

# Improper Atrial Pacing: Differential Diagnosis

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**A** 73-year-old man with a medical history of ischemic cardiomyopathy (left ventricular ejection fraction, 0.20–0.24), coronary artery disease with percutaneous coronary intervention to the left anterior descending coronary artery, end-stage renal disease, hypertension, and diabetes mellitus presented at a routine clinical visit. We interrogated his biventricular implantable cardioverter-defibrillator (ICD) (Medtronic Claria MRI™ CRT-D SureScan™), which was programmed in DDDR mode (dual-chamber, sensed, rate-adaptive). The patient's electrocardiogram (ECG) raised concerns about improper pacing (Fig. 1).



**Fig. 1**

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## The ECG shows which of the following?

- A) Atrial lead oversensing
- B) Atrial lead undersensing
- C) Normal device function with premature atrial beats
- D) Normal device function with premature ventricular beats

See next page for the answer, as well as a link to the Focus on ECGs  
blog, where you can participate in a moderated discussion.

# FOCUS ON ECGs: ANSWER #22

## Answer

### B) Atrial lead undersensing

The patient's ECG (Fig. 2) shows sinus rhythm in beats 1 through 3. The ICD correctly sensed the atrial activity and paced the right ventricle after the predetermined atrioventricular (AV) delay. Beat 4, a premature ventricular beat, was correctly sensed. In beat 5, the device did not sense atrial activity during the programmed period, and it correctly provided atrial pacing, followed by ventricular pacing. Beats 6, 7, 9, 10, and 11 were correctly atrial-sensed, ventricular-paced beats. However, beat 8 is notable because the native atrial depolarization was not sensed and was followed by AV sequential pacing.

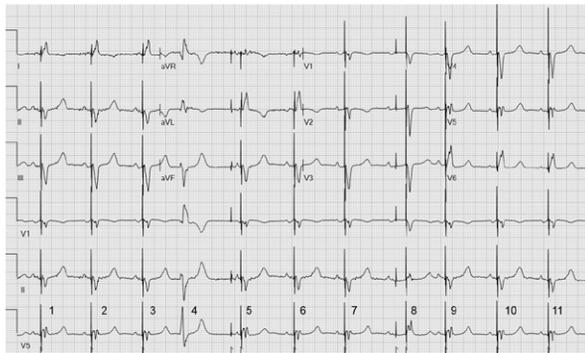


Fig. 2

Undersensing, which occurs when an ICD fails to detect native myocardial depolarization appropriately, can cause asynchronous pacing because depolarization occurs according to the ICD's settings rather than spontaneous cardiac activity. Atrial or ventricular undersensing can be caused by poor lead contact, programming errors (specifically, inappropriately high sensing thresholds), electrolyte abnormalities, or myocardial voltage signals

that the device cannot sense.<sup>1</sup> An inappropriately high number of pacemaker spikes on a surface ECG is a clue.

Our patient's ICD was programmed to detect atrial depolarization in accordance with P-wave amplitude. Interrogating the device revealed its inability to determine atrial sensing amplitude; even after we decreased atrial sensitivity from 0.30 to 0.25 mV, it indicated that the patient's P-wave amplitude was below 0.25 mV. In addition, an elevated pacing threshold of 5 V suggested that poor lead contact had caused the atrial undersensing. On the other hand, the ICD's lower pacing rate of 60 beats/min and programmed AV delay of 170 ms enabled ventricular tracking 79% of the time without concern for ventricular sensing and capture, so we reprogrammed the ICD instead of performing invasive procedures to reposition the atrial lead.

## References

1. Safavi-Naeini P, Saeed M. Pacemaker troubleshooting: common clinical scenarios. *Tex Heart Inst J* 2016;43(5): 415-8.

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