

## 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<sup>+</sup> mode). Three months after pacemaker implantation, the DDD<sup>+</sup> mode was activated for 3 months, which was observed by 3 months of conventional DDDR pacing. The DDD<sup>+</sup> mode markedly reduced the mean number of AF episodes per day from  $22.3 \pm 13.3$  (DDDR) to  $1.0 \pm 1.3$  (DDD<sup>+</sup>), as well as the number of atrial extrasystoles per hour from  $58.8 \pm 78.9$  (DDDR) to  $2.3 \pm 2.5$  (DDD<sup>+</sup>).*

### Key Words

Atrial fibrillation (AF), atrial extrasystoles, pacing for AF prevention, permanent atrial overdrive, DDD<sup>+</sup> 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<sup>+</sup> 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<sup>+</sup> 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

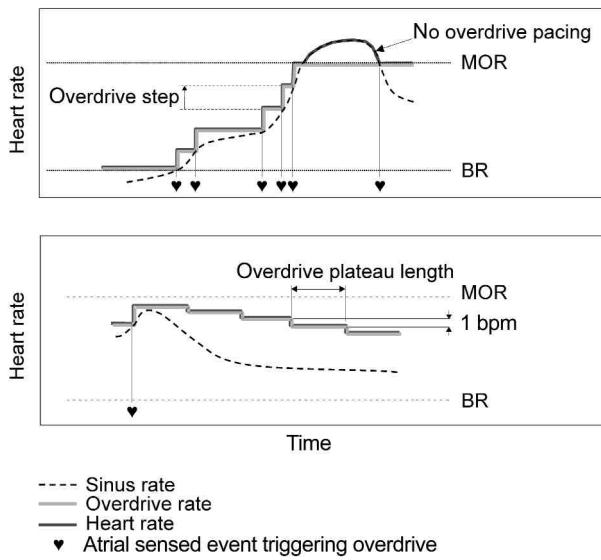


Figure 1. Principle of the DDD<sup>+</sup> algorithm. MOR = maximum overdrive rate, BR = basic rate.

mean paced atrial rate over a longer period of time (approximately 12 hours) exceeds the safety rate limit (approximately 90 bpm). In the latter situation, the pacemaker switches to corresponding non-overdrive mode. When the mean paced atrial rate falls below the safety rate limit, the overdrive pacing will be resumed. After four overdrive deactivations due to exceeding the safety rate limit, the pacemaker will permanently remain in the corresponding non-overdrive mode.

The patients were programmed to DDD<sup>+</sup> mode for 3 months and to DDDR mode for 3 months, in order to compare the two modes. In the DDD<sup>+</sup> mode, the basic rate was set to a value that was 5 bpm higher than the resting rate. The following parameters were compared using counters in the Philos DR pacemaker memory:

	DDD <sup>+</sup>			
	Pt 1	Pt 2	Pt 3	Mean ± SD
Single AES/day	121.6	2.6	52.2	58.8 ± 59.8
AES couplets/day	0.09	0	0.49	0.19 ± 0.26
AES triplets/day	0	0	0	0
AES/hour	5	0	2	2.3 ± 2.5
Tachy episodes/day	2.5	0	0.47	1.0 ± 1.3

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

- Number of single AES;
- Number of AES couplets;
- Number of AES triplets;
- Number of AES/hour;
- Number of atrial tachyarrhythmia episodes.

### Results

The results for all three patients are shown in Table 1 for the DDD<sup>+</sup> mode and in Table 2 for the DDDR mode. As seen, the number of single AES was 24 times lower in DDD<sup>+</sup> 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

- [1] Attuel P. Suppression of atrial fibrillation using a new pacing algorithm. *Prog Biomed Res.* 2000; 5: 13-18.
- [2] Kannel WB, Abbott RD, Savage DD, et al. Epidemiologic features of chronic atrial fibrillation: The Framingham Study. *N Engl J Med.* 1982; 306: 1018-1022.

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

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

## CLASSIFICATION TA/ESA

Zone TA 140 cpm  
 Zone f1A 250 cpm  
 Zone de FA 340 cpm  
 Prématurité Atr. 20 %

Démarré 24.04.2001 11:30  
 Durée 35 Jours

	Compteur TA
FA	0
f1A à FA	0
TA à FA	0
f1A	1
TA à f1A	1
TA	939
FS à TA	938

	Compteur ESA
ESA isolées	4256
Doublets	3
Triplets	0
ESA par heure	5
Intervalle ESA-ESA le + court.	219 ms

## CLASSIFICATION TA/ESA

Zone TA 140 cpm  
 Zone f1A 250 cpm  
 Zone de FA 340 cpm  
 Prématurité Atr. 20 %

Démarré 14.02.2001 10:18  
 Durée 41 Jours

	Compteur TA
FA	0
f1A à FA	0
TA à FA	0
f1A	62
TA à f1A	62
TA	7516
FS à TA	7493

	Compteur ESA
ESA isolées	21164
Doublets	64
Triplets	0
ESA par heure	21
Intervalle ESA-ESA le + court.	234 ms

## ESA US FRÉQ. ATR.

Démarré 24.04.2001 11:30  
 Durée 35 Jours

cpm	0	8	15	23	30	%	Total
< 31	0	0	0	0	0	0	0
31 - 40	0	0	0	0	0	0	0
41 - 50	1	0	0	0	0	1	27
51 - 60	1	0	0	0	0	1	63
61 - 70	27	0	0	0	0	27	1210
71 - 80	29	0	0	0	0	29	1282
81 - 90	11	0	0	0	0	11	492
91 - 100	8	0	0	0	0	8	335
101 - 110	6	0	0	0	0	6	262
111 - 120	7	0	0	0	0	7	329
121 - 130	3	0	0	0	0	3	142
131 - 140	1	0	0	0	0	1	33
141 - 150	1	0	0	0	0	1	31
151 - 160	0	0	0	0	0	0	22
161 - 171	1	0	0	0	0	1	34
> 171	4	0	0	0	0	4	155
<b>Total</b>						<b>100</b>	<b>4417</b>

## ESA US FRÉQ. ATR.

Démarré 14.02.2001 10:18  
 Durée 41 Jours

cpm	0	18	35	53	70	%	Total
< 31	0	0	0	0	0	0	0
31 - 40	0	0	0	0	0	0	0
41 - 50	0	0	0	0	0	0	5
51 - 60	1	0	0	0	0	1	291
61 - 70	5	0	0	0	0	5	1296
71 - 80	64	0	0	0	0	64	16341
81 - 90	24	0	0	0	0	24	6128
91 - 100	4	0	0	0	0	4	1124
101 - 110	1	0	0	0	0	1	264
111 - 120	0	0	0	0	0	0	118
121 - 130	0	0	0	0	0	0	40
131 - 140	0	0	0	0	0	0	20
141 - 150	0	0	0	0	0	0	11
151 - 160	0	0	0	0	0	0	4
161 - 171	0	0	0	0	0	0	2
> 171	0	0	0	0	0	0	2
<b>Total</b>						<b>100</b>	<b>25646</b>

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

- [3] Wolf PA, Dawber TR, Thomas HE, et al. Epidemiologic assessment of chronic atrial fibrillation and risk of stroke: The Framingham Study. *Neurology*. 1978; 28: 973-977.
- [4] Gallagher MM, Camm AJ. Classification of atrial fibrillation. *PACE*. 1997; 20: 1603-1605.
- [5] Grogan M, Smith HC, Gersh BJ, et al. Left ventricular dysfunction due to atrial fibrillation in patients initially believed to have idiopathic dilated cardiomyopathy. *Am J Cardiol*. 1992; 69: 1570-1573.
- [6] Coumel P, Friocourt P, Mugica J, et al. Long-term prevention of vagal atrial arrhythmia by atrial pacing at 90/minute: experience with 6 cases. *PACE*. 1983; 6: 552-560.
- [7] Murgatroyd FD, Nitzsche R, Slade AK, et al. A new pacing algorithm for overdrive suppression of atrial fibrillation. Chorus Multicenter Study Group. *PACE*. 1994; 17: 1966-1973.
- [8] Wiberg S, Lonnerholm S, Jensen S, et al. Effect of right atrial overdrive pacing on symptomatic attacks of atrial fibrillation: a multicenter randomized study (abstract) *PACE*. 2001; 24: 554.

- [9] Ricci R, Santini M, Puglisi A, et al. Impact of consistent atrial pacing algorithm on the number of premature atrial complexes and paroxysmal atrial fibrillation recurrences in brady-tachy syndrome: a randomized prospective cross over study. *J Interv Card Electrophysiol* 2001; 5: 33-44.

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