Influence of pacing modalities on the incidence of atrial fibrillation in patients without prior atrial fibrillation

A prospective study

A. V. Mattioli, D. Vivoli and G. Mattioli

Department of Cardiology, University of Modena, Modena, Italy

Aim Many studies suggest that patients who receive a physiological pacemaker have a reduced incidence of atrial fibrillation compared to patients receiving a ventricular pacemaker.

Methods In order to evaluate the impact of different pacing modalities on the incidence of atrial fibrillation, we prospectively analysed 210 patients. Patients with previous episodes of atrial fibrillation were excluded from the study. The patient population included 110 patients paced for sick sinus syndrome and 100 patients paced for total atrioventricular block or second degree type atrioventricular block.

Results Patients were followed for 5 years; the incidence of atrial fibrillation was 10% at 1 year, 23% at 3 years and 31% at 5 years. There was an increase in the incidence of atrial fibrillation in patients receiving a ventricular pacemaker compared to patients receiving a physiological pacemaker.

Conclusion The pacing modality appeared to influence the incidence of atrial fibrillation in paced patients; patients with ventricular pacing had a significantly higher incidence of arrhythmias than did patients with physiological pacing.

Key Words: Atrial fibrillation, ventricular pacing, physiological pacing

Several retrospective studies have shown a correlation between pacing modes and the occurrence of atrial fibrillation[1-4]. No prospective studies have been done, however, and the retrospective reports frequently lack methodological rigour due to both incomplete follow-up and cohorts that are non-contemporary[1,2,5,6]. The most important 'confounding factor' in analysing the data is the presence of atrial fibrillation before the implantation of the pacemaker. The incidence of prior atrial fibrillation varies in different series of patients[3,5,7,8]. Sometimes prior atrial fibrillation is the only significant predictor of the development of atrial fibrillation in patients with pacemakers and an adjustment for this factor in the data analysis is required[5].

To avoid this important source of bias, we designed a prospective study and excluded from our series patients with prior atrial fibrillation.


Correspondence: Prof. Giorgio Mattioli, Department of Cardiology, Modena University, 71, Via del Pozzo, 41100 Modena, Italy.

0195-668X/98/020282+05 $18.00/0 hj970616 © 1998 The European Society of Cardiology
Patients with congenital heart disease, dilated cardiomyopathy, and valvular heart disease were excluded from the study, as were patients treated with antiarrhythmic drugs. The criteria for coronary heart disease included definite angina pectoris or a history of myocardial infarction. Patients with no evidence of organic heart disease were classified as having conduction system disease only. Baseline variables describing cardiac disease and concomitant diseases are shown in Table 1.

Pacemaker implantation was performed when the patients presented high degree atrioventricular block and second degree atrioventricular block (type II Mobitz). The definition of sick sinus syndrome was limited to: sinus arrest or cardio-inhibitory carotid syndrome; bradycardia–tachycardia syndrome; symptomatic, inappropriate or unexpected bradycardia.

The pacing mode was randomized. Pulse generators were ventricular in 105 patients (VVI and VVI-R), and atrial and dual chamber in 105 patients (AAI, DDD, DDD-R and VDD). AAI, DDD, DDD-R and VDD and all atrial and dual chamber pacemakers, were defined as 'physiological pacing'.

The study protocol was approved by the Ethical Committee of our University and informed consent was obtained from all participants.

Follow-up

The follow-up began on the date of pacemaker implantation. Patients were censored at the time of death or atrial fibrillation, at the end of the study, or at the occurrence of the end-point.

The end-point was chronic atrial fibrillation defined as stable atrial fibrillation present in three ECGs obtained over 6–8 months, without evidence of sinus rhythm up to the end of the study. Pacemaker reprogramming during follow-up was not considered when performing the statistical analysis.

### Statistical analysis

Actuarial curves for the incidence of chronic atrial fibrillation were calculated by the Kaplan–Meier method. Continuous variables are expressed as means ± SD.

### Results

No significant differences existed between the patient subgroups with respect to age or gender distribution. Patients were followed for a maximum of 60 months. Fifty-six patients developed atrial fibrillation (Fig. 1) and 16 patients died during the follow-up period. The actuarial incidence of chronic atrial fibrillation was 10% at 1 year, 11% at 2 years, 23% at 3 years, and 31% at five years.

No significant differences existed between patients with atrioventricular block and patients with sick sinus syndrome with respect to the incidence of chronic atrial fibrillation (Fig. 2). The incidence of chronic atrial fibrillation was higher in patients with non-physiological pacing modalities than in those with physiological pacing modalities. Patients paced with a ventricular pacing mode were at higher risk for chronic atrial fibrillation (Fig. 3).

Patients with sick sinus syndrome who had a physiological pacing modality were particularly protected from atrial fibrillation. The protection was less obvious in patients who had atrioventricular block and the same pacing mode. In patients who had sick sinus syndrome and a physiological pacing mode, the incidence of atrial fibrillation was significantly less than in patients with a ventricular pacing mode (P < 0.02; Fig. 3).

### Discussion

It is generally believed that atrial fibrillation is more common in paced patients who have sick sinus

<table>
<thead>
<tr>
<th>Clinical parameters</th>
<th>All patients (210)</th>
<th>Sick sinus syndrome (110)</th>
<th>A V block (100)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (median)</td>
<td>77</td>
<td>78</td>
<td>76</td>
<td>ns</td>
</tr>
<tr>
<td>Female/Male</td>
<td>97/113</td>
<td>49/61</td>
<td>48/52</td>
<td>ns</td>
</tr>
<tr>
<td>Ventricular pacemaker</td>
<td>105</td>
<td>50</td>
<td>55</td>
<td>ns</td>
</tr>
<tr>
<td>Physiological pacemaker</td>
<td>105</td>
<td>60</td>
<td>45</td>
<td>ns</td>
</tr>
<tr>
<td>Disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAD</td>
<td>99</td>
<td>41</td>
<td>58</td>
<td>ns</td>
</tr>
<tr>
<td>Cardiomyopathy</td>
<td>55</td>
<td>21</td>
<td>34</td>
<td>P &gt; 0.05</td>
</tr>
<tr>
<td>Others</td>
<td>24</td>
<td>9</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>101</td>
<td>47</td>
<td>54</td>
<td>ns</td>
</tr>
<tr>
<td>Diabetes</td>
<td>75</td>
<td>32</td>
<td>43</td>
<td>ns</td>
</tr>
<tr>
<td>Medication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-implant antiarrhythmic drugs</td>
<td>35</td>
<td>20</td>
<td>15</td>
<td>ns</td>
</tr>
<tr>
<td>Antiplatelets drugs</td>
<td>101</td>
<td>59</td>
<td>42</td>
<td>ns</td>
</tr>
</tbody>
</table>
**Figure 1**  Symptom-free event curve that shows the annual incidence of events in the total population.

**Figure 2**  Plot of comparative incidence of chronic atrial fibrillation (CAF) with respect to the conduction disorder that led to pacing. Legend: SSS = sick sinus syndrome (□); BAV = atrioventricular block (○).
syndrome than in those with other conduction disorders that require pacing, such as atrioventricular block. The results of this study did not support this hypothesis: no significant differences were found between patients with atrioventricular block and patients with sick sinus syndrome with respect to the incidence of chronic atrial fibrillation. The mechanisms by which chronic atrial fibrillation occurs in patients who are paced for atrioventricular block are probably quite different from the mechanisms by which the same arrhythmia occurs in patients paced for sick sinus syndrome.

In patients paced for atrioventricular block, the dissociation between atrial and ventricular contractions may play an important role in the development of atrial fibrillation\cite{9}. In patients with sick sinus syndrome, chronic atrial fibrillation is part of the natural history of the disease\cite{5,10,11}.

An age-related increase in parasympathetic tone, concomitant ultrastructural alterations in the atrium, and the development of sinus node fibrosis may favour bradycardia sinus atrial block and macro and micro reentry mechanisms for atrial fibrillation\cite{12-16}. The results of this study support previous reports in which atrial fibrillation developed more often in patients who were paced with a ventricular pacing mode rather than a physiological pacemaker\cite{15,16,17,18}. Most previous studies, however, lacked methodological rigour and resulted in the studies being subject to bias\cite{5}. One common bias is that these studies are retrospective and the pacing mode was not randomized\cite{6,19}.

Another important source of bias is the inclusion of patients with long or short periods of previous atrial fibrillation. For example, in one study a pre-implant history of atrial fibrillation was present in 15% of AAI patients vs 36% of VVI patients\cite{7}. A prior history of paroxysmal atrial fibrillation is one of the strongest independent predictors of post-implant chronic atrial fibrillation. Sgarbossa et al.\cite{5} found that the incidence of chronic atrial fibrillation was 16% during the first 5 years of follow-up in patients without a history of paroxysmal atrial fibrillation. They concluded that the development of chronic atrial fibrillation was secondarily determined by the pacing modality.

The very high hazard ratio associated with the presence of prior atrial fibrillation was a ‘confounding factor’ in previous studies that led us to stratify the data with respect to the presence of possible confounding factors.

Figure 3 Plot of comparative incidence of chronic atrial fibrillation (CAF) in patients with sick sinus syndrome with respect to physiological (□) or ventricular (△) pacing modes.

**Conclusion**

In conclusion, the incidence of chronic atrial fibrillation was the same in patients who were paced for atrioventricular block or for sick sinus syndrome. Chronic atrial fibrillation occurred independent of prior atrial
tachyarrhythmias in paced patients. The incidence of atrial fibrillation was significantly lower in patients treated with a physiological pacemaker.

References