



SHOULD WE CONSIDER RESCUE CRT?

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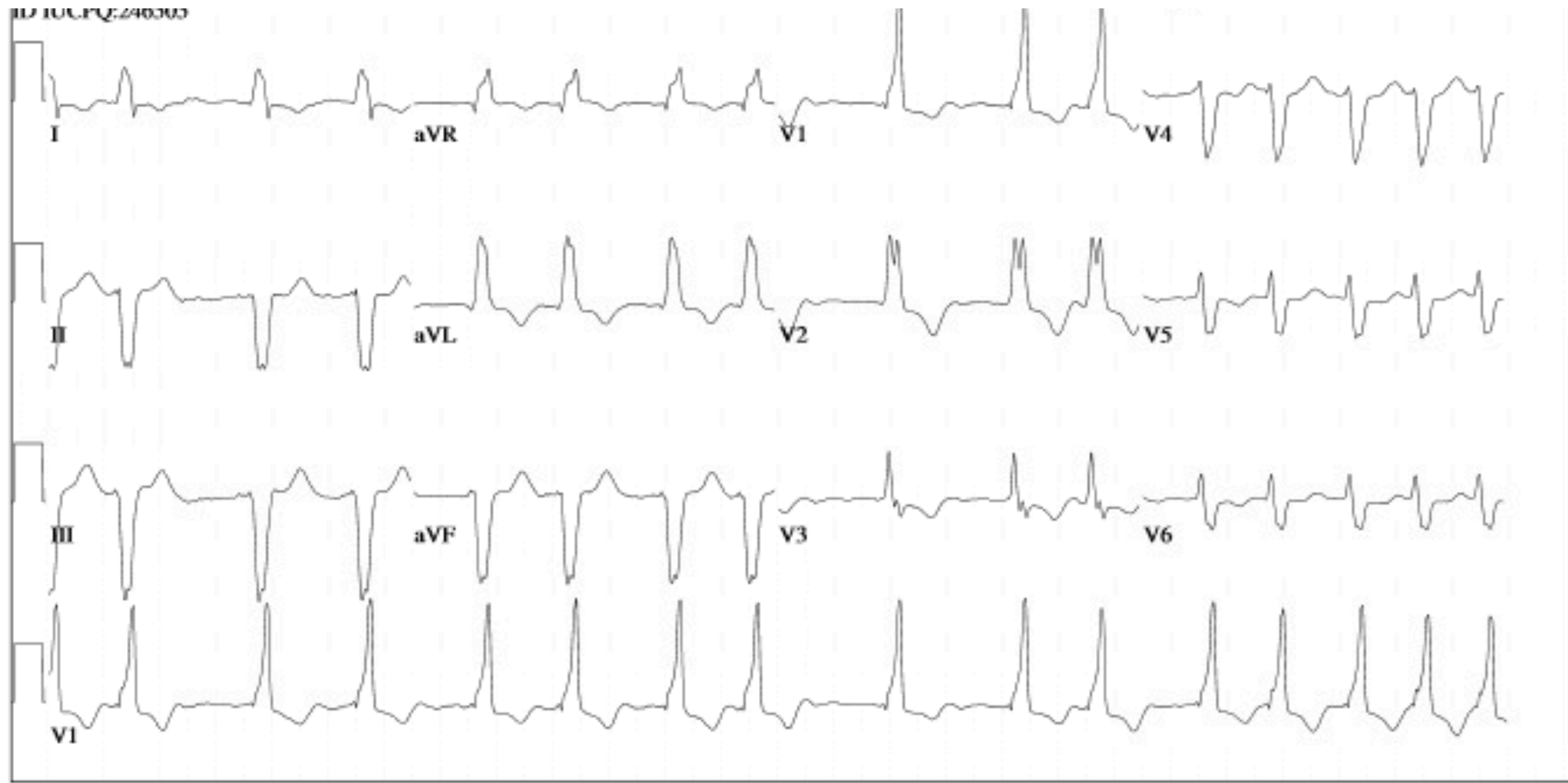
Cardiac Electrophysiologist IUCPQ

Learning Objectives

- At the end of the session, participants will be able to:
- Understand the role of CRT in "end-stage HF"
- Identify in-patients in whom CRT should be avoided
- Describe the need for any special preparations that should be made for in-hospital CRT

Case presentation

- 67Y male
- Admitted for progressive dyspnea (functional class 4), peripheral oedema, orthopnea, and weakness.
- Known with:
 - Ischemic cardiopathy: coronary bypass in 2011, PCI in February
 - LVEF 40-45% in October 2018
 - Atrial fibrillation
 - RBBB
 - Creatinine 100



Investigation

- Creatinine 178
- Coronary angiogram: Bypass to LAD and RC patent, Bypass to marginal occluded but stents on circumflex patent. No need for revascularisation
- Echo: Moderate to severe mitral regurgitation. LVEF 23-30%
- Transoesophageal echo confirms moderate to severe mitral regurgitation

Case presentation

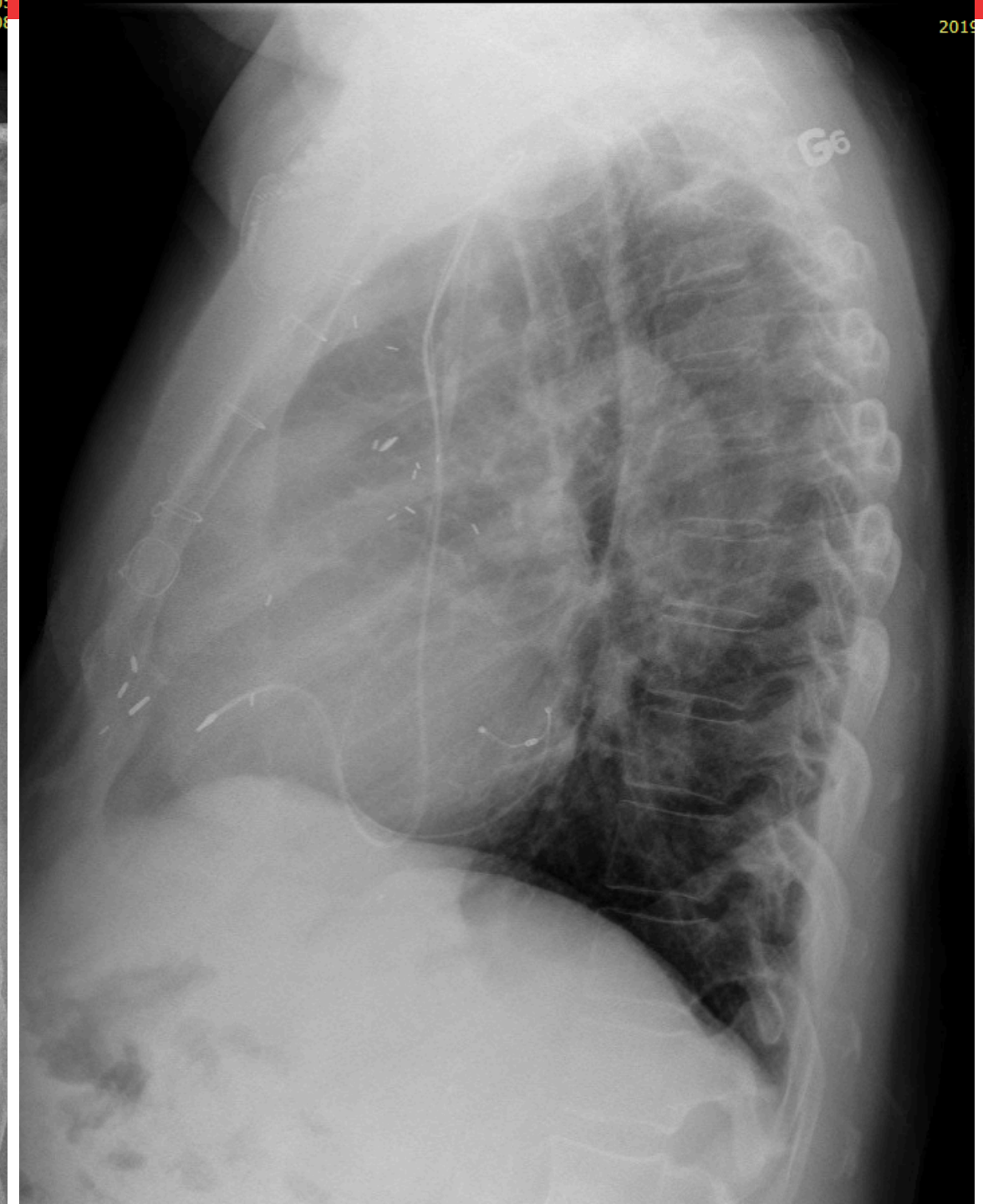
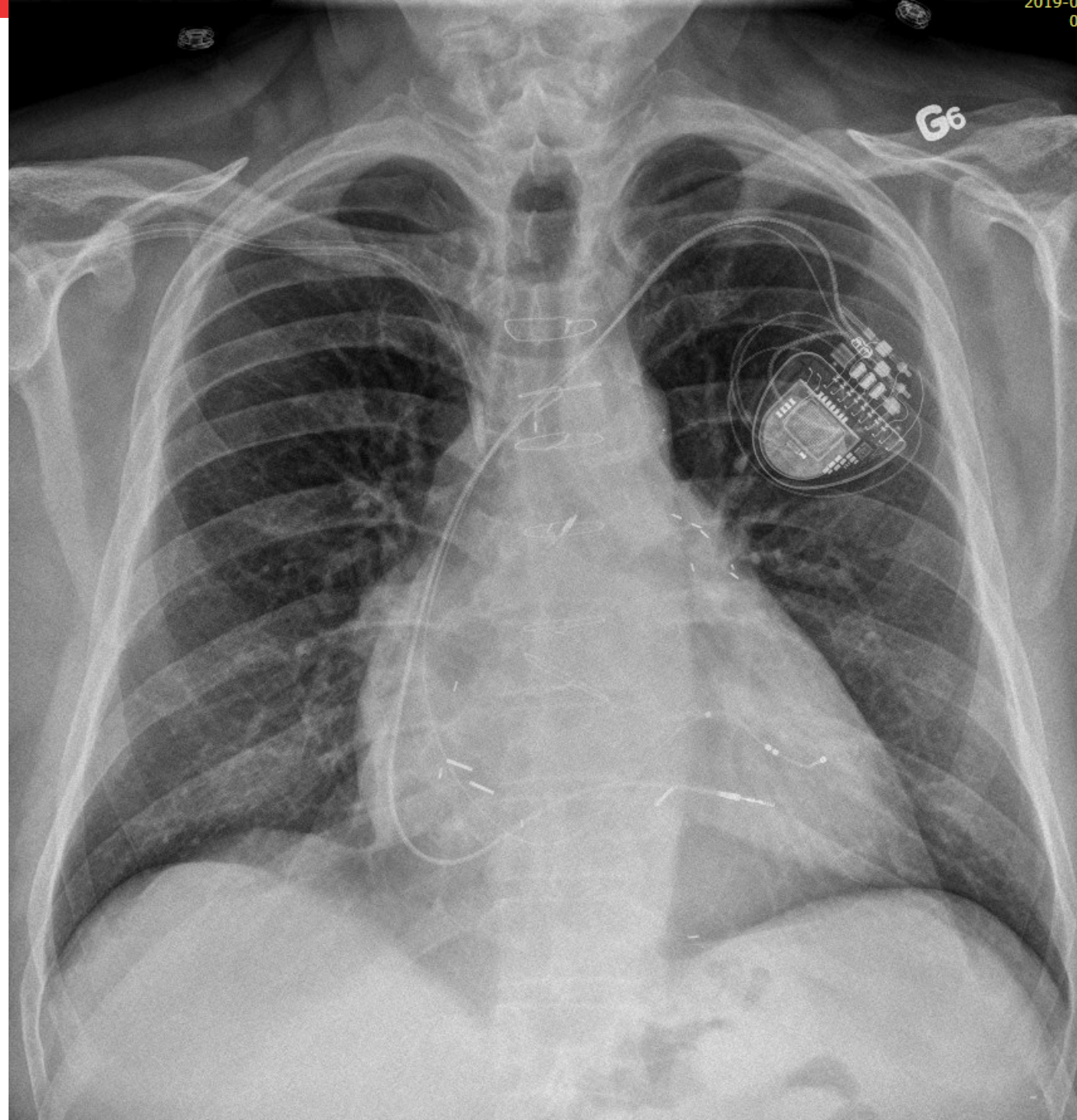
- Despite IV furosemide and milrinone, clinical deterioration with acute renal failure, and respiratory distress.
- Dialysis started.

What would you offer this patient?

- MitraClip
- LVAD
- CRT-D
- CRT-P
- CRT-D and AV junction ablation
- CRT –P and AV junction ablation

Case

- Patient was offered CRT-P and AVJ ablation
- 48h after CRT, he was weaned off milrinone
- Dialysis was no longer necessary and creatinine improved
- 10 days later he was discharged home, creatinine 108, functional class 2-3, gradually recovering



Case presentation

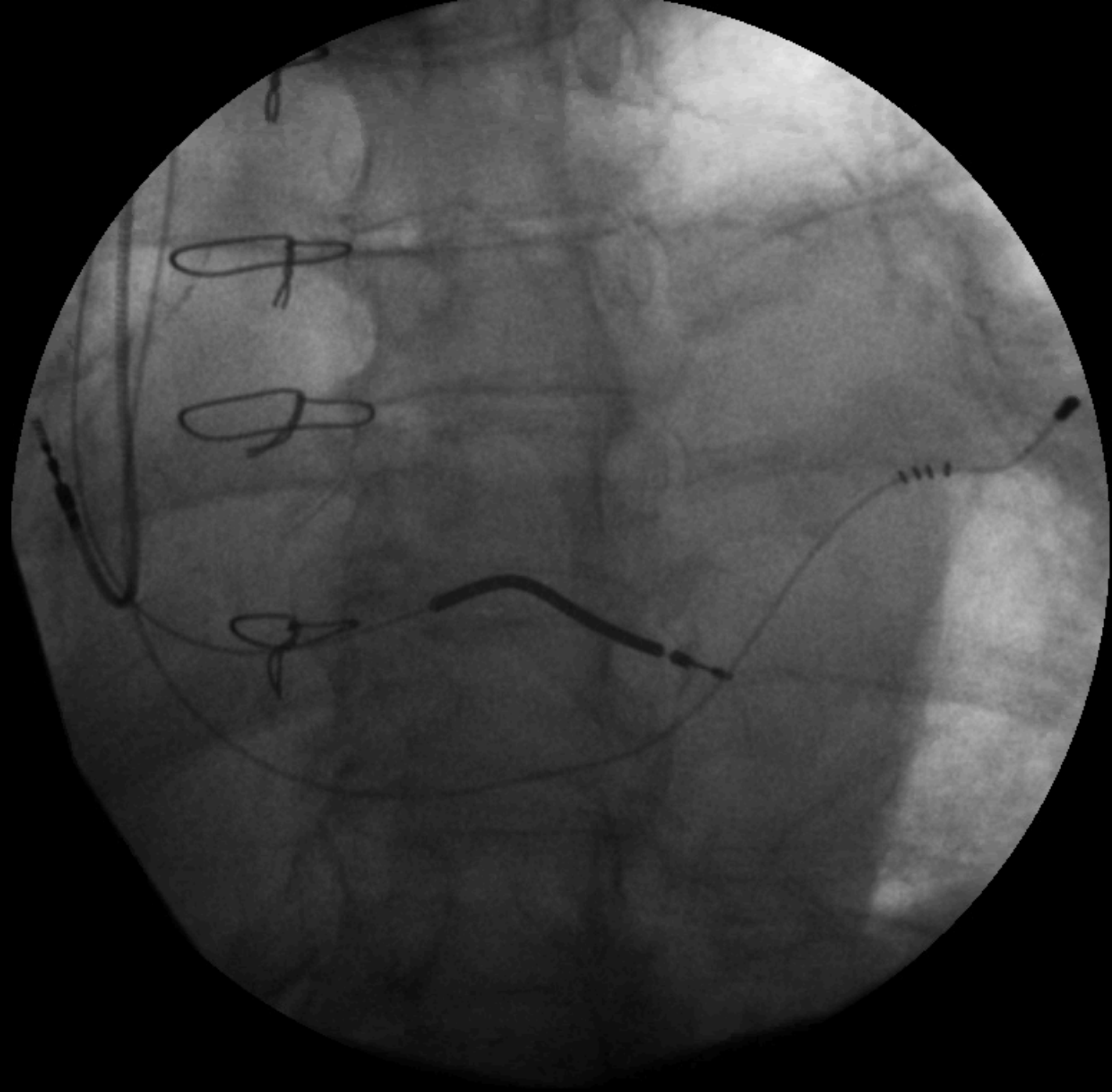
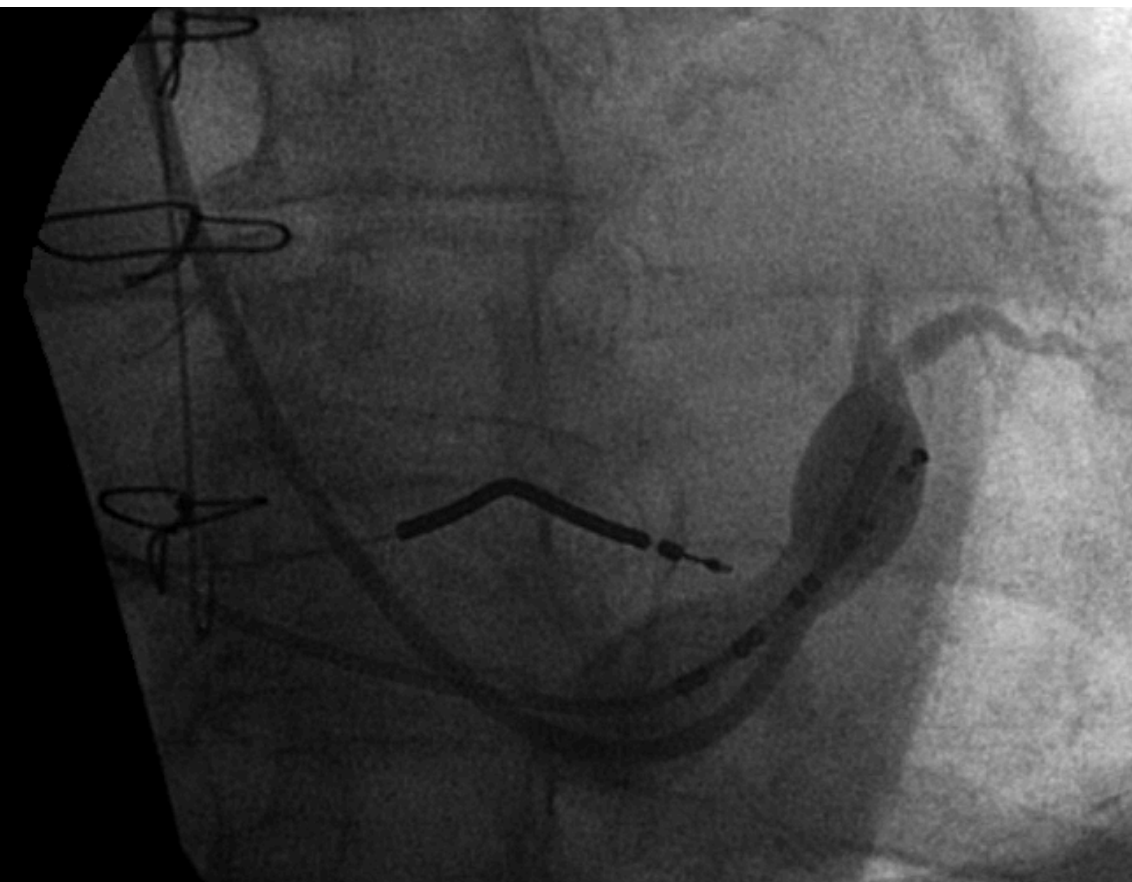
- 76Y male
- Mixed ischemic and dilated cardiomyopathy
- LVEF 15-20%
- Dual chamber ICD – pace dependant 3rd degree AV block: paced QRS 200 ms. Previous failure to implant CRT lead in the coronary sinus.
- Complex device history with prior extraction (infection) and high DFT
- Cardiogenic shock, inotrope dependant (milrinone and levophed)
- Renal failure creatinine 212

What would you offer this patient?

- LVAD
- Another attempt at endovenous CRT
- Epicardial CRT (mini thoracotomy)
- Palliative care

Case- Follow up

- Another attempt at endovenous CRT was made and was successful.
- Improvement was immediate, with diuresis, improvement in BP and weaning of inotropes.
- Renal function improved (creatinine 160-170)
- EF remained low (18%)
- Patient survived > 4 years, functional class 3 with occasional episodes of deterioration most often treated on an outpatient basis with increase in diuretics



Rescue CRT in end-stage heart failure patients

- No guidance
- In current guidelines, recommendation is to implant CRT in « ambulatory class 4 patients »
- Studies have generally excluded this population given their poor life expectancy

- CRT is recommended for patients in sinus rhythm with NYHA class II, NYHA class III, or ambulatory NYHA class IV heart failure symptoms, a LVEF $\leq 35\%$, and QRS duration ≥ 130 ms because of LBBB (Strong Recommendation, High-Quality Evidence).
 - Practical tip: Patients with LBBB and QRS duration ≥ 150 ms are more likely to benefit from CRT.
- CRT may be considered for patients in sinus rhythm with NYHA class II, NYHA class III, or ambulatory NYHA class IV heart failure, a LVEF $\leq 35\%$, and QRS duration ≥ 150 msec not because of LBBB conduction (Weak Recommendation, Low-Quality Evidence).
 - Practical tip: there is no clear evidence of benefit with CRT among patients with QRS durations < 150 ms because of non-LBBB conduction.

- CRT may be considered for patients with chronic RV pacing or who are likely to be chronically paced, have signs and/or symptoms of heart failure, and a LVEF value $\leq 35\%$ (Weak Recommendation, Low-Quality Evidence)
 - Practical tip: The risk of CRT upgrade needs to be considered and balanced with the potential benefit of CRT upgrade.
 - Patients who undergo pacemaker implantation who are likely to have a high pacing burden (similar to BLOCK HF) might benefit from CRT.
- CRT may be considered for patients in permanent AF who are otherwise suitable for this therapy (Weak Recommendation, Low-Quality Evidence).
 - Benefits of CRT appear greatest in patients with $\geq 95\%$ biventricular pacing. AV node ablation may be necessary to achieve this.

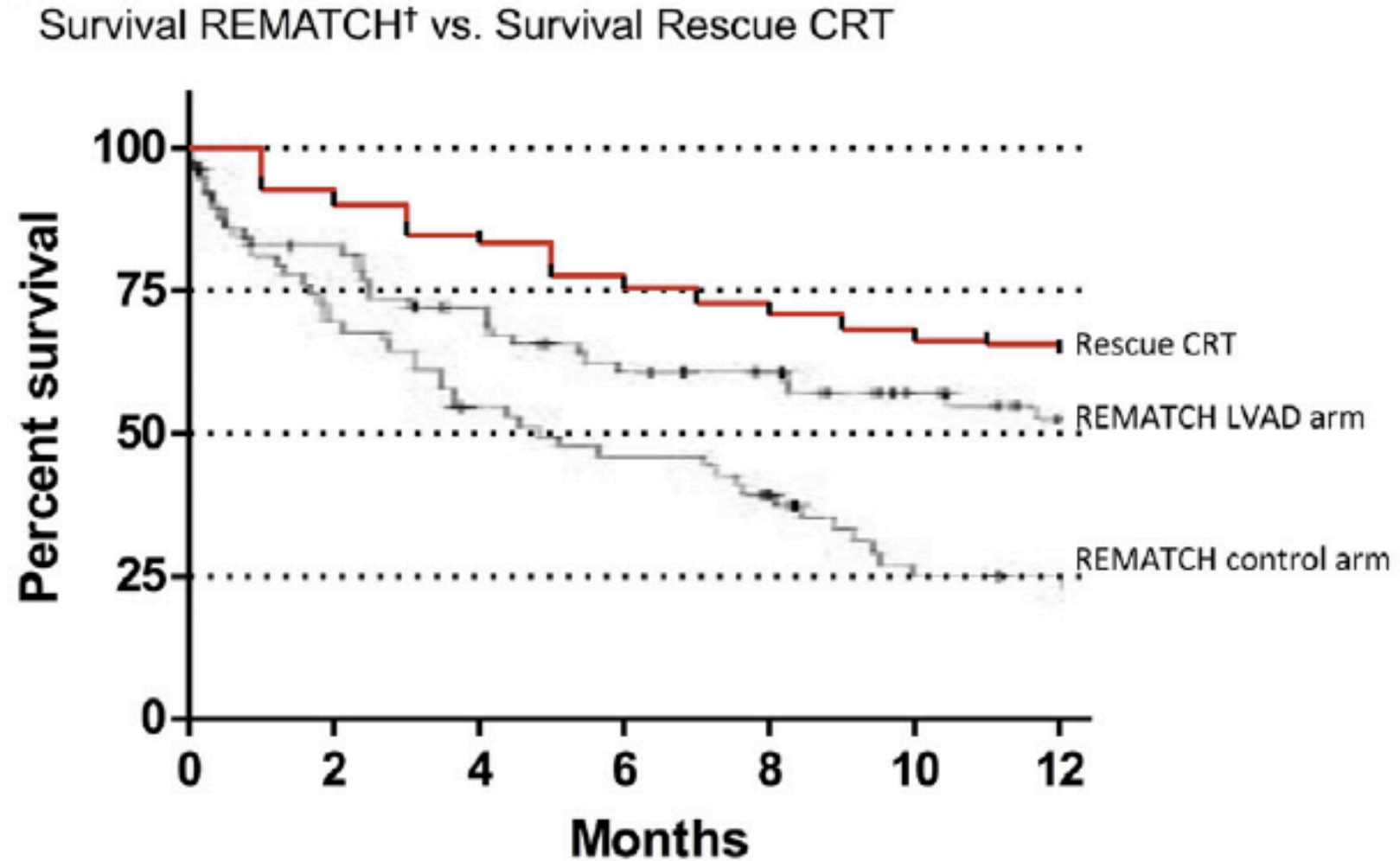
Meta-Analysis

- 8 studies
- 151 patients
- 93% of patients were weaned off inotropes after CRT
- 12 months survival 69%

To Class 1	2%
To Class 2	36%
To Class3	43%
Class 4	10%

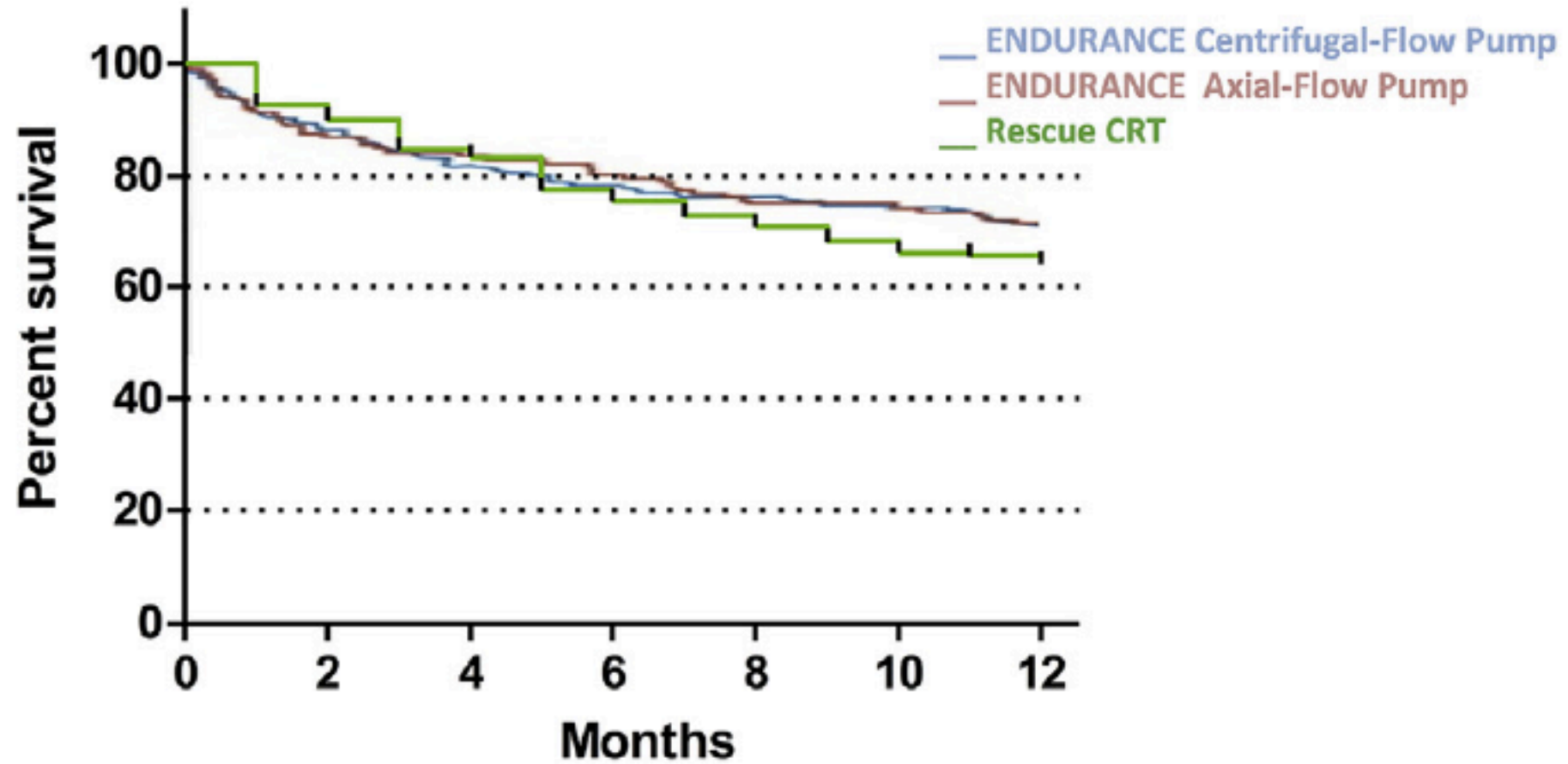
Follow-up	877 ± 620 days
Age	64±12 years
Male	80%
Ischemic Heart disease	64%
Functionnal class 4	80%
QRS duration	171±33 ms
LBBB	50%
RBBB	9%
IVCD	21%
Paced	10%
LVEF	20±6%
CRT-D	96.8%

Rematch: first generation pulsatile LVAD

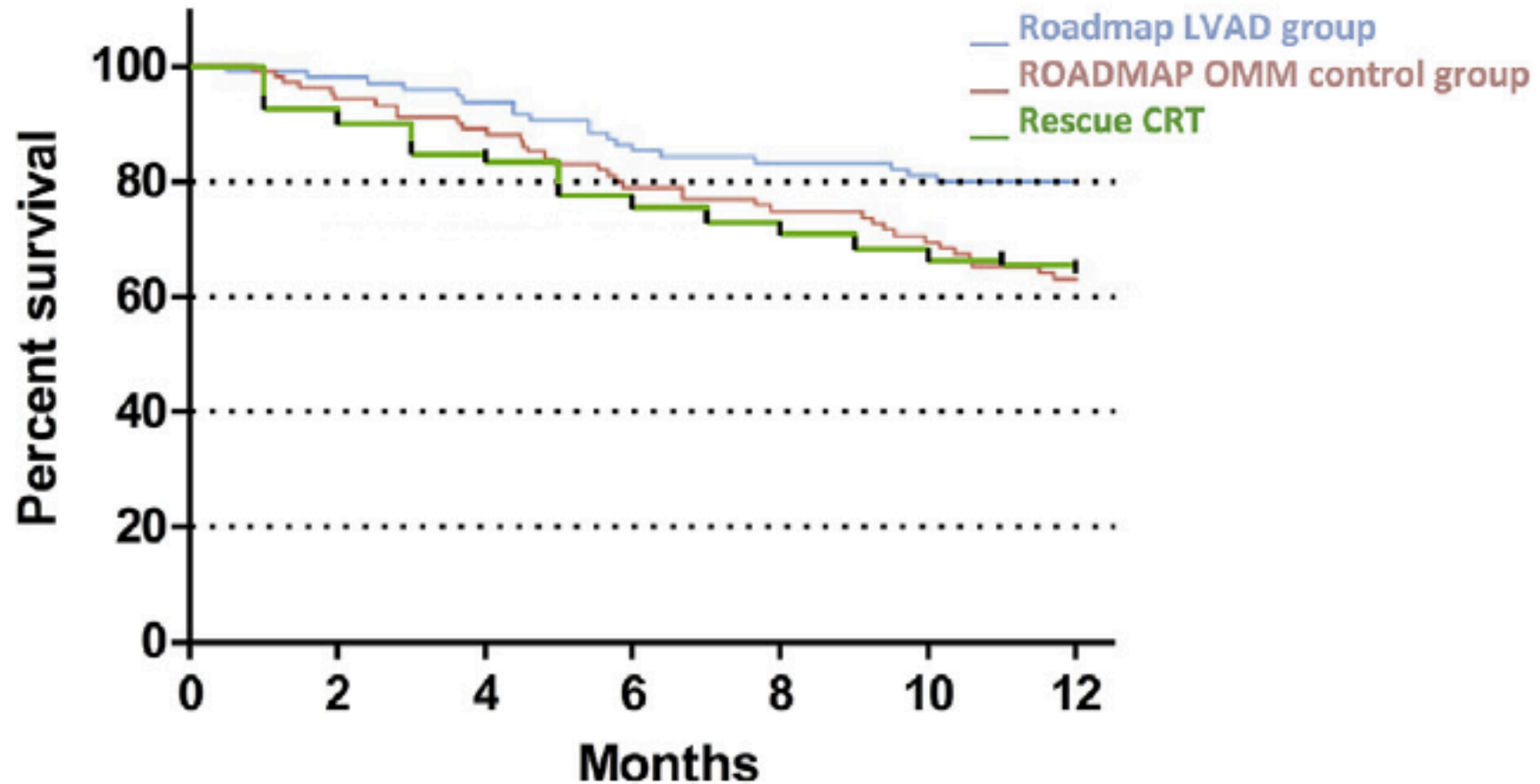


Heartware HVAD

Event Free Survival ENDURANCE[†] vs. Survival Rescue CRT

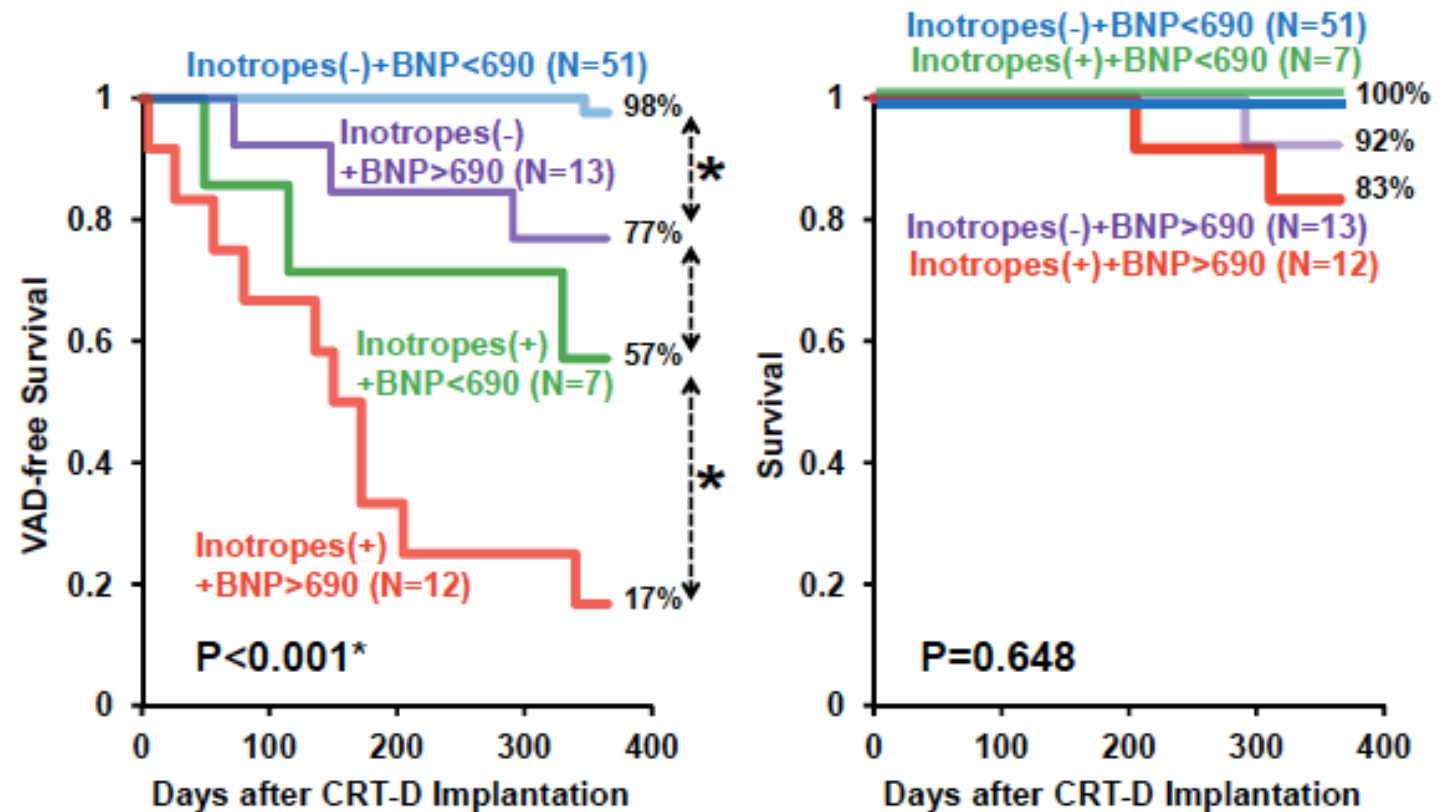


Event Free Survival ROADMAP[‡] vs. Survival Rescue CRT



Learning from studies where CRT did not work as well

- 84 patients
 - 20% inotrope-dependant
 - EF<35%
 - **24% had QRS < 120 ms**
 - **Only 25% had LBBB**
- 1y LVAD-free survival predictors and mortality
 - BNP>690 pg/ml
 - Inotrope dependance



Learning from studies where CRT did not work as well

- 67 patients
- Advanced HF class 3 or 4
- Only 16% responders
- Positive response to CRT:
 - ↑ LVEF 10%
- Predictors of response:
 - **LA volume index $<43\text{ml/m}^2$**
 - **LBBB**
- LVAD-free survival in responders was 86% vs 52% in non responders

Evidence for CRT in AF

- MUSTIC trial
 - 37 patients – cross over study
 - Improvement in 6min walk test, peakVO₂, trend towards better QOL. 84,6% patients preferred BIV pacing RV pacing *Leclercq et al, Comparative effect of BIV and RV in HF patients with AF, EHJ 2002*
- RAFT AF
 - 1798 patients, 229 in AF with controlled HR
 - No benefit in AF subgroup

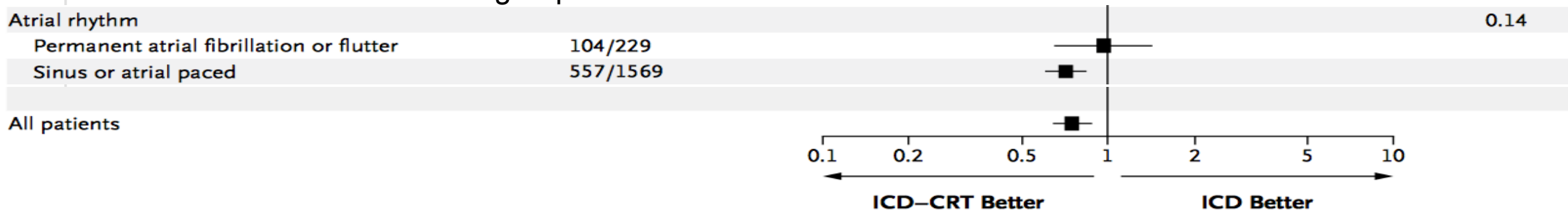


Figure 3. Subgroup Analyses of Death or Hospitalization for Heart Failure (Composite Primary Outcome).

Atrioventricular junction ablation

- Improves response to CRT in permanent AF patients
 - Improved LV remodeling
 - Gasparini et al, JACC 2016
- Lower mortality in patients with AVJ ablation compared to rate controlled by medication
 - Gasparini et al, EHJ 2008
- Survival in AF+AVJ ablation similar to SR population, better than AF under medication for rate control
 - Gasparini et al, JACC HF 2013

Target: $\geq 95\%$ BLV pacing

Functional mitral regurgitation

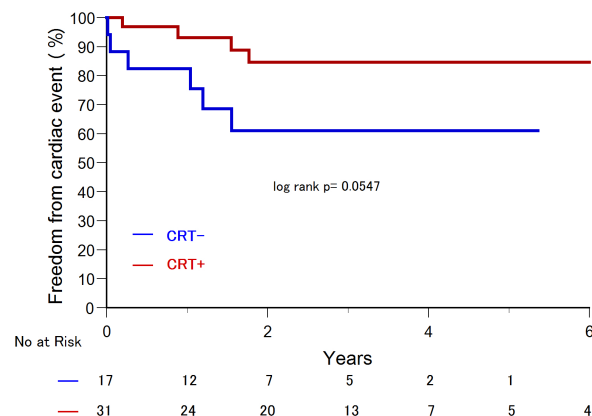
	Atrial Fibrillation	Sinus Rhythm	P value
Reduction in LVESV	18.6% reduction	18.1% reduction	ns
Reduction in LA volume	2.3% reduction	10.2% reduction	0.05
Mitral annular diameter (A4C)	3.4% reduction	3.9% reduction	ns
Mitral annular diameter (PSLAX)	0	4.4% reduction	<0.001
Improvement in functional mitral regurgitation (≥ 1 grade)	30.7 % of patients	45.6% of patients	0.011

Ventricular reverse remodeling with CRT is similar in patients with atrial fibrillation and sinus rhythm but atrial reverse remodeling is significantly better in sinus rhythm. The reduction of functional mitral regurgitation with CRT is superior in sinus rhythm.

Left epicardial lead during cardiac surgery

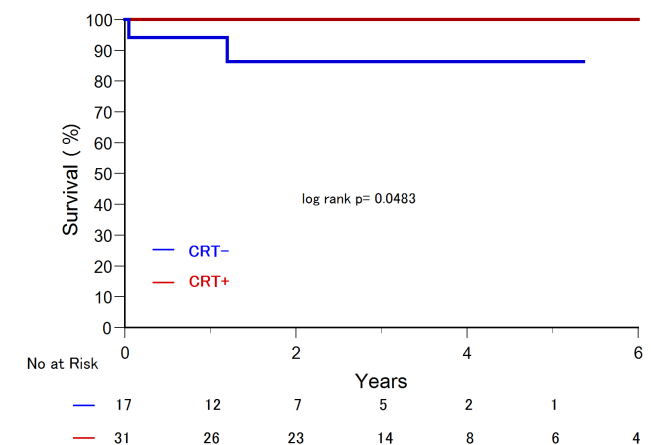
- 48 patients
- EF < 35% and QRS ≥120 ms undergoing cardiac surgery for CABG ± valvular surgery
- CRT+
 - LVEF improved from 24±5% to 43±13% (compared to 27±8% to 34±12% CRT-)
 - LVEDD improved from 65±8mm to 56±9mm (vs 61±6 mm to 58±7 CRT-)
 - 25% had early connection (≤1 month) because of severe heart failure symptoms

Freedom from HF and or cardiac death



CRT+: hospit 1 before 3 after CRT, 0 death
CRT- : hospit 4, death 2

Survival



Patient Selection

- LBBB
- Non LBBB with significant intraventricular delay
 - In studies where CRT response was poor, mean QRS duration was 127-147 ms whereas in studies with good CRT response the mean QRS duration was 153-205 ms
- AF
 - Aim for very high LV pacing % (>95%)
 - Liberal approach to AV junction ablation

Considerations for CRT in end-stage Heart Failure

- Responders to CRT have the same characteristics as responders in « healthier » population: stick to guideline's recommendations!
 - QRS duration, LBBB, dyssynchrony
- Small amount of contrast needed: renal failure should not be a reason to withhold treatment
- Decision between CRT-D and CRT-P: according to underlying disease. Shared decision making.
- AF: control heart rate

Conclusion

- Rescue CRT can be considered in Class 4 heart failure patients under inotrope therapy as some may benefit from such therapy
- The decision needs to be individualized and the presence of dyssynchrony is key
- The choice of CRT-P vs CRT-D must be discussed
- Complication rate is low especially when compared to that of LVAD