Electrophysiology-guided defibrillator implantation early after ST-elevation myocardial infarction

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BACKGROUND Sudden death risk is highest early after myocardial infarction (MI). Inducible ventricular tachycardia (VT) confers increased risk of spontaneous ventricular arrhythmias.

OBJECTIVE The purpose of this study was to evaluate outcomes of electrophysiology (EP)-guided defibrillator implantation early after ST-elevation MI in patients with ejection fraction ≤40%.

METHODS EP study was performed 9 days after MI (n = 360). Predischarge defibrillator was recommended if VT with cycle length ≥200 ms was induced with ≤4 extrastimuli (EP-positive [EP_{pos}], n = 142). EP-negative (EP_{neg}) patients were discharged without a defibrillator (n = 218). Primary endpoint was either sudden death or spontaneous ventricular arrhythmia.

RESULTS Defibrillator was implanted in 71% of EP_{pos} patients (median 21 days post-MI) and withheld in 94% of EP_{neg} patients. At 2 years, primary endpoint was 4.3% in the EP_{neg} group and 22% in the EP_{pos} group (adjusted hazard ratio 0.46, $P = .035$, EP_{neg} vs EP_{pos}). Lack of a defibrillator in EP_{pos} patients conferred a fourfold increased risk of sudden death ($P = .014$). EP_{neg} patients without a defibrillator were at significantly lower risk for the primary endpoint than were EP_{pos} patients without a defibrillator (adjusted HR 0.34, $P = .011$). Short inducible VT cycle length (200–230 ms) and use of the fourth extrastimulus identified patients at significant arrhythmic risk.

CONCLUSION EP study performed early after MI identified patients at significant long-term arrhythmic risk at a critical time after MI in whom defibrillator implantation was protective. A large majority of patients (EP_{neg}; two thirds) were at significantly lower risk of arrhythmic events without a defibrillator in the long term.

KEYWORDS Electrophysiologic study; Implantable cardioverter-defibrillator; Myocardial infarction; Sudden death; Ventricular tachycardia

ABBREVIATIONS **CL** = cycle length; **EF** = ejection fraction; **EP** = electrophysiology; **ICD** = implantable cardioverter-defibrillator; **MI** = myocardial infarction; **STEMI** = ST-elevation myocardial infarction; **VF** = ventricular fibrillation; **VT** = ventricular tachycardia

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Introduction

Prophylactic implantable cardioverter-defibrillator (ICD) placement confers a significant survival benefit in patients with depressed ejection fraction (EF) in the chronic phase after myocardial infarction (MI).[1,2] The risk of sudden death is highest in the first 30 days post-MI.[3] Paradoxically, there is no demonstrable survival benefit with prophylactic ICD implantation within this high-risk time period,[4,5] possibly due to the limited ability of previously used risk stratifiers to differentiate the risk of arrhythmic death from nonarrhythmic causes.[6]

In the prelytic era, the inducibility of ventricular tachycardia early post-MI using a protocol of up to four extrastimuli from the present institution identified patients at high risk for arrhythmic death.[7–9] This observational study describes the long-term outcomes of electrophysiology (EP)-guided ICD implantation early post-MI to provide insight into the potential utility of this protocol for appropriate ICD selection.

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Methods

Patient selection

Consecutive eligible survivors of ST-elevation myocardial infarction (STEMI) were recruited over a 9-year period (n = 360; see exclusions in Figure 1). The study was approved by the Hospital Ethics Committee, and all patients gave informed consent. After full revascularization, optimal medical therapy was commenced (Table 1) and EF assessed ≥3 days post-MI. If EF was >40%, patients were discharged on optimal medical therapy without any further inpatient evaluation. If EF was ≤40%, an inpatient EP study was performed for sudden death risk stratification (Figure 1).[10] EP study was only performed after full revascularization with no evidence of ongoing myocardial ischemia,

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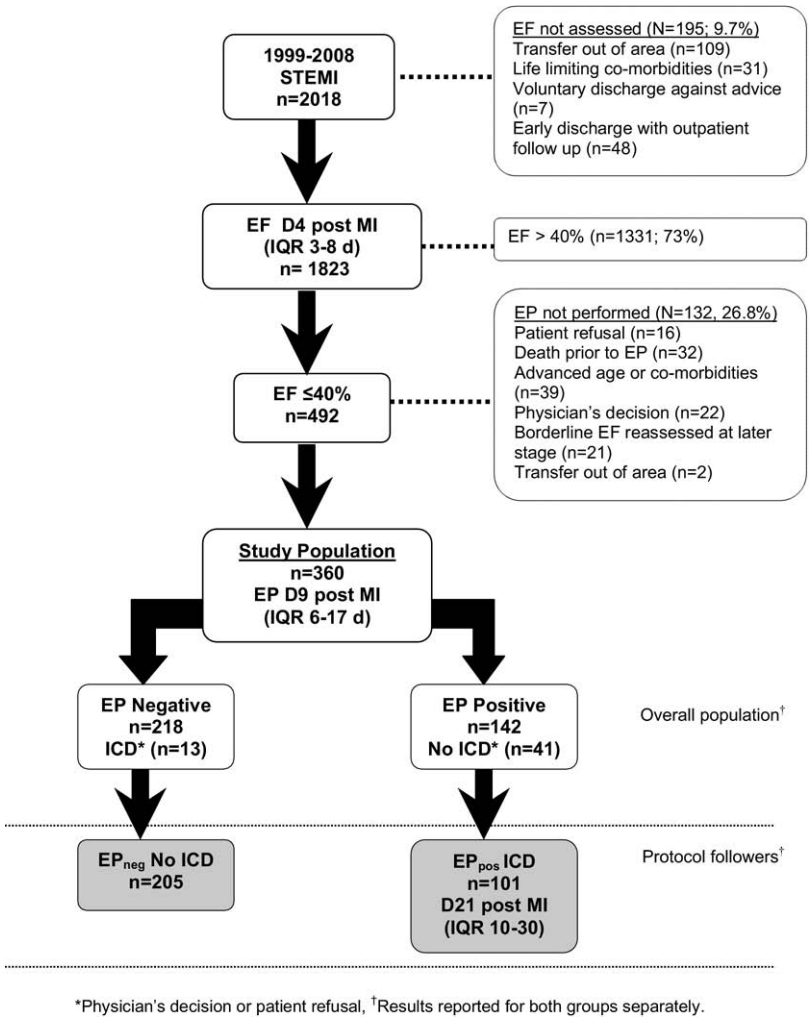

Figure 1 Patient selection. EF = ejection fraction; EP = electrophysiology; ICD = implantable cardioverter-defibrillator; IQR = interquartile range; MI = myocardial infarction; STEMI = ST-elevation myocardial infarction.

sustained ventricular tachycardia (VT)/ventricular fibrillation (VF) >48 hours post-MI, cardiogenic shock, or decompensated heart failure, and after commencement of guideline-driven optimal medical therapy.

Electrophysiologic study

EP study was performed under sedation in the absence of antiarrhythmic medication. Beta-blockers except for sotalol were not withheld. Programmed stimulation was performed at twice diastolic threshold at the right ventricular apex using a programmable stimulator. A drive train (S1S1) of eight beats at 400 ms was followed by up to four extrastimuli delivered one at time. Stimuli were rectangular pulses of 2-ms duration with a 3-second delay between each drive train. The initial extrastimulus was delivered at a coupling interval of 300 ms and then decreased in 10-ms steps to ventricular refractoriness (Figure 2A). If the earliest possible extrastimulus (e.g., S1S2) failed to induce VT, that extrastimulus was delivered 10 ms outside the ventricular effective refractory period and an additional extrastimulus added (e.g., S2S3, Figure 2B). The additional extrastimulus was decreased in 10-ms steps in the same manner. Additional extrastimuli were added in a similar manner (Figures 2C and 2D) until either VT or VF was induced (Figure 2E) or refractoriness of the fourth extrastimulus was reached. There was no set lower limit for the shortest permissible extrastimulus coupling interval.

The endpoint for stimulation was sustained monomorphic VT lasting >10 seconds. If sustained monomorphic VT with cycle length (CL) ≥200 ms was induced by ≤4 extrastimuli, the EP result was considered positive for inducible VT.[10–12] VF or ventricular flutter with CL <200 ms was considered a negative result. Stimulation was repeated a second time if the initial induction was negative for VT.

ICD implantation

If EP positive, predischarge ICD implantation was recommended. If EP negative, discharge without an ICD was recommended (Figure 1).[10]

ICD programming

All devices were pectoral systems with the manufacturer and type determined by the hospital availability. Defibrillation threshold testing was performed either at the time

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