

# Arrhythmia Induction During Atrial Pacing With Atrial “Floating” Electrodes

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Atrial pacing with floating electrodes primarily designed for single lead VDD systems has disadvantages attributable to the «floatability» of the electrodes. Body and breathing movements cause changes in the position of the atrial dipole that can lead to failure of atrial capture and sensing, and even alternation of the stimulated chamber. We report the induction of typical intranodal tachycardia episodes related to intermittent failure of atrial capture in a patient with an implanted single lead DDD pacing system. Such systems pose a substantial risk of potentially arrhythmogenic asynchronous pacing.

**Key words:** *Pacemakers. Arrhythmia.*

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## Inducción de arritmias durante la estimulación auricular mediante electrodos «flotantes» auriculares

La estimulación auricular mediante electrodos flotantes diseñados primariamente para sistemas VDD monocable presenta inconvenientes derivados de su propia característica de «flotabilidad». Los movimientos corporales y respiratorios condicionan variaciones en la posición del dipolo auricular que pueden ocasionar fallos de detección y estimulación e incluso alternancia de la cámara estimulada. Describimos la inducción de episodios de taquicardia intranodal típica, en relación con fallos intermitentes en la captura auricular, en un paciente portador de un sistema de estimulación DDD monocable. Este tipo de sistemas tiene un riesgo considerable de estimulación asincrónica potencialmente arritmogénica.

**Palabras clave:** *Marcapasos. Arritmia.*

## INTRODUCTION

The use of single-lead VDD pacemakers enables atrioventricular synchrony to be maintained in patients who have impaired atrioventricular conduction with preserved sinus node function. The principal advantages of these pacemakers are the simplified implantation procedure and reduced overload of the venous system.<sup>1</sup>

For a number of years, there has been an interest in developing single-lead DDD pacing.<sup>2,3</sup> During 1997 and 1998, at the Hospital Clínico in Zaragoza, Spain, we implanted a number of VDD pacemakers that were also able to provide atrial stimulation by means of overlapping biphasic impulses (OLBIs) from “floating” electrodes. This mode of stimulation involves the

generation of two broad large-amplitude unipolar impulses of opposite polarity.<sup>4</sup>

## CASE REPORT

Our patient was an 85-year-old ex-smoker with a history of trifascicular block and episodic syncope of cardiogenic origin. In 1997, a permanent VDD pacemaker (Eikos SLD, Biotronik, with an Intermedics UniPass electrode) was implanted. Use of a Holter monitor prior to pacemaker implantation confirmed the existence of severe paroxysmal atrioventricular block but there was no evidence of concomitant sinus node dysfunction.

The pacemaker was programmed to function in a VDD mode just after implantation and performed without problems. During the follow-up period, and in accordance with the standard procedure for evaluating this type of pacemaker, atrial stimulation using OLBIs was started.

During a subsequent routine check-up, intermittent failure of atrial capture was observed during atrial

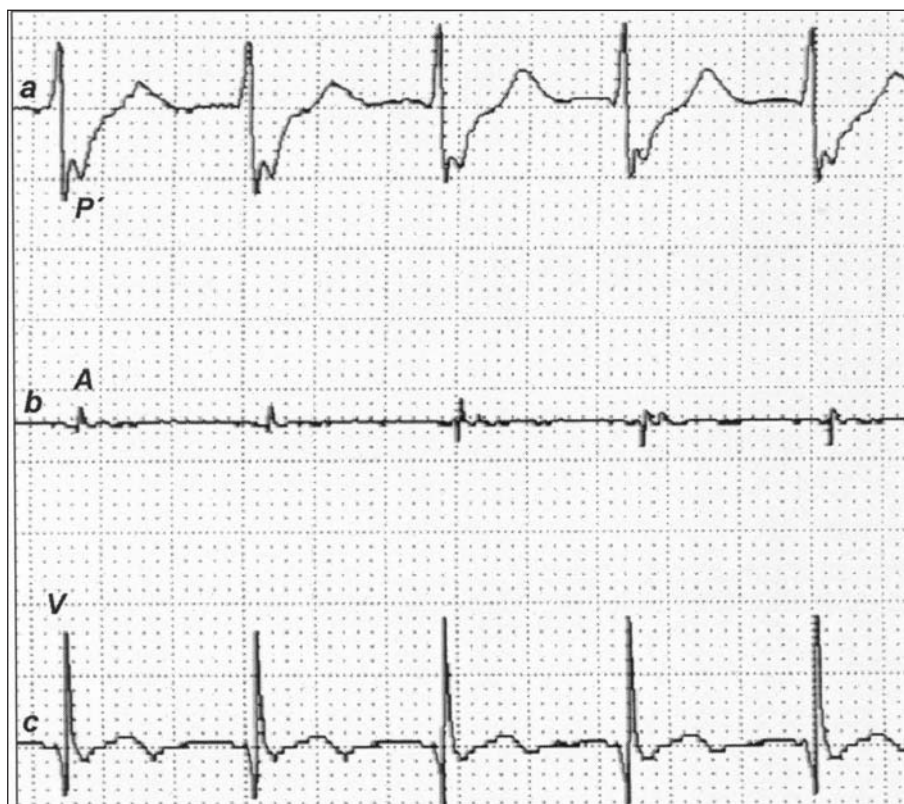
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**Fig. 1.** AAI pacing using a floating electrode (external recording). Intermittent sensing and stimulation failures induced intranodal tachycardia. *P* indicates spontaneous P wave; *E*, capture failure; *A*, stimulated P wave; *P'*, P wave during tachycardia.



**Fig. 2.** a: external lead; b: atrial electrocardiogram; c: ventricular electrocardiogram during intranodal tachycardia. *P* indicates P wave; *A*, atrial activity; *V*, ventricular activity.

stimulation using AAI pacing at a near-threshold voltage. This resulted in reproducibly induced sustained episodes of intranodal tachycardia (Figures 1 and 2).

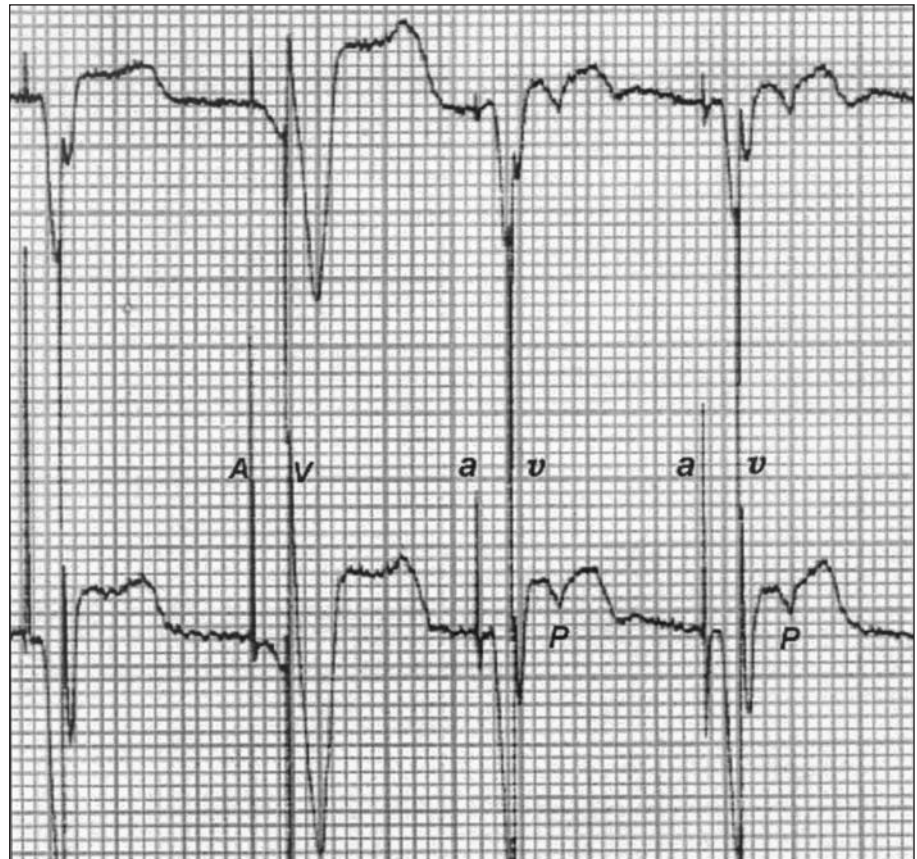
## DISCUSSION

The electrode sensors designed for use with single-lead VDD pacing comprise two poles that "float" within the atrium. These enable the atrial

depolarization signal to be detected without the need for contact with the atrial wall.

Initially at least, this "floating" state means that the relative position and orientation of the two poles will change in response to numerous factors, including postural alterations, breathing, physical exercise and heart failure.<sup>5</sup>

During VDD pacing, these variations in position and orientation can modify the amplitude of the atrial signal detected such that, in some cases, there is an intermittent



**Fig. 3.** Variations observed during single-lead DDD pacing (external leads). A indicates effective atrial impulse; V, effective ventricular impulse; a, atrial impulse that triggered ventricular capture; v, ineffective ventricular impulse; P,

loss of atrioventricular synchronization, which is usually of no clinical significance. However, pacemaker syndrome or pacemaker-mediated tachycardia can occur.

During single-lead DDD pacing, failures in signal detection or atrial capture can lead to asynchronous stimulation, which can induce arrhythmias under certain conditions, as were observed in the patient described above. Such arrhythmias can result in episodes of sustained intranodal tachycardia despite the underlying deterioration in atrioventricular conduction. Asynchronous stimulation can also be produced by other types of pacing.<sup>6</sup>

Our experience has shown that the variable nature of this type of pacing can even cause a different chamber to be stimulated by the bipolar electrode in the atrium (Figure 3).

The possibility that asynchronous stimulation, whether atrial or ventricular, can occur is one of the main obstacles to the development of single-lead DDD pacing. Pacemakers should not be programmed to operate in a DDD mode, at least in ambulatory patients, in

view of the possibility that potentially fatal ventricular arrhythmias can be induced.<sup>4</sup>

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