# Assessment of Defibrillation Threshold upon Implantable Cardioverter-Defibrillator implant in Relation to patient's prognosis

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# Objective of the Study

This study investigated whether defibrillation threshold (DFT) testing upon implantable cardioverter-defibrillator (ICD) implantation impacts patient's prognosis.

# Background of the study

- Since ICD was first introduced in the early 1980s, DFT at the time of implantation has been considered standard because the results have been used to predict the likelihood that these devices would successfully terminate sustained ventricular tachyarrhythmias when they occurred clinically.

# DFT testing

- There are several methods of VF induction, such as shock-on-T, fast burst pacing, low voltage alternating current, and upper limit vulnerability. The device is checked if it detects VF properly and restores VF back to sinus rhythm.

- DFT: the lowest amount of energy capable of terminating an episode of induced VF, determined through either a step-up or step-down method.

- The device energy output is programmed at DFT plus 10 J safety margin.

# Advantages

**DFT**

1. Ensure appropriate sensing of VF, system integrity, and effective defibrillation.

2. Can set possible lowest energy to save the battery when the patient needs multiple shocks

**Non-DFT**

1. Avoid potential complications associated with DFT testing

# Disadvantages

**DFT**

1. Complications, possible damage

**Non-DFT**

1. Unsure if the defibrillator works appropriately when the patient develops VF.

2. When the patient receives a shock, myocardial damage may be more profound because defibrillator is set at the maximum energy output.

# Background of the study

- DFT testing is not risk free and its usefulness or importance has been questioned.

- It has been reported that DFT testing is potentially linked to neurologic damage, cardiac arrest [1, 2], pulseless electrical activity, myocardial damage [3], transient reduction of left ventricular systolic function [4], and death [5].


1. Steinbeck G et al. Am Heart J 1994; 127:1064-1067
2. Birnie D et al. Heart Rhythm 2008; 5: 387-390
3. Frame R et al. Pacing Clin electrophysiol 1992; 15:870–7
4. Joglar JA et al. Am J Cardiol 1999; 83: 270-272. A276
5. Kolb C et al. Int J cardiol 2006;11;2:74-5

# Background of the study

- The subgroup analysis of SCD-HeFT suggested that among patients with heart failure in whom an ICD is implanted for primary prevention, those who receive shocks for any arrhythmia have a substantially higher risk of death than similar patients who do not receive such shocks. [6]

- PREPARE study demonstrated improved mortality when IDC for primary prevention was programmed to reduce shocks. [7]

6. Poole J. E et al. N. Engl J M 2008 Sep 4 359(10): 1009-1017

7. Wilkoff B. L et al. J Am Coll Cardiol. 2008 Aug 12; 52(7): 541-550

# Background of the study

- Above studies suggest ICD shocks for any reasons are detrimental.

- In this study, we investigated whether ICD shocks upon implant, i.e. DFT testing, also affect patient's prognosis.

# Methods

- IRB approval on 10/24/2011

- This study was a retrospective review of 73 patients who underwent ICD implantation for primary sudden cardiac death prevention in the Catholic Health System from September 2009 to October 2011. 19 patients were excluded based on the exclusion criteria. Total 54 patients were included in this study.

# Methods

Exclusion from study groups:

- Patients who received ICD for secondary prevention
- Patients who received ICD for cardiac resynchronization therapy
- Patients who did not follow up in pacemaker clinic or did not have proper interrogation documents.

# Methods

24 patients who underwent DFT testing by shock-on-T method during ICD implant (DFT group) and 30 patients who did not undergo DFT upon ICD implant (Non-DFT group) were compared. The patient's events and prognosis were followed in the outpatient clinic up to 9 months.

# Methods

- Statistical analysis was done by the unpaired T- test and Chi-Square test.

# Results-Clinical Characteristics

| Parameters | DFT Group* | Non-DFT Group* | P Values** | 95% Confidence Interval |
|---|---|---|---|---|
| Age (years) | 67.20±16.03 | 68.8±13.12 | 0.69 | -6.366 to 9.550 |
| Female | 9 (37%) | 10 (33%) | 0.755 | -0.309 to -0.226 |
| HTN | 21 (87%) | 23 (76%) | 0.318 | -0.324 to 0.107 |
| DM | 7 (29%) | 15 (30%) | 0.126 | -0.061 to 0.477 |
| smoking | 12 (50%) | 7 (23%) | 0.042 | -0.524 to -0.010 |
| CAD | 14 (58%) | 22 (73%) | 0.253 | -0.111 to 0.411 |
| CKD | 13 (54%) | 10 (33%) | 0.129 | -0.479 to 0.062 |
| LVH | 12 (50%) | 11 (36%) | 0.334 | -0.408 to 0.141 |
| EF (%) | 28.5±7.4 | 26.2±10.39 | 0.380 | -7.292 to 2.825 |
| LA pressure (mmHg) | 12.22±4.41 | 15.38±9.46 | 0.254 | -1.235 to 7.579 |

*Values are Mean±1 SD or number(%)

** P value significant at < 0.001

# Follow up data of the pacemaker checkup

| Parameters | DFT Group* (# of Patients) | Non- DFT Group* (# of patients) | P Values** | 95% Confidence Interval |
|---|---|---|---|---|
| VT | 1 (4%) | 2 (7%) | 0.777 | -0.20086 to 0.15086 |
| NSVT | 6 (25%) | 8 (27%) | 0.570 | -0.33817 to 0.18817 |
| SVT | 3 (12.5%) | 3 (30%) | 0.208 | -0.23609 to 0.05276 |
| ICD therapy | 2 (8%) | 2 (7%) | 0.820 | -0.16326 to 0.12992 |
| Mortality | 4 (16%) | 4 (13%) | 0.738 | -0.165 to 0.232 |

*Values are Mean±1 SD or number(%)

** P value significant at < 0.001

# Follow up data of the pacemaker checkup

| Parameters | DFT Group* (# of events) | Non- DFT Group* (# of events) | P Values** | 95% Confidence Interval |
|---|---|---|---|---|
| VT | 0.17±0.48 | 1.26±3.5 | 0.138 | -0.408 to 2.564 |
| NSVT | 1.92±3.82 | 34.37±160.28 | 0.327 | -33.345 to 98.245 |
| ATP | 0.042±0.2 | 0.2±0.81 | 0.353 | -0.18 to 0.497 |
| # of shocks | 0.042±0.2 | 0.1±0.4 | 0.521 | -0.123 to 0.24 |

*Values are Mean±1 SD or number(%)

** P value significant at < 0.001

# Summary of Results

1. There was no statistical difference in patient's clinical characteristics between the two groups.

2. There was no statistical difference in patient's events (SVT, VT, and ICD therapy) .

3. There was no statistical difference in patient's prognosis.

# Conclusions

- Although ICD shocks for any reasons were suggested to be detrimental, our study failed to demonstrate the detrimental DFT effect on patient's prognosis.

- A larger scale study with a longer follow up will be warranted.

# Discussion

- DFT testing is designed to confirm if ICD works properly when VF occurs.
- Although ICD shocks of any reason are reported detrimental, ICD shocks on DFT testing itself did not affect short term prognosis (up to 9 months) of the patients.
- It was also shown that DFT testing did not improve patient's prognosis either.

# Discussion

- If DFT testing doesn't offer any benefit, why bother?

- Current clinical practice during ICD implantation varies considerably.

# Discussion

- There were some surveys which assessed the current practice of testing defibrillation function at the time of ICD implant. 19.3-30 % responders reported no testing at the time of implantation in Europe.

- It may be important to identify the high risk group who truly benefit from DFT testing.

**To be (do), or not to be (do), that is the question.**

*Hamlet*

*Shakespeare*

# First do no harm!

*Hippocrates*

*460-377 BC*

# Thank you

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