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EDITORIAL

The Clinical Challenge of Predicting and Preventing Sudden Cardiac Death Immediately after Myocardial Infarction

N.A. Mark Estes III, MD

Tufts University School of Medicine, Boston, MA, USA

ABSTRACT

Despite many advances in treatment of myocardial infarction (MI) with percutaneous coronary intervention (PCI) and pharmacologic therapies, mortality immediately after MI remains high in patients with impaired left ventricular function. One of the greatest challenges facing the contemporary cardiologist is predicting and preventing sudden cardiac death (SCD) immediately after MI. Unfortunately, the trials assessing the role of the implantable cardioverter defibrillator (ICD) in patients at high risk for SCD immediately post MI have failed to show survival benefit. Current clinical guidelines restrict ICD implants to patients at least 40 days after MI with continued left ventricular dysfunction while on optimal medical therapy. It is evident that additional research is needed to identify strategies to prevent SCD and improve survival immediately after MI. In the meantime, clinicians should optimize and individualize therapy in the immediate post MI patient while carefully considering the risk of SCD and the competing risk of mortality from other causes.

KEY WORDS: *sudden cardiac death; acute myocardial infarction; left ventricular dysfunction; coronary artery disease; implantable cardioverter defibrillator*

Abbreviations
ICD = implantable cardioverter defibrillator
LVEF = left ventricular ejection fraction
MI = myocardial infarction
PCI = percutaneous coronary intervention
SCD = sudden cardiac death
STEMI = ST elevation myocardial infarction

Correspondence to:
N.A. Mark Estes III, MD
Professor of Medicine
Tufts University School of Medicine
750 Washington Street
Boston, MA 02111, USA
Tel.: 617-636-6156, Fax: 617-636-4586
E-mail: nestes@tuftsmedicalcenter.org

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One of the greatest challenges facing the contemporary cardiologist is predicting and preventing sudden cardiac death (SCD) immediately after myocardial infarction (MI).[1,2] Despite many advances in treatment of ST segment elevation MI (STEMI) with percutaneous coronary intervention (PCI) and pharmacologic therapies, mortality immediately after STEMI remains high in patients with impaired left ventricular ejection fraction (LVEF). In this patient population there is a disproportionately high risk of sudden death relative to total mortality.[3,4] Despite optimal therapy, the risk of SCD is highest in the few months post MI among patients with left ventricular dysfunction.[4] It is evident that early implementation of strategies for prevention of sudden death immediately after a STEMI are essential to improve total mortality.

Both invasive and noninvasive risk stratification techniques have been evaluated in an effort to identify individuals at high risk of SCD after STEMI.[5] Risk stratification methods should provide information about the ratio of sudden and non-sudden cardiac death.[5,6] The techniques of risk stratification need to be clinically linked to effective pharmacologic or nonpharmacologic interventions that prevent SCD and improve mortality. [6] Percutaneous coronary intervention (PCI), beta-blockers and angiotensin converting enzymes inhibitors improve long-term outcomes in patients after MI. Antiarrhythmic agents used to suppress spontaneous or induced arrhythmias have had a

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neutral or negative effect on mortality in this patient population.[6] While the implantable cardioverter defibrillator (ICD) reduces arrhythmic death in patients immediately after MI, it has not impacted favorably on total mortality.[7,8]

Traditionally the LVEF has been a useful marker of increased mortality after MI.[6] However, it is not useful for identification of patients at increased risk of arrhythmic death relative to total mortality.[2,6] Among the risk stratification techniques evaluated alone or in conjunction with LVEF to identify patients at high risk for arrhythmic mortality are spontaneous or induced ventricular arrhythmias and multiple noninvasive risk stratification techniques.[5] However, neither the invasive or noninvasive risk stratification techniques have sufficient overall predictive accuracy to improve the ratio of SCD to total mortality.[2,6] In patients with high rates of sudden death but low rates of non-sudden death, ICD therapy can provide effective and cost-effective therapy.[2,6] However, when used in patients with lower ratios of sudden to non-sudden death the benefit of therapy is substantially diminished as these patients have a high mortality rate even if SCD is effectively prevented.[2,6]

Multiple clinical trials randomizing several thousand patients have demonstrated that the ICD prevents sudden death and significantly reduces overall mortality among patients with left ventricular dysfunction due to ischemic heart disease.[2,6] These trials demonstrating a survival benefit have excluded patients with recent myocardial infarction.[2,6] However, the trials assessing the role of the ICD in patients at high risk for SCD immediately post MI have failed to show survival benefit.[7,8] The DINAMIT Trial assessed the strategy of ICD use in a randomized controlled prospective study of 674 patients within 4-40 days after an index MI. All enrolled were on optimal pharmacologic therapy and had LVEF <35% with markers of autonomic dysfunction. Only 27% of patients were treated with PCI. While depressed LVEF and low heart rate variability identify patients with increased mortality risk, the trial did not identify any subsequent benefit from use of the ICD in these high risk patients.[7]

Another clinical trial, the IRIS Trial, evaluated the strategy of early post MI ICD implantation with randomization of 900 high risk patients within one month of an MI. Patients were selected based on an LVEF <40% while on optimal medical therapy.[8] Primary PCI was performed in 245 of these patients. While the ICD group showed a significant reduction in the arrhythmic mortality, this was offset by an increase in nonarrhythmic death, similar to the DINAMIT Trial.[7,8]

A prospective randomized trial evaluating the strategy of home automated external defibrillators use in high risk post MI patients also failed to improve survival when compared to conventional resuscitation methods.[9] While there is a reasonable rationale for a strategy of short-term use of noninvasive vest defibrillation in high risk post MI patients, this approach remains to be evaluated in appropriately designed prospective trials.

There are multiple potential reasons for this lack of survival benefit with early risk stratification and ICD intervention in post MI patients. Implantable cardioverter defibrillators (ICDs) may not reduce arrhythmic death and improve total mortality in this patient population.[7,8] It is also possible that the ICD therapy could demonstrate a survival benefit if risk stratification techniques were better able to identify patients at risk of arrhythmic death compared to death from causes other than sudden death. The ICD may decrease arrhythmic death but increases total mortality due to deleterious effects of implantation or shock therapy. These explanations are not mutually exclusive and multiple factors may contribute to lack of demonstrated benefit. Additional factors that might contribute to the lack of demonstrated benefit are related to limitations of the study designs and power. Recent autopsy observations, of patients experiencing sudden cardiac arrest in the immediate post-MI period indicate that there is a high frequency of cardiac rupture or recurrent MI in the first month after the index MI, whereas arrhythmic deaths become more likely subsequently.[10] These findings may help to explain the lack of benefit of early ICD therapy after MI.[6,10]

Current clinical guidelines restrict ICD implants to patients at least 40 days after MI with continued impairment of left ventricular function while on optimal medical therapy.[11] It is evident that additional research is needed with appropriately designed and powered studies to identify risk stratification and intervention strategies to prevent SCD and improve survival immediately after MI. In the meantime, clinicians should optimize and individualize therapy in the immediate post MI patient while carefully considering the risk of sudden death and the competing risk of mortality from other causes.

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