



Insufficient compliance with current implantable cardioverter defibrillator (ICD) therapy guidelines in post myocardial infarction patients is associated with increased mortality

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ABSTRACT

Current clinical guidelines advocate implantable cardioverter defibrillator (ICD) therapy for the prevention of sudden cardiac death among post myocardial infarction (MI) patients. However, there are scarce data regarding compliance with the guidelines and utilization of this life-saving treatment. We aimed to assess the rate of ICD utilization among post MI patients with left ventricular ejection fraction (LVEF) $\leq 35\%$.

Methods: All patients admitted with a ST-elevation MI at a single tertiary care center from 2005 to 2009, discharged alive with LVEF $\leq 35\%$ and surviving 40 days were included. Patients already implanted with an ICD and whose residence was outside the hospital's area of coverage were excluded. ICD utilization, LVEF re-assessment and mortality were assessed during mean follow up time of 2 years.

Results: Of the 285 subjects, only 26 (9%) received an ICD. There were significant differences in ICD use among different medical health organizations (insurers). Among the 259 subjects not implanted with an ICD, repeat echocardiography study for the re-assessment of LVEF was performed in only 176 (68%). Of those, LVEF remained severely impaired in 47%. After excluding subject whose LVEF improved at follow up, the ICD utilization rate was 14%. In a multi-variable analysis, significant predictors of ICD utilization were age below the median of 61 years, and a repeat echocardiography. Using propensity score and matching of subjects implanted with ICD with those not implanted, ICD implantation was found to be associated with survival benefit.

Conclusions: ICDs are underutilized in post MI patients and compliance with current guidelines is insufficient. Failure to re-assess LVEF is a barrier for this life-saving treatment. Withholding ICD therapy among unselected post MI patients with depressed LVEF is associated with a markedly increased mortality.

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1. Introduction

Survivors of an acute myocardial infarction (MI) that are left with reduced left ventricular function are at risk for life threatening ventricular arrhythmias and sudden cardiac death (SCD) [1,2]. Over the last decade numerous trials have shown that implantable cardioverter defibrillators (ICD) improve survival among specific post MI patients with reduced left ventricular ejection fraction (LVEF) [3,4], and accordingly practice guideline were developed [5].

Nevertheless, adherence to guidelines is not uniform and although the ICD is an effective treatment, the rates of device implantation for primary prevention of SCD vary between countries, regions, and are also influenced by demographic factors [6–8]. Therefore, we aimed to

assess the rates of utilization of ICDs for primary prevention of sudden cardiac death among a real-world cohort of MI survivors with severe left ventricular (LV) dysfunction, and to identify barriers to ICD use.

2. Methods

2.1. Study population

All consecutive patients discharged alive from the coronary care unit of a tertiary medical center following an acute ST-segment elevation MI with severe LV dysfunction (LVEF $< 35\%$), between the years 2005 and 2009, were included. Soroka University Medical Center is located in Be'er Sheva, the largest city in southern Israel, and it serves an area of approximately 700,000 people, 14% of the country's total population. Patients who were implanted with an ICD earlier or died within 40 days of their MI, and those whose residence was outside the hospital's area of coverage were excluded. Data regarding demographic and clinical variables as well as follow up data were extracted from the patients' medical records. Mortality data were received via the national death registry. In addition, since every patient in Israel is medically covered by one of 4 sick funds or health medical organizations (HMO), and since the HMO both authorize each and every ICD implantation as well as reimburse the hospital, we also compared the rates of ICD utilization among the different HMOs.

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2.2. Statistical analysis

Continuous and dichotomous variables were compared using the *t*-test and chi-square respectively. Survival analysis was done using Kaplan–Meier estimates and the log-rank test. In order to look for variables predicting ICD implantation a step wise backwards logistic regression model was constructed with $p > 0.1$ as the exit criterion. Variables in the model were age (above or below the median of 61 years), gender, diabetes, hypertension, baseline LVEF (<30% vs. 30–35%), and repeat echocardiography study (vs. none).

To assess the relationship between ICD therapy and all-cause mortality, and since the devices were implanted in different time points following the index MI, we performed the following analysis in order to avoid survival bias; as a first step we created a propensity score for ICD implantation based on the above mentioned logistic regression model. Out of the 26 ICD cases we could individually match 22 patients with 66 non-ICD patients (ratio 1:3) based on a) time to ICD implantation – patients without ICD who survived at least the period of time equal to time to the ICD implantation for the matched case and b) quintiles of the propensity score. Finally, Cox proportional regression model for the prediction of all cause mortality was built with the inclusion of ICD status, propensity score, age, gender and the degree of left ventricular dysfunction. *p*-values less than 0.05 (two-sided) were considered to be statistically significant.

The study was approved by the hospital's ethics committee.

3. Results

3.1. ICD utilization rate

A total of 285 patients were included, with a mean age (\pm SD) of 61 (\pm 14) years, of which 25% were women. Of the 285 subjects, 26

(9%) received an ICD (Fig. 1) at a median of 610 days after their acute admission (range: 94–1834 days). Among those not implanted with an ICD (259, 91%), repeat echocardiography to re-assess LV function was performed in only 68% (176) at a median of 132 days after the first study. Of those, LVEF improved in 53% patients (94) and remained severely impaired in the rest. Thus, LVEF did not improve or was not assessed in 165 (64%) of those not implanted (Fig. 1). Excluding patients whose LVEF improved on a follow up echocardiography from the ICD-eligible cohort, makes the ICD utilization rate 14% (26 out of 191 patients).

3.2. Factors influencing ICD utilization

Subjects implanted with an ICD tended to be younger but there were no significant differences in age, gender or co-morbidities between those implanted or not with an ICD. However, the rate of ICD utilization varied significantly among the HMOs (Table 1). In a multi-variable analysis, and after excluding subject with improved LVEF on repeat assessment, significant predictors of ICD utilization were age below the median of 61 years (HR = 3.6, 95%CI = 1.3–9.7) and a repeat echocardiogram (showing no LVEF improvement) vs. no repeat study (HR = 23.9, 95%CI = 3.1–182.0). Gender and co-morbidities did not predict ICD use.

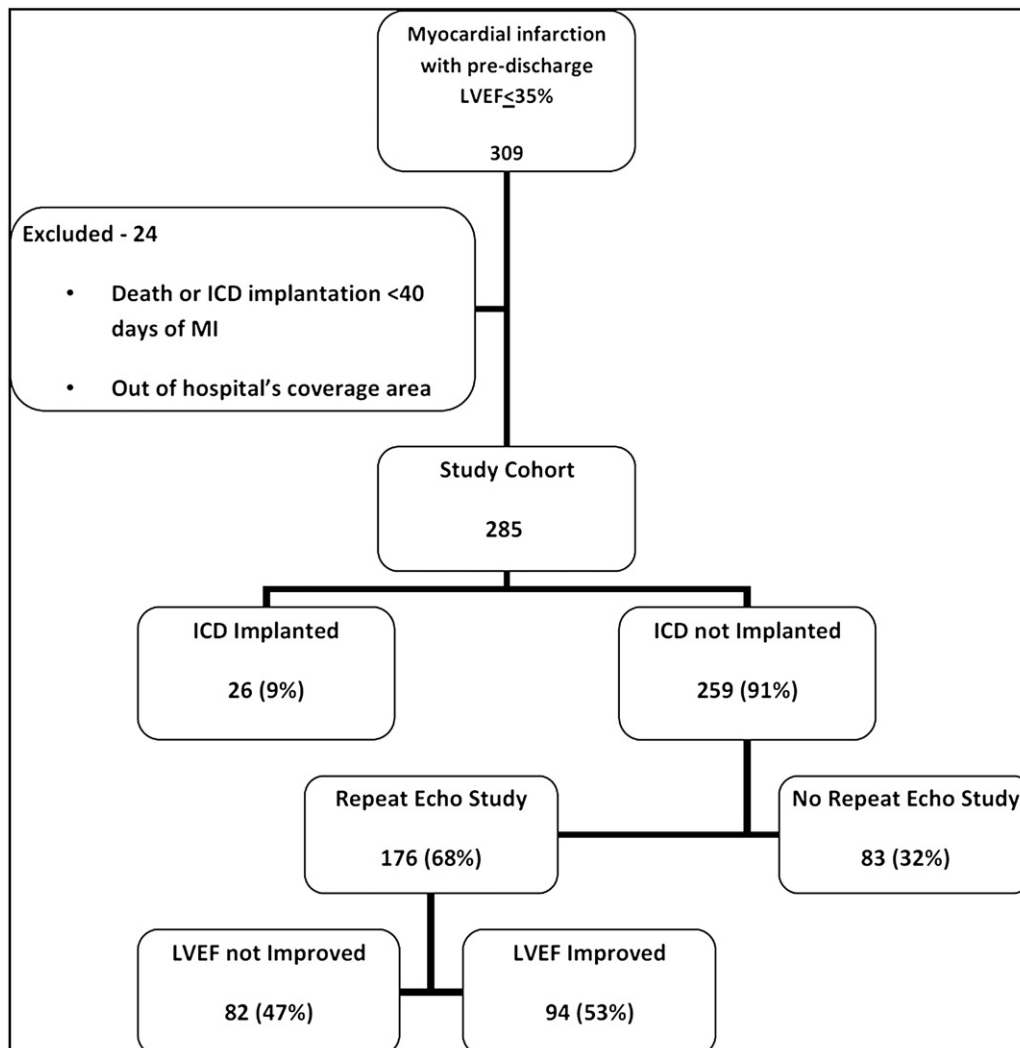


Fig. 1. The study cohort, ICD utilization, and repeat echo studies among unselected post MI patient with left ventricular systolic dysfunction.

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