

## CASE REPORT

# Things are not always what they seem: pacemaker dysfunction or just a technical limitation?

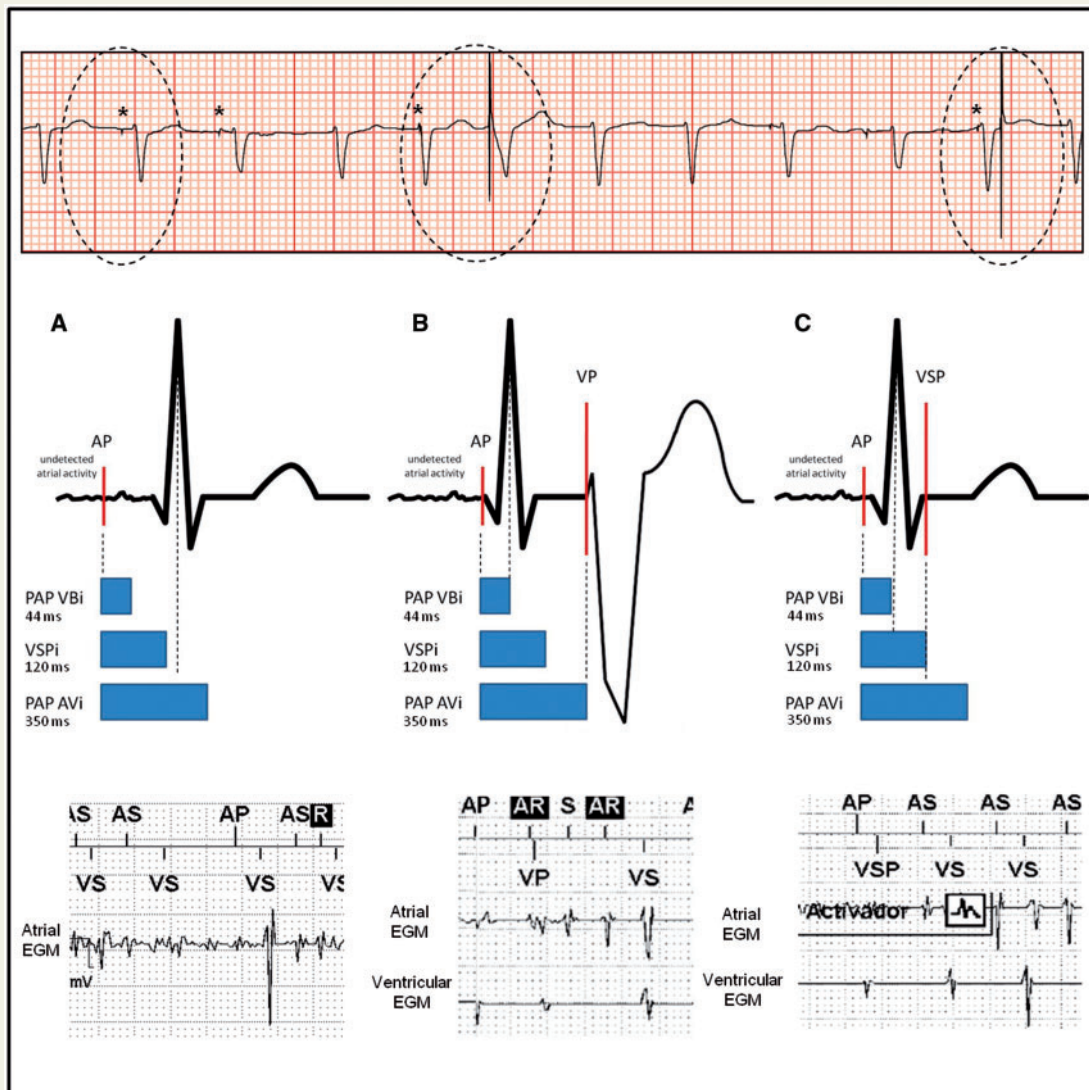
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A routine electrocardiogram (ECG) performed in a 90-year-old patient with sinus node disease and a dual-chamber pacemaker (Endurity MRI, St. Jude Medical) programmed in DDDR mode showed atrial fibrillation (AF) with abnormal stimulation spikes: atrial pacing (AP) despite the presence of AF and ventricular pacing (VP) with too short R-R wave intervals or even on the T wave. What are we dealing with?

The ECG shows three typical phenomena related to atrial undersensing during AF: atrial pacing (AP) over undetected atrial high-rate activity and ventricular pacing (VP) over the programmed high-rate limit due to ventricular undersensing during post-atrial pacing ventricular blanking interval (PAP VBi) and ventricular safety pacing interval (VSPi). 'A' shows AP, despite the presence of AF. We can appreciate



bipolar atrial pacing spikes (\*) on the ECG. Intrinsic ventricular conduction through the atrioventricular (AV) node is present showing narrow QRS complexes that are correctly detected in the post-atrial pacing AV interval (PAP AVi). Intracardiac atrial EGM shows a fast and irregular atrial activity compatible with AF. The pacemaker does not detect and classify these signals in the marker channel causing occasional AP. 'B' shows VP over the programmed high-rate limit. The ECG shows an intrinsic narrow QRS complex followed by unipolar VP with a coupling interval of 320 ms (187 b.p.m.). Note that the VP is preceded by an atrial pacing (\*) that generates a new PAP AVi and the narrow QRS complex falls into the PAP VBi (44 ms). Therefore, the narrow QRS complex is not detected, and VP is delivered at the PAP AVi programmed (350 ms). Stored intracardiac EGM example shows the same phenomenon: AP occurs almost simultaneous with a ventricular EGM that falls into PAP VBi, it is not detected, and VP is delivered. 'C' shows VSP phenomenon. The ECG shows an intrinsic narrow QRS complex followed by unipolar VP on the T wave. Note that the VP is preceded by an AP (\*) that generates a new PAP AVi, and the narrow QRS complex falls into the VSPi (120 ms). Ventricular safety pacing enables a 'crosstalk detection window' immediately following the PAP VBi, where the detection of an atrial pulse in the ventricular channel triggers a VP 120 ms after the event. This algorithm ensures that an atrial pulse detected by the ventricular channel immediately after the atrial pulse does not inhibit VP.<sup>1</sup> However, in this case, a ventricular complex falls into VSPi, the ventricular channel detects it and is misinterpreted as crosstalk triggering a VP. Stored intracardiac EGM example shows the same phenomenon: the presence of a ventricular EGM is noted after the AP and VSP are delivered 120 ms after the atrial pulse. Atrial sensitivity is increased to assure atrial sensing during AF and to allow appropriate automatic switch mode activation. Episodic AF undersensing by dual-chamber pacemakers is not rare and may cause different ECG abnormalities, sometimes misinterpreted as device dysfunction. However, things are not always what they seem. Sometimes, this abnormal ECG reflects a correct, although inappropriate, pacemaker functioning due to diagnostic limitations in relation to the programmed atrial sensitivity.<sup>2</sup>

**Conflict of interest:** none declared.

## References

1. Lim S. Ventricular safety pacing, ventricular sense response, and ventricular tachycardia. *Heart Rhythm* 2010;**7**:567–9.
2. Leung SK, Lau CP, Lam CT, Tse HF, Tang MO, Chung F et al. Programmed atrial sensitivity: a critical determinant in atrial fibrillation detection and optimal automatic mode switching. *Pacing Clin Electrophysiol* 1998;**21**:2214–9.