Analysis of Ventricular Arrhythmia Episodes in Patients at Risk for Ventricular Fibrillation

M Triventi[1], S Valsecchi[2], M Landolina[3], M Gasparini[4], M Lunati[5], F Censi[1], G Calcagnini[1], P Bartolini[1]

[1]Dept Technologies and Health - Italian National Institute of Health
[2]Medtronic Italia
[3]Electrophysiology and Arrhythmia Unit, IRCCS Policlinico San Matteo, Pavia, Italy
[4]Department of Cardiology, IRCCS, Istituto Clinico Humanitas Rozzano-Milano, Milan, Italy
[5]Division of Electrophysiology, Niguarda Ca' Granda Hospital, Milan, Italy

Abstract

Implantable cardioverter defibrillators (ICD) are usually implanted in patients with malignant ventricular tachyarrhytmias. Aim of this study was to investigate the recurrence of minor ventricular arrhythmias to predict the occurrence of ventricular fibrillation episodes in patients with ICD. The study design was a retrospective analysis of 237 patients, whose ICD was programmed to deliver electrical therapy only for ventricular fibrillation (VF) but not for ventricular tachycardia (VT). We calculated the number, the mean duration and the mean ventricular cycle of the non-sustained ventricular tachyarrhythmias (NST) and of the sustained ventricular tachyarrhythmias (ST). We found that VF patients had a significant higher incidence of ventricular tachycardia compared to the no-VF patients.In addition, the mean VT episodes duration was higher in patients of the VF group than in patients free from ventricular fibrillation and the ventricular cycle length resulted to be significantly shorter in VF patients.

1. Introduction

Implantable cardioverter defibrillators (ICD) have become a cornerstone therapy for the primary and secondary prevention of cardiac arrests (1-4).

ICDs are usually implanted in patients with malignant ventricular tachyarrhytmias or, prophylactically, in patients with systolic dysfunction.

Such devices also provide the storing of information regarding different types of occurred ventricular tachyarrhythmias (VT). The storage function of ICD can offer the opportunity of evaluating the recurrence of minor ventricular arrhythmias and ventricular fibrillation (VF) episodes. It has been hypothised that the degeneration of monomorphic ventricular tachycardia (VT) into ventricular fibrillation (VF) accounts for the majority of sudden arrhythmic deaths (5).

The purpose of the present study was to investigate the recurrence and distribution of minor ventricular arrhythmias to predict the occurrence of ventricular fibrillation episodes in patients with implantable cardioverter defibrillator.

2. Methods

Study population

The study design was a retrospective analysis of selected patients implanted with Medtronic InSync™ ICD, 7272 and 7279 devices (Minneapolis, Minnesota).

The InSync™ ICD is a multi-programmable dual chamber implantable cardioverter defibrillator with biventricular pacing for cardiac resynchronization. The ICD automatically detects and treats episodes of VF, VT, fast ventricular tachycardia (FVT), and bradyarrhythmia. When a cardiac arrhythmia is detected, the implantable device delivers defibrillation, cardioversion, antitachycardia pacing, or pacing therapy (6). The ICD also provides storing function, including stored electrograms, records of tachyarrhythmia episodes detected and treated, bradycardia interventions, and the efficacy of therapy. This information can be printed and retained in the patient's file, saved in the programmer to read back at a later time or saved in electronic format on a floppy diskette from a database (InSync ICD Italian Registry database).

To date, the Registry consist of 841 patients (All Patients, AP). We extracted 237 patients (Implanted Patients, IP) whose ICD was programmed to detect and deliver electrical therapy for ventricular fibrillation, while ventricular tachycardia was detected but not treated. All the patients were implanted at least one year before the

TABLE 1. Clinical Characteristic of the Registry			
Patient characteristics	IP group (n=237)	No IP group (n= 604)	p value
Male, n	190/217	490/543	0.277
Age, years	64±12	66±11	0.063
Primary Prevention, n	134/237	264/604	<0.001
Ischemic etiology, n	127/216	348/538	0.130
Chronic AF, n	34/216	82/538	0.864
QRS duration, ms	163±33	164±31	0.777
Hospitalization last 12 months	1.3±1.4	1.1±1.2	0.133
Ejection Fraction, %	25.9±6.8	26.2±7.0	0.633
Mitral regurgitation, °	2.1±0.9	2.1±0.9	0.648
NYHA II, n NYHA III, n NYHA IV, n	42 136 31	121 336 38	0.011

collection of the ICD data. Only the data of the last twelve months were included in the analysis.

The clinical characteristics of the IP group are shown in Table 1 and compared with those of the remaining patients of the registry (No IP group).

Data analysis

We analysed the characteristics and the distribution of the non-sustained ventricular tachyarrhythmias (NST) and the sustained ventricular tachyarrhythmias (ST) for the IP group.

We classify VT as NST if shorter than 30 sec and as ST otherwise.

In order to estimate the characteristics and the distribution of NST and ST episodes, we needed to define a Reference Time (RT): it coincides with the "date of the first VF episode" for patients who experienced a VF episode (VF group); for patients who did not (no-VF group), RT was considered as "the date of the last follow-up visit".

In particular, we computed the number, the rate, the mean duration and the mean ventricular cycle of each NST and ST episode occurred before RT.

We also computed the monthly occurrence of NST and ST episodes, up to six month prior to the RT.

Continuous variables were expressed as mean ± SD. P values < 0.05 were considered statistically significant.

3. Results

We found that 13.7% of AP experienced one or more VF episodes, while 86.3% did not. For the 237 patients of the IP studied group, we had similar percentage values: 10.1% (24 patients, VF Group) of patients presented VF episodes and 89.9% (213, No-VF group) did not (Fig. 1).

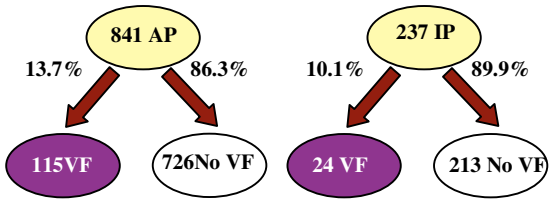

Fig 1. Partition of entire sample of patients (All Patient, AP) and patients under estimation (Implanted Patients, IP) between VF (left side) and no VF (right side) groups.

No significant differences were observed in the clinical parameters between VF and No VF groups (Table 2), except for higher prevalence of ischemic etiology among No VF patients.

The percentage of patients who experienced at least one VT episode was higher in the no VF group than in the VF one (54% vs. 33%, Fig. 2).

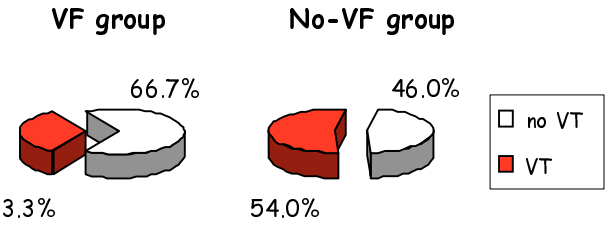

Fig 2. Percentage of patients who showed at least one episode of ventricular tachycardia: comparison between VF and No-VF group.

TABLE 2. Comparison of Clinical Characteristic of the VF and No VF groups			
Patient characteristics	NoVF (213)	VF (24)	p value
Male, n	169/194	21/23	0.747
Age, years	65±12	64±10	0.904
Primary Prevention, n	121/192	13/23	0.543
Ischemic etiology, n	122/193	5/23	<0.001
Chronic AF, n	29/193	5/23	0.403
QRS duration, ms	163±34	167±23	0.651
Hospitalization last 12 mths	1.4±1.4	0.8±1.2	0.219
Ejection Fraction, %	25.9±7.0	25.8±5.0	0.943
Mitral regurgitation, °	2.2±1.0	1.5±0.5	0.085
NYHA II, n NYHA III, n NYHA IV, n	39 123 27	3 13 4	*0.415*

Sustained and non-sustained VT episodes analysis

For the IP group, 1737 NST episodes and 193 ST episodes were identified. The percentage number of ST is significantly greater for VF patients than for no-VF group (Fig. 3, p<0001).

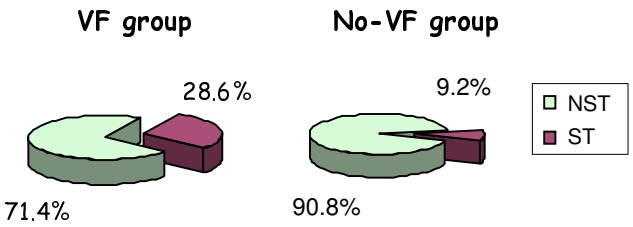

Fig 3. The percentage number of NST and ST episodes for VF patients and no-VF group.

Only a minority of patients experienced ST episodes in both group (13 in No VF group and 1 VF patient).

The mean duration and the mean ventricular cycle of VT episodes were 40.6 ± 99.5 s and 312.5 ± 47.6 ms, respectively, for VF patients and 4.9 ± 12.9 s and 433.1± 112.2 ms for patients without VF episodes (Table 3).

4. Discussion and conclusions

Aim of this study was to investigate the recurrence of minor ventricular arrhythmias as a predictor of ventricular fibrillation in patients with implantable cardioverter defibrillator.

Our analysis concerned data relatives to 237 ICD implanted patients, from a larger database of 841 patients. These 237 patients were selected as those whose ICD whose programmed to deliver therapy only for VF. This study group turned out to have the same incidence of VF episodes of the entire database.

Patients with an history of Ischemic Etiology had a lower incidence of VF.

We extracted 1737 NST and 193 ST episodes, over an observation period of one year.

VF patients had a significant higher incidence of ventricular tachycardia compared to the no-VF patients.

The mean VT episodes duration was higher in patients of the VF group than in patients free from ventricular fibrillation.

In addition, the ventricular cycle length resulted to be significantly shorter in VF patients.

It is generally believed that VT triggers VF (5,7), so that an increased number of VT episodes is expected in patients suffering from VF episodes.

Recently, Raitt et al. (8) suggested that the underlying mechanisms of VT and VF have basic clinical and electrophysiologic differences.

In our population, characterized by EF<35%, we found that the higher the occurrence of VF, the higher the incidence of VT.

TABLE 3. VT mean duration and ventricular cycle			
	VT episode		
	No VF	VF	P value
Mean Duration (sec)	4.9 ±12.9	40.6 ± 99.5	p<0.001
Mean Ventricular Cycle (msec)	433.1 ± 112.2	312.5 ± 47.6	p<0.005

References

[1] Moss AJ, Hall WJ, Cannom DS, et al. Improved survival with an implanted defibrillator in patients with coronary disease at high risk for ventricular arrhythmia. Multicenter Automatic Defibrillator Implantation Trial Investigators. N Engl J Med 1996;335:1933 - 40.

[2] Moss AJ, Zareba W, Hall WJ, et al. Multicenter Automatic Defibrillator Implantation Trial II Investigators. Prophylactic implantation of a defibrillator in patients with myocardial infarction and reduced ejection fraction. N Engl J Med 2002;346:877- 83.

[3] The Antiarrhythmics versus Implantable Defibrillators (AVID) Investigators. A comparison of antiarrhythmic-drug therapy with implantable defibrillators in patients resuscitated from near-fatal ventricular arrhythmias. The Antiarrhythmics versus Implantable Defibrillators (AVID) Investigators. N Engl J Med 1997;337:1576 - 83.

[4] Kuck KH, Cappato R, Siebels J, et al. Randomized comparison of antiarrhythmic drug therapy with implantable defibrillators in patients resuscitated from cardiac arrest : the Cardiac Arrest Study Hamburg (CASH). Circulation 2000;102:748 -54.

[5] Engelstein ED, Zipes DP. Sudden cardiac death. In: Alexander RW, Schlant RC, Fuster V, eds. The heart, arteries and veins. New York: McGraw- Hill, 1998:1081–112.

[6] Wilkoff B, Kuhlkamp G, Volosin K, Ellenbogen K, Woldecker B, Kacet S,Gillberg J, De Souza C: Critical analysis of dual chamber cardioverter defibrillator arrhythmia detection. Circulation 2001;103:383-386

[7] Pratt CM, Francis MJ, Luck JC, Wyndham CR, Miller RR, Quinones MA. Analysis of ambulatory electrocardiograms in 15 patients during spontaneous ventricular fibrillation with special reference to preceding arrhythmic events. J Am Coll Cardiol. 1983 Nov;2(5):789-97.

[8] Raitt MH, Klein RC, Wyse DG et al. Antiarrhythmics Versus Implantable Defibrillators Investigators. Comparison of arrhythmia recurrence in patients presenting with ventricular fibrillation versus ventricular tachycardia in the Antiarrhythmics Versus Implantable Defibrillators (AVID) trial. Am J Cardiol. 2003 Apr 1;91(7):812-6.

Address for correspondence

Michele Triventi
Dept of Technologies and Health
Italian National Institute of Health
Viale Regina Elena 299
00161 Roma
Italy