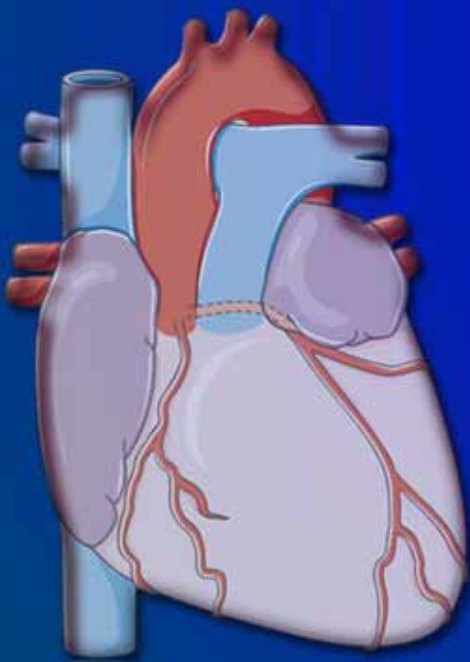


Cardiac Resynchronisation Therapy

Experience From Clinical Cases

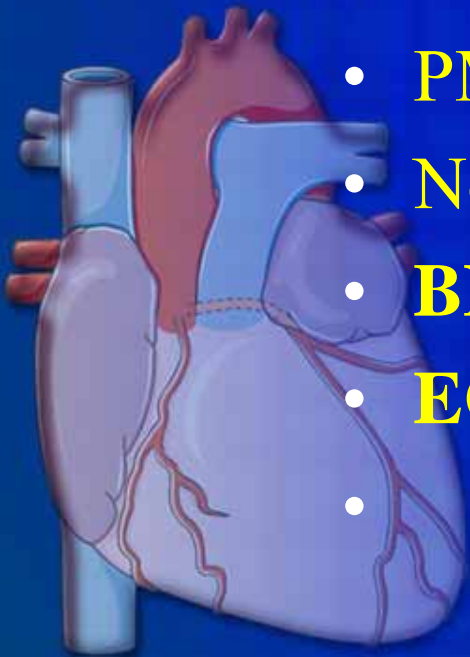


Dr Nizam Domah , Dr Deva Chellen, Dr S Deenoo

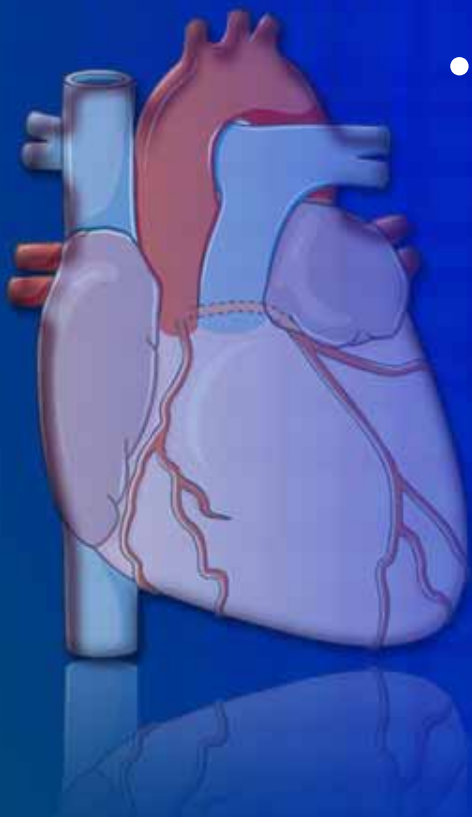
Victoria Hospital

Clinical Case 1

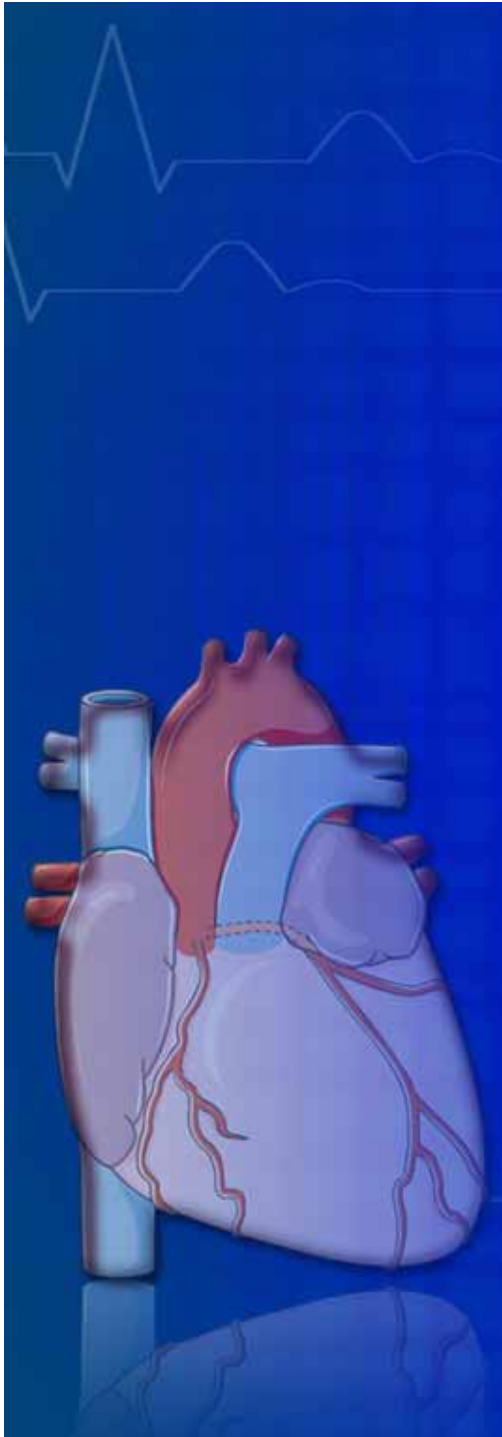
- Female 62 yrs
- 1st admission 03/06/2004 with Hx of sudden onset of Acute SOB c Palpitations.
- Dyspnea with Orthopnea ++.Gallop rhythm
Bilateral Crepts +++
- PMH : DM, HTN, Hyperlipidemia - Nil
- No h/o of anginal pain.
- **BP 130/80mm/hg**
- **ECG : NSR, HR 120/min**
- **LBBB with large QRS complexes**



- Treatment started :
Classical treatment for APO :
loading dose diuretics ; IV nitrates ..
- Portable CXR : Gross Cardiomegaly
pulmonary venous congestion



- Bed side Cardiac Echocardiogram :
Features of DCM with poor LVEF 20%;
Globulous LV with global hypokinesia ,
left atrium not dilated;
MR GD 1 ,
estimated PAP 45mmhg.
Valves are normal .



Blood investigations :

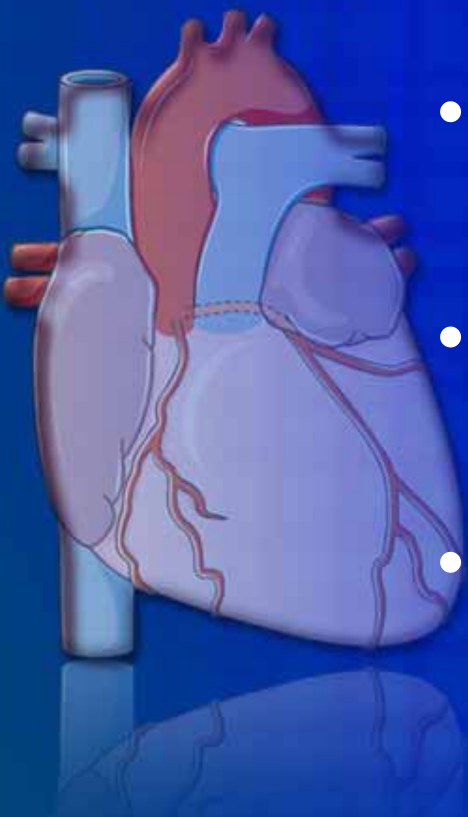
Troponin **NEGATIVE**.

Random blood sugar 6.3 mmol

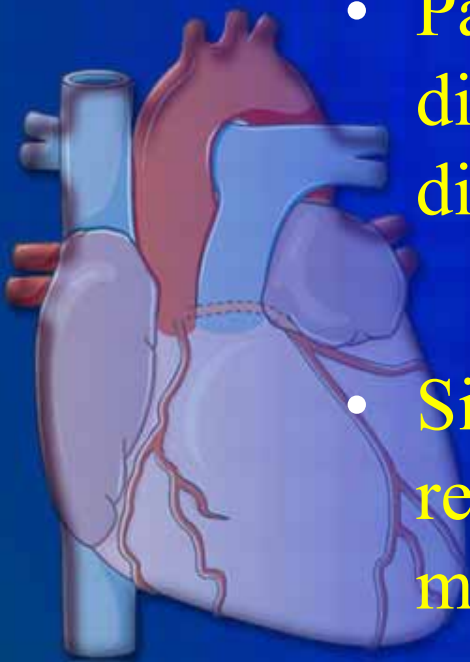
Urea & Electrolytes – Within normal range

Free T3 T4 TSH... all normal.

- Further Investigations !
- Once patient dry....
Coronary angio: Normal Arteries
- Most likely aetiology Idiopathic
Cardiomyopathy. Viral ??
- Discharged on D6 on ACE inhib.,
Diuretics, Nitroglycerin Patch (to reduce
pre-load), carvedilol , anti vit K ..

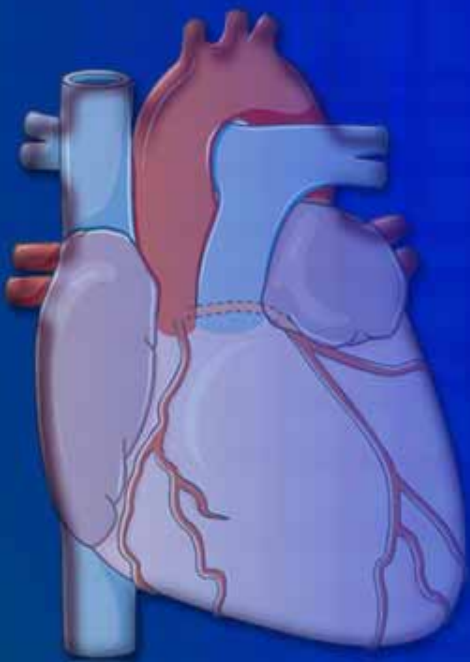


- Re admission within 1 wk with relapse of pulm oedema ..
- Confirms that meds prescribed were regularly being taken.
- Treatment were revised and diuretics titrated up.
- Patient stayed this time for 4 days and discharged on same except higher dose of diuretics..
- Since then patient has been admitted very regularly and no more responding to maximal medical treatment.....

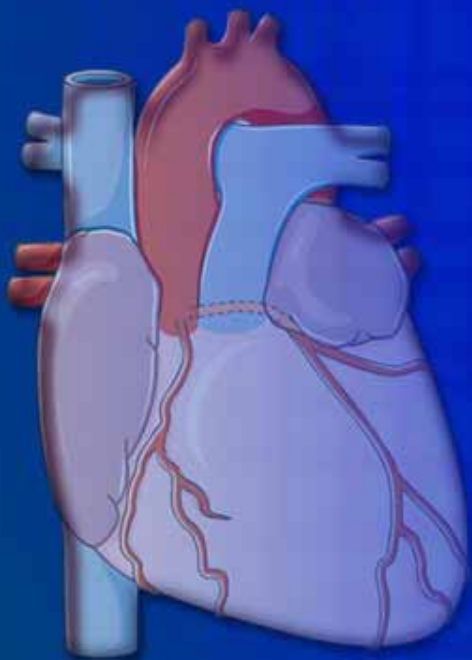


Pt still symptomatic:

NYHA III/IV orthopneic.



WHAT NEXT.



Mx Options in Refractory Heart Failure

DEVICE THERAPY

- CRT
- ICD
- CRT-D (Combo Device)

SURGICAL

Revascularization
Mitral Valve repair/
replacement
LVaDs
Cardiac transplant
TAH
Stem Cell Therapy
LV remodeling surgeries
(Batista or Dor's procedure)

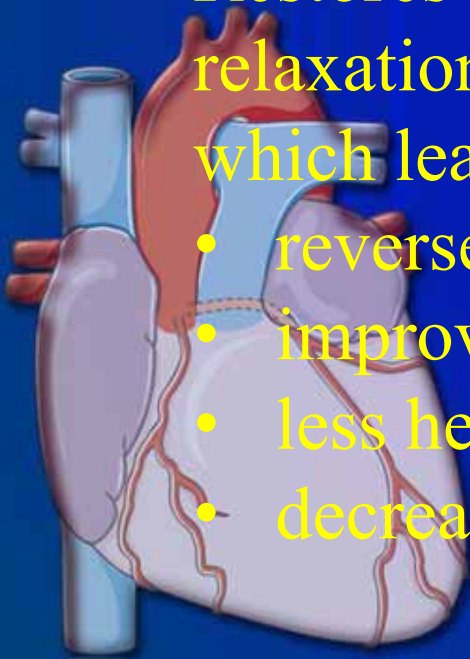
Others : Ultrafiltration(Peritoneal Dialysis)
Corcap

Background CRT

One of the most successful heart failure therapies to emerge in the last decade and is applicable to ~25–30% of patients with symptomatic heart failure

Restores the coordination of contraction and relaxation among the cardiac chambers, which leads to

- reverse ventricular remodelling,
- improved exercise tolerance,
- less heart failure admissions and
- decreased mortality



Concept of Dyssynchrony

Electrical
dyssynchrony

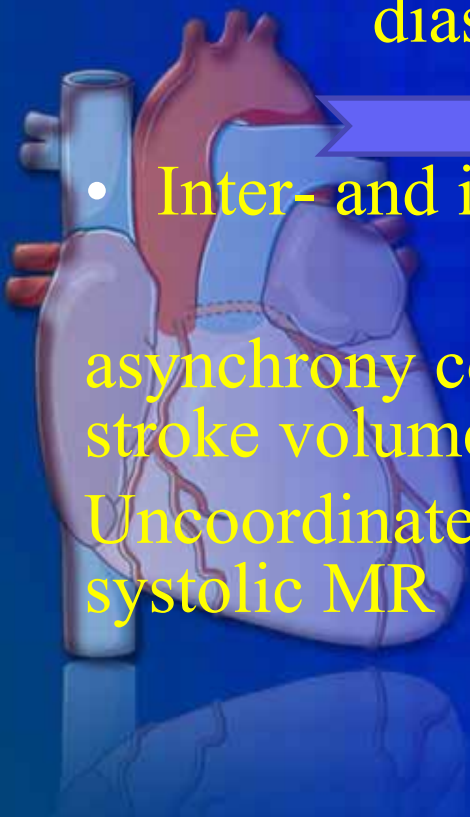


Mechanical
dyssynchrony



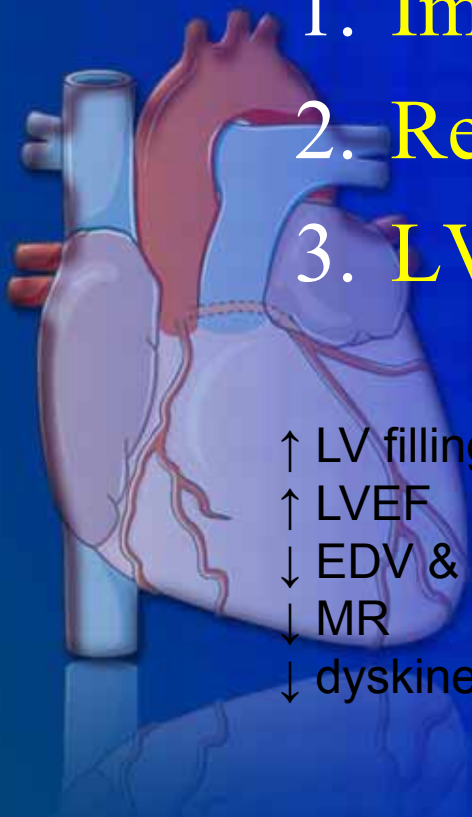
Dyssynchrony

- AV- delay
 - Prolonged AV interval → delayed systolic contraction of LV → impairment of early diastolic filling
 - ↳ LA diastolic pressure < LV diastolic pressure → diastolic MR
 - ↳ LV preload → ↓ contractility
- Inter- and intra-ventricular conduction delay (ventricular dyssynchrony)
 - asynchrony contraction → ↓ efficiency of contraction → ↓ stroke volume
 - Uncoordinated papillary muscle → aggravation of functional systolic MR



Resynchronization

- Restores AV, inter- and intra-ventricular dyssynchrony leading to:
 1. Improvement of LV function
 2. Reduction of functional MR
 3. LV reverse remodeling



- ↑ LV filling time
- ↑ LVEF
- ↓ EDV & ESV
- ↓ MR
- ↓ dyskinesia

Dyssynchrony

- Electrical dyssynchrony
 - QRS duration
 - Intracardiac electrogram
- Mechanical dyssynchrony
 - UCG
 - MRI
 - Nuclear medicine

Mechanical Dyssynchrony

- Echocardiography
 - Mmode
 - Tissue velocity imaging:
 - Velocity, time to peak velocity
 - Strain, time to peak strain
 - Speckle tracking

Methods of patient assessment prior to CRT implant

	Assessment	Goals
Basic requirements	ECG	QRS duration and morphology rhythm, PR interval, P-wave morphology
	Echocardiogram	Ejection fraction, LV size, MR, RV function
	Functional testing (6 min hall walk test or CPX)	Baseline objective functional status
	History and physical exam	NYHA symptom class, comorbidities, life-expectancy, risk for altered venous anatomy, suitability for procedure
	Serum chemistries	Electrolytes and renal function, coagulation tests
	Medication usage	Maximally tolerated doses for appropriate duration. Include diuretic evaluation for volume status

Additional evaluations: optional	Mechanical dyssynchrony by echo	Type and extent of dyssynchrony
	Stress echocardiography	Assess 'recruitable' myocardium
	Cardiac CT angiography	Great cardiac vein and branch mapping, CS ostium, LVEF, chamber sizes
	CMRI	Great cardiac vein and branch mapping, CS ostium, LV tissue characteristics including infarct area, LVEF
	QOL measurement	Baseline measurement for future comparison

CRT for severe HF



- EF <35%
- QRS>120ms +LBBB
- sinus rhythm
- NYHA III~IV (ambulatory)
- on optimal recommended medical therapy.



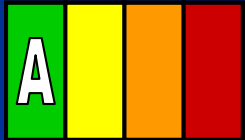
- EF <35%
- QRS>120ms
- Atrial fibrillation
- NYHA III~IV (ambulatory)
- on optimal recommended medical therapy.



- EF <35%
- Ventricular pacing dependant
- NYHA III~IV (ambulatory)
- on optimal recommended medical therapy.

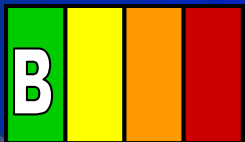
Cardiac Resynchronization Therapy in Patients With Systolic Heart Failure

I IIa IIb III



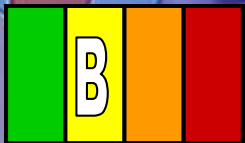
CRT is indicated for patients who have left ventricular ejection fraction (LVEF) less than or equal to 35%, sinus rhythm, LBBB with a QRS duration greater than or equal to 150 ms, and NYHA class II, III, or ambulatory IV symptoms on GDMT. (Level of Evidence: A for NYHA class III/IV; Level of Evidence: B for NYHA class II).¹

I IIa IIb III



CRT can be useful for patients who have LVEF less than or equal to 35%, sinus rhythm, LBBB with a QRS duration 120 to 149 ms, and NYHA class II, III, or ambulatory IV symptoms on GDMT.²

I IIa IIb III

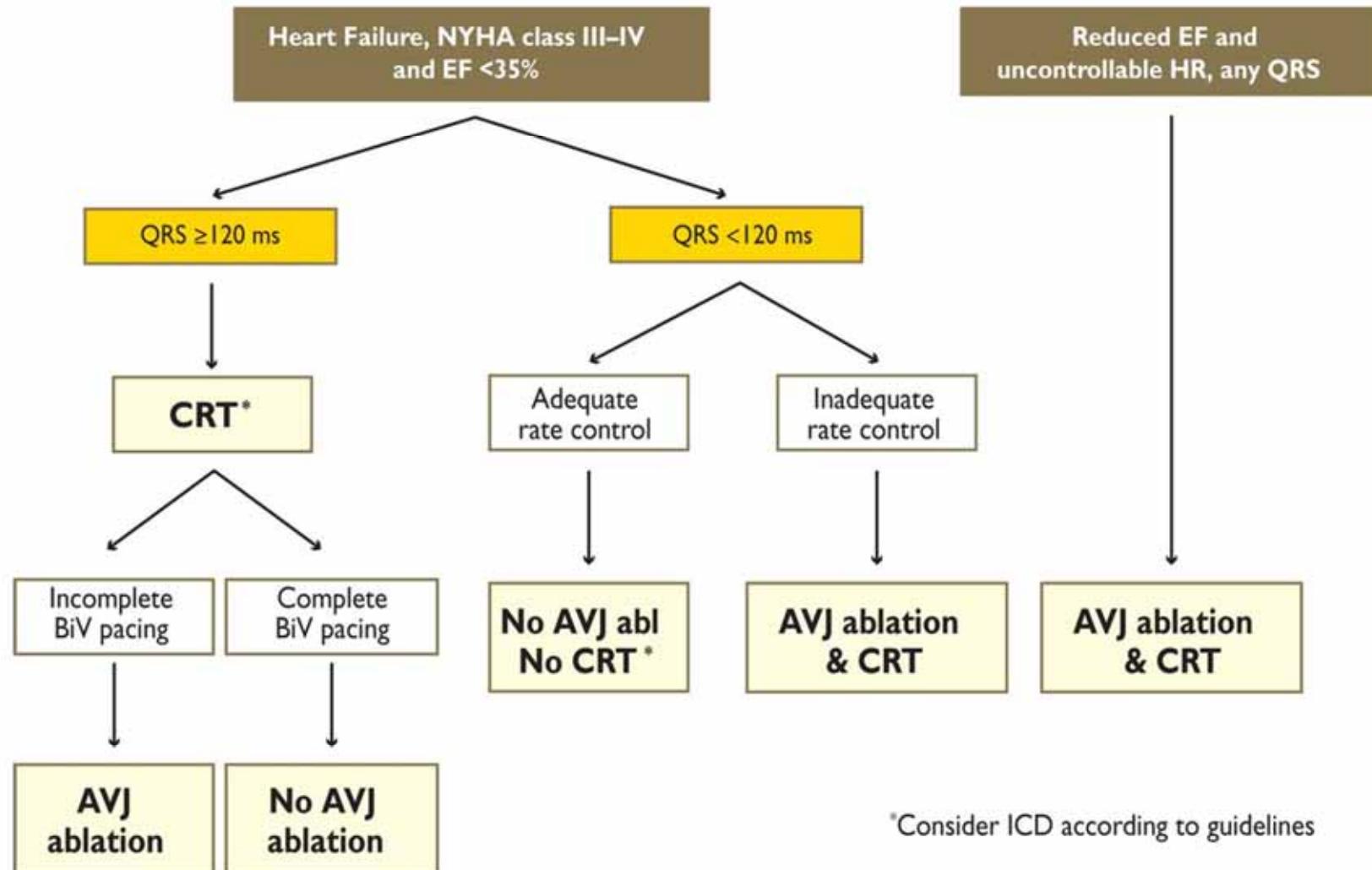


CRT can be useful for patients who have LVEF less than or equal to 35%, sinus rhythm, a non-LBBB pattern with a QRS duration greater than or equal to 150 ms, and NYHA class III/ambulatory class IV symptoms on GDMT.²

I IIa IIb III



Indication for atrioventricular junction (AVJ) ablation in patients with symptomatic permanent atrial fibrillation (AF) and optimal pharmacological therapy.

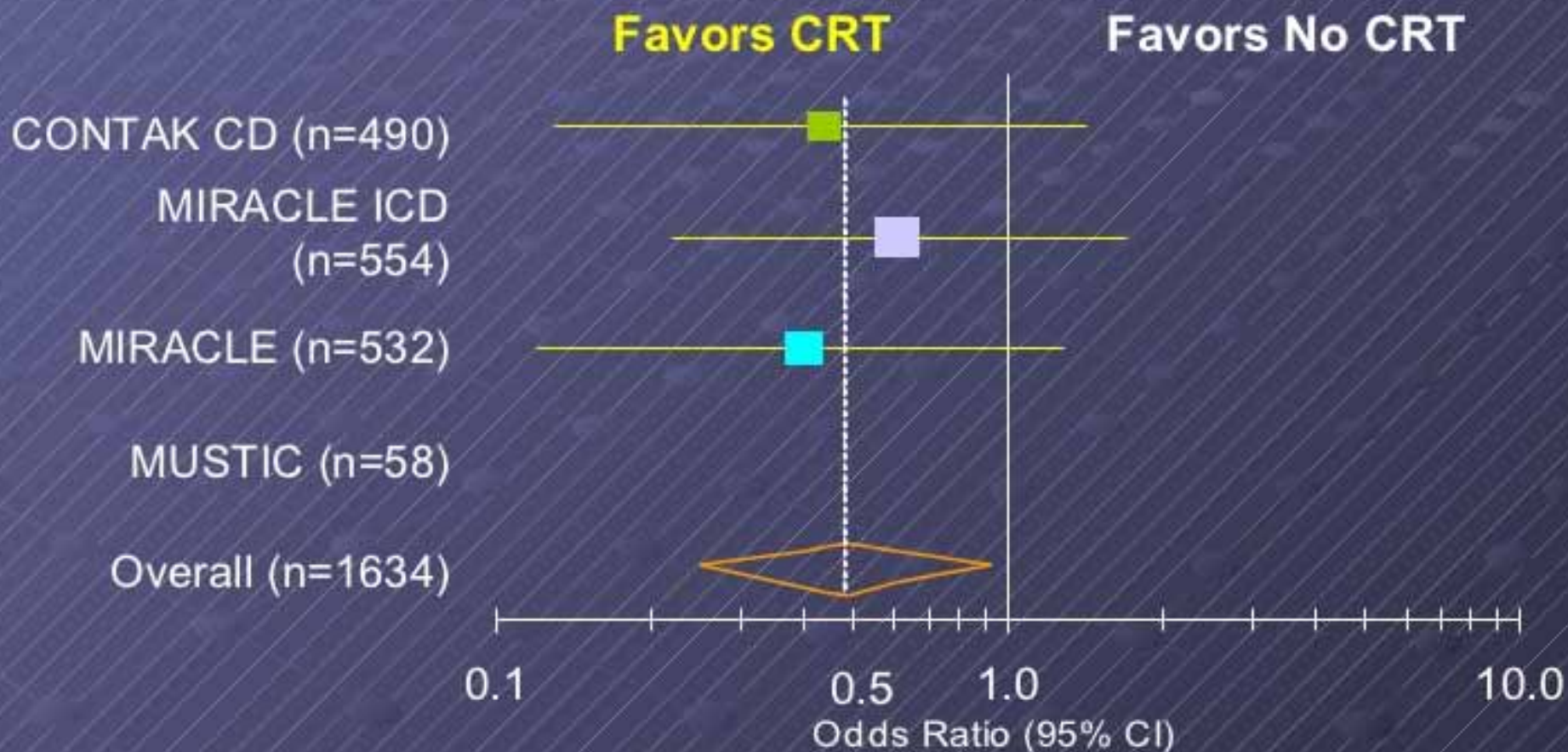


Authors/Task Force Members et al. Eur Heart J
2013;eurheartj.eht150

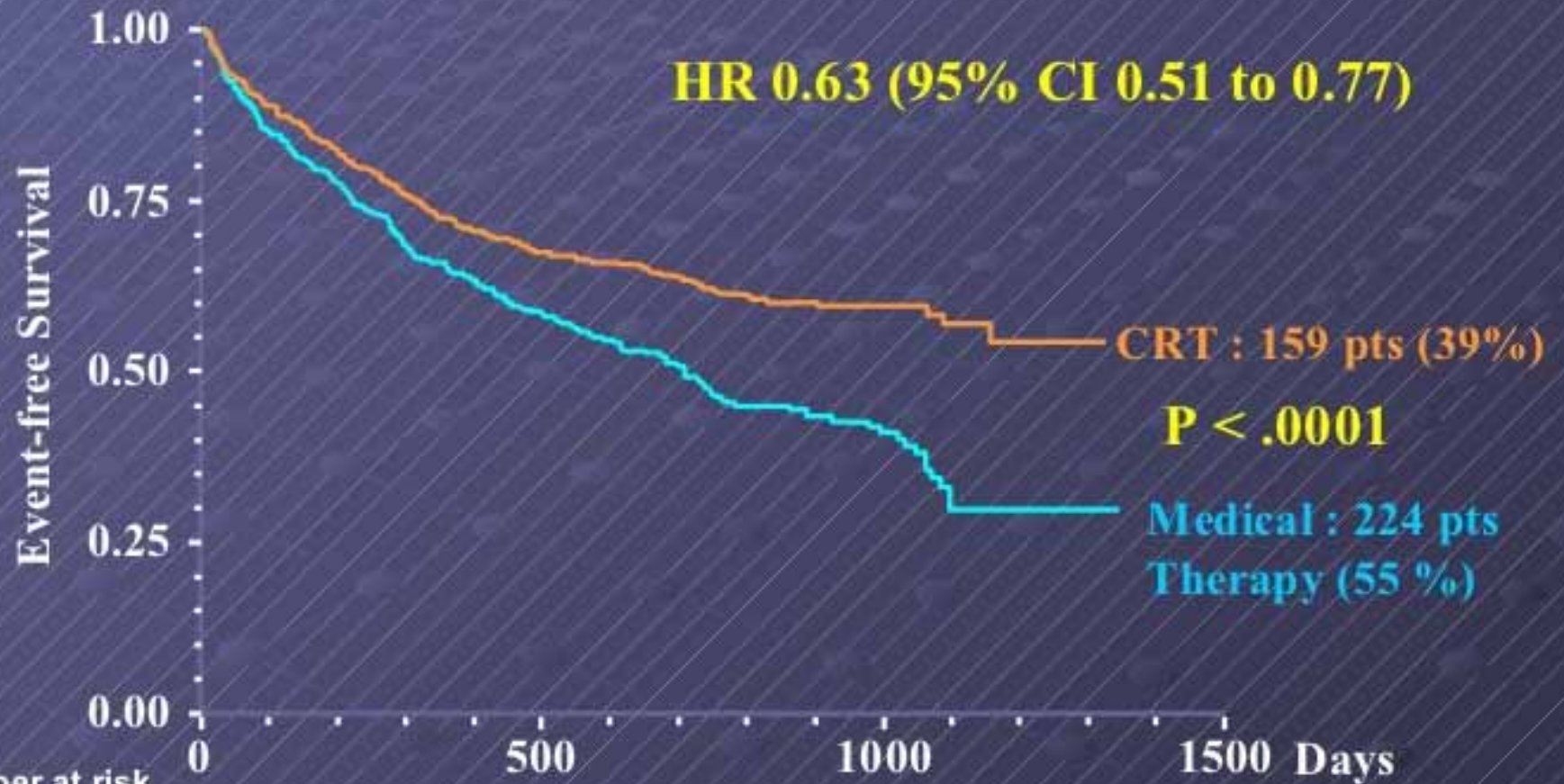
Progressive Heart Failure Mortality

51% Relative Reduction with CRT

Overall odds ratio (95% CI) of 0.49 (0.25 - 0.93)



CARE-HF: Primary Endpoint (All-cause Mortality or HF Hosp.)



Number at risk

CRT	409	323	273	166	68	7
Medical Therapy	404	292	232	118	48	3

409

323

273

166

68

7

404

292

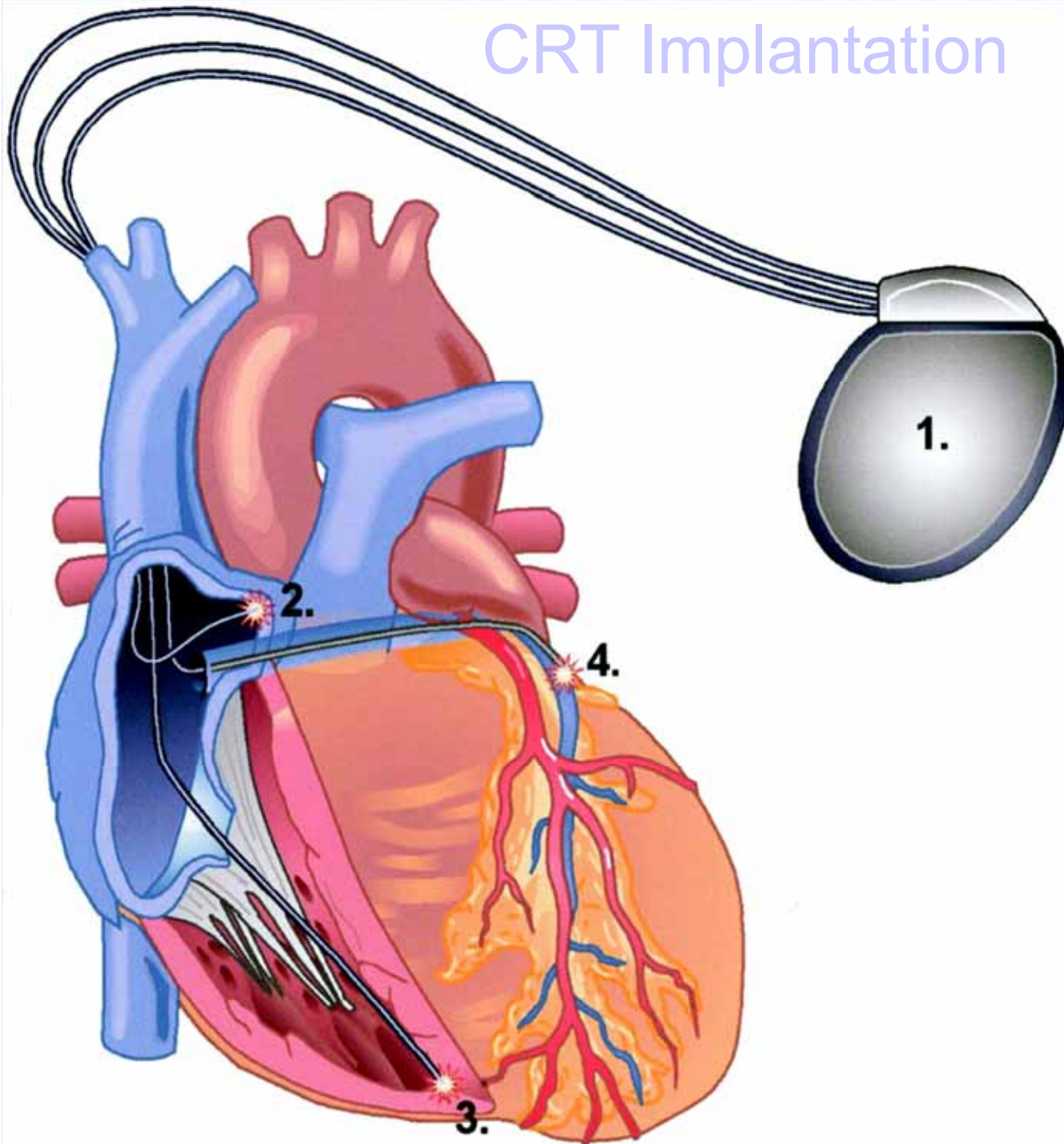
232

118

48

3

CRT Implantation

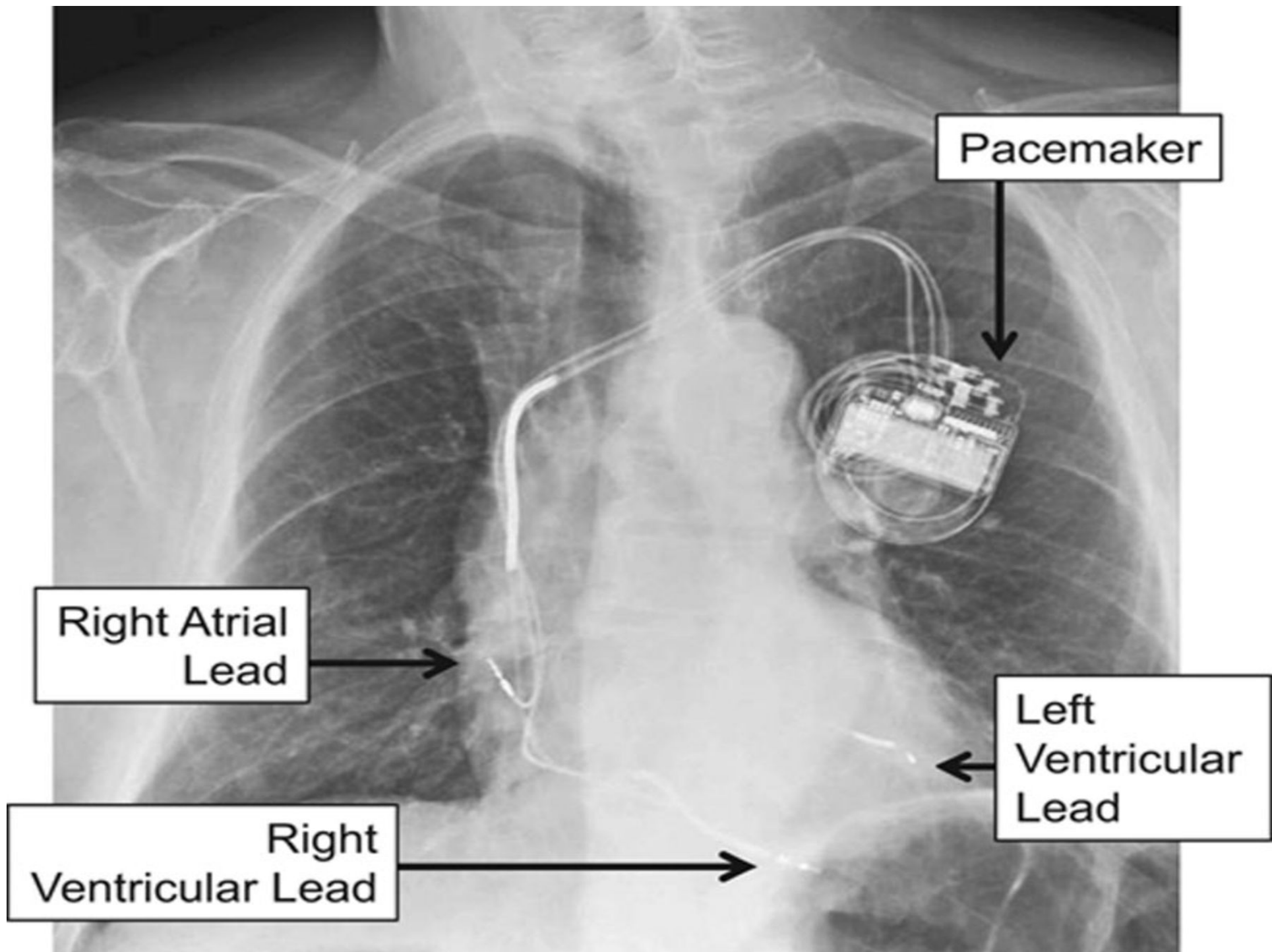


CRT.
1, Pacemaker generator;

2, right atrial pacer wire;

3, right ventricular pacer wire;
And

4, coronary sinus (“left ventricular”) pacer wire.



Back to Clinical Case 1

Female 62 yrs

DM, HTN, IHD - Nil

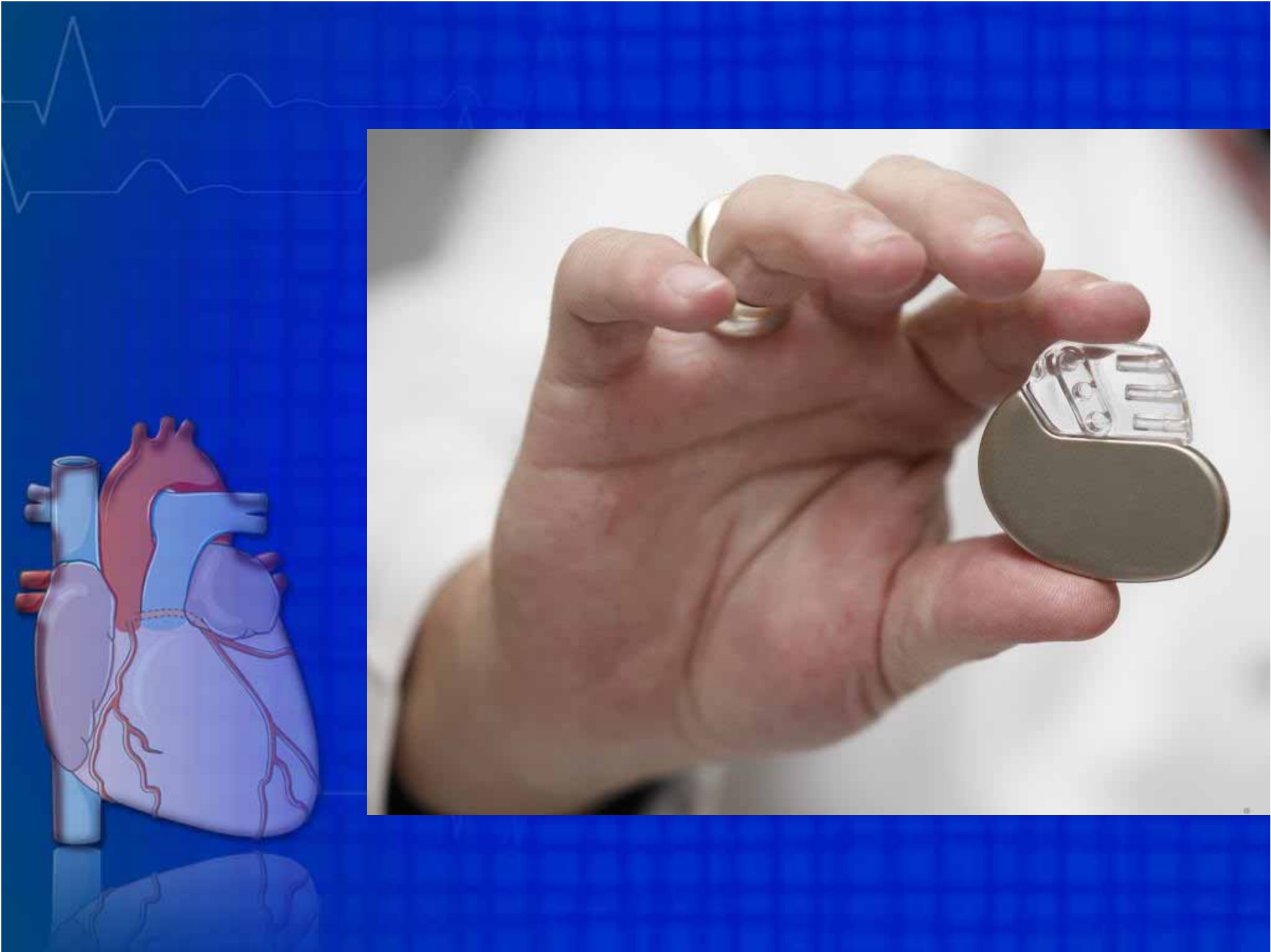
DCM with poor lvf 20%

LBBB with large QRS

Refractory despite guideline-directed medical therapy (GDMT)

So She fits in..

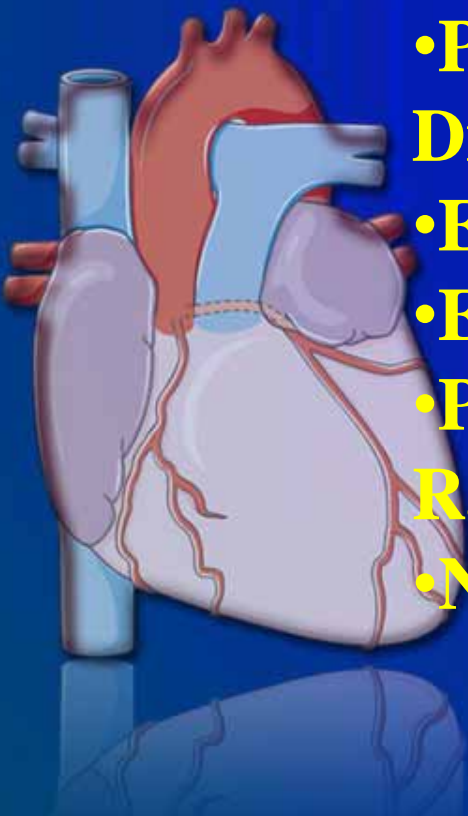




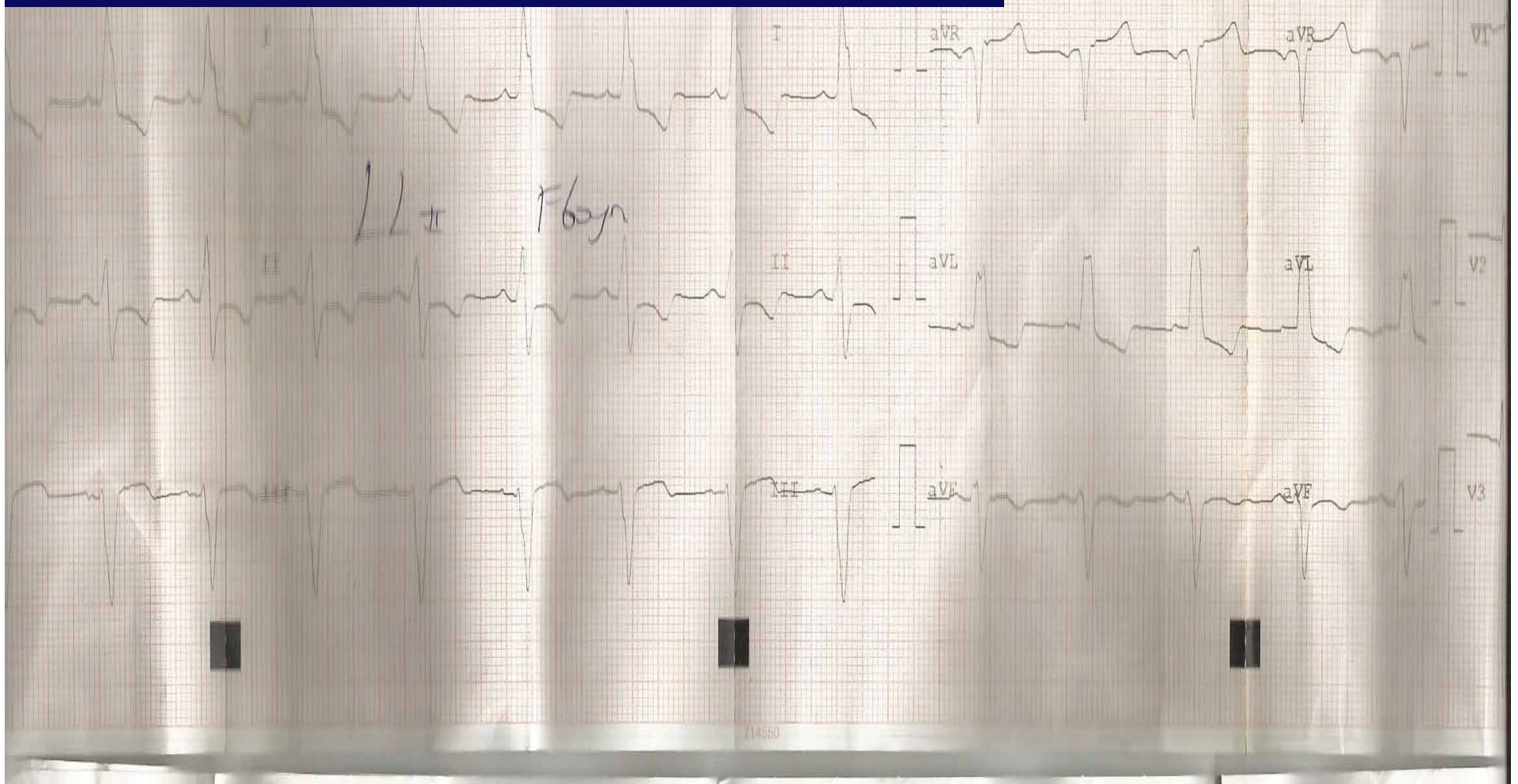
OUTCOME POST IMPLANT

Clinical outcome post implant:

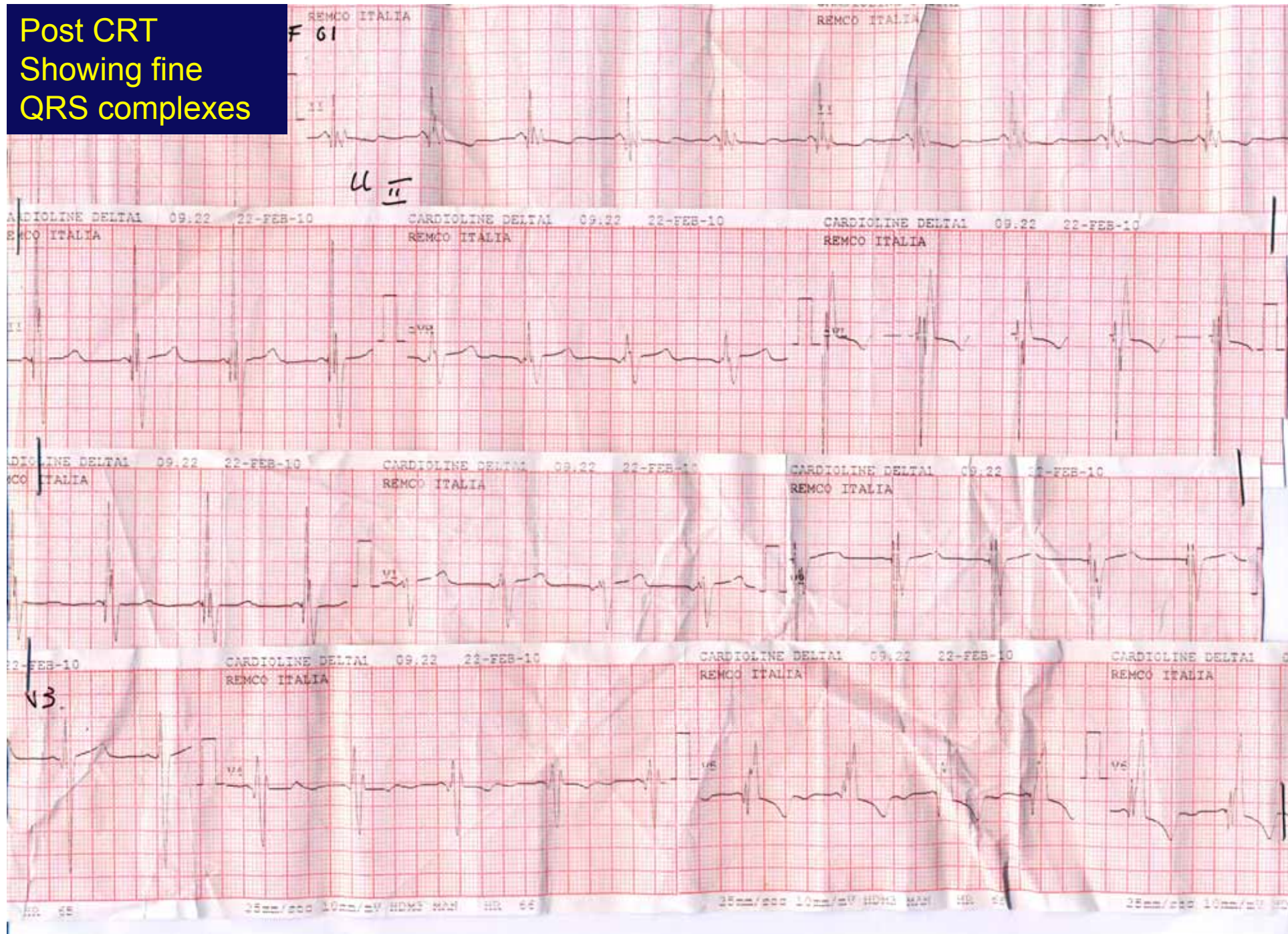
- Drastic improvement within 2 wks : NYHA I
- No orthopnea ;
- Progressively resume normal activities ;
- Diuretics tailored off .
- ECG –Fine QRS complexes
- ECHO LVEF 40-45 %
- Present Meds :Carvedilol 25 mg bd ;
Ramipril 5 mg od..
- No Admission since implantation (2009)

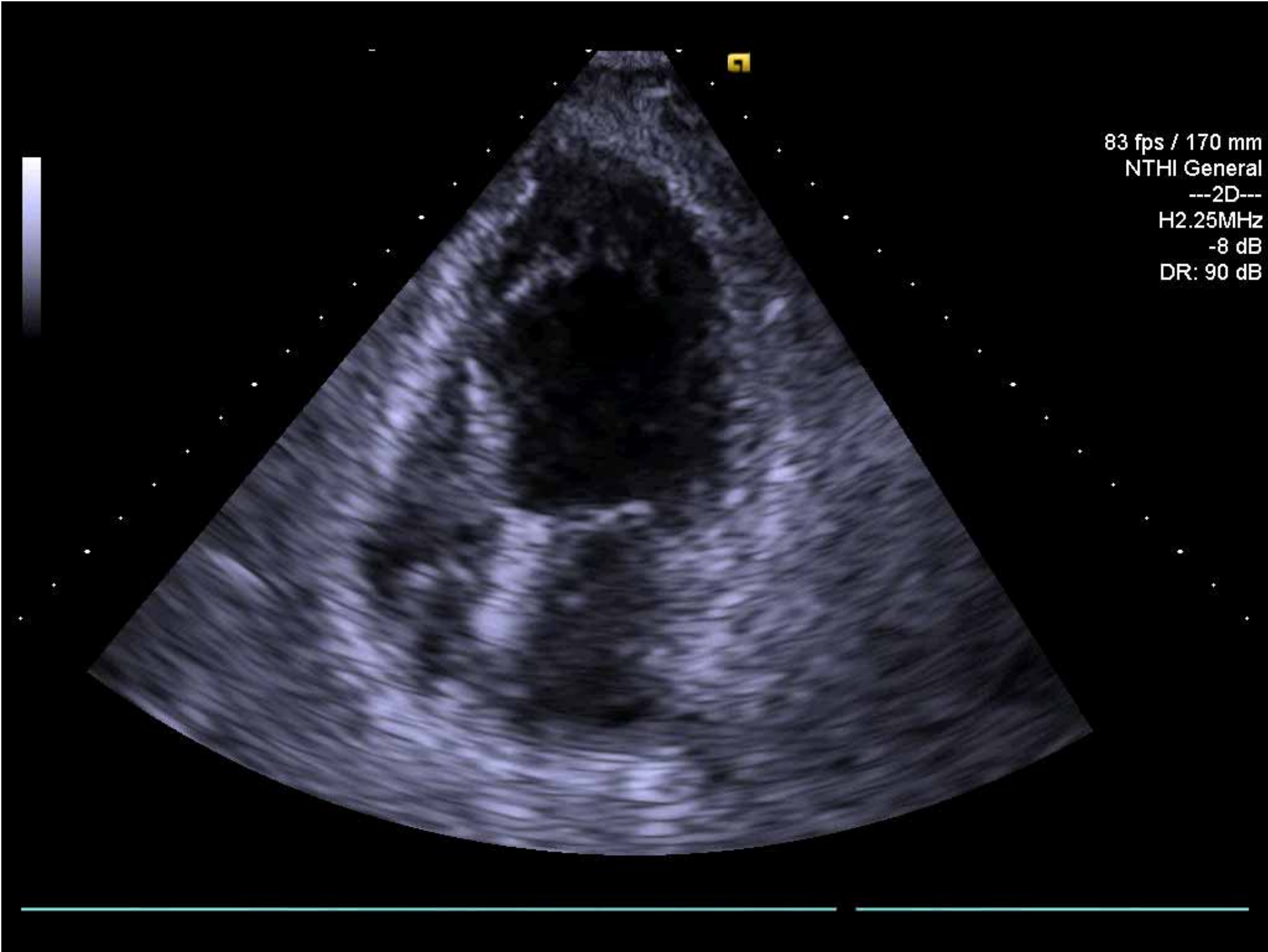


Pre CRT showing Wide QRS Complexes

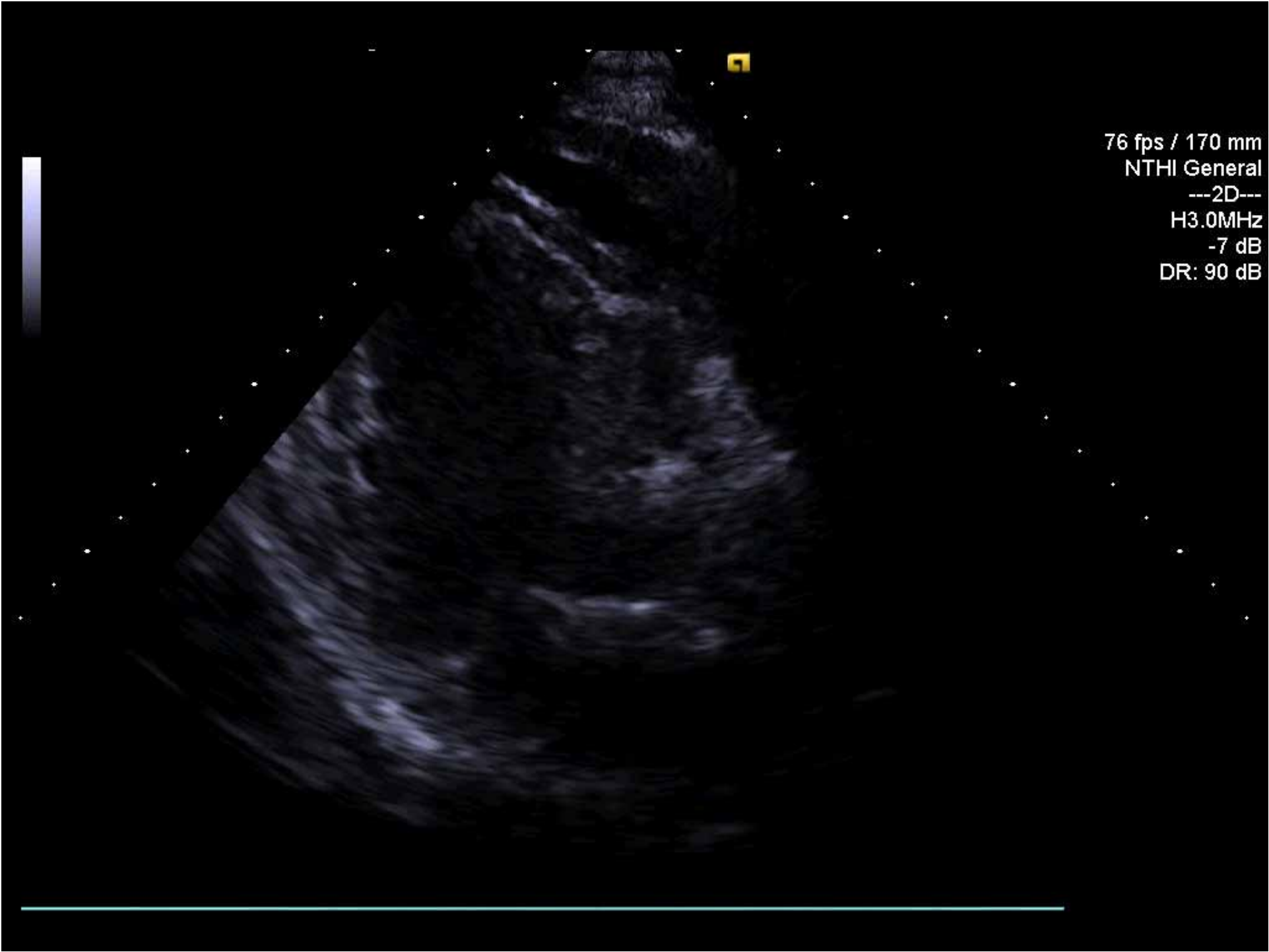


Post CRT
Showing fine
QRS complexes





83 fps / 170 mm
NTHI General
---2D---
H2.25MHz
-8 dB
DR: 90 dB



76 fps / 170 mm
NTHI General
---2D---
H3.0MHz
-7 dB
DR: 90 dB

Clinical Case 2

- Male 57 yrs
- Acute AWTMI 1992 (Thrombolysed)
- CAG 1997 : LAD Non signif lesion ,
LCX & RCA Normal

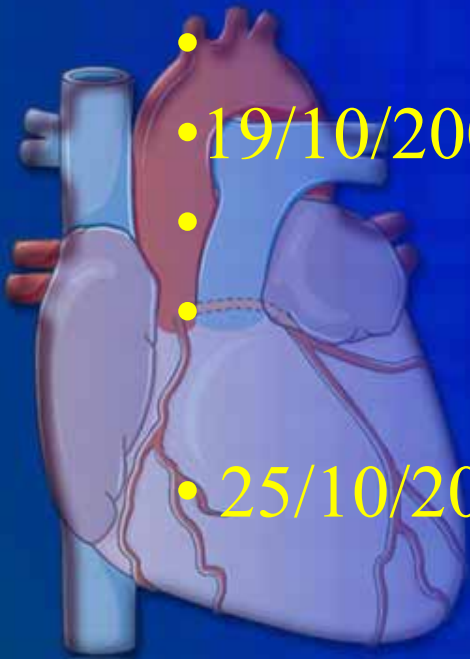
Med Rx

• 19/10/2000 Admitted c VT → DC Shocked *5times

↓
NSR , HR 73/min

↓
VT ,Fits DC Shocked *5times

• 25/10/2000





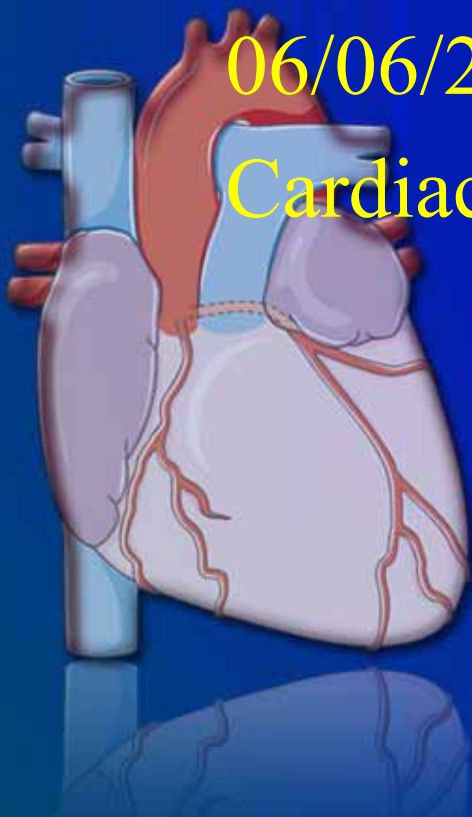
Stable on Med Rx for 5yrs

06/06/2006 VT DC Shocked 150/200J *3times

Cardiac Echo : Dilated LV c EF 20%

Akinetic Septum

Further Management !



- RE-Coronary Angiography:
Minor lesion LAD, LCX, RCA Normal

- Optimal Med Rx :
Carvedilol , Aldactone, Cordarone , ASA , ATV

- Still having episodes of VT

Benefited from CRT –D

No Admission since implantation



Device Monitoring



(Continued) VF 29 Apr 2012 1:11

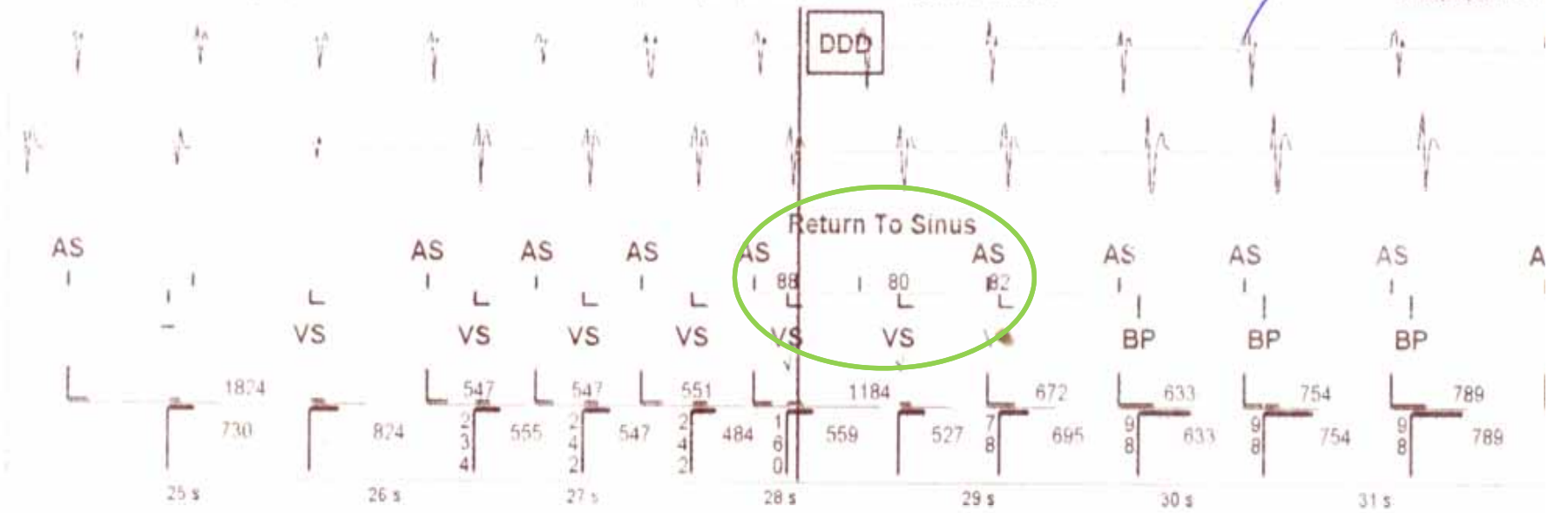
Report 5 of 6

Position 1 A Sense Amp: Aulogain (1.1 mm/mV)

Position 2 V Sense Amp: Aulogain (0.4 mm/mV)

Position 3 Markers

Sweep Speed: 25 mm/s



CRT Cost Effectiveness

- Cost-effectiveness of CRT has been evaluated extensively^{1,2,3,4}
- Initial investment in implantation and ongoing device management is substantial
- However, cost effectiveness measures have been positive
 - Reduced hospitalization plus
 - Improved quality of life plus
 - Improved survival yields
 - Favorable incremental cost-effectiveness ratios (ICERS) per Quality Adjusted Life Year (QALY)

1. Fox M, et al. Health Technol Assess. 2007;11(47):1-248 [Meta-analysis]

2. Calvert MJ, et al. Eur Heart J. 2005;26:2681-8. [CARE-HF sponsored by Medtronic]

3. Caro JJ et al. Curr Med Res Opin 2006; 22: 1171 – 9.

4. Feldman AM, et al. J Am Coll Cardiol 2005;46:2311–21. [COMPANION sponsored by Guidant]

Adverse Effects

- Unable to implant LV lead due to unfavourable anatomy (3-10%)
 - Diaphragmatic stimulation due to proximity of phrenic nerve
 - Coronary sinus dissection (0.3-4.0%)
 - Coronary sinus perforation & tamponade (0.8-2.0%)
 - Periprocedural death (0.4%)
 - Dislodgement of LV lead (10%)
-
- Pneumothorax
 - Complete Heart Block
 - Asystole
 - Pacemaker pocket infection
 - External electromagnetic field

Further Study

- **? Benefit in NYHA I/II patients**
 - REVERSE⁷: no significance at end point
 - MADIT-CRT: late 2009
- **Approx. 20-30% of patients with CRT are non-responders**
 - Is the QRS duration a good predictor of CRT response?
 - Could echo evidence of ventricular dyssynchrony be more predictive?⁸
 - "Dyssynchrony study"⁹
- **Application in patients with AF?**

Thank You

