



Yield of LV dyssynchrony *as assessed with phase analysis* by gated myocardial perfusion SPECT in patients with ICD or CRTD: prediction of cardiac outcome

Nili Zafrir,, Tamir Bental, Boris Strasberg, Ariel Gutstein, Israel Mats, Doron Belzer, Yosef Hasid, Alejandro Solodky

Cardiology Department, Rabin Medical Center, Beilinson Hospital and Sackler Faculty of Medicine, Tel Aviv University, Israel

**No Disclosure**

# Background

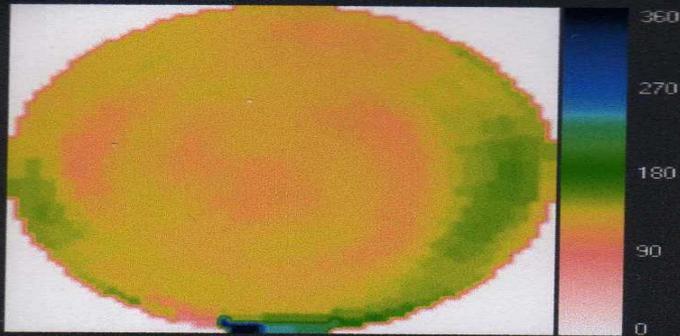
- Patients with heart failure and  $LVEF \leq 35\%$  receive **ICD** as primary prevention although it is not activated in the majority of them.
- Moreover, patients with heart failure and prolonged QRS who receive **CRTD**, third of them do not demonstrate clinical improvement
- **Mechanical LV dyssynchrony (MLVD)** is common in patients with LV dysfunction, and can be detected by different imaging modalities. However, its exact utility in identifying patients who benefit CRT or CRTD is not well established

# Background

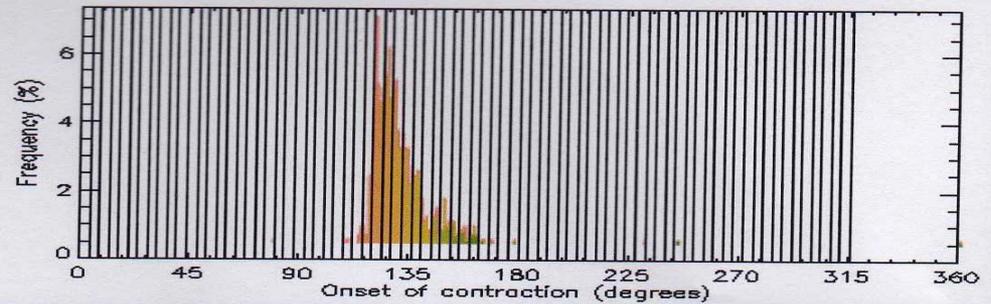
- **Mechanical LV dyssynchrony** by Gated SPECT studies has been validated for measuring by phase analysis; a count based method that extract amplitude and phase from regional LV count changes throughout the cardiac cycle
- This technique is fully automated and processes data obtained during routine gated SPECT imaging.
- The most applicable parameters related with LV dyssynchrony: **phase standard deviation (SD)** and **phase histogram bandwidth (PBW)**.

# Normal phase analysis

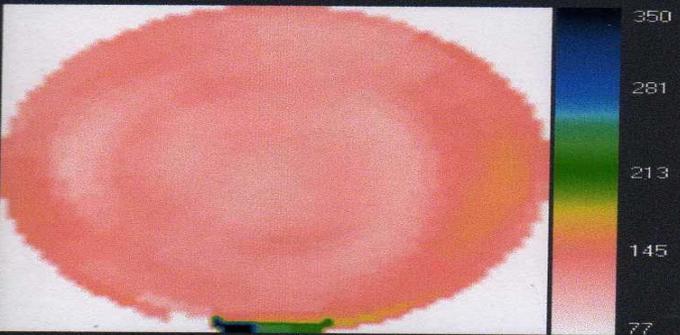
Raw Phase Polarmap



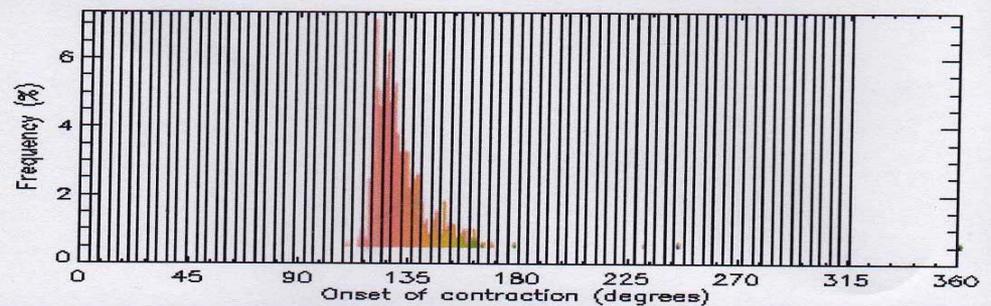
Raw Phase Histogram



Normalized Phase Polarmap



Normalized Phase Histogram

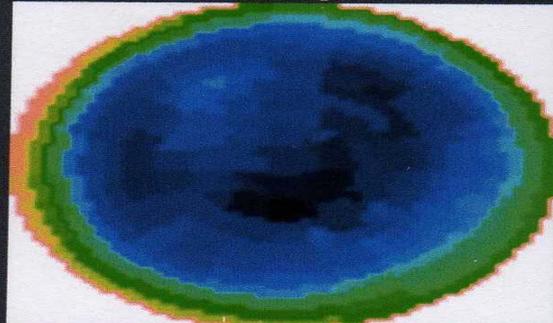


Dynamic Systolic Wall-Thickening Display

Summed Polarmap



Polarmap w/ Moving Contraction



- Rest
- Phase
- Style 1
- Faster
- Slower
- Reload
- Stop
- Previous
- Next
- Range 360

Systolic Wall-Thickening Analysis

Heart Rate (bpm):	-1
Peak Phase (degree):	117.000
Standard Deviation (degrees):	14.5280
Histogram Bandwidth (degrees):	34.0000
Histogram Skewness:	4.41878
Histogram Kurtosis:	20.4594
Patient Sex:	Female
Peak Phase:	140.240 +/- 14.8900
Standard Deviation:	11.7800 +/- 5.16000
Histogram Bandwidth:	30.5800 +/- 9.56000
Histogram Skewness:	4.60000 +/- 0.720000
Histogram Kurtosis:	23.2100 +/- 8.16000

Smooth Phase Map Save Phase Result



Patient Name: \*\*\*\*\*

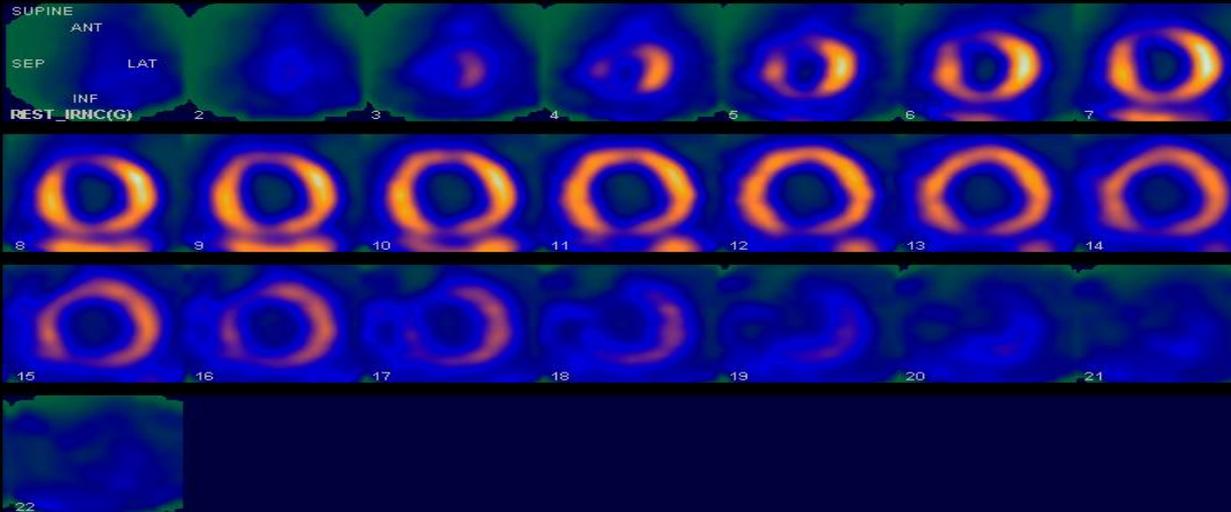
Patient Id: \*\*\*\*\*

Nuclear Cardiology Unit  
Rabin Medical Center Beilinson

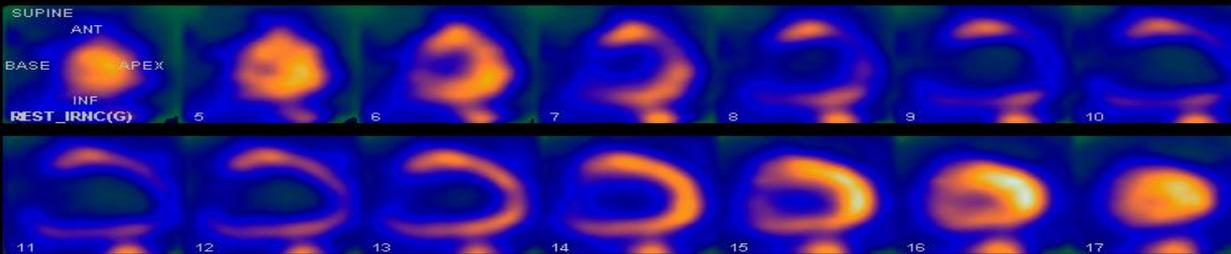
Study Name: VIABILITY REST G

Date & Time: 26-11-09

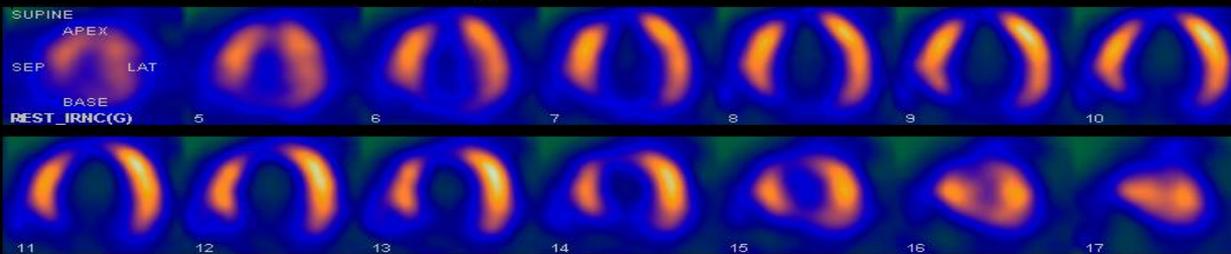
Manufacturer Model: VENTRI



<----- Apical      Short Axis      Basal ----->



<----- Septal      Vertical Axis      Lateral ----->



<----- Inferior      Horizontal Axis      Anterior ----->

REST\_IRNC(G)

Date: 2009/11/26 13:59

EF: 15%

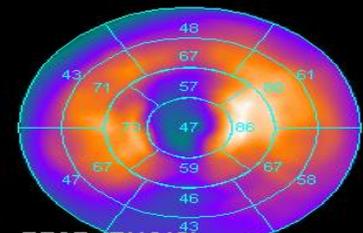
EDV: 298ml

ESV: 252ml

SV: 46ml

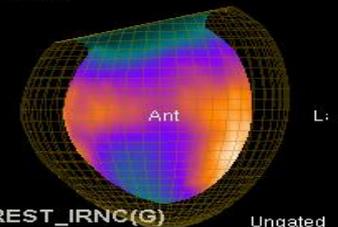


REST\_ShiftIRNC(G)(motion corrected)  
2



REST\_IRNC(G)

Endo+Epi      Base





Patient Name: \*\*\*\*\*

Patient Id: \*\*\*\*\*

Nuclear Cardiology Unit  
Rabin Medical Center Beilinson

Study Name: VIABILITY REST G

Date & Time: 02-03-10

Manufacturer Model: VENTRI

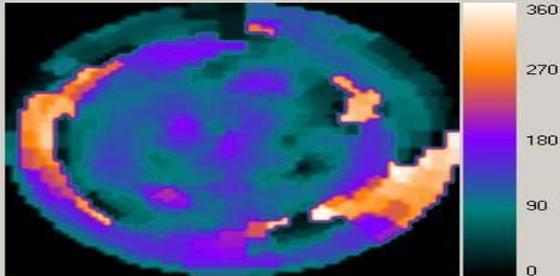
# LV dyssynchrony

2 Day Sestamibi  
03/02/2010 12:53:40.00

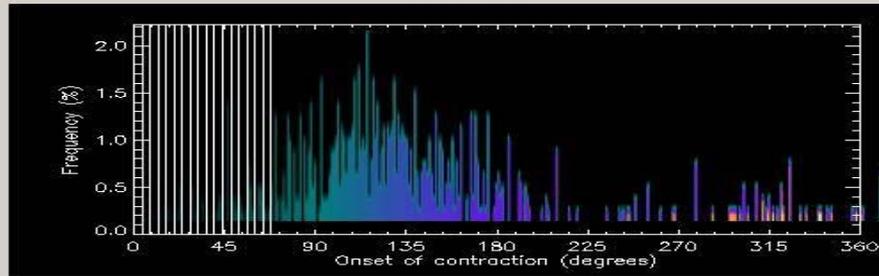
General Hospital / Nuclear Medicine

Estimated Systolic Wall-Thickening Phases

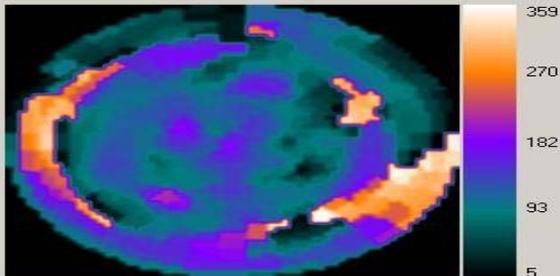
Raw Phase Polarmap



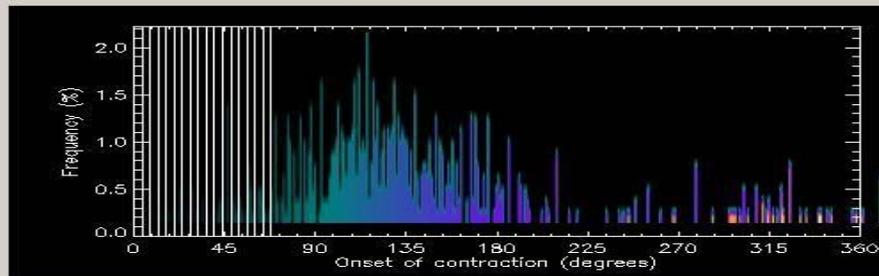
Raw Phase Histogram



Normalized Phase Polarmap

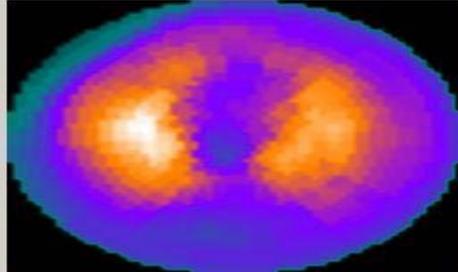


Normalized Phase Histogram

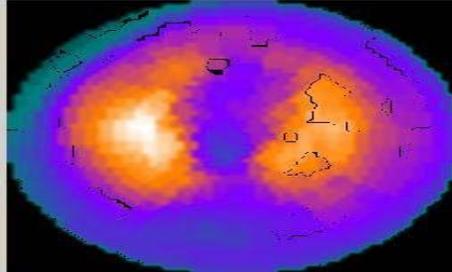


Dynamic Systolic Wall-Thickening Display

Summed Polarmap



Polarmap w/ Moving Contraction



- Rest Only
- Phase
- Style 1
- Faster
- Slower
- Reload
- Stop
- Previous
- Next
- Range 360

Systolic Wall-Thickening Analysis

Heart Rate (bpm):	0
Peak Phase (degrees):	112.000
Standard Deviation (degrees):	64.2427
Histogram Bandwidth (degrees):	193.000
Histogram Skewness:	1.76319
Histogram Kurtosis:	2.69185
Patient Sex:	Male
Peak Phase:	134.510 +/- 11.3289
Standard Deviation:	14.1500 +/- 5.12000
Histogram Bandwidth:	38.7100 +/- 11.8400
Histogram Skewness:	4.19000 +/- 0.680000
Histogram Kurtosis:	19.7100 +/- 7.68000

Smooth Phase Map Save Phase Result

# Aim

- To assess **LV dyssynchrony** by phase analysis from gated SPECT myocardial perfusion imaging (MPI), in patients prior **ICD** for primary prevention or **CRTD**
- To investigate whether **LV dyssynchrony** can also be used to identify who might benefit from receiving ICD or CRTD therapy.
- Predictors for **cardiac events** in patients received ICD or CRTD.

# Methods

- During 2010-2012, In a prospective study, patients post MI with LVEF  $\leq 35\%$  who were scheduled for ICD or CRTD underwent gated SPECT MPI study prior procedure ( about one month)
- LV dyssynchrony was measured by “syncTool software “ phase standard deviation (PSD) and histogram bandwidth (PBW).

# Methods

- Patients characteristics, risk factors for CAD, SPECT MPI, phase analysis results, QRS width of baseline ECG and EF were analyzed and compared in ICD and CRTD groups
- The patients were followed-up for cardiac events defined as: cardiac death, heart failure deterioration - hospitalization, life threatening arrhythmias

# Results

- The study cohort consisted of 108 pts, 58 with ICD and 50 pts with CRTD
- The patients were followed up for mean of  $16.4 \pm 8.0$  months for cardiac death, CHF deterioration, VT/VF/shock. There were 32 (24%) cardiac events
- Cardiac Events
  - 14 cardiac death
  - 12 HF deterioration + hospitalizations
  - 6 VT/VF/appropriate shock

**Table 1: Clinical characteristics, MPI and Phase Analysis results**

	<b>ICD</b>	<b>CRTD</b>	<b>p value</b>
<b>Number</b>	<b>58</b>	<b>50</b>	<b>ns</b>
<b>Age</b>	<b>68.6 ± 10</b>	<b>69.1 ± 12</b>	<b>ns</b>
<b>Male</b>	<b>50 (86%)</b>	<b>41 (82%)</b>	<b>ns</b>
<b>BMI (kg/m<sup>2</sup>)</b>	<b>25.6 ± 3.6</b>	<b>27.7 ± 5.5</b>	<b>0.05</b>
<b>DM</b>	<b>35 (60%)</b>	<b>28 (56%)</b>	<b>ns</b>
<b>HTN</b>	<b>30 (51.7%)</b>	<b>21 (42%)</b>	<b>ns</b>
<b>QRS width</b>	<b>115 ± 33</b>	<b>139 ± 32</b>	<b>0.0001</b>
<b>NYHA class</b>	<b>2.3 ± 0.75</b>	<b>2.7 ± 0.6</b>	<b>0.03</b>
<b>Scar</b>	<b>3.52 ± 1.5</b>	<b>2.88 ± 1.9</b>	<b>0.06</b>
<b>EF (%)</b>	<b>25.7 ± 6.5</b>	<b>23.7 ± 6.9</b>	<b>ns</b>
<b>LV dyssynchrony</b>			
<b>Phase: SD*</b>	<b>61.9 ± 18.8</b>	<b>56.7 ± 19</b>	<b>ns</b>
<b>Phase: BW**</b>	<b>192.5 ± 79</b>	<b>145 ± 79</b>	<b>ns</b>

\* normal SD = 18° ± 11°

\*\* normal BW = 46° ± 30°

# Cardiac events

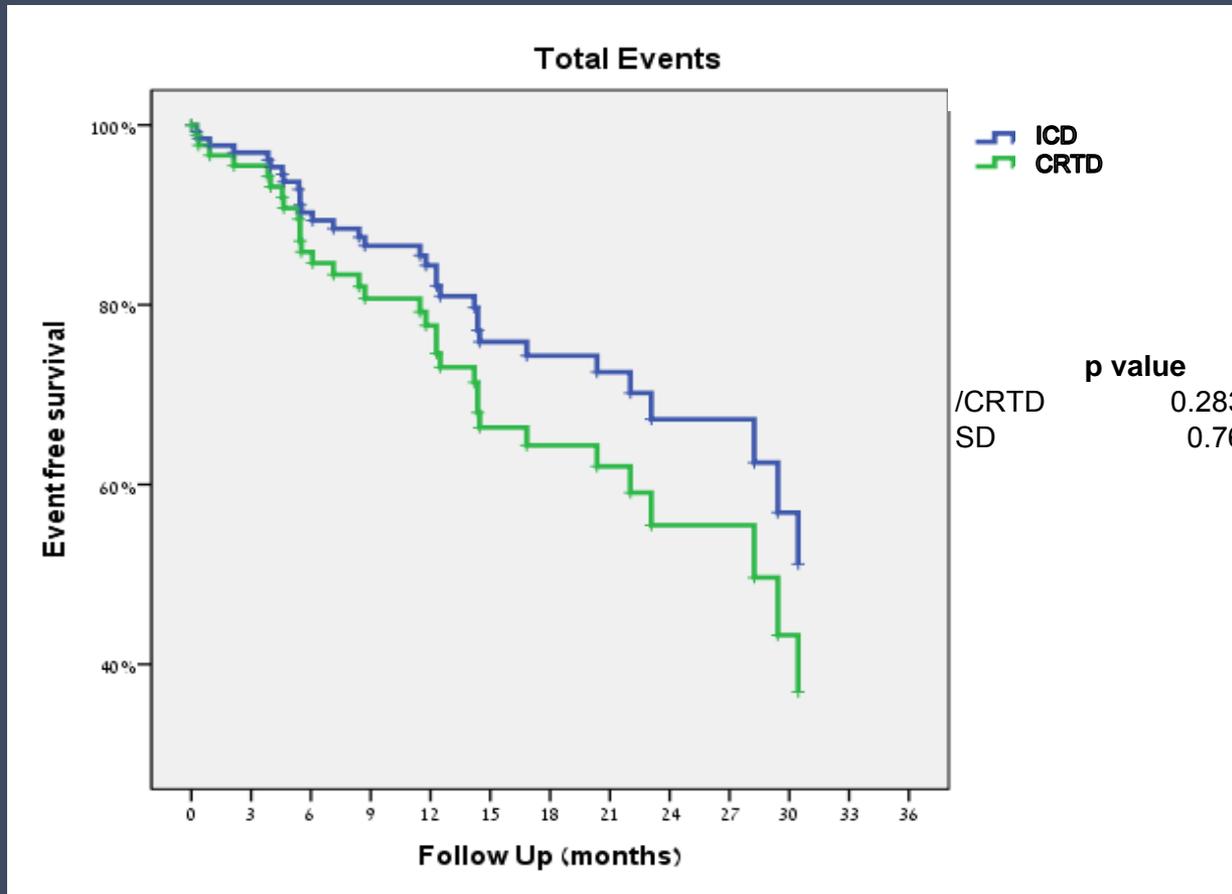
	ICD N=58	CRTD N=50	p value
<b>Cardiac death</b>	<b>4 (6.9% )</b>	<b>10( 20% )</b>	<b>0.05</b>
HF deterioration	4 (6.9%)	8 (16%)	0.2
VT/VF/ATP	5 (8.5%)	1 (2%)	0.1
<b>Total events</b>	<b>13 (22.4%)</b>	<b>19 (38%)</b>	<b>0.093</b>

# Results

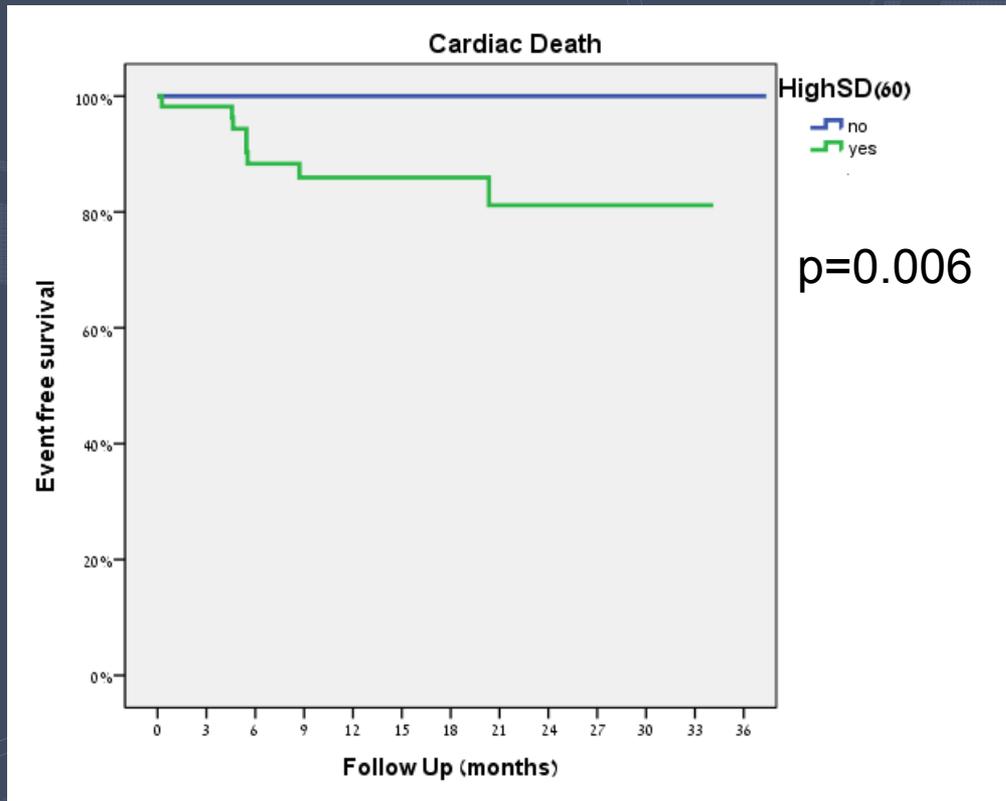
## Univariate analysis for cardiac events

	HR	CI 95%	P
■ NYHA	1.505	1.002 -2.260	0.049

# Cardiac events in patients with ICD and CRTD



# LV dyssynchrony with phase SD >60° predicts cardiac death in ICD and CRTD patients



# Limitation

- Preliminary results in a small cohort

# Conclusions

- LVEF, infarct size, **LV dyssynchrony** were similar in **ICD** post MI and **CRTD** patients
- NYHA class and QRS width were significantly higher in patients with CRTD vs patients with ICD
- **Cardiac death** was significantly higher in patients with CRTD vs patients with ICD only.
- **NYHA** class prior procedure was the only predictor for cardiac death in patients with ICD or CRTD
- Patients with **LV dyssynchrony** ( $SD > 60^\circ$ ) had significantly more cardiac events and cardiac deaths



**THANK YOU !!**