Intermittent Loss of Telemetry Data
Lessons From a Leadless Pacemaker

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ABSTRACT

We present the case of a 63-year-old female patient who presented to the pacemaker clinic for a scheduled interrogation of her leadless pacemaker. The device interrogation was suggestive of intermittent under-sensing with failure to pace. Connecting the electrocardiogram lead to the pacing system analyzer raised the suspicion of intermittent loss of telemetry data. (Level of Difficulty: Beginner.) (J Am Coll Cardiol Case Rep 2021;3:146–9) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

A 63-year-old female patient presented for her scheduled leadless pacemaker interrogation 1 month following the procedure. The ventricular pacing percentage range was 0.0% to 0.1% with no change in the pacing parameters. During the second device visit 7 months post implantation, the patient remained asymptomatic. Pacemaker parameters were stable and satisfactory compared to the first visit. Immediately post-implantation, the R wave was measured at 15.2 mV, impedance measured at 630 Ω, and threshold measured at 1.0 V at 0.24 ms, whereas in the second follow-up visit, the R wave was measured at 14.1 mV, the impedance measured at 580 Ω, and threshold measured 0.5 V at 0.24 ms. However, the pacing system analyzer showed features that were considered initially as device malfunction. There was a lack of electrograms (EGMs) and a lack of annotations on the marker channel suggestive of the absence of ventricular depolarization (Figure 1). These features were initially considered as sensing malfunction. On the other hand, the absence of pacing spikes in the anticipated intervals according to device programming was suggestive of failure to pace.

LEARNING OBJECTIVES

- Intermittent loss of telemetry communication is rare but can be seen during the interrogation of a leadless pacemaker.
- The deep location of the leadless pacemaker generator and the deep inspiration and a large body habitus can increase the possibility of intermittent loss of telemetry communication during a device interrogation. This is easily resolved by repositioning the patient to get better telemetry communication.
- Artifact with growing EGM in size due to autogain signal adjustment can be seen on the return of telemetry communication.
- An ECG lead can provide useful information during troubleshooting device interrogation.

MEDICAL HISTORY

The patient had had a dual-chamber pacemaker with passive fixation leads implanted 19 years previously.
due to sinus pauses in the context of sick sinus syndrome. Other medical history included hypertension and type 2 diabetes mellitus.

Twelve years previously, while undergoing a routine generator change, the patient’s pacemaker’s atrial lead was found nonfunctional, but in view of ventricular pacing <3%, it was decided by the treating physician to replace the generator and not intervene in the leads. The device was programmed VVI with a lower rate limit of 60 beats/min, and the ventricular pacing percentage remained low at <5%. One year previously, the patient had her second generator change, again with a dual-chamber pacemaker programmed to VVI mode. Following this procedure, the patient had unsettling pain over the wound for a few months with no signs of systemic infection. It was decided to proceed to extract the device for presumed pocket infection and subsequently reimplant it.

Considering the infection of the previous system, a blocked venous anatomy, and the low pacing percentage, a decision was made to implant a leadless pacemaker according to current guidelines (1). This took place 1 week later, and the lower rate limit was set at 50 beats/min.

Differential diagnosis included under-sensing with failure to pace and loss of telemetry data

Investigations

A chest radiograph did not show any evidence of device dislodgement (Figure 2). The electrocardiogram (ECG) lead was connected and, as expected, there was an intermittent loss of telemetry communication during inspiration (Figure 3). This resulted in a drop-out of the sense marker (Figure 3A), artifact signal (Figure 3B), autogain adjustment of returned signal (Figure 3C), lack of ventricular sensing annotation, and distortion of the EGM corresponding to the 7th and 8th QRS complexes (Figures 3D and 3E, respectively). Sensing malfunction was unlikely in view of the satisfactory pacing, sensing, and threshold parameters. Furthermore, a pacing spike would be expected if the device did not sense any ventricular signal (Figure 1). All these findings were in keeping with intermittent loss of telemetry communication.

Management

Repositioning the wand to ensure at least 2 bars of telemetry during both inspiration and expiration and also advising the patient to breathe normally, avoiding deep breaths, eliminated this intermittent observation.

Discussion

This case presents recordings of a pacing system analyzer that could be misinterpreted as combined under-sensing and failure to pace. In Figure 1, the ECG lead is not connected, and the EGM and marker channel show lack of EGMs and ventricular sensing annotations, respectively. Nevertheless, there are some slight deviations of the baseline in the EGM channel following the 3rd and 6th EGM in the EGM channel, which raise the suspicion of loss of telemetry data. These deflections are timed with the anticipated T waves, even though they are slightly wider with a notch at the end. Following the 8th EGM,
there were drop outs in the EGM channel. Furthermore, there were no pacing spikes in the anticipated interval based on the programmed lower rate limit of the pacemaker.

Connecting an ECG lead during device interrogation was useful to troubleshoot this observation in this patient, with a body mass index of 31.4 and a device implanted in the lower septum instead of the apex, both of which could render pacemaker-to-wand communication challenging. The patient had an intrinsic sinus rhythm with intermittent loss of telemetry communication (Figure 3) as shown by the lack of EGM and ventricular sensing annotation corresponding to the 3rd QRS complex (Figure 3A).

There was also an artifact signal (Figure 3B) and an autogain adjustment of the returned EGM signal that followed (Figure 3C). Finally, the loss of telemetry communication was also shown by the lack of ventricular sensing annotation and distortion of the EGM corresponding to the 7th and 8th QRS complexes (Figures 3D and 3E, respectively). Of note, the initial printout from the pacing system analyzer (Figure 1) shows a preference for over-filtering of the high-frequency QRS complexes, whereas it seems that the T-wave transmission remained unaffected. Nevertheless, the EGM marked with the 4th circle in Figure 1 shows a loss of both QRS and T-wave EGMs, whereas as shown in Figure 3, it is obvious that the initial and terminal part of the EGM (marked D) managed to transmit, but there was considerable distortion in between. This shows that both high- and low-frequency signal transmissions were affected to a different extent, depending most probably on the depth of breathing.

FOLLOW-UP

The patient will be followed annually in the pacemaker clinic.

CONCLUSIONS

Leadless pacemakers incorporate the pacing electrodes on the generator, which is deeper inside the human body than the conventional pacemaker. Hence, loss of telemetry communication can be seen in a patient with leadless pacemaker, especially during inspiration and in obese patients. Loss of signal annotation and artifact and autogain

FIGURE 2 Chest Radiograph

Chest radiograph shows the position of the leadless pacemaker.

FIGURE 3 Device Interrogation With Connected ECG Lead

(Top) The trace represents an intracardiac electrogram, whereas the second trace represents a pacemaker annotation. (Bottom) The trace represents an ECG, which shows sinus rhythm. Intermittent telemetry communication errors are demonstrated by the lack of EGM and ventricular sensing annotation corresponding to the 3rd QRS complex (A), artifact signal (B), autogain adjustment of the returned signal (C), a lack of ventricular sensing annotation, and distortion of the EGM corresponding to the 7th (D) and 8th QRS complexes (E).

ECG = electrocardiogram; EGM = electrogram.
adjustments of returned signals are clues to intermittent loss of telemetry communication. This can be easily resolved by repositioning the patient to get better telemetry communication.

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**REFERENCE**

1. Kusumoto FM, Schoenfeld MH, Barrett C, et al. 2018 ACC/AHA/HRS guideline on the evaluation and management of patients with bradycardia and cardiac conduction delay: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. J Am Coll Cardiol 2019;74: e51-156.

**KEY WORDS** bradycardia, cardiac pacemaker, electrocardiogram