Case Reports:
Overdrive Pacing to Prevent Atrial Fibrillation

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Summary
This article presents a study of three patients with frequent episodes of atrial fibrillation (AF) and conventional indications for dual-chamber pacing, followed for 9 months after a Philos DR pacemaker implantation. The pacemaker provides atrial overdrive pacing for the prevention of AF (DDD+ mode). Three months after pacemaker implantation, the DDD+ mode was activated for 3 months, which was observed by 3 months of conventional DDDR pacing. The DDD+ mode markedly reduced the mean number of AF episodes per day from 22.3 ± 13.3 (DDDR) to 1.0 ± 1.3 (DDD+), as well as the number of atrial extrasystoles per hour from 58.8 ± 78.9 (DDDR) to 2.3 ± 2.5 (DDD+).

Key Words
Atrial fibrillation (AF), atrial extrasystoles, pacing for AF prevention, permanent atrial overdrive, DDD+ mode

Introduction
Atrial fibrillation (AF) is the most common sustained arrhythmia with an incidence of 0.4% in the overall population. Predominantly elderly people suffer from AF: 2 – 4% of those older than 60 years, and > 13% of those older than 70 years [1-4]. AF causes one-third of all strokes and gives rise to high health care costs. As AF often appears in combination with other heart conditions, such as congestive heart failure [5,6], it further reduces the already impaired exercise tolerance of those heart failure patients. Paroxysmal AF is often related to a high incidence of atrial extrasystoles (AES), a condition treated by atrial overdrive pacing. Previous results have shown that AES and AF can be reduced with high-rate atrial pacing [7,8]. This was achieved by programming the pacemaker to DDD mode, with a basic rate set to 90 beats/min (bpm). However, many patients do not tolerate this fast rate. Patient tolerance has been improved with the introduction of dynamic atrial overdrive pacing as a substitute for high fixed-rate pacing. In this paper, we compare the effects of DDD+ and conventional DDDR pacing in three patients presenting with frequent AF episodes.

Materials and Methods
The AF prevention algorithm in Philos DR pacemakers (Biotronik Germany) is activated by programming the DDD+ mode. In this mode, the pacing rate is increased by a programmable overdrive step each time an atrial event is sensed. Premature atrial events (atrial extrasystoles) are also taken into account (see Figure 1). This overdrive step size is programmed to LOW, MEDIUM, or HIGH. The acceleration can never exceed the programmable maximum overdrive rate. When no atrial event is sensed during a programmable number of cycles (the overdrive plateau), the pacing rate is decreased by 1 beat/min. The pacing rate is thus gradually decreased after each plateau until either the basic rate is reached or until a spontaneous event triggers another pacing rate increase. Philos DR and Philos D pacemakers offer overdrive pacing in the DDD mode, as well as in DDT/A, DDT/V, AAI, and AAT modes. The pacemakers have several built-in safety functions. The maximum overdrive rate limit temporarily deactivates the overdrive during fast intrinsic rates. Another safety feature deactivates overdrive for at least several hours when the
Results

The results for all three patients are shown in Table 1 for the DDD+ mode and in Table 2 for the DDDR mode. As seen, the number of single AES was 24 times lower in DDD+ than in DDDR mode. These findings are in line with previous studies, which showed a reduction in the number of AF and AES with high-rate or dynamic atrial overdrive pacing [7-9]. Figure 2 shows the correlation between the AES and the atrial rate, illustrating the progressive acceleration of the atrial pacing rate by the used AF prevention algorithm. During DDDR pacing (Figure 3), 88% of AES were between 70 and 90 bpm, which might not be well tolerated.

Discussion

The presented preliminary results demonstrate the benefits of permanent, dynamic atrial overdrive pacing for the prevention of AF as compared to conventional pacing modes. Further data in a larger patient population are necessary to validate these encouraging preliminary findings.

References


Table 1. The number of atrial extrasystoles (AES) and atrial tachy episodes per day in DDD+ mode in the three patients studied.

<table>
<thead>
<tr>
<th></th>
<th>Pt 1</th>
<th>Pt 2</th>
<th>Pt 3</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single AES/day</td>
<td>121.6</td>
<td>2.6</td>
<td>52.2</td>
<td>58.8 ± 59.8</td>
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<tr>
<td>AES couplets/day</td>
<td>0.09</td>
<td>0</td>
<td>0.49</td>
<td>0.19 ± 0.26</td>
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<tr>
<td>AES triplets/day</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AES/hour</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>2.3 ± 2.5</td>
</tr>
<tr>
<td>Tachy episodes/day</td>
<td>2.5</td>
<td>0</td>
<td>0.47</td>
<td>1.0 ± 1.3</td>
</tr>
</tbody>
</table>

Table 2. The number of atrial extrasystoles (AES) and atrial tachy episodes per day in DDDR mode in the three patients studied.

<table>
<thead>
<tr>
<th></th>
<th>Pt 1</th>
<th>Pt 2</th>
<th>Pt 3</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single AES/day</td>
<td>516.2</td>
<td>95.8</td>
<td>3579.3</td>
<td>1397.1 ± 1901.5</td>
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<tr>
<td>AES couplets/day</td>
<td>1.6</td>
<td>37</td>
<td>1.1</td>
<td>13.1 ± 20.6</td>
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<tr>
<td>AES triplets/day</td>
<td>0</td>
<td>0.31</td>
<td>0</td>
<td>0.10 ± 0.17</td>
</tr>
<tr>
<td>AES/hour</td>
<td>21</td>
<td>5</td>
<td>149</td>
<td>58.8 ± 78.9</td>
</tr>
<tr>
<td>Tachy episodes/day</td>
<td>-</td>
<td>31.8</td>
<td>12.9</td>
<td>22.3 ± 13.3</td>
</tr>
</tbody>
</table>


Figure 2. Diagnostic data showing counters of atrial extrasystoles (ESA, in French) and the relationship between ESA and the atrial rate histogram in DDD* mode (patient 1).

Figure 3. Date retrieved from the pacemaker diagnostic memory: counters of atrial extrasystoles (ESA, in French) and the atrial rate histogram in DDDR mode (patient 1).

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