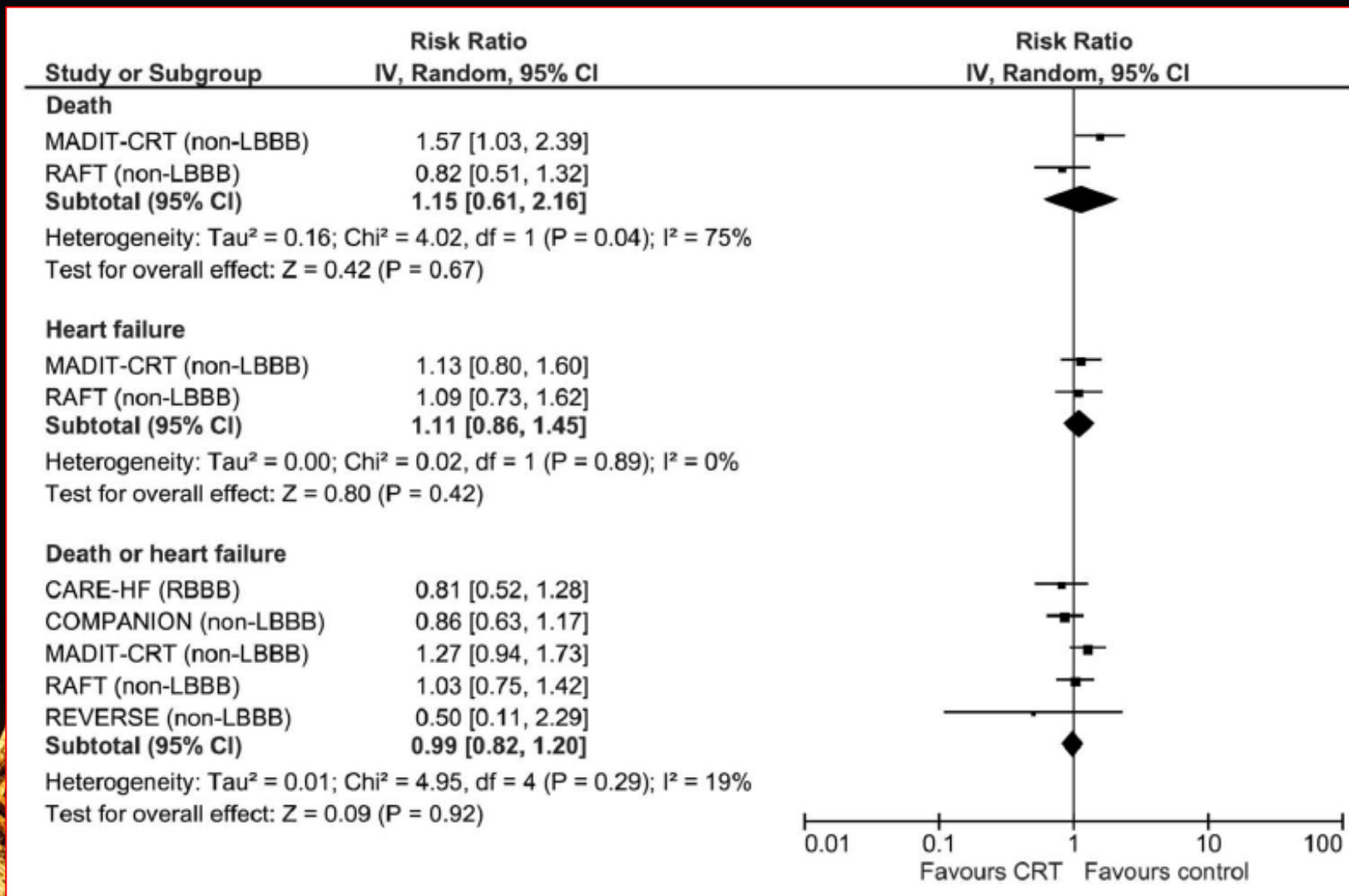
CRT in 15,000 MEDICARE Patients



	Early (1-y) Death, %
LBBB	11.3
IVCD	14.5
RBBB	16.7
QRSd ≥ 150 ms	11.5
QRSd 120–149 ms	14.1
Nonischemic CM	9.5
Ischemic CM	13.9
NYHA class I–II	8.0
NYHA class III	11.6
NYHA class IV	21.6

Conduction delay	
LBBB	1.00
RBBB	1.44 (1.26–1.65)
IVCD	1.18 (1.05–1.32)
QRSd, ms	
120–149	1.00
≥ 150	0.77 (0.70–0.84)

CRT in Non-LBBB: Metaanalysis 2015

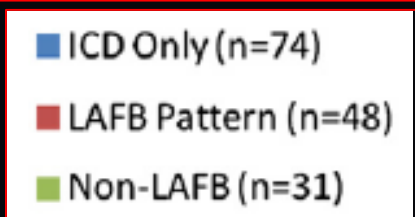
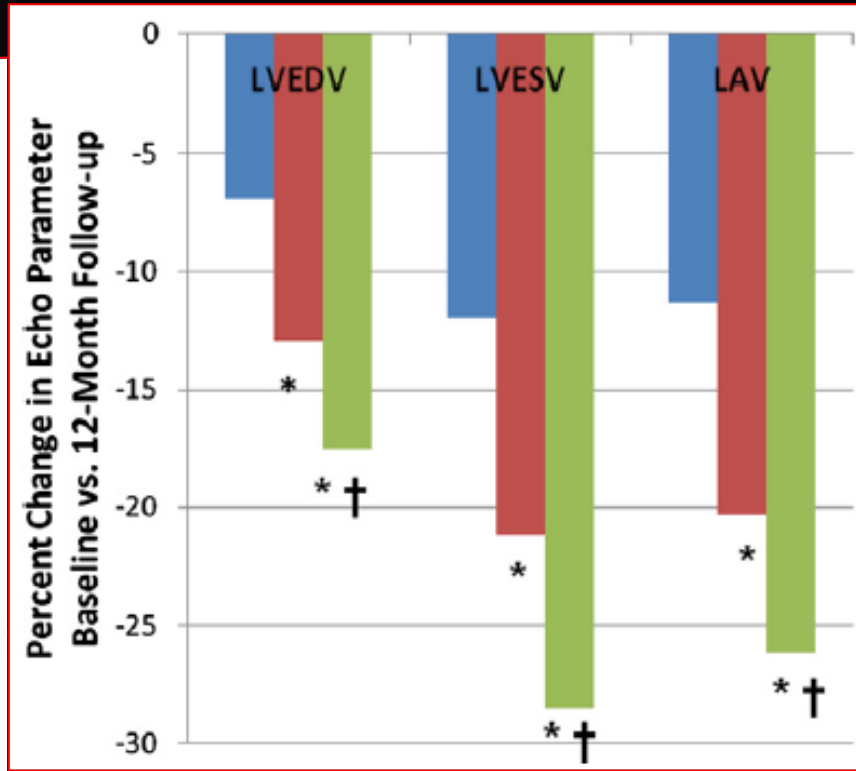
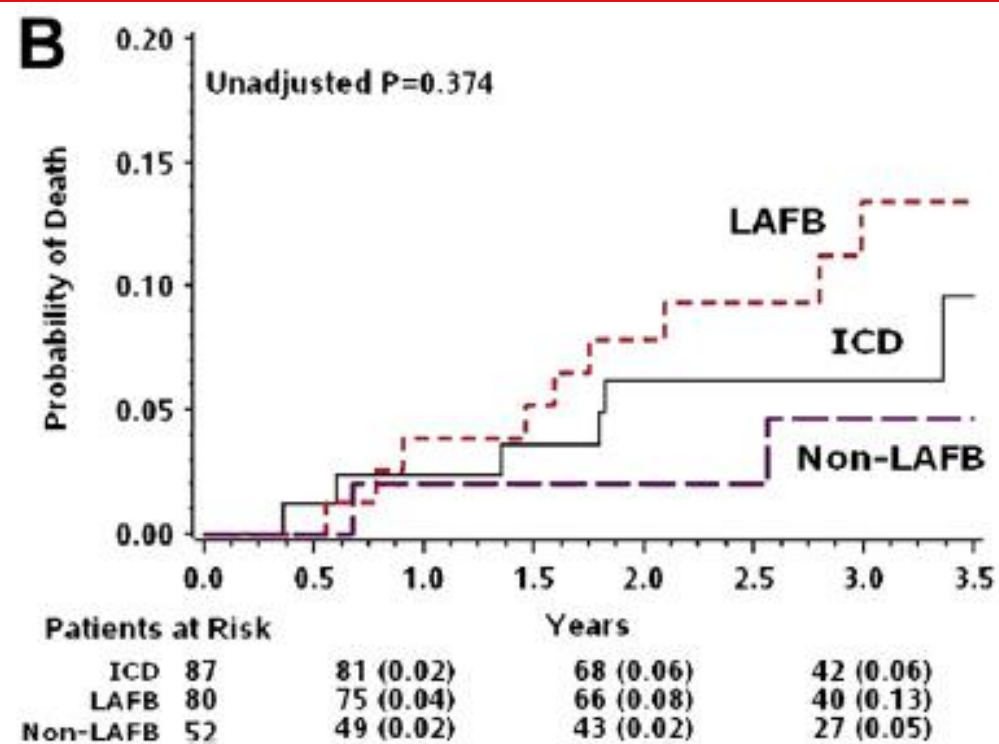


ESC Guidelines 2013

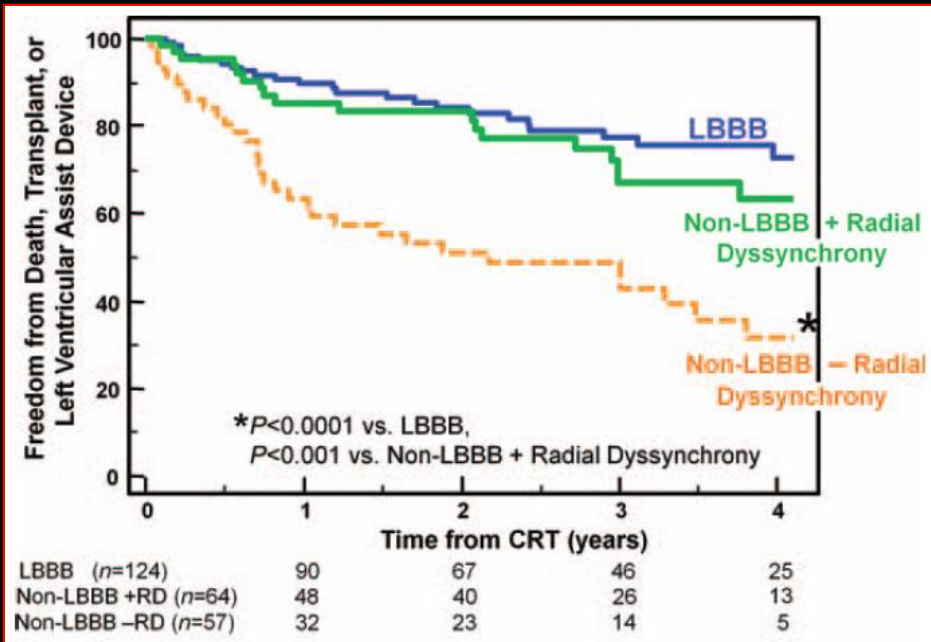
- Sinus rhythm
- LVEF \leq 35%
- optimal medical therapy
- NYHA class II, III or (ambulatory) IV

Recommendation	Class	Level of Evidence
LBBB, QRS > 150 ms	I	A
LBBB, QRS 120-150 ms	I	B
Non-LBBB, QRS > 150 ms	IIa	B
Non-LBBB, QRS 120-150 ms	IIb	B
QRS < 120 ms	III	B

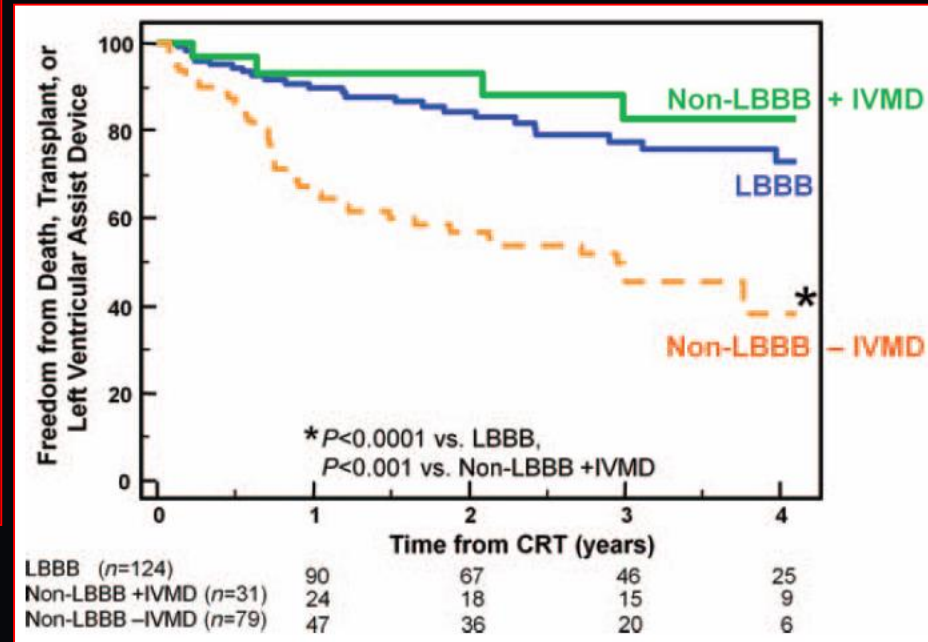
RBBB ± LAHB



CRT in Non-LBBB: Dyssynchrony

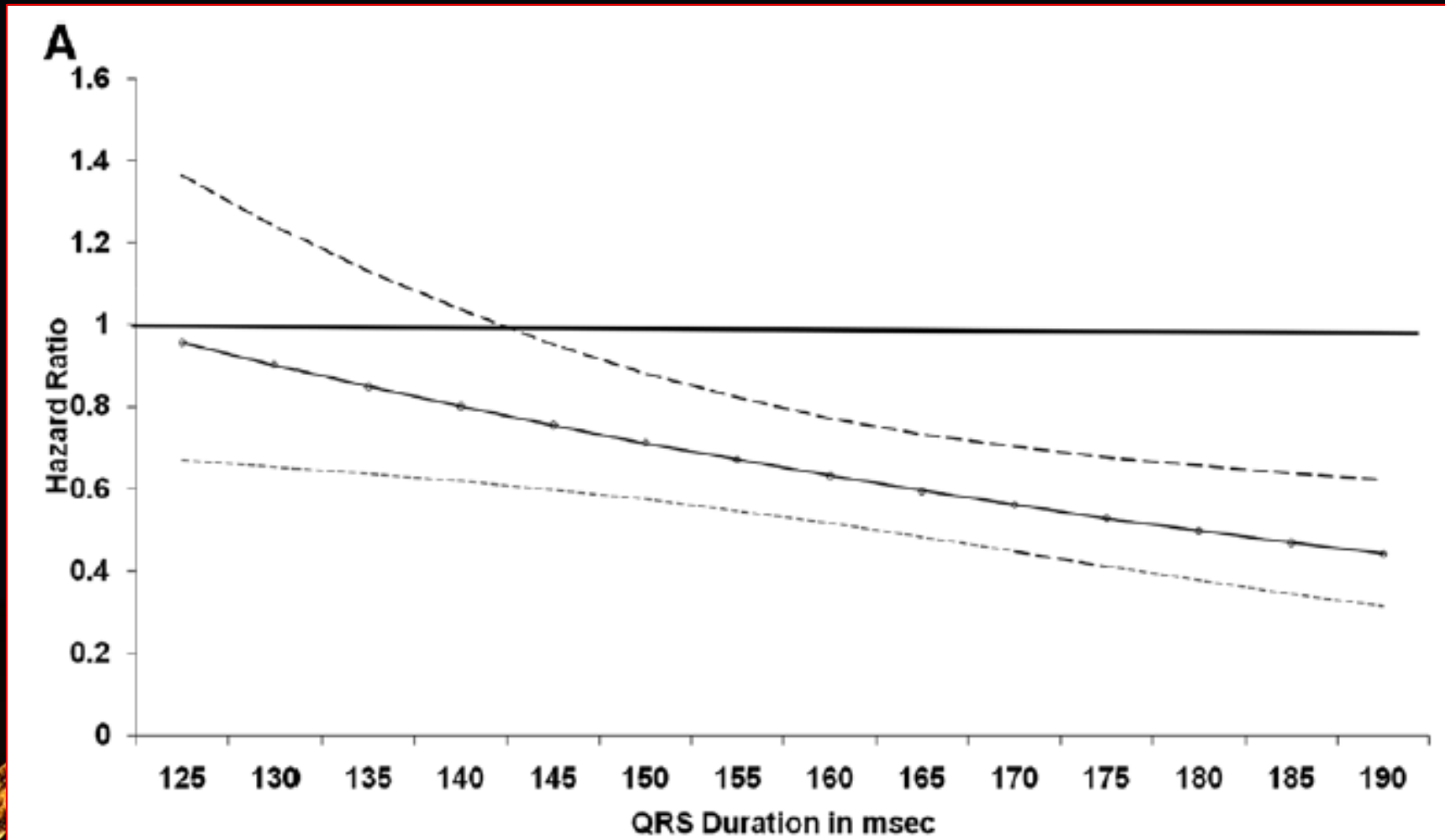


Pittsburg, PA



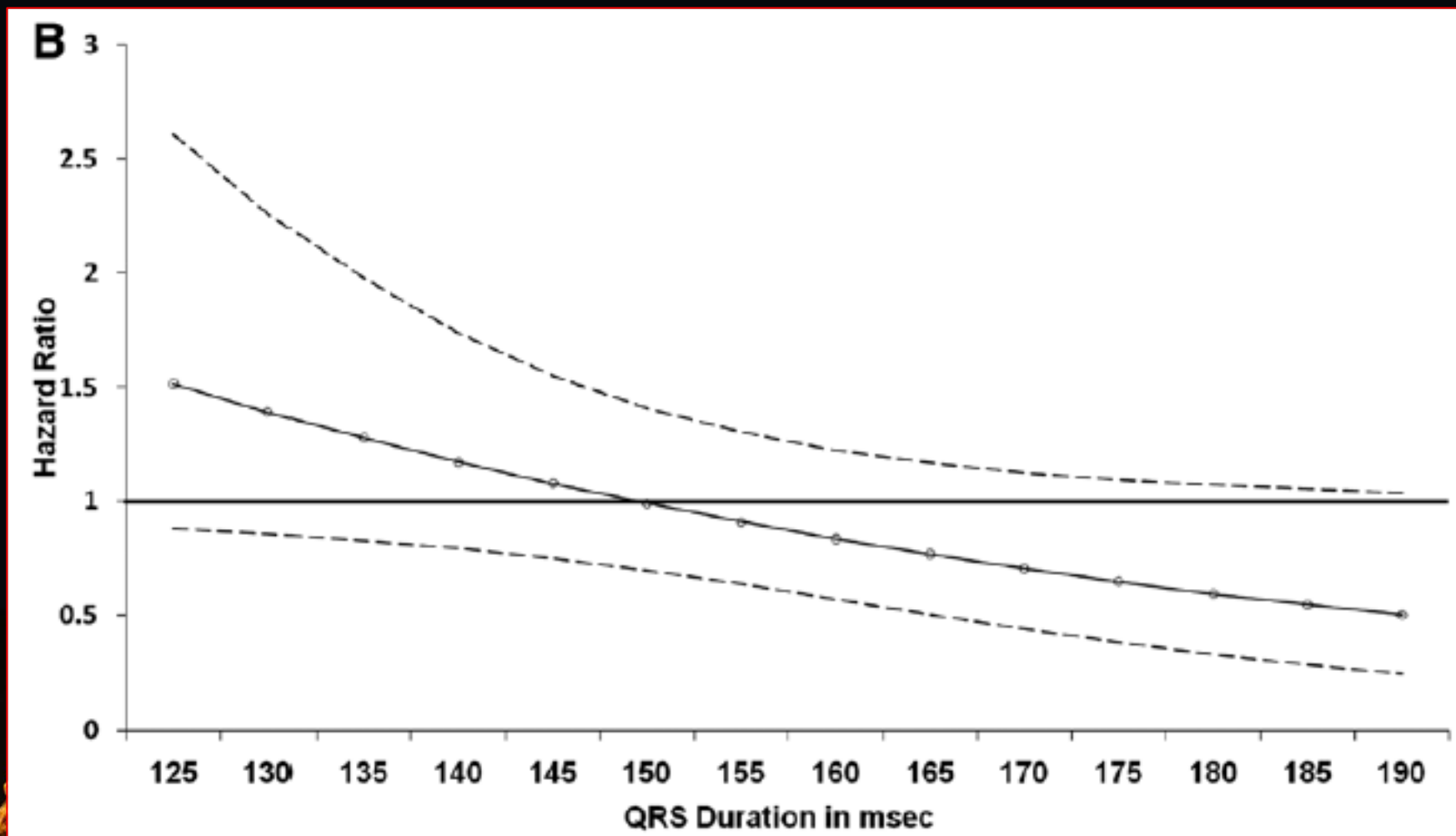
→ Non-LBBB pts with dyssynchrony better long-term survival with CRT than non-LBBB pts without dyssynchrony

LBBB and QRS Duration: RAFT



Hazard ratio for primary composite endpoint

Non-LBBB and QRS Duration: RAFT



Hazard ratio for primary composite endpoint

Non-LBBB and PQ Duration: MADIT-CRT

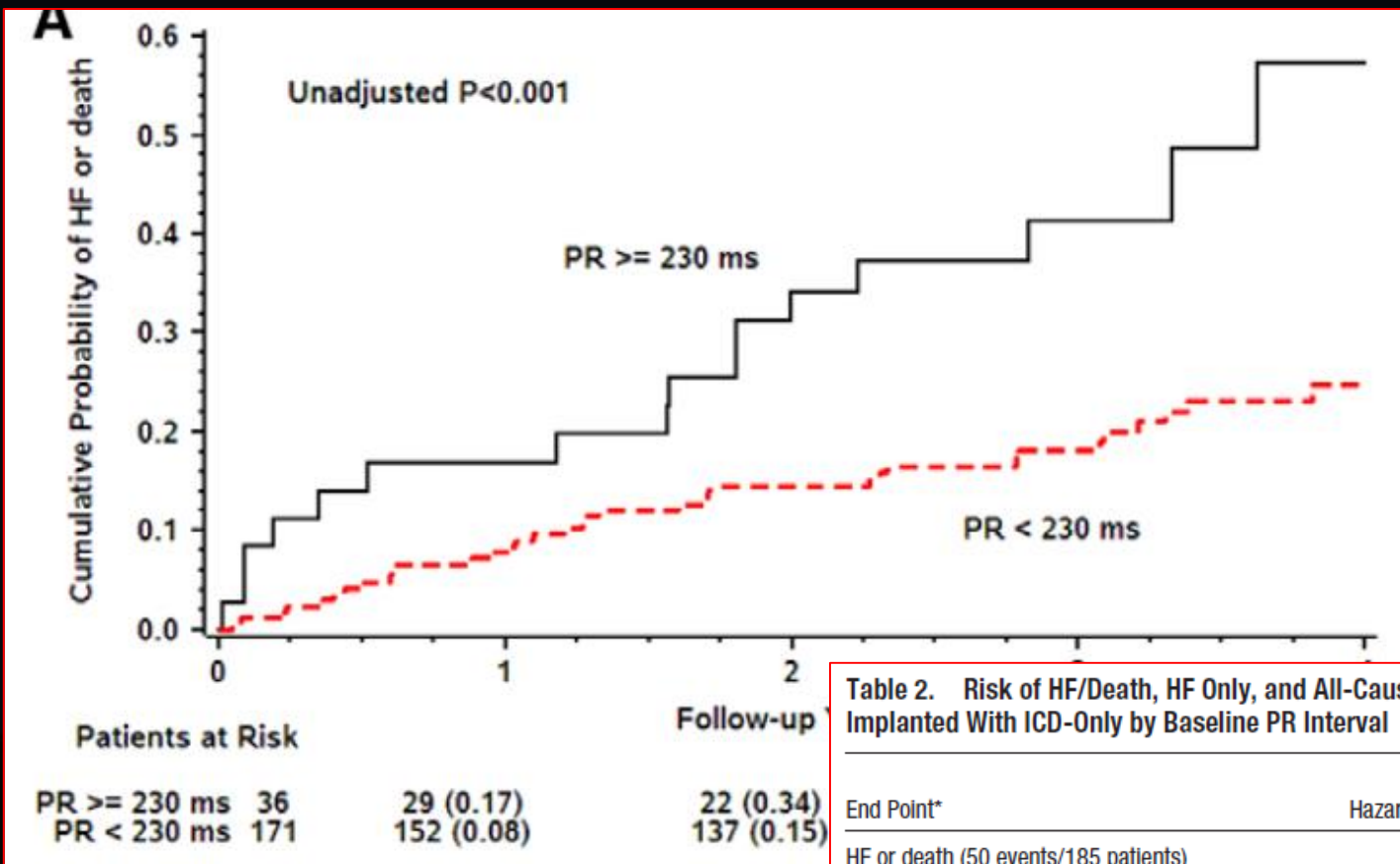
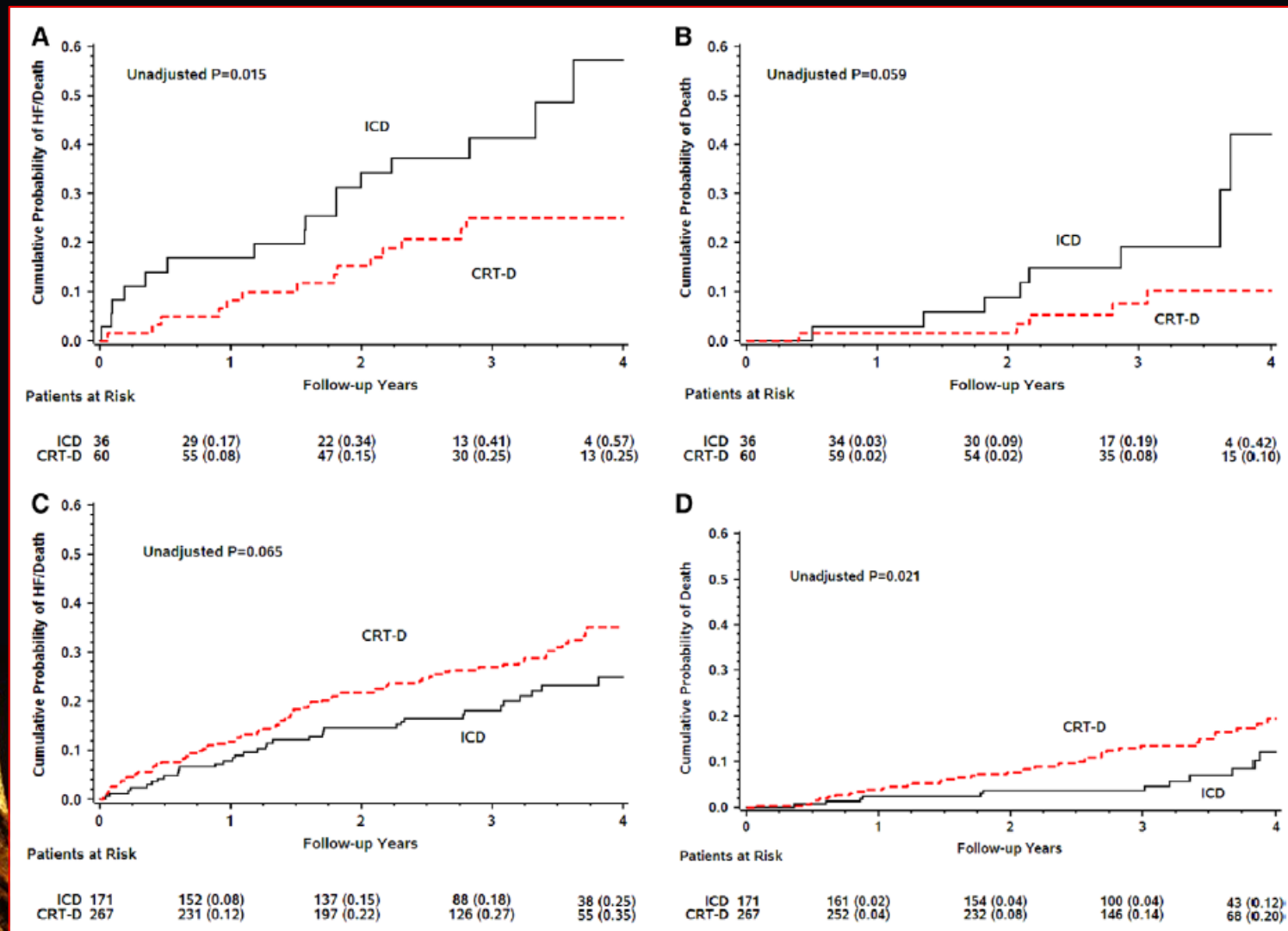


Table 2. Risk of HF/Death, HF Only, and All-Cause Mortality in Non-LBBB Patients Implanted With ICD-Only by Baseline PR Interval

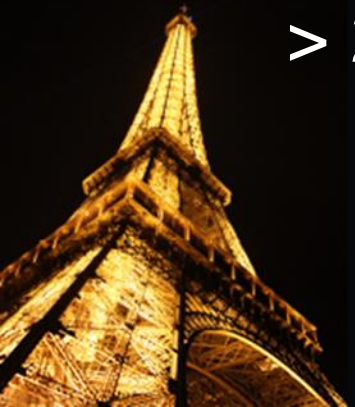
End Point*	Hazard Ratio	95% Confidence Interval	P Value
HF or death (50 events/185 patients)			
PR \geq 230 vs PR <230 ms (17 vs 33 events)	3.28	1.72–6.26	<0.001
HF only (45 events/185 patients)			
PR \geq 230 vs PR <230 ms (16 vs 29 events)	3.56	1.82–6.98	<0.001
All-cause mortality (20 events/185 patients)			
PR \geq 230 vs PR < 230 ms (8 vs 12 events)	3.56	1.34–9.51	0.01

Non-LBBB and PQ Duration: MADIT-CRT



CRT Update 2017

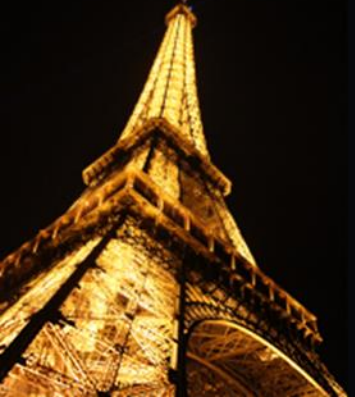
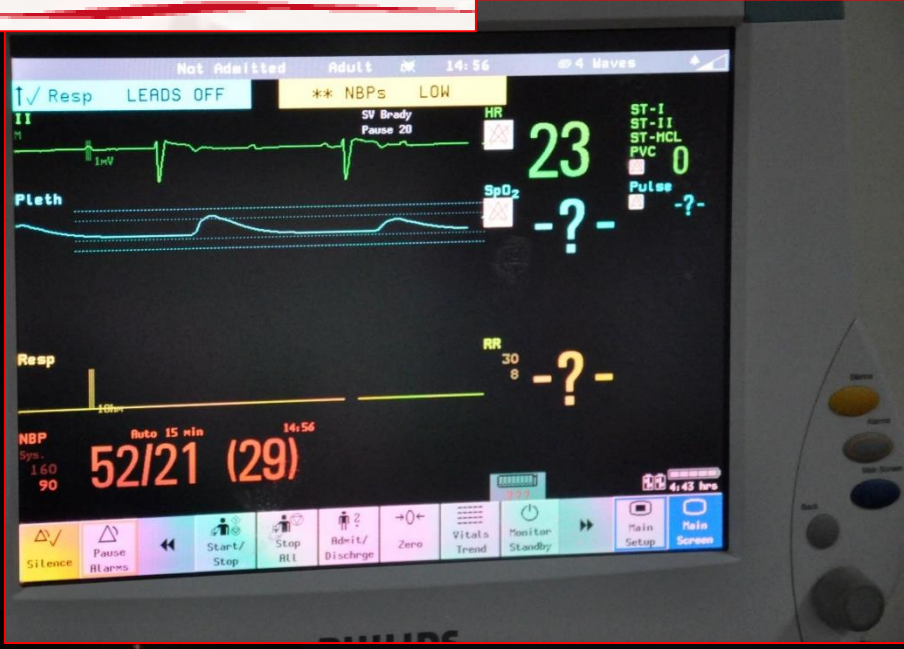
- Better materials
- Quadripolar leads (+MPP) increase response to CRT
- Endocardial (multisite) LV pacing
- Indication: permanent AF, Non-LBBB, PQ > 230 ms





East African Heart Rhythm Project

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Thank You for Your Attention!

AF and CRT: Metaanalysis

