

Evaluation of the Results of a Differential Approach to the Treatment of Patients with Myocardial Infarction and Ventricular Arrhythmias

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Summary

There are many newly proposed predictors of sudden cardiac death (SCD) after myocardial infarction (MI). A traditional factor that can influence the prognosis after MI is ventricular arrhythmias (VA). The purpose of this study is to evaluate the results of a differential approach to the treatment of patients with MI and VA. In total, 115 patients with MI were studied, in whom VA was classified as ventricular fibrillation, sustained and non-sustained ventricular tachycardia, and complex ventricular premature beats based on a 24-h Holter ECG. By applying new concepts for investigating such patients and stratifying their risk of SCD, 36 patients were included in a very high-risk group (sustained ventricular tachycardia or ventricular fibrillation) and 39 patients were included in a high-risk group (nonsustained ventricular tachycardia or complex ventricular premature beats plus reduced left ventricular ejection fraction and/or late ventricular potentials). In the very high-risk group 12 patients (33.3%) received an implantable cardioverter defibrillator (ICD), eight patients (22.2%) underwent radiofrequency catheter ablation, and four patients (11.1%) underwent myocardial revascularization. There were no cases of SCD among these patients over a 0.5 to 5-year follow-up period. Out of 12 patients in the very high-risk group who were undergoing drug therapy, seven died suddenly (SCD mortality 19.4%). In the high-risk group 11 patients (28.2%) underwent myocardial revascularization and 15 patients died suddenly (SCD mortality 38.5%). These results suggest that surgical treatment of VAs (such as ICD implantation and radiofrequency catheter ablation) should be implemented in clinical practice to a much larger degree in the very high-risk group, where half of the patients treated exclusively with drugs died suddenly. Secondly, an intracardiac electrophysiologic study should be performed more actively both in very high-risk and high-risk patients. Finally, a differential approach to treating VA in patients after MI decreases the frequency of fatal events, in conjunction with the use of well-known predictors of SCD.

Key Words

Sudden cardiac death, risk stratification, ventricular arrhythmias, implantable cardioverter defibrillator (ICD), radiofrequency catheter ablation

Introduction

The problem of sudden cardiac death (SCD) is serious for patients who have experienced a myocardial infarction (MI) [1]. There are many modern predictors of SCD, such as low left ventricular ejection fraction, disorders of the vegetative regulation of heart rate, ventricular arrhythmias (VA), sustained ventricular tachy-

cardia (sustained VT) during intracardiac electrophysiological procedures, late ventricular potentials, myocardial ischemia, T-wave alternation, and others [2-4]. A well-known predictor for SCD after MI is VA [2,5]. The post MI-period can be complicated by different types of VA:

- ventricular fibrillation (VF),
- sustained or non-sustained VT, and
- ventricular premature beats (VPB) of various patterns.

The prognostic value of these arrhythmias is different; only a portion of patients with arrhythmias experience fatal events [6]. Therefore, the question regarding the necessity of a differential approach to treating these patients is of great importance, bearing in mind that antiarrhythmic drugs may be dangerous [7] and SCD prophylaxis using an ICD is very expensive [8-10]. The purpose of our study is to evaluate the results of a differential approach to treating patients with MI and VA.

Materials and Methods

Patients

A total of 115 patients with MI and VA on 24-h Holter ECG (VF, sustained VT, nonsustained VT, complex VPB) were studied. Patients were excluded from the study if they refused to provide written informed consent or had additional severe disorders that could influence the prognosis. The mean age was 58.1 ± 3.2 years with a predominance of male patients (96.5%). Development of MI was complicated by heart failure resulting in NYHA classes III-IV and left ventricular aneurysm with an ejection fraction of $< 40\%$ in more than half of all cases. The patients' clinical data are provided in Table 1. The patients underwent a follow-up between 0.5 and 5 years (mean 2.1 years) after enrollment.

Diagnosis

Echocardiography was performed using standard methods (Aloka model 2000, Russia). All patients underwent ambulatory ECG monitoring and all records were analyzed for the presence of VPB by a computer-assisted system (Kardiotekhnika 4000, Incard, Russia). A nonsustained VT was defined as three or more repetitive ventricular contractions lasting up to 30 s. A sustained VT was defined as an episode requiring countershock due to loss of consciousness, or lasting longer than 30 s. A cardiac analyzer (Cardis 310, Geolink-Electronics, Russia) with special software (Ritmon 1M, Russia) was used to generate a signal-averaged ECG with definition of late ventricular potentials [11] and to record heart rate variability (HRV) [12]. Analysis of the HRV was carried out in short 5-min recordings at rest, during deep breathing, and in stand-

No. of patients	115
Male	111 (96.5%)
Age (mean \pm standard deviation)	58.1 \pm 3.2 years
Anterior MI	62 (53.9%)
Q-wave MI	75 (65.2%)
Recurrent MI	51 (44.4%)
Left ventricular aneurysm	69 (60.0%)
NYHA class II	31 (27.0%)
NYHA class III-IV	73 (63.5%)
Left ventricular EF $< 40\%$	71 (61.7%)
Smoking	52 (45.2%)
Hypertonic disease II – III	72 (62.6%)

Table 1. Clinical data of the study patients. MI = myocardial infarction, NYHA = New York Heart Association, EF = ejection fraction.

	Criteria
Very high risk	Sustained VT or VF
High risk	At least two major predictor, e.g., late ventricular potentials, left ventricular EF $< 40\%$, VA (sustained and non-sustained VT, VF, VPB) prognostic index of SCD on HRV analysis
Middle risk	One major predictor and one minor predictor, e.g., recurrent myocardial infarction, positive simple standing test
Low risk	No more than one predictor

Table 2. Patients' risk stratification for sudden cardiac death. VA = ventricular arrhythmia, VT = ventricular tachycardia, VF = ventricular fibrillation, EF = ejection fraction, VPB = ventricular premature beats, HRV = heart rate variability, MI = myocardial infarction, SCD = sudden cardiac death.

ing position. An intracardiac EP study was performed according to standard protocol with electrical stimulation for the reproduction of tachyarrhythmias [3].

Risk Stratification

Recently, we used a large selection of patients (551 persons) with MI to devise concepts for investigating MI patients to stratify their risk of SCD and develop an individual program of prophylaxis [13]. In accordance with this stratification during the first stage of investigation, we recommended noninvasive methods such as Holter ECG monitoring, signal-averaged ECG with definition of late ventricular potentials,

echocardiography, and HRV analysis. For patients with a high and very high risk of SCD we performed an intracardiac EP study. The approach to risk stratification is presented in Table 2.

Statistical Analysis

Mean group data were expressed as mean \pm standard deviation. The statistical difference was estimated by the unpaired student t-test or the χ^2 -test; a p-value < 0.05 was considered significant.

Results

After the patients were stratified into groups based on SCD risk, we focused our research on 75 patients in either the very high-risk group (36 patients) or the high-risk group (39 patients.) Patients with middle and low risk of SCD are not considered in this paper.

Very High-Risk Group

In the very high-risk group, 24 patients (66.7%) underwent various invasive interventions. Twelve of them (33.3%) received an ICD; nine ICD patients received curative shocks, confirming that they had recurring life-threatening tachyarrhythmias. We have no information about possible curative shocks in an additional two patients due to their short-term follow-up. Radiofrequency catheter ablation of the monomorphic arrhythmia zone was performed in eight patients (22.2%). Two patients had repeated surgery due to recurrence of sustained VT; these patients did not have any episodes of VA later on. Four patients (11.1%) with CCS (Canadian Cardiovascular Society) class III-IV angina pectoris exhibited signs of VA due to ischemia detected by Holter monitoring, stress tests, and coronary arteriography. These patients underwent myocardial revascularization and plastic surgery to repair aneurysms. Two patients underwent radiofrequency catheter ablation of sustained VT. Cases of SCD among patients who underwent surgical treatment were not registered during the follow-up period. One patient died from severe congestive heart failure, and another died from non-cardiac reasons.

The remaining 12 patients (33.3%) had indications for surgical treatment, but surgery was not performed for various reasons (excessive cost of interventions, patient's refusal). These patients received the standard therapy for ischemic heart disease (beta-blockers, antiplatelets, nitrates, ACE inhibitors, and statins), and

amiodarone was recommended as antiarrhythmic drug. Among these patients, seven (19.4%) died during the follow-up period, in all cases due to SCD. Other patients did not experience sustained VT events.

High-Risk Group

In the high-risk group, an intracardiac EP study was performed in only three of the 39 patients. In our opinion, this was due to an inadequate diagnosis of these patients. The only type of surgical treatment in this group of patients was myocardial revascularization in combination with plastic surgery of left ventricular aneurysms. Eleven patients (28.2%) underwent this procedure. The other 28 patients (71.8%) were treated with the antiarrhythmic drug amiodarone. Fifteen patients died from SCD (38.5%), in two of them following after surgery. In seven (17.9%) cases death was associated with cardiac reasons.

Discussion

A comparison of SCD mortality between the groups (19.4% in the very high-risk group and 38.5% in the high-risk group) showed no statistically significant difference (p-value = 0.07), although the SCD probability in the high-risk group was double of that in the very high-risk group. We believe that this was due to the wider application of preventive measures, such as ICD implantation and radiofrequency catheter ablation in the very high-risk group [10,14]. We postulate that the high incidence of SCD in the high-risk group resulted from inadequate physician diagnosis of these patients and infrequent use of antiarrhythmic drugs due to their proarrhythmic potential. It is also necessary to note that sometimes patients did not properly follow their physician's instructions about medications. For example, by the end of the first year of follow-up only 50% of patients were prescribed amiodarone and beta-blockers, whereas the documented application of digoxin and diuretic agents increased by a factor of two.

It is important to understand the patient's position. They do not feel any alarming symptoms of VA and are certainly not familiar with the danger of arrhythmias. Therefore, they rejected invasive and expensive methods of investigation such as coronary arteriography and intracardiac EP study. That is why we unfortunately must report that nearly 50% of patients from the high-risk and very high-risk groups succumbed to SCD when they received only non-surgical treatment. This

fact compels us to propose that the following be introduced more widely into clinical practice: SCD risk stratification of patients after MI; a differential approach to patient management using modern treatment methods such as ICD implantation, catheter ablation procedures, and antiarrhythmic drugs [8,10,14]. Our approach differs slightly from the recommendation of the ACC, AHA, and NASPE [10], where patients with a low left ventricular ejection fraction and non-sustained VT need ICD implantation without previous intracardiac EP study. Since it is not possible to use ICD implantation widely in our country, we perform an intracardiac EP study as a method for selecting the most suitable patients for invasive treatment of VA after MI.

Conclusion

- Surgical treatment of VAs (such as ICD implantation and radiofrequency catheter ablation) should be implemented in clinical practice to a much higher degree, because in the very high-risk group, more than 50% of patients treated exclusively with drugs died of SCD.
- An intracardiac EP study should be performed more actively in both very high-risk and high-risk patients.
- A differential approach to treating ventricular arrhythmias in patients after MI decreases the frequency of fatal events, when well-know predictors of SCD are used.

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