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IMPLANTABLE CARDIOVERTER DEFIBRILLATORS

Indications for dual-chamber cardioverter defibrillators at implant and at 1 year follow-up: a retrospective analysis in the single-chamber defibrillator era

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Aim This retrospective four-centre study assessed the current indications for dual-chamber implantable cardioverter defibrillators (ICDs) at implant and during a medium-term follow-up period in a group of patients treated by single-chamber ICD in the pre dual-chamber ICD era.

Methods and Results The study population consisted of 153 consecutive patients (127 males, mean age 58 ± 6 years) treated by single-chamber ICD for ventricular tachycardia and/or ventricular fibrillation. Definite indications for having a dual-chamber ICD included the presence of sinus node dysfunction and of second- or third-degree atrioventricular (AV) block, while possible indications were represented by paroxysmal atrial fibrillation or flutter and first-degree AV block. At implant, dual-chamber ICD would appear definitely indicated in 10·5% of cases, and possibly indicated in an additional 17·5% of cases. During 12 ± 10 months follow-up, such percentages remained stable (11 and 19·5%, respectively). Inappropriate ICD intervention was documented in five of 13 patients (38%), with episodes of paroxysmal atrial fibrillation or flutter.

Conclusion In this non-selected study population, a dual-chamber ICD would have potentially benefited approximately 30% of the patients. During medium-term follow-up, there was no progression towards increasing dual-chamber ICD indications. The 15% cumulative incidence of paroxysmal atrial tachyarrhythmias justifies the activation of dedicated detection algorithms.
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Key Words: Implantable cardioverter defibrillator, dual-chamber pacing.

Introduction

The development of dual-chamber implantable cardioverter defibrillators (ICDs) enables atrio-ventricular pacing and sensing without problematic pacemaker-ICD interaction in cases of bradycardia, as well as sensing of atrial events in cases of atrial tachyarrhythmias[1–5]. However, the proportion of patients with indications for dual-chamber ICDs is still controversial. Some authors believe that dual-chamber ICDs could be useful for only a small subgroup of the ICD recipients[6]; in contrast, others believe that it could be used in the majority of the ICD population[7–9]. Moreover, only few and limited data are available about clinical indications and possible advantages of the dual-chamber ICD during the follow-up period[6,9].

Therefore, the aim of this retrospective four-centre study was to evaluate the current indications for a

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dual-chamber ICD at implant, and evaluate the time course of such indications in a group of patients treated by single-chamber ICDs in the pre dual-chamber ICD era. The correct identification of candidates for dual-chamber ICD is fundamental, due to the higher technological complexity and cost of these devices with respect to single-chamber ICDs.

Methods

The study population included 153 consecutive patients (127 males) who underwent transvenous non-thoracotomy implantation of single-chamber ICDs between January 1991 and December 1997. Mean age was 58 ± 6 years; 144 of 153 patients (94%) had organic heart disease, ischaemic in 97 patients (64%). Idiopathic dilated cardiomyopathy was present in 30 patients (20%), arrhythmogenic right ventricular disease in seven patients (4%), idiopathic ventricular fibrillation in 10 patients (6%), and valvular heart disease and other aetiologies in nine patients (6%). Mean left ventricular ejection fraction was 38 ± 14%. Main arrhythmia indication for ICD use was sustained ventricular tachycardia in 94 patients (62%), ventricular fibrillation in 36 patients (24%), combined history of ventricular tachycardia and ventricular fibrillation in 19 patients (12%), and syncope with inducible sustained ventricular arrhythmias in three patients (2%).

At implant and during 12 ± 10 months follow-up, the authors evaluated the presence of: (1) sinus node dysfunction; (2) first-degree atrioventricular (AV) block; (3) second- or third-degree AV block; (4) history of paroxysmal atrial fibrillation or atrial flutter; and (5) chronic atrial fibrillation or atrial flutter. Patients that might have been considered candidates for dual-chamber ICD implantation were divided in two categories. *Definite indications* included: (1) sinus node dysfunction, defined as resting ventricular rate <50 bpm on standard ECG and/or sinus pauses ≥3 s on Holter monitoring, and (2) second- or third-degree AV block, either chronic or paroxysmal. These two bradycardia syndromes are considered class 1 indications for dual-chamber pacing[10,11]. *Possible indications* were: (1) history of paroxysmal atrial tachyarrhythmias, and (2) first-degree AV block, arbitrarily defined as PQ interval ≥0·24 s. The last two conditions could lead to inappropriate ICD intervention[12] or inadequate cardiac pacing for haemodynamic reasons[13] with single-chamber ICDs.

No patient had a separate single- or dual-chamber pacemaker during the study. All the patients underwent clinical visits and device checks every 3 months or when clinically indicated. Amiodarone or Sotalol were started or continued in patients with frequent recurrences of ventricular tachycardia or ventricular fibrillation, and in patients with documented episodes of paroxysmal atrial tachyarrhythmias.

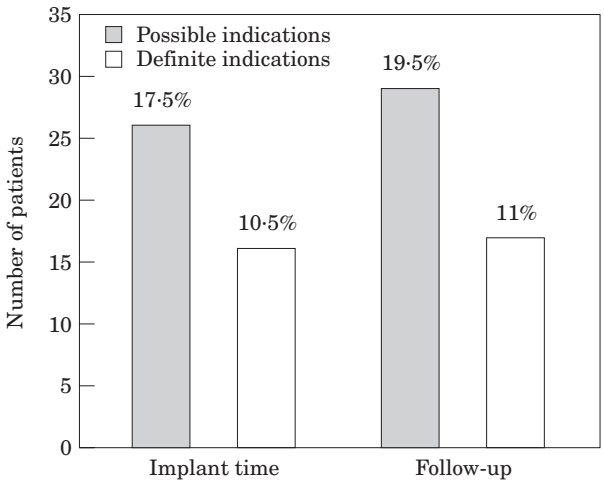

Figure 1 **Percentage of patients with possible and definite indications for dual-chamber ICD at implant and during 1-year follow-up.**

Results

At implant, sinus node dysfunction was documented in 13 patients (8·5%), second- or third-degree AV block in three patients (2%), first-degree AV block (PR interval 0·27 ± 0·02 s) in 16 patients (11%), paroxysmal atrial fibrillation in 10 patients (6·5%), and chronic atrial fibrillation in 10 patients (6·5%). In summary, definite indications were present in 10·5% of cases, and possible indications in 17·5% (Fig. 1).

During the follow-up period, sinus node dysfunction was present in 15 patients (10%), with evidence of two new cases. Second- or third-degree AV block persisted in two patients, while in the third patient it disappeared, due to amiodarone withdrawal. First-degree AV block was found in 16 patients (11%); in particular, two patients developed first-degree AV block and, in two others, this conduction defect disappeared. Paroxysmal atrial flutter and atrial fibrillation were documented in one and 12 patients (8·5%), respectively, with disappearance of atrial fibrillation in seven patients and a new appearance in 10 other patients. Inappropriate ICD intervention was documented in five of those 13 cases (38%) due to rapid ventricular rate (>150 bpm). The high crossover rate during the follow-up period may be related to the antiarrhythmic treatment of patients with a history of paroxysmal atrial fibrillation at implant. The new appearance of paroxysmal atrial fibrillation (10 out of 149 patients), however, raised to 8·5% the incidence of this arrhythmia during the follow-up. Chronic atrial fibrillation was documented in 14 patients (9%) with four new cases. In summary, during the 1-year mean follow-up period, definite indications for dual-chamber ICD were present in 11% of patients and possible indications in 19·5% of patients (Fig. 1).

Discussion

Possible advantages of dual-chamber ICDs are: (1) preservation of AV synchrony during antibradycardia pacing, with a lower incidence of atrial fibrillation and thromboembolic complications compared with VVI pacing[14–17]; (2) higher capability to discriminate malignant ventricular arrhythmias from supraventricular tachycardia[18]; and (3) special haemodynamic benefits in patients with depressed left ventricular function due to AV synchronous pacing with optimized delay[19,20]. At this moment, the indications for dual-chamber ICDs are controversial. Previous retrospective studies evaluated the clinical characteristics mainly at implant[7,8], and only few data have been concerned with the follow-up period[6,9].

In this study, the clinical and electrocardiographic indications for dual-chamber ICDs were examined not only at implant time, but also during a medium-term follow-up period. The study population presented the classical clinical and arrhythmological characteristics of ICD recipients[10]. All cases were treated with single-chamber ICDs and no patient was concomitantly treated with a pacemaker during the study period.

Definite indications (Fig. 1)

The presence of sinus node dysfunction and of second- or third-degree AV block was found at the time of ICD placement in 10·5% of cases, and this value remained stable during follow-up (11%). Consistent with these data, Geleen *et al.*[7] found that 21 of 139 patients (15%) of their series required a dual-chamber antibradycardia pacing for high-degree AV block or sick sinus syndrome. Also, in the studies by Best *et al.*[9] and Higgins *et al.*[8], dual-chamber ICDs appeared to be definitely indicated with American College of Cardiology (ACC)/American Heart Association (AHA) class 1 pacing indications[10,11] in 28 of 253 patients (11%) and in 26 of 122 patients (21·3%), respectively. On the other hand, in the series by Andrews *et al.*[6], dual-chamber pacing for bradycardia was needed in only 6% of 200 consecutive patients, who received an ICD with VVI capability. These discrepancies may be related to differences in the main clinical characteristics or to the different use of antiarrhythmics, digoxin or beta-blockers. Unfortunately, all four cited studies did not evaluate the possible modifications of these class 1 indications during follow-up.

Possible indications (Fig. 1)

In this study, first-degree AV block and a history of paroxysmal atrial fibrillation were considered possible indications for dual-chamber ICD use and accounted for 11 and 6·5%, respectively, of the cases. During the follow-up, period these figures remained stable (11 and 8·5%, respectively). The use of antiarrhythmic agents in patients with symptomatic paroxysmal atrial fibrillation may justify the disappearance of this arrhythmia in some cases. However, the number of atrial fibrillation episodes may be underestimated, due to the possibility of asymptomatic atrial fibrillation and to the absence of atrial diagnostic memory function in the single-chamber ICD used. Inappropriate ICD intervention was frequently documented (38%) in cases of paroxysmal atrial fibrillation. In the series by Best *et al.*[9], dual-chamber ICD usage was considered to be probably indicated in 72 patients (28%), who met the ACC/AHA class 2 pacing indications and who were in New York Heart Association (NYHA) functional class III or IV. Dual-chamber ICD therapy was considered possibly indicated in another 35 patients (14%), due to the presence of less than 20% left ventricular ejection fraction or a history of paroxysmal atrial fibrillation. During the follow-up period, 0·8% of the patients developed chronic atrial fibrillation and 2·4% of patients had a first episode of paroxysmal atrial fibrillation. In the Higgins *et al.* study[8], 'other or ICD-specific indications' were documented in 32 patients (26·3%) and they included syncope with abnormal electrophysiological data (8%), HV interval >84 ms or pacing-induced infraHisian block (3·5%), inappropriate shocks for atrial arrhythmias (2·5%), and severe heart failure with bradycardia or conduction disease (12·3%). In the Andrews *et al.* study[6], supraventricular tachycardia, mostly atrial fibrillation, occurred in 63 of 200 patients (32%). The different definitions of possible and probable dual-chamber ICD indications make a comparison between previous and the present series difficult, and only in the Best *et al.* study[9] was the incidence of paroxysmal atrial fibrillation during follow-up considered.

Limitations

This is a retrospective analysis of consecutive patients treated in the era of single chamber ICD with only ventricular pacing capability. Therefore, one cannot theoretically exclude a negative effect of this pacing modality in some patients[15]. Moreover, the authors did not evaluate the possibility of haemodynamic benefit of dual- or triple-(biventricular) chamber pacing and sensing in patients with severe left ventricular dysfunction and/or history of congestive heart failure in the absence of classical pacing indications. However, at the moment, no definitive data about the long-term effects of this pacing modality are available[19,20]. The possibility of asymptomatic episodes of atrial arrythmias cannot be excluded due to the absence of atrial diagnostic function in the single-chamber ICDs. Finally, these results need to be confirmed over a longer follow-up.

Conclusions

In this non-selected study population, dual-chamber ICD implantation appeared to be definitely indicated in

10·5% of cases due to sinus node dysfunction and second- or third-degree AV block, and possibly indicated in an additional 17·5% of cases due to first-degree AV block and paroxysmal atrial fibrillation. During 1-year follow-up, such percentages remained stable, and thus a progression towards increasing dual-chamber ICD indications appears unlikely. The percentage of patients suitable for a dual-chamber ICD may be underestimated because this study has not considered the possible haemodynamic improvement from dual-chamber pacing and sensing as an indication. The reported 15% cumulative incidence of paroxysmal atrial fibrillation justifies the activation of dedicated algorithms, evaluating the morphology and relationship of endocardial signals.

Finally, the detection, prevention and treatment of atrial tachyarrhythmias and the possible improvement of haemodynamic status by dual- or triple-chamber ICDs with respect to single-chamber ICD needs to be evaluated by a study with a prospective design, which would randomize new ICD recipients to single-chamber vs dual-chamber ICD devices.

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