Focus on ECGs: Case #10

Bigeminy and a Pacemaker

Luke Cunningham, MD
Yochai Birnbaum, MD

An 81-year-old woman with a medical history of coronary artery disease, paroxysmal atrial fibrillation, and sick sinus syndrome, and implantation in 2013 of an ALTRUA™ dual-chamber pacemaker (Boston Scientific Corporation; Natick, Mass), presented after device interrogation revealed elevated impedance of >2,500 Ω in her atrial lead. The device settings were DDD mode, a lower rate limit of 60 beats/min, and a maximum atrioventricular (AV) delay of 330 ms. She reported fatigue, dyspnea on exertion, and occasional palpitations. She was admitted for new atrial lead implantation, and an electrocardiogram was obtained (Fig. 1).

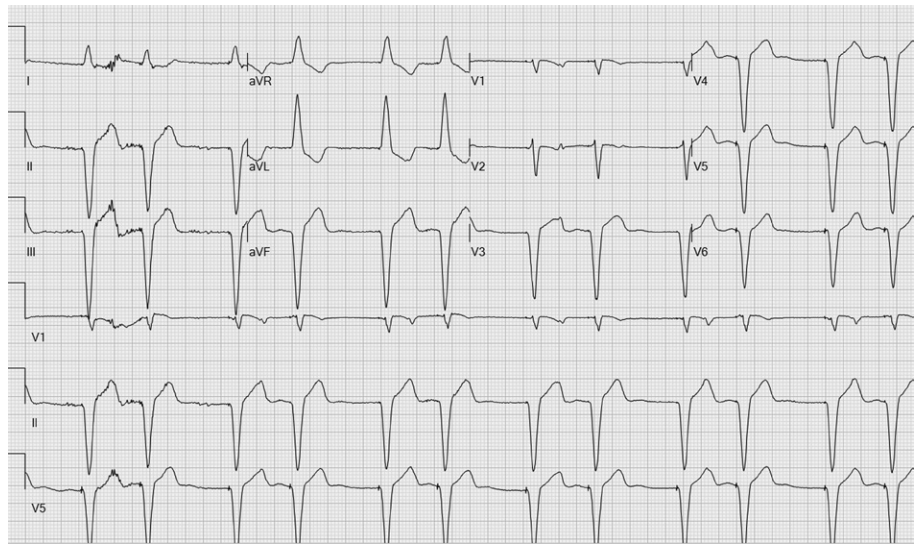

Fig. 1

The electrocardiogram shows which of the following?

A) Ventricular bigeminy
B) Normal ventricular-paced rhythm with undersensed premature atrial depolarizations
C) Normal ventricular pacing with underlying sinus rhythm
D) Normal ventricular pacing with retrograde atrial depolarizations

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.*

From: *Section of Cardiology, Department of Medicine (Drs. Birnbaum and Cunningham), Baylor College of Medicine; and Department of Cardiology, Texas Heart Institute and Baylor–St. Luke's Medical Center (Dr. Birnbaum); Houston, Texas 77030*

Dr. Cunningham is now at the Department of Cardiology, Baylor University Medical Center, Dallas, Texas.

Address for reprints:
Luke Cunningham, MD, 935 Lausanne Ave., Dallas, TX 75208

E-mail: *luke.cunningham@BSWHealth.org*

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Answer

D) Normal ventricular pacing with retrograde atrial depolarizations

Figure 1 shows ventricular depolarizations in a bigeminal pattern in lead V_1, all of which are preceded by a pacing stimulus, which excludes selection A. In addition, the first beat (odd numbers) in each pair is followed by an atrial depolarization (Fig. 2, arrows), which appears to be retrograde atrial activation from the ventricular-paced beat.

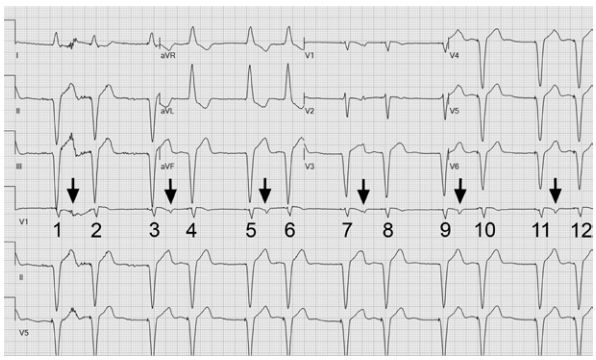

Fig. 2

This observation is supported by the predominantly negative deflection of the P waves and the proximity to the preceding T wave. Therefore, underlying sinus rhythm is not seen, so selection C is excluded. These atrial depolarizations appear to have been sensed by the pacing device, because a ventricular-paced beat is seen after each atrial beat at a consistent delay of 300 ms, and the programmed AV delay was 330 ms, correlating with this finding. Selection B is therefore excluded.

The pattern of the tracing is of particular note, given the grouped beats of ventricular pacing in a bigeminal pattern. Absence of an atrial depolarization is noted after the second ventricular-paced beat in each pair (even numbers). Therefore, second-degree 2:1 retrograde AV block is present. Had retrograde conduction of ventricular-paced beats continued, a pattern of pacemaker-induced tachycardia might have been seen. "Endless-loop" tachycardia is a known sequela of DDD pacing in dual-chamber pacemakers.[1-3] Its characteristics are usually a function of the set AV delay and ventriculoatrial (VA) blanking periods.[3] Our patient's programmed atrial blanking period after ventricular pacing was 120 ms with an observed VA conduction of 320 ms, well outside this period. However, pacemaker-induced tachycardia is not present, evidenced by the absence of atrial depolarization after each second ventricular-paced beat.

In cardiac electrophysiologic studies of healthy patients, VA conduction in ventricular pacing has had an average refractory cycle length of 432 ms (range, 360–600 ms). Most patients (66%) had block within the AV node, whereas the remaining patients had block within the His-Purkinje system.[4] Our patient was elderly and had sick sinus syndrome, making underlying AV nodal disease highly likely. A longer refractory period of the AV node could explain the intermittent absence of retrograde P waves with ventricular pacing.

Ultimately, our patient underwent uncomplicated implantation of a new right atrial lead, with normal device function thereafter.

References

1. Furman S, Fisher JD. Endless loop tachycardia in an AV universal (DDD) pacemaker. Pacing Clin Electrophysiol 1982;5(4):486-9.
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4. Mahmud R, Denker S, Lehmann M, Gilbert C, Akhtar M. Functional characteristics of retrograde conduction in a pacing model of "endless loop tachycardia". J Am Coll Cardiol 1984;3(6):1488-99.

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