

# What to do when the battery runs down.

## CRT with no clinical benefit

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Declaration of interests - none



# Considerations

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- **Assessing “response” is unique to CRT**
- **Patient wishes**
- **Pacing dependent**
  - RV pacing alone will worsen outcome
  - CRT advisable
- **Non-response**
  - Medication and life-style check
  - Can CRT be improved
  - Rhythm control – consider AV node ablation, flutter ablation
  - Mitral regurgitation
  - Treat anaemia etc.

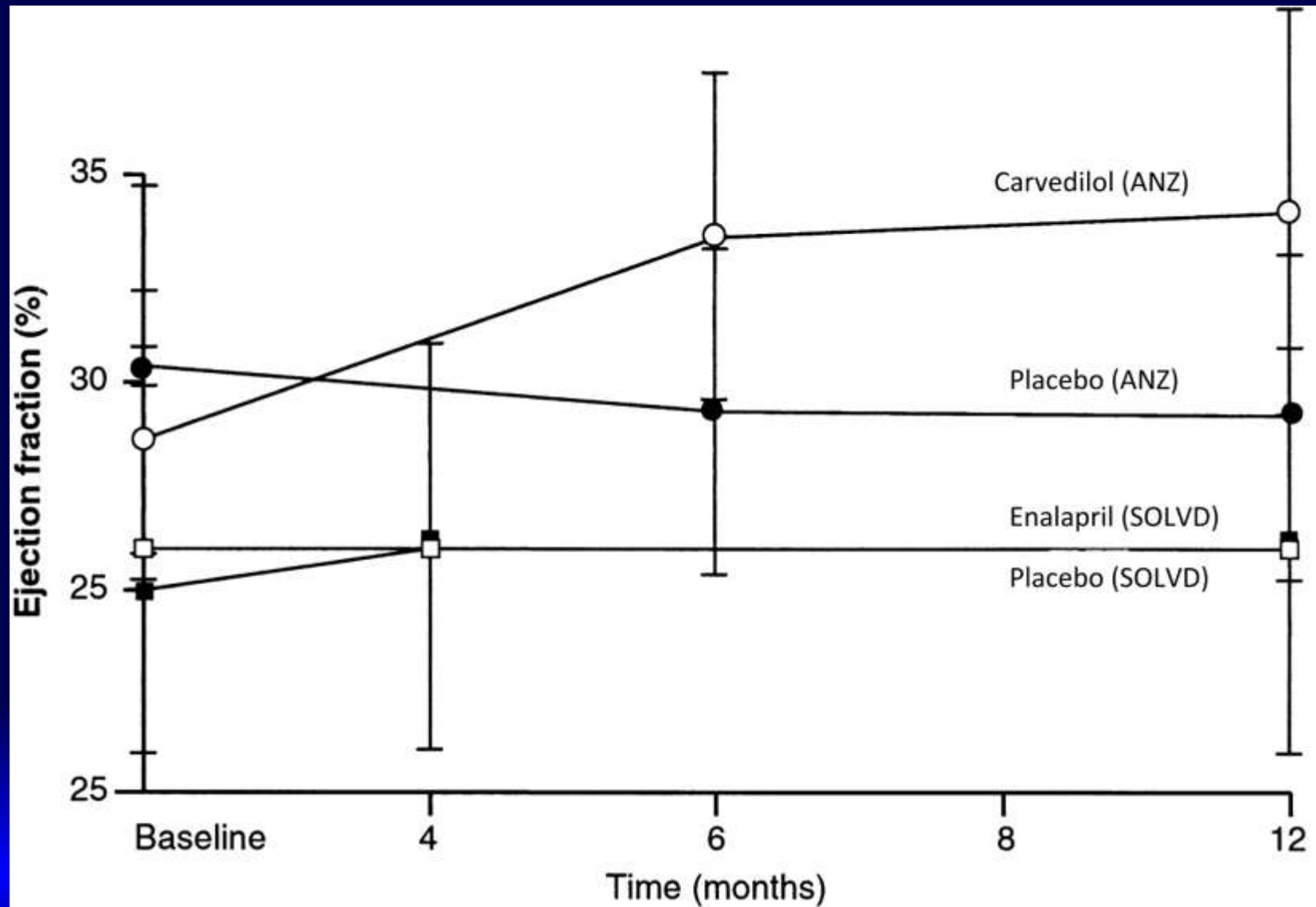
# Responder rates

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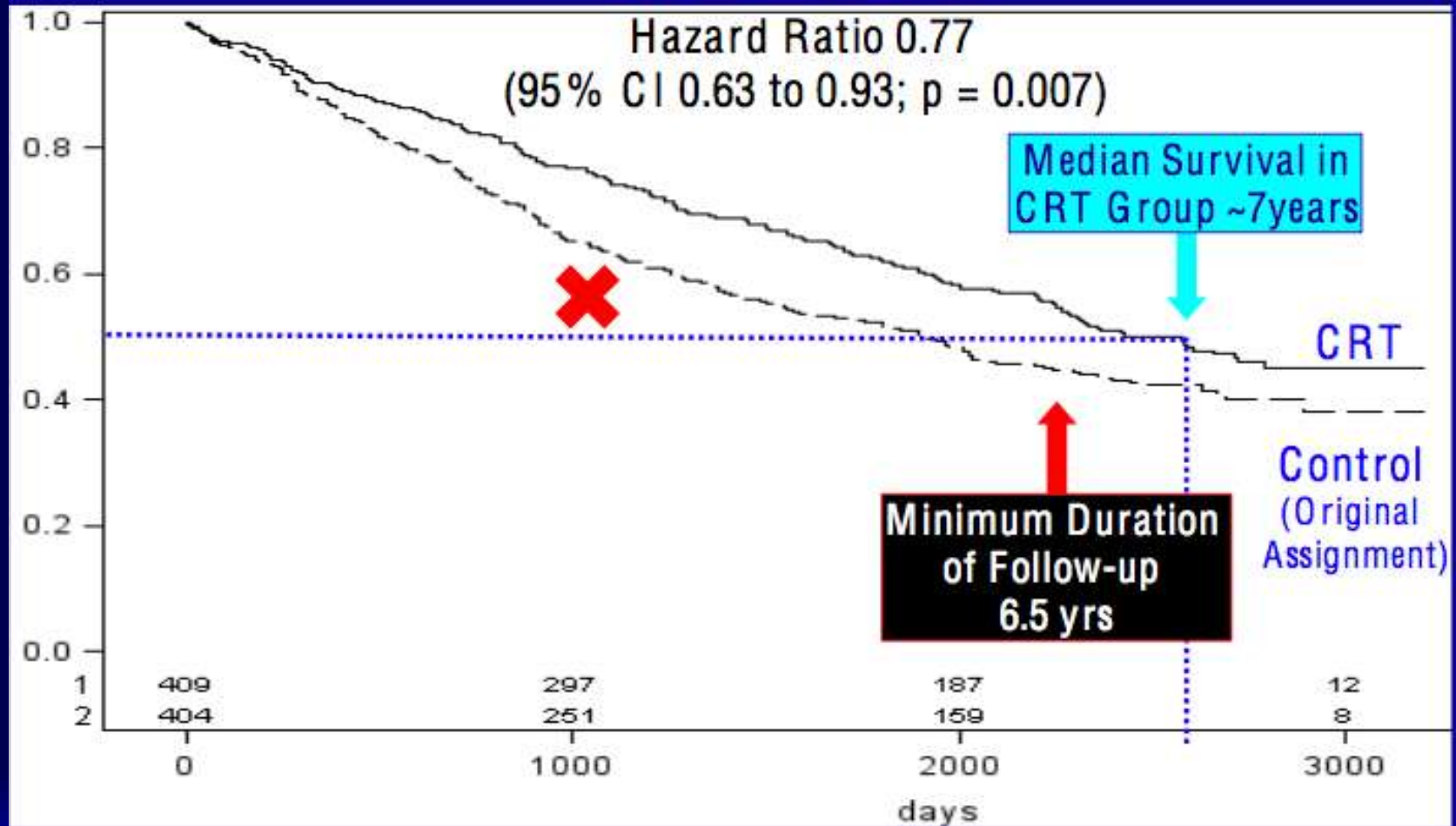
- **Compared with placebo, what is the response to medication ( $\geq 1$  NYHA class)**
  - ACEI 24.9%
  - BB 6%
  - Spironalactone 8%
- **Median survival for devices**
  - CRT-P 4.6 years Added life 0.85
  - CRT-D 5.15 years Added life 1.39
- **Palliative care**
  - Treats symptoms with no effect on survival
- **Chemotherapy**
  - Improves survival with worsening of quality of life

1. CONSENSUS N Engl J Med 1987;316:1429-35
2. CIBIS Circulation 1994;90:1765-73
3. RALES N Engl J Med 1999;341:709-17.

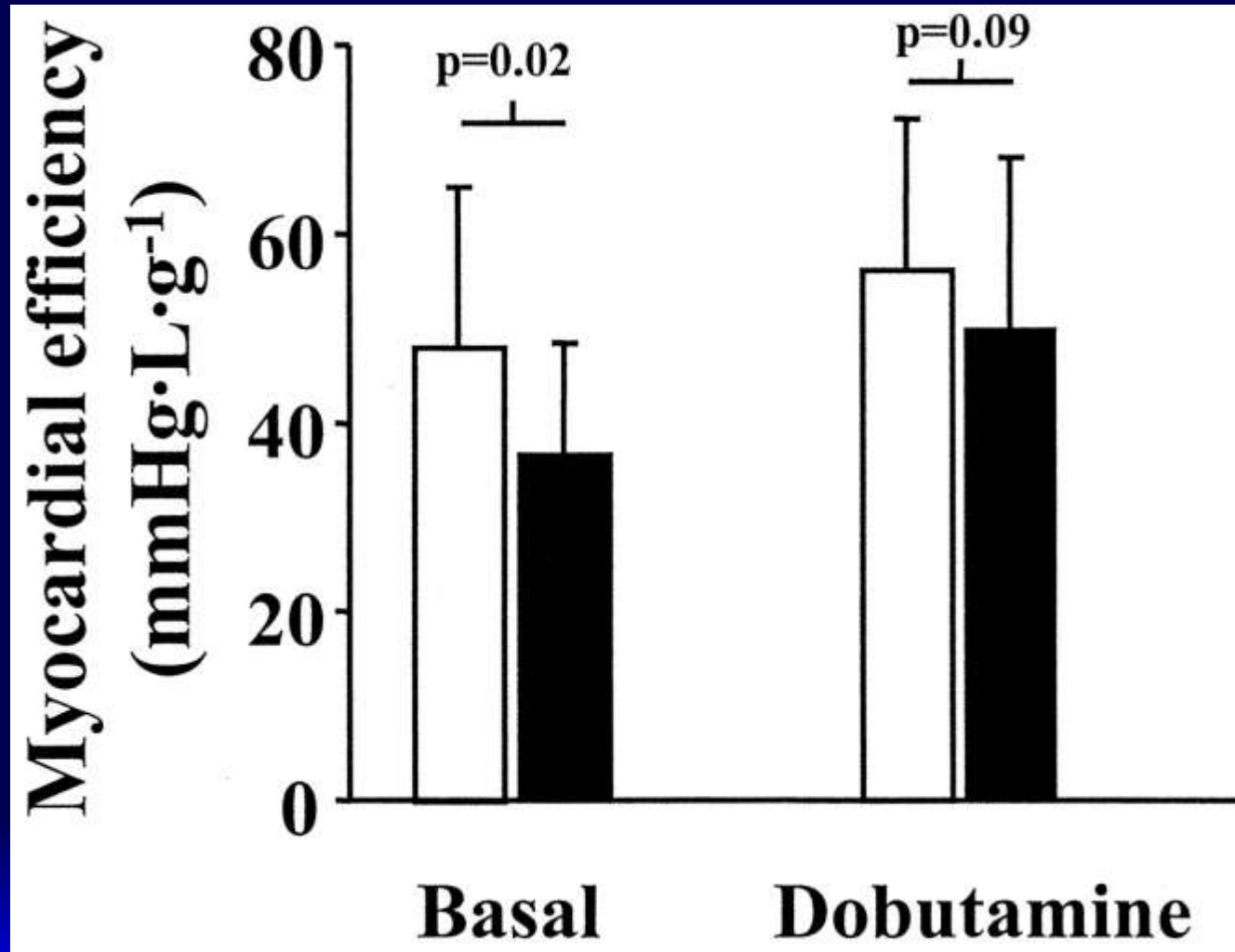
# Ejection fraction and outcome



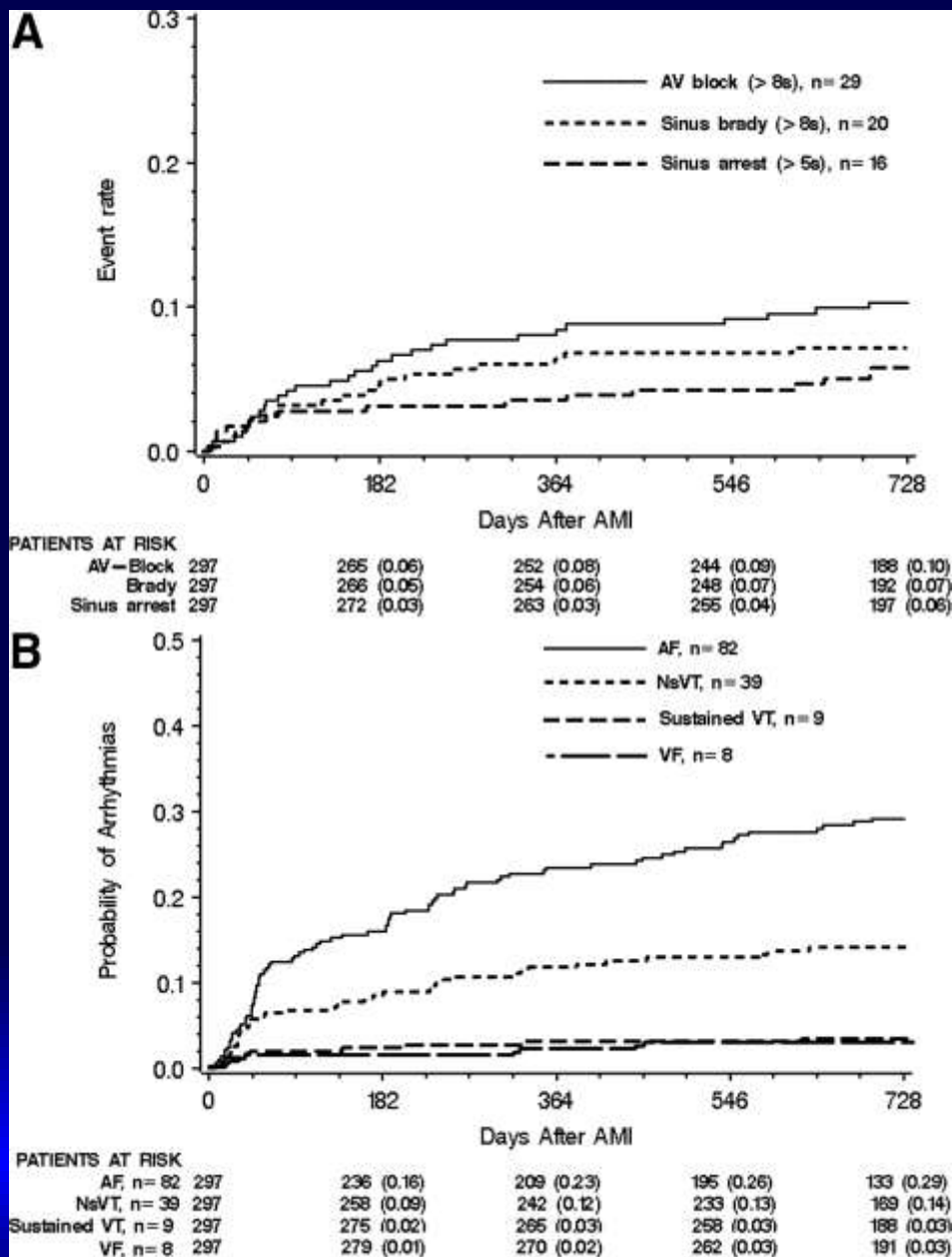
# Benefits of CRT: CARE-HF



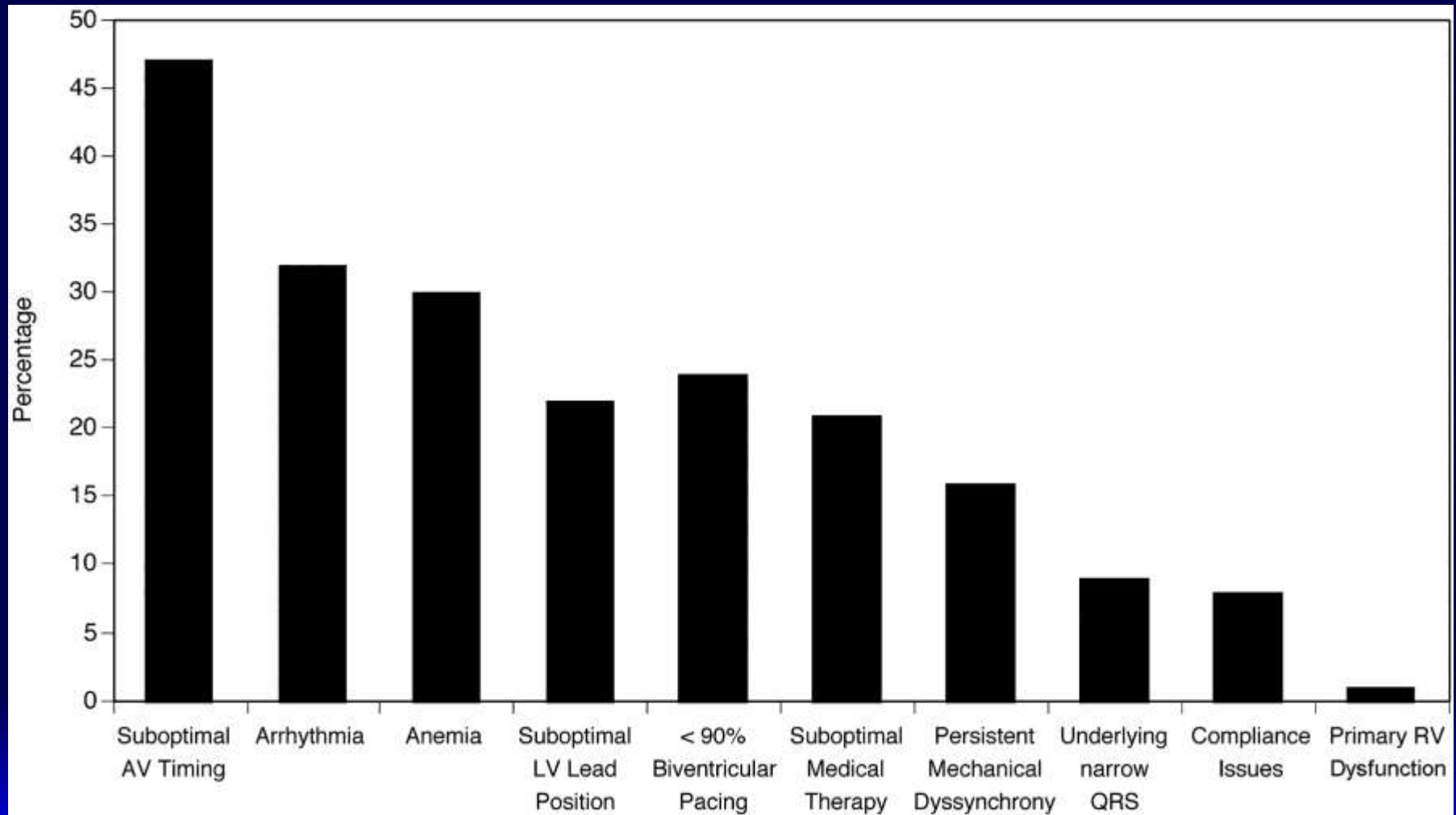
## Effect of CRT on myocardial efficiency



# Pacing indication is common in HF patients

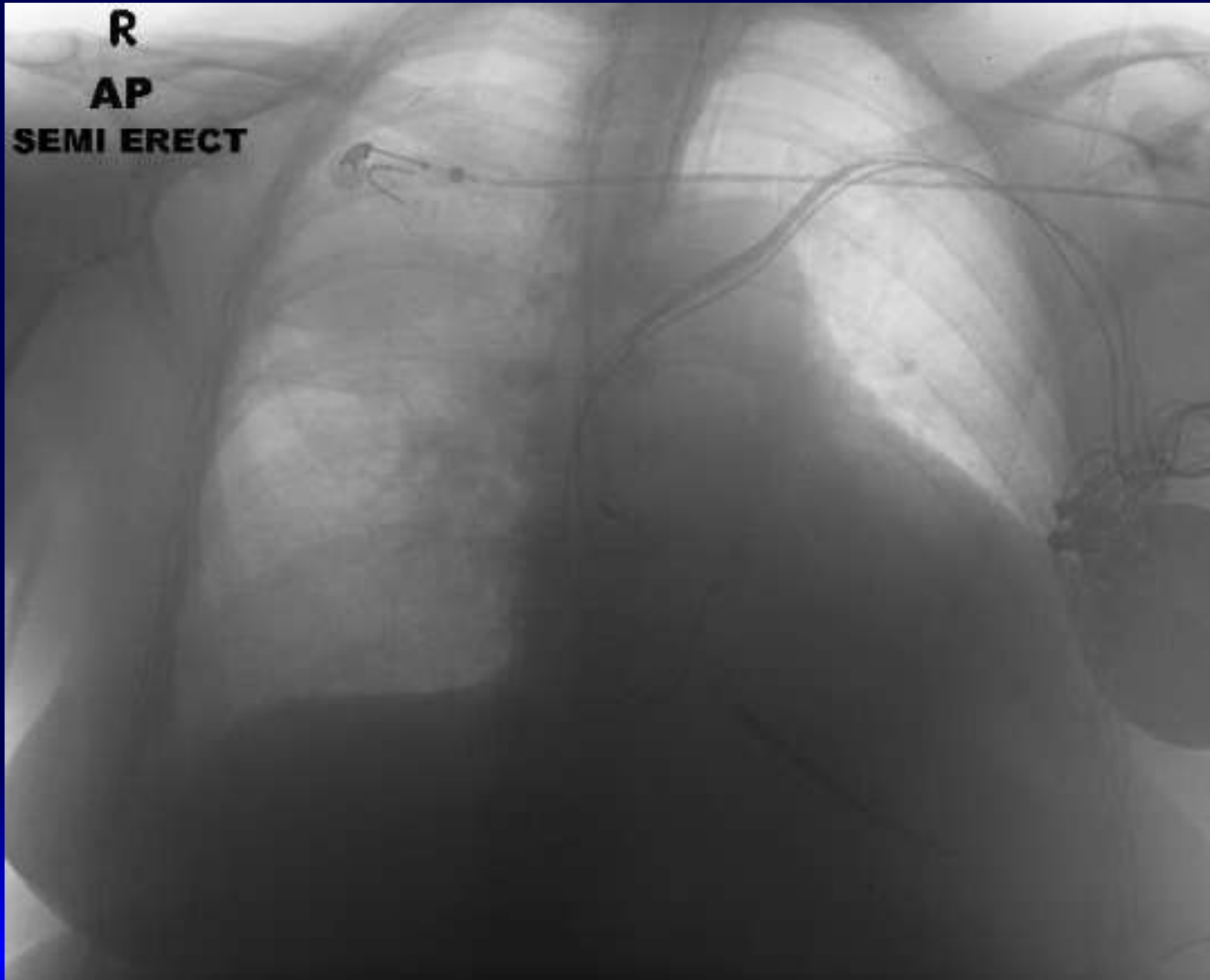


# Potential reasons for sub-optimal response in CRT patients



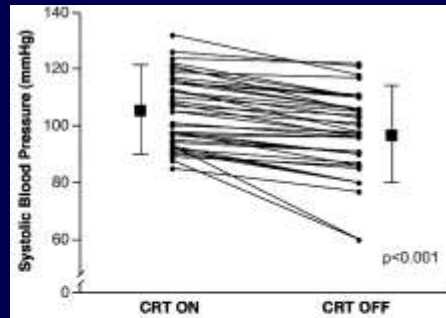
## LV lead displaced (visiting from abroad)

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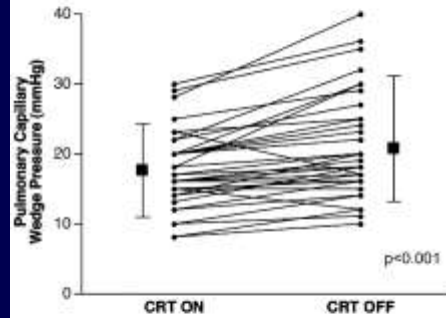


# Haemodynamic effects of switching off CRT in non-responders

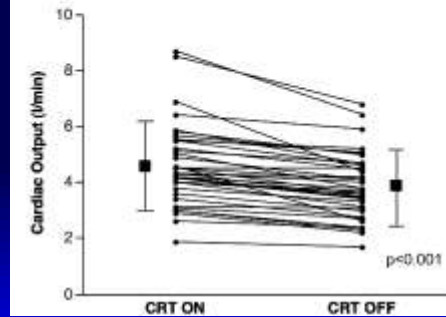
Systolic BP



PCWP



Cardiac output



# Haemodynamic effects of CRT in non-responders

Table 3 Hemodynamic and Echocardiographic Changes in Patients With CRT-ON and CRT-OFF (n = 40)

Variable	CRT-ON	CRT-OFF	p Value
Heart rate (beats/min)	69 ± 34	67 ± 38	NS
Systolic blood pressure (mm Hg)	105 ± 12	98 ± 13	<0.001
Central venous pressure (mm Hg)	9 ± 7	11 ± 7	<0.001
Systolic pulmonary artery pressure (mm Hg)	44 ± 13	49 ± 15	<0.001
Diastolic pulmonary artery pressure (mm Hg)	22 ± 8	25 ± 9	<0.001
Pulmonary capillary wedge pressure (mm Hg)	17 ± 6	21 ± 7	<0.001
Cardiac output (l/min)	4.6 ± 1.4	4.0 ± 1.1	<0.001
QRS width (ms)	161 ± 29	202 ± 39	<0.001
Mitral valve regurgitation (scale 0–4/4)	1.9 ± 0.8	2.1 ± 1	<0.001
Mitral valve E velocity (cm/s)	96 ± 26	108 ± 37	<0.001
Mitral valve E deceleration time (ms)	178 ± 63	159 ± 59	<0.001
LV diastolic filling time (ms)	377 ± 138	300 ± 118	<0.001
Onset QRS until end of A-wave time (ms)	69 ± 47	19 ± 31	<0.001
LV inflow velocity time integral	19 ± 6	16 ± 5	<0.001
LV outflow velocity time integral	14 ± 5	11 ± 4	<0.001
Interventricular mechanical dyssynchrony (ms)	22 ± 15	45 ± 25	<0.001
Intraventricular mechanical dyssynchrony (ms)	15 ± 26	57 ± 41	<0.001

Values are mean ± SD.

## Recommendations to non-responders

Recommendation (%)	All Patients (n = 75)	Neutral Intervention (n = 20)	Favorable Intervention (n = 55)	p Value Favorable vs. Neutral
Better with CRT-ON	88	85	89	NS
AV changes (>30 ms)	45	20	69	<0.001
Unchanged device settings	36	65	25	0.003
Arrhythmia intervention	31	30	31	NS
LV lead revision	9	0	9	0.006
CRT-OFF	9	10	9	NS
Other (compliance, medication, diet, and so on)	53	40	58	NS

AV = atrioventricular; CRT = cardiac resynchronization therapy; LV = left ventricular.

# Importance of LV lead position

REVERSE Clinical Trial

## Results: LV lead position

CRT ON group

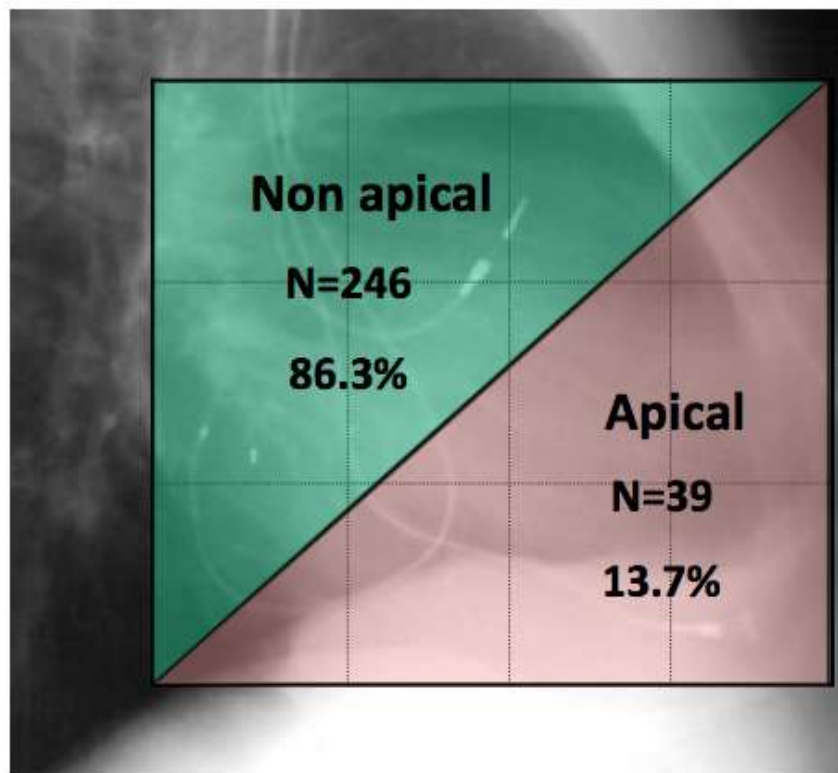
<b>Lateral</b>	<b>Non lateral</b>
<b>N=229</b>	<b>N=56</b>
<b>80.3%</b>	<b>19.7%</b>

# Importance of LV lead position

REVERSE Clinical Trial

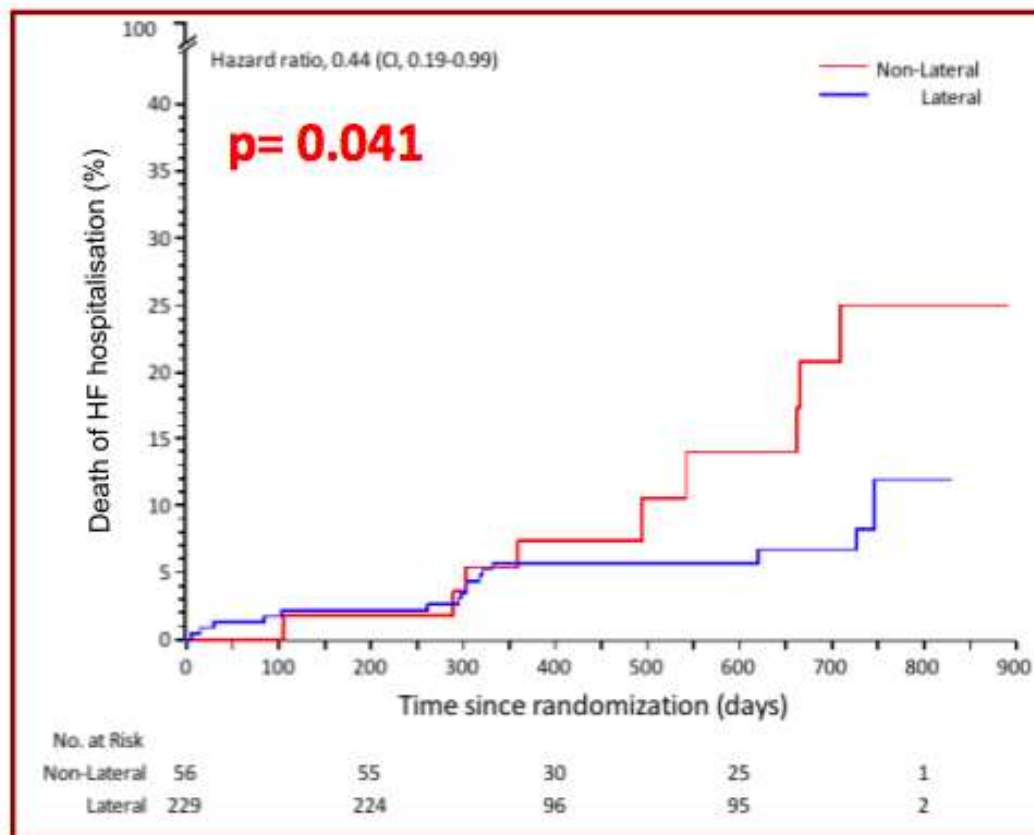
## Results: LV lead position

CRT ON group



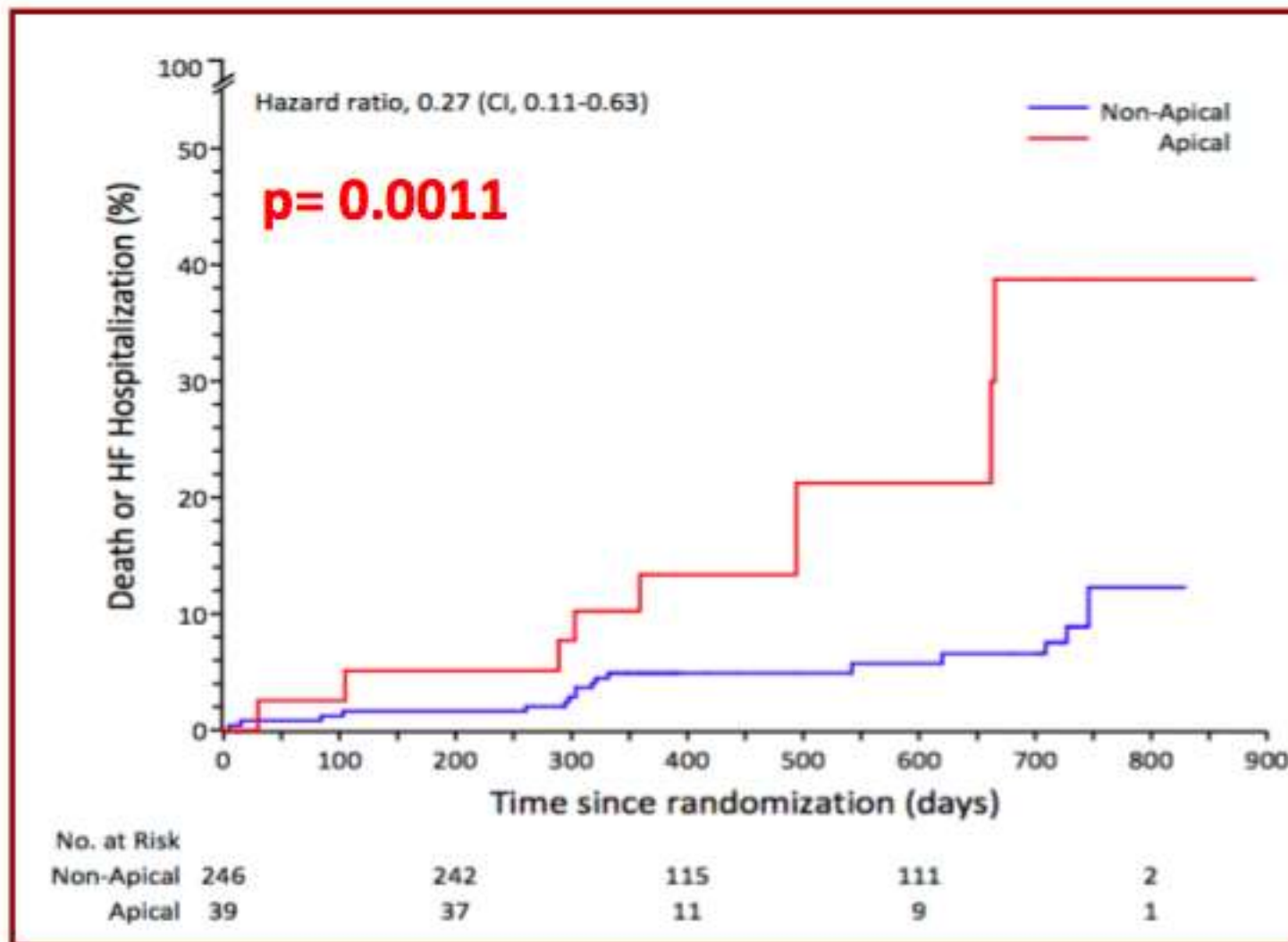
# Importance of lateral position

## Non lateral vs lateral



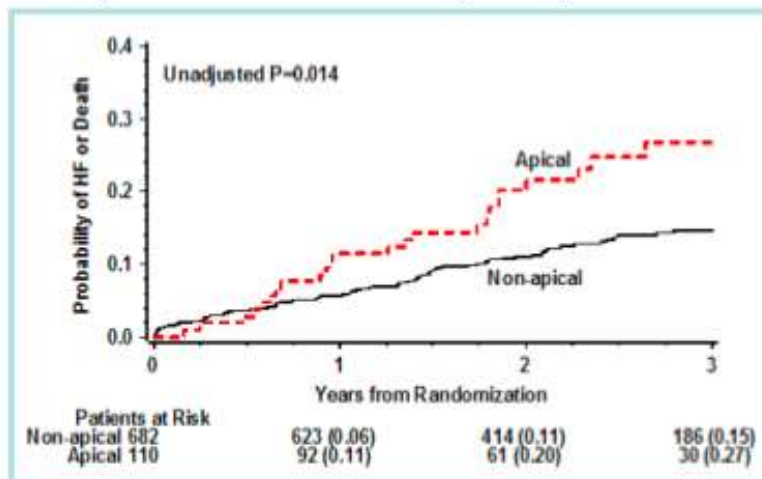
# Importance of non-apical LV lead position

## Non apical vs apical



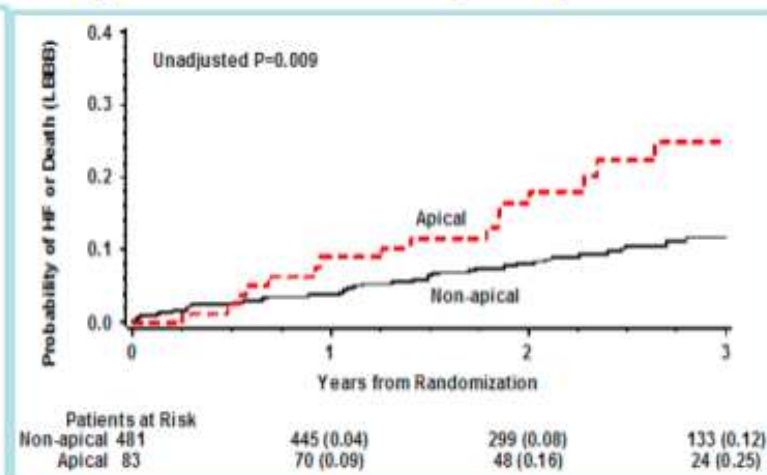
# MADIT-CRT: effect of LV apical lead position

## Apical versus Non-apical position



Overall population

## Apical versus Non-apical position



LBBB population

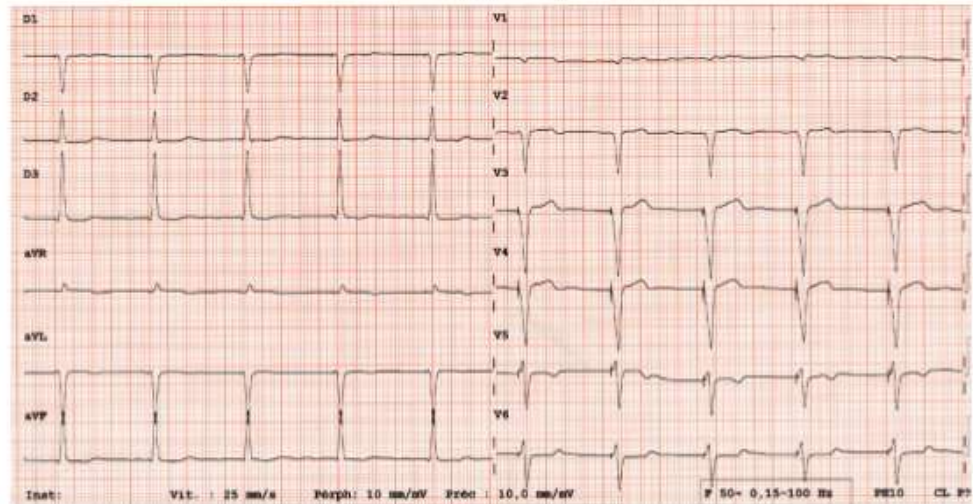
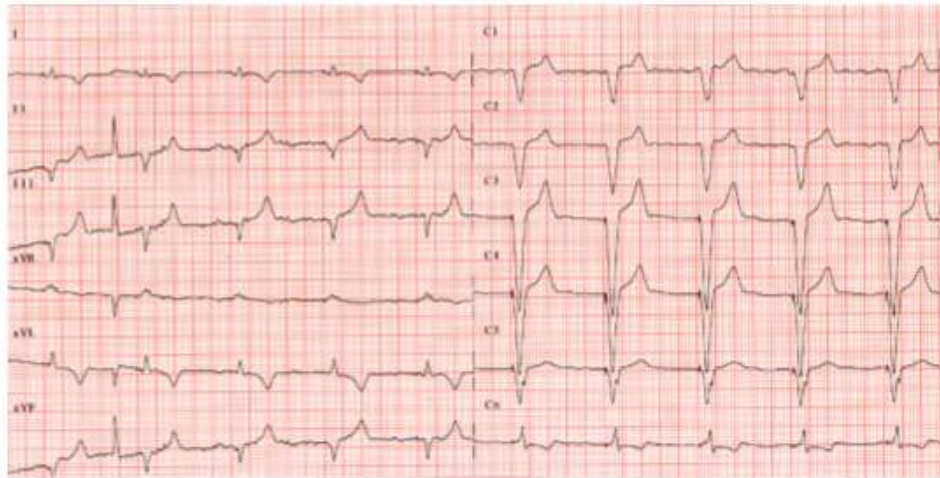
*Singh. Circulation 2011; 123: 1159-1166*

## LV lead options

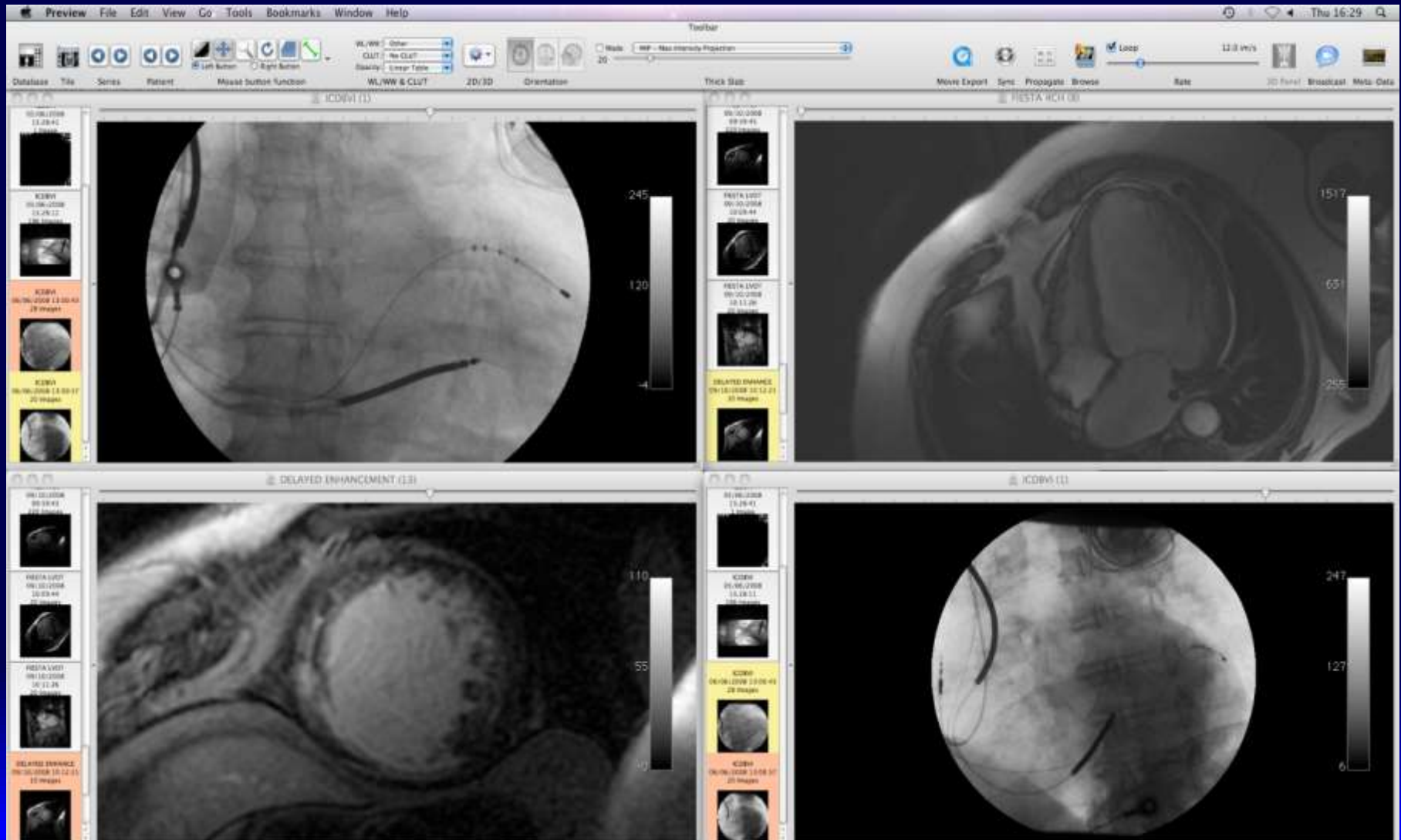
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- **Modification of the location of the LV lead from anterior to lateral?**
- **Surgical approach?**
- **Addition of a second LV lead?**
- **Endocardial pacing?**

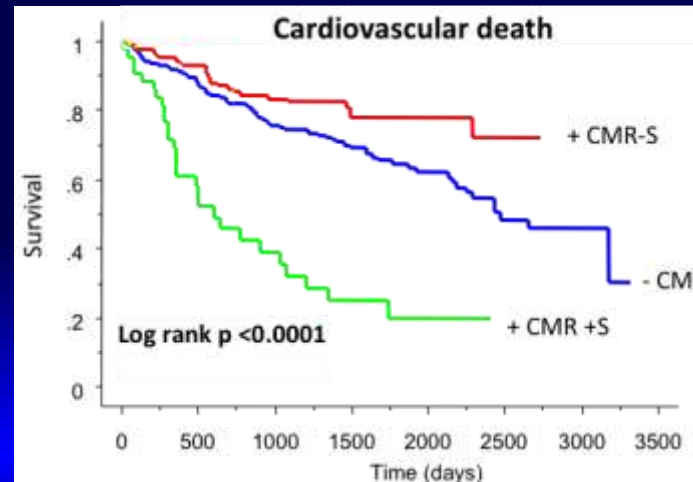
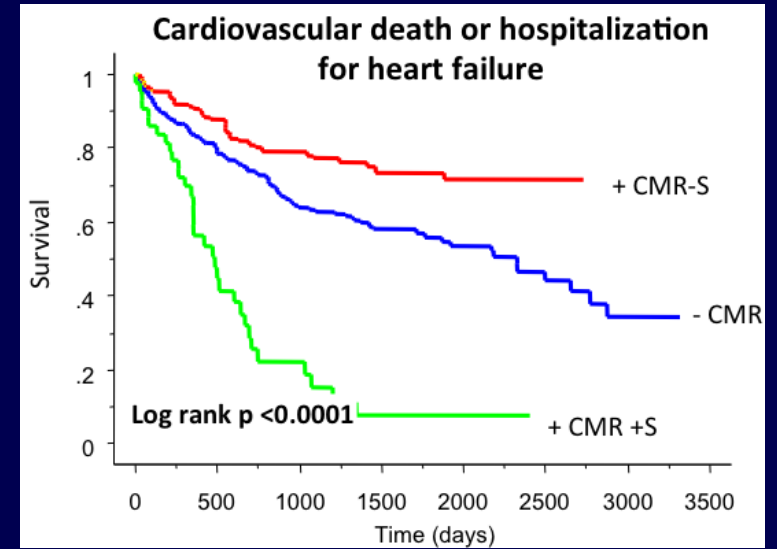
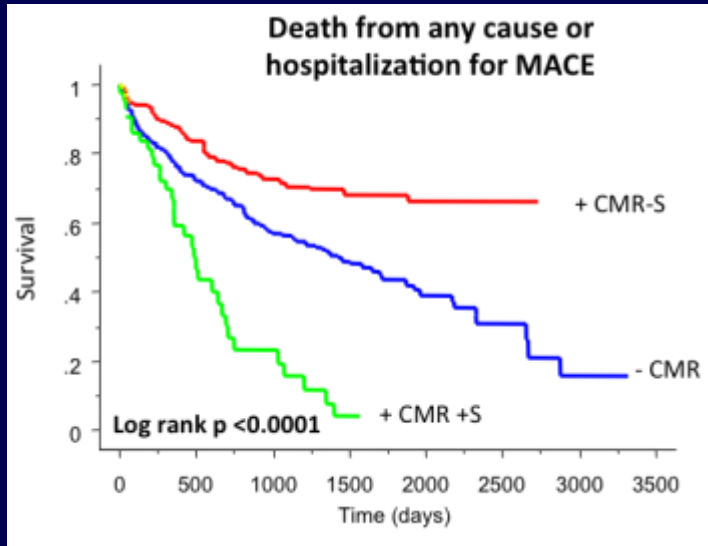
# Effect of modifying LV lead position



# Effect of pacing left ventricular scar

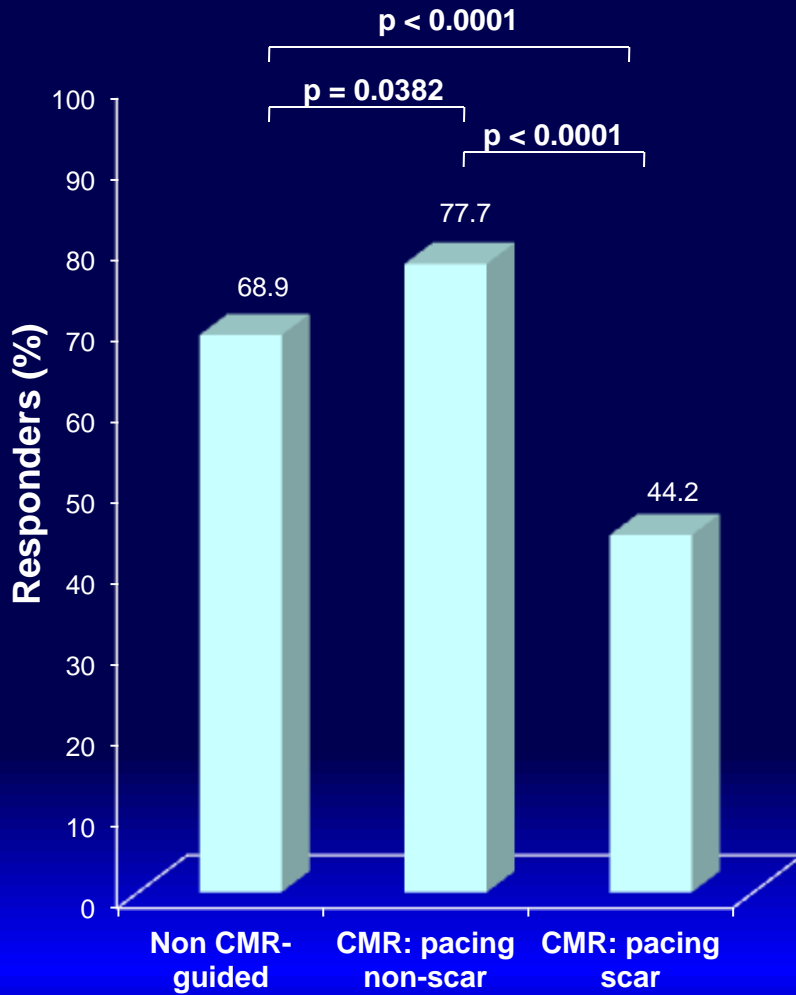


# Pacing scar results in worse outcomes

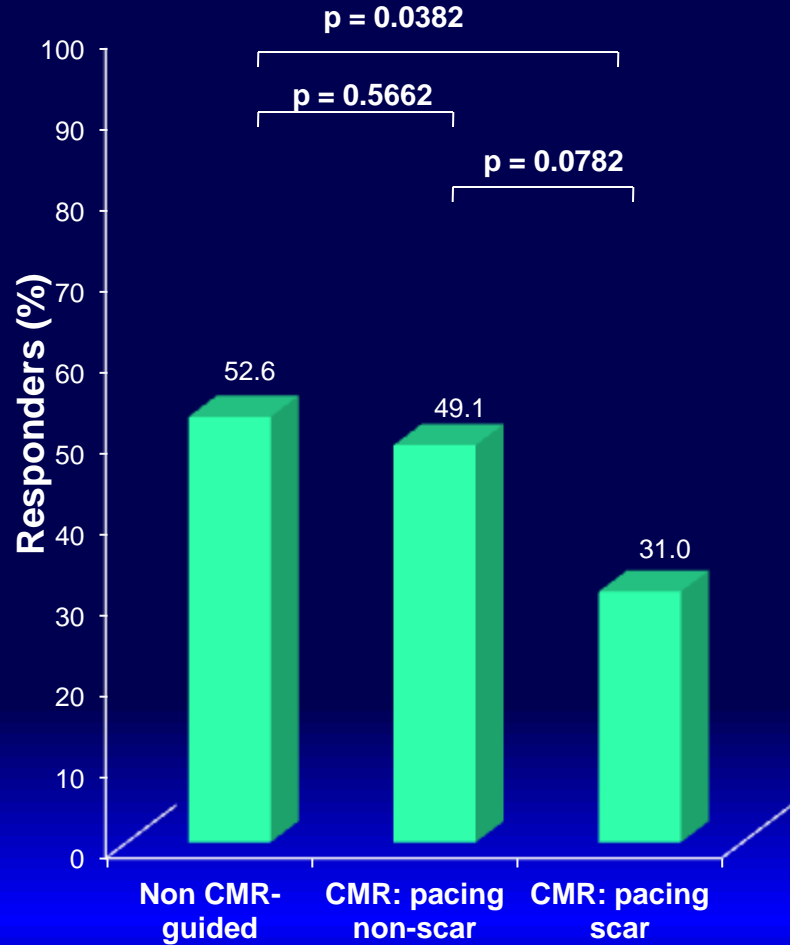


# Pacing scar results in worse response

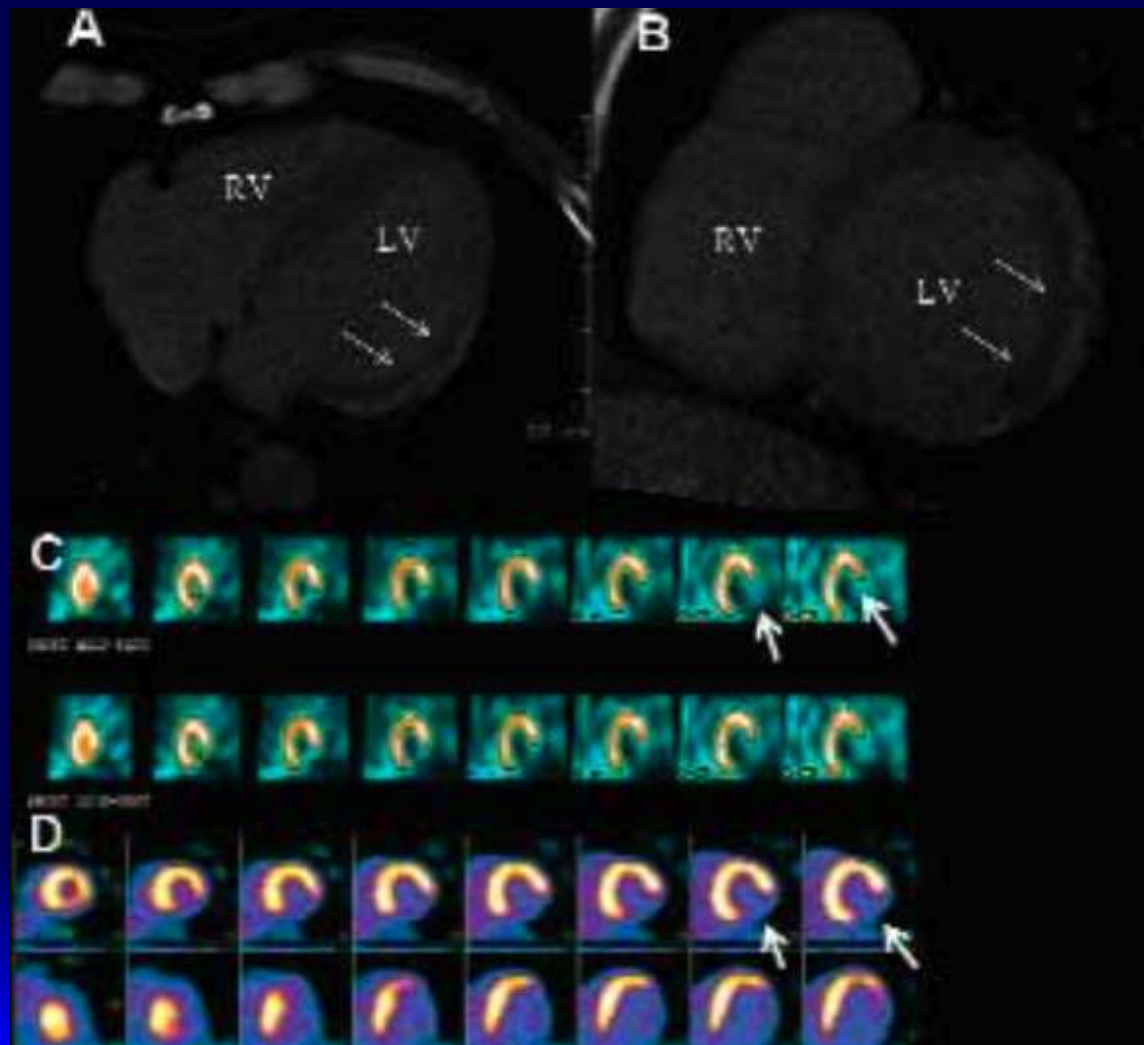
## Composite clinical score



## Echocardiographic response

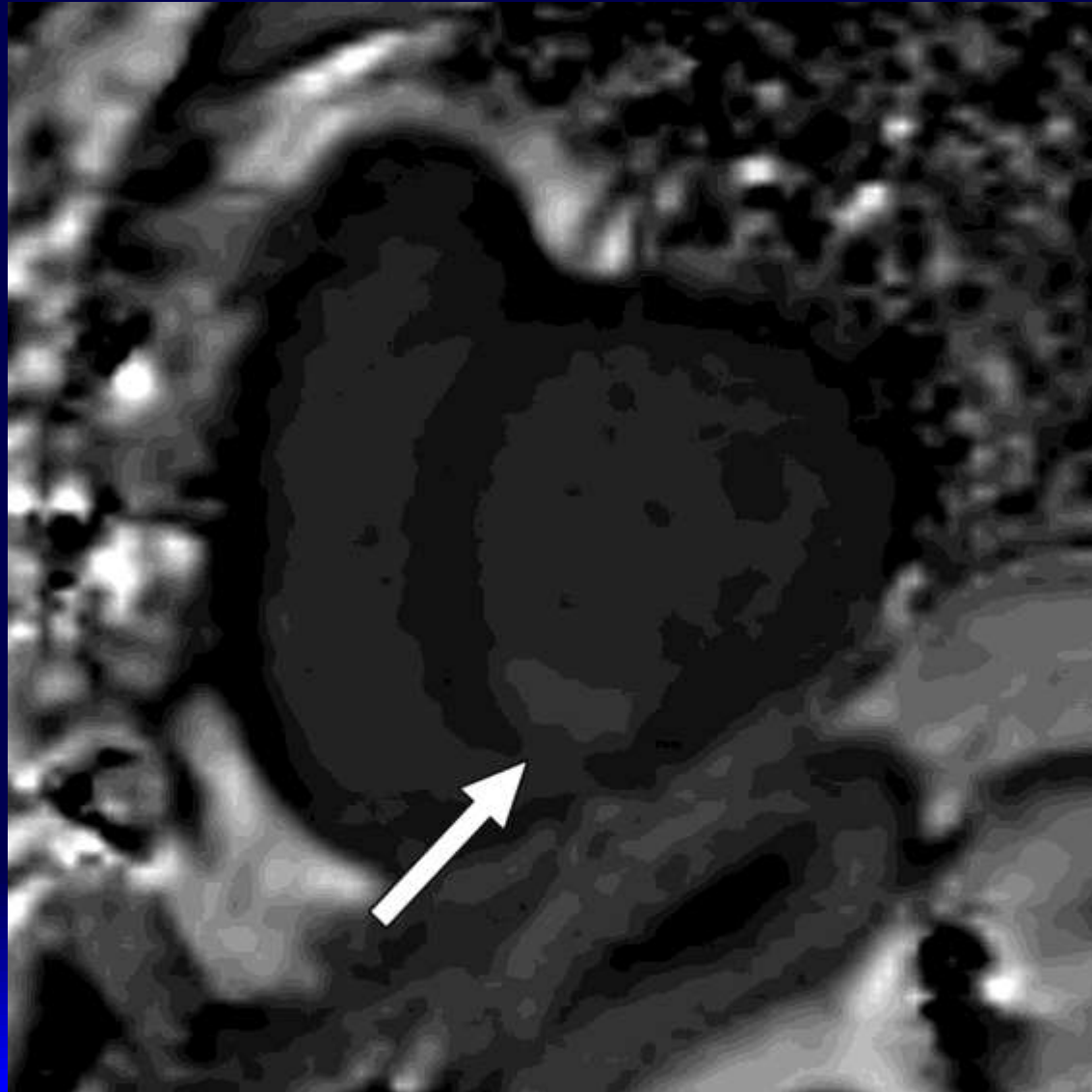


# CT and PET for demonstration of scar



## Scar with CT

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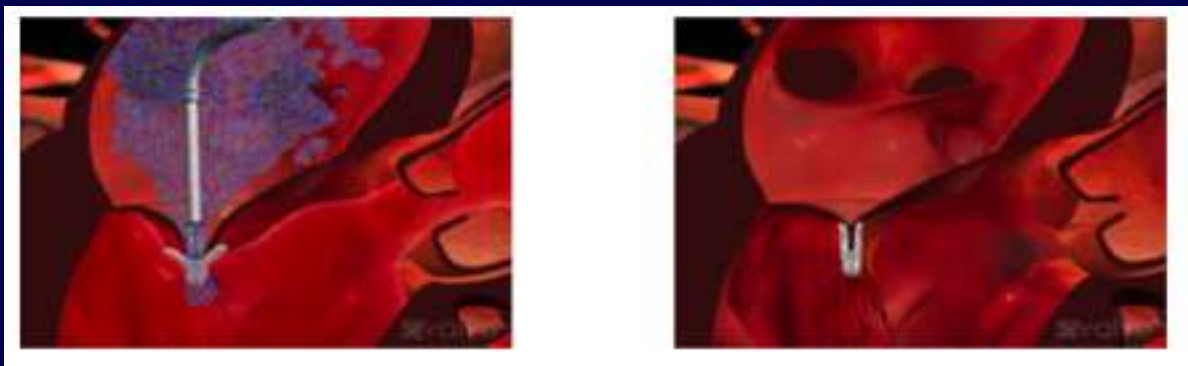


## Other options: Mitra-clip

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Change in NYHA class and MR after MitraClip in CRT non-responders (PERMIT-CARE registry)

50 pts ,33 months after CRT ; LVEF:27% ;STS Score=14%



92% NYHA grade 3 and 4 prior to mitra-clip, 22% at 1 year  
4.2% mortality at 30 days

## Considerations in non-responder to CRT

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- **Review indication for implant**
- **Consider**
  - LV lead position
  - AV node ablation
  - Mitra-clip
- **Check medication**
- **“Non-responder” term is unique to CRT**
- **CRT may ameliorate the deterioration that all patients with heart failure are likely to experience.**

