Original Research Article

Effectiveness of antitachycardia pacing therapy after primary prophylaxis implantation of implantable defibrillators in coronary artery disease patients

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ABSTRACT

Purpose: Effectiveness of implantable defibrillators (ICD) has been proven with large randomized trials. Unfortunately, ICD discharge is painful and potentially threatening for the patient despite its life saving effects. We analyzed influence of the clinical parameters present before implantation on the effectiveness of antitachycardia pacing therapy (ATP) in terminating ventricular tachycardia (VT) slower than 200 bpm in the coronary artery disease patients with prophylactic implanted ICD in a single centre retrospective trial.

Patients/methods: We analyzed 121 consecutive coronary disease patients with ICD implanted in primary prophylaxis between 2001 and 2007, with the mean age of 62 ± 10 years. The mean follow-up was 876 ± 538 days.

Results: 32 of them had VT. In 27 persons (84.4%) at least one ATP attempt terminate VT. ATP was always successful in 21 patients. We analyzed age, sex, LVEF, NYHA class, widening of QRS complex, atrial fibrillation, type of myocardial infarction or diabetes. There were no significant differences in clinical features between patients with successful and unsuccessful ATP therapy.

Conclusions: High effectiveness of ATP was shown in this group. There were no clinical factors indicating success of this type of therapy. That could justify programming ATP as the first line therapy in the VT zone in primary prophylaxis coronary artery disease patients to reduce application of shock therapy.

It should be possible to apply a single mode of programming when discharging patients after the implantation procedure regardless of the patient's clinical condition. This could help to control and programme the devices, thus reducing the risk of errors.

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1. Introduction

The basic goal of implantable cardioverter-defibrillator (ICD) is the termination of life threatening ventricular arrhythmia: ventricular fibrillation or haemodynamically unstable ventricular tachycardia. Extensive experience with applying ICD unequivocally shows that this treatment is beneficial in ventricular arrhythmia patients [1–4]. Unfortunately ICD discards for malignant ventricular arrhythmia are very painful. At the moment the largest group of ICD patients are those qualified for the surgery in primary prophylaxis of sudden cardiac death (SCD). Because ventricular tachycardia (VT) is the most frequent arrhythmia observed in this group of patients a particular attention was paid to programming therapy in VT.

The aim of this paper was to analyze the influence of the clinical parameters present before implantation on the effectiveness of antitachycardia pacing therapy (ATP) in terminating ventricular tachycardia slower than 200 bpm in the group of patients with coronary artery disease and prophylactic implanted ICD.

2. Patients and methods

The observation included 121 consecutive coronary disease patients with ICD implanted in primary prophylaxis between 2001

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and 2007. The indications for the preventive ICD implantation were changed during the study according to the current guidelines: the period 2000–2002 included patients with the presence of non-sustained ventricular tachycardia and left ventricular dysfunction after myocardial infarction (LVEF $\leq$ 40%), with a positive electrophysiological study, in 2003–2007 with left ventricular dysfunction after myocardial infarction (initially LVEF $\leq$ 30%, and since 2006 LVEF $\leq$ 35%) with no additional risk factors [5–9]. When necessary an electrophysiological study was performed according to a standard protocol [10].

The follow up time till the final observation or death was 42–2833 days, mean follow-up was 876 days (SD $\pm$ 538). The assumed minimum observation period was 365 days, six patients died before the end of the first year of observation.

The group consisted of 15 women and 106 men (87.6%). The patients' age ranged from 22 to 79, averaging 62 $\pm$ 10. Clinical characteristics of the patients are presented in Table 1.

Coronary artery disease was documented in 112 patients by myocardial infarction and angiography, and in remaining 9 patients by documented coronary artery stenosis in angiography. Depending on the outcome of coronary angiography, revascularization was performed in 71% of patient, in the rest there was no possibility of revascularization.

ECG recordings have been analyzed in order to determine QRS widening: fifty two patients (43% of subjects) showed QRS complex duration of at least 120 ms, including 38 patients with LBBB morphology. In the whole group the average QRS complex duration was 126 $\pm$ 34 ms.

During the follow-up the patients were treated in line with the standards of pharmacological therapy of coronary disease and heart failure treatment. Beta-blockers, including sotalol (4 patients), were used in 100% of patients. The decisions concerning prescribing medication and its doses, including

antiarrhythmic medicine were made by patient's doctor. There was no common treatment scheme. The decision to implement or to terminate antiarrhythmic treatment, mainly with amiodarone, were also taken by patients' doctors who often were not affiliated with the follow-up centre. Therefore, the data concerning pharmacological treatment may be incomplete and so was not subject of statistical analyses.

In our clinic all decisions concerning programming cardioverter defibrillators were made both for treatment and diagnostic purposes based on their assessment of their patients' clinical state and their arrhythmias. The most frequent pattern/model was the following detection criteria: 182–200 bpm for ventricular tachycardia and above 200 bpm for ventricular fibrillation. In zone of ventricular tachycardia antitachycardia pacing therapy was most commonly introduced. Type of ATP therapy depend on physician decision and were burst or ramp stimulation. Electrical shock therapy was applied both in ventricular fibrillation and ventricular tachycardia.

Assessment of arrhythmia was run based on internal ICD Holter memory and patients' files. In our analyses we included patients with arrhythmia lasting long enough to warrant applying treatment, either ATP or shock treatment. Using the ICD detection criteria for implanted converter defibrillators the following was identified: ventricular tachycardia up to 200 bpm (VT) and ventricular fibrillation (VF) above 200 bpm.

Statistical analysis was run with the use of SAS 8.2., SAS Institute Inc., Cary, NC, USA.

The results of one-variable analyses were presented as mean values and standard deviation of quantity characteristics or as a frequency and percentage of nominal characteristics.

Using Shapiro–Wilk test we estimated congruence of continuous variables distribution with normal distribution. To compare the significance of differences between mean values, depending on variances homogeneity or heterogeneity we have used T-Student and Cochran–Cox test respectively. Variance homogeneity was analyzed with F-test.

Verification of zero hypothesis was performed assuming statistical significance of $\alpha \leq 0.05$.

3. Results

In 44 (36%) patients adequate ICD interventions were registered including 32 patients with multiple interventions during the follow-up.

Ventricular tachycardia was present in 32 people (73% patients with adequate interventions). In 16 patients it was observed along with the faster arrhythmia, in the remaining 16 patients it was the only type of arrhythmia observed. Risk of the arrhythmia occurrence was previously described [11].

In monomorphic ventricular tachycardia slower than 200 bpm high effectiveness of ATP was registered (Fig. 1). As many as 27 patients (84.4% among 32 people with VT) had at least one effective sequence of anti-tachycardia pacing therapy. ATP therapy was always effective in 21 patients (65.6% patients with VT), including 13 with multiple stimulations (40.6%). In 4 patients (12.5%) ATP was always ineffective. In further 6 patients (18.8%) at least one episode of ventricular tachycardia was not terminated by ATP and required cardioversion (in three patients during electric storm). W five patients among 10 ineffective ATP (15.6% VT population and in only 4.1% of total ICD population), ATP caused the increase of arrhythmia till faster ventricular tachycardia or ventricular fibrillation was terminated by electric shock therapy.

Cardioversion was employed as the only therapy for terminating ventricular tachycardia in one of 32 patients (3.1%).

Clinical characteristics of the groups of patients with different ATP clinical effectiveness were analyzed based on the data

Table 1
Clinical characteristics of patients (patients number 121).

Clinical characteristic of patients	Value
Age	62 $\pm$ 10 years
	Number of patients (%)
Gender: women	15 (12%)
LVEF	28 $\pm$ 4%
NYHA I	1 (1%)
NYHA II	68 (56%)
NYHA III	52 (43%)
Undergone myocardial infarction	112 (94.1%)
Anterior myocardial infarction	84 (69.4%)[a]
Interior myocardial infarction	44 (36.4%)[a]
Other localization of myocardial infarction	18 (14.9%)[a]
SCD during acute myocardial infarction	13 (11%)
nsVT presence	97 (77%)
Atrial fibrillation	44 (36.4%)
Paroxysmal	28 (23.1%)
Chronic	16 (13.2%)
QRS complex duration above 120 ms	52 (43%)
Mean QRS complex duration	126 $\pm$ 34 ms
Indication for permanent pacing	24 (20%)
Patients with prior pacemaker implantation	6 (5%)
Diabetes	20 (16.5%)
Renal failure	19 (16%)
Beta-blockers utilization, including sotalol	121 (100%)
Undergone coronary revascularisation (PTCA, CABG)	86 (71%)
PTCA	46 (38%)
CABG	30 (25%)
PTCA i CABG	10 (8%)

LVEF, left ventricle ejection fraction; NYHA, New York Heart Failure class, SCD, sudden cardiac death; nsVT, non sustained ventricular tachycardia; PTCA, percutaneous transluminal coronary angioplasty; CABG, coronary artery bypass graft.

[a] 43 patients suffered more than one myocardial infarction.