

## Occasional dropped ventricular pacing in a patient with no underlying rhythm and an Advisa<sup>®</sup> dual-chamber pacemaker

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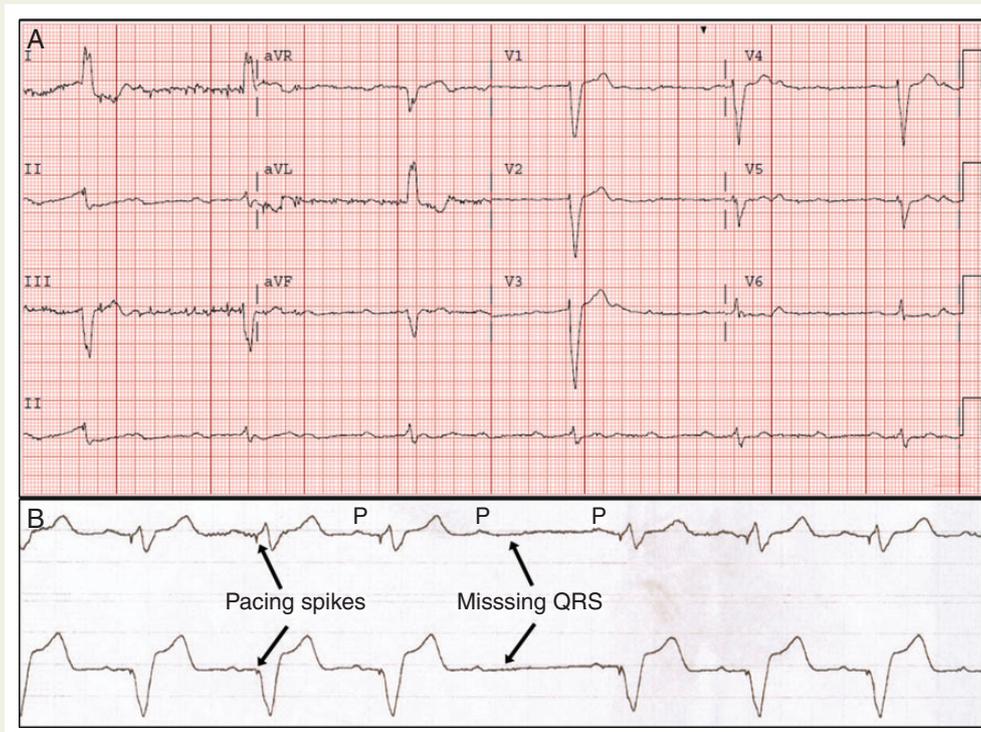
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An 86-year-old white male with complete heart block and no underlying ventricular escape rhythm was implanted with an Advisa MRI<sup>®</sup> dual-chamber pacemaker. Telemetry recordings revealed occasional, isolated P waves without pacing spikes or paced QRS complexes. Decreasing the right ventricle (RV) channel sensitivity to a value of 1.2 mV or higher eliminated completely this phenomenon. The observance of an occasional dropped ventricular paced (VP) event is possible in the Advisa family of devices and occurs during the collection of reference electrogram (EGM). Specifically, turning on/off the EGM amplifiers results in a disturbance of the RV sense amplifier. The intermittent electrical disturbance occurs infrequently, but timed to a predictable interval—a multiple increment of an hour and 30 s. This specific interval increment is associated with the scheduling of the reference EGM collection. Infrequent, occasional dropped VP events are most likely to occur when collection of the reference EGM is synchronized to an atrial sense (AS) event during complete heart block, since cross-chamber blanking following an AS event is not active in the device.

An 86-year-old white male with past medical history significant for chronic obstructive pulmonary disease, hyperlipidaemia, seizure disorder, and depression was brought to the emergency room (ER) by his family for progressively worsening weakness and lethargy. He was awake but confused. According to his family, he had more frequent seizures in the past few weeks but no complaints of dizziness, shortness of breath, or chest pain.

Patient's vitals were notable for a heart rate of 32 b.p.m., a blood pressure of 75/30 mmHg, and respiratory rate of 20 per minute. A 12-lead ECG revealed sinus rhythm, third degree atrioventricular (AV) block, and left bundle branch escape rhythm (Figure 1A). Blood work revealed: serum potassium of 4.0 meq/L, serum calcium of 9.2 mg/dL, serum creatinine of 1.30 mg/dL, serum blood urea of 24 mg/dL, haemoglobin of 12.8 gm/dL, haematocrit of 37.2%, and a thyroid stimulating hormone level of 1.73  $\mu$ IU/mL. Intravenous



**Figure 1** A. Presenting 12-lead ECG showing sinus rhythm, third degree AV block, and LBBB escape rhythm at a rate of 32 bpm. B. Telemetry strip showing sinus rhythm with paced ventricular rhythm after implant of an Advisa MRI<sup>®</sup> (Metronic) dual chamber pacemaker. Intermittent P waves not followed by a paced QRS complex or an isolated pacing spike.

atropine given in ER did not result in improvement of AV conduction. A normal saline bolus and dopamine infusion resulted in improved blood pressure and alertness, but no improvement in conduction.

He was subsequently admitted to the cardiac intensive care unit and a temporary transvenous pacemaker wire was placed through the femoral vein. He was taking phenobarbital and lacosamide that were both required to control his seizure disorder.

After temporary pacing initiation, he had no underlying rhythm at 48 h. In anticipation of potential need for brain MRI imaging, an Advia MRI<sup>®</sup> A2DR01 (Medtronic) was implanted.

On review of his telemetry tracings, it was noted that there were isolated P waves without pacing spikes or paced QRS complexes (Figure 1B). The patient was asymptomatic during these episodes. A chest radiograph showed no change in the pacemaker leads position. Interrogation of the device demonstrated that all parameters to be within normal range. There was no noise noted on the leads. Isometric arm exercises did not reveal any abnormalities during device interrogation. The sensitivity in the RV channel was decreased to 11.3 mV, which completely eliminated the isolated lack of paced ventricular complexes.

Subsequently, Medtronic technical services were contacted. They confirmed this phenomenon is possible in the Advia MRI pacemaker, and were reported to occur intermittently on an hour and 30 s schedule—typically during periods of complete heart block when the device is in DDD/DDDR mode and operating as AS–VP. Subsequent discussion with Medtronic engineers revealed that a false ventricular sense may occur due to residual electrical disturbance on the ventricular sense amplifier. The electrical disturbance is created by turning on/off of the diagnostic EGM amplifiers during reference EGM collection. In the Advia MRI pacemaker, the reference EGM is used by the Patient-Activated Detailed EGM Viewer feature. The Patient-Activated Detailed EGM Viewer is available only in the CareLink<sup>®</sup> system and is intended to help assess and diagnose symptomatic episodes.

The collection of reference EGM is non-programmable and is always active in the device. Further details provided by the manufacturer included the following:

- The scheduled reference EGM collection is synchronized to sensing and pacing events so that the device's sense amplifiers are blanked. However, there is no ventricular blanking following an AS event, which makes this phenomenon possible.
- An occasional 'dropped VP' is specific to DDDR and DDD modes during atrial tracking (AS–VP). The VP events are evenly spaced with one VP missing where one is expected.
- The behaviour in other pacing modes (VVIR, VVI, DDIR, DDI) is different. In these modes, there is a false V-sense somewhere during the pacing escape interval that resets the pacing escape interval. A VP is not expected at the time of this false V-sense and therefore during these modes the behaviour would result in a random ventricular oversense.
- Decreasing the ventricular sensitivity from 0.9 to 1.2 mV or higher may eliminate this phenomenon. Medtronic reliability engineers reported this behaviour is continuing to be monitored and tracked, and the estimated worldwide rate of occurrence is presently <0.05% worldwide, but this may be underreported.

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