Knowing About Device Algorithms to Understand the Rhythm and Role of Managed Ventricular Pacing

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ABSTRACT: A 66-year-old patient with a DR pacemaker for intermittent atrioventricular block presented with an electrocardiogram (ECG) showing some P waves non followed by QRS complexes, raising suspicion of device dysfunction. The device was equipped with a special algorithm (Managed Ventricular Pacing; Medtronic), and the observed ECG tracing was a normal consequence of the function of such algorithms. Being aware of the function of specific algorithms is essential to adequately analyze rhythms.

KEYWORDS: Pacing, Algorithm, managed, ventricular

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Case Presentation

A 66-year-old patient who was implanted with the Adapta DR pacemaker (Medtronic Inc, Minneapolis, MN, USA) presented to the emergency room after his general cardiologist noticed an aberrant electrocardiogram (ECG) (Figure 1) with suspicion of device dysfunction. The patient was asymptomatic. He had his device implanted at our institution 2 years prior for paroxysmal atrioventricular (AV) block and had undergone a regular device follow-up, which showed normal device function. His ECG (Figure 1) displayed sinus rhythm with baseline first-degree AV block and Mobitz 2 second-degree AV block. After checking the device (Figure 2) and becoming aware of the function of the Managed Ventricular Pacing (MVP; Medtronic) algorithm, the patient was reassured and subsequently discharged.

Discussion

In our institution, we initiated a quality improvement program to enhance physiological pacing by reducing unnecessary ventricular pacing,[1] and therefore, this practice has become more widespread in our facility because we started the program.

The Adapta DR pacemaker (Medtronic) is equipped with the MVP algorithm. This algorithm works using a default atrial-based pacing mode (AAI(R)) with automatic switching to the DDD(R) mode if loss of AV conduction is detected. Loss of AV conduction is defined as 2 of the most recent 4 A-A intervals with no ventricular sensed (Vs) event. Therefore, in the event of a missing Vs event, the device gives a backup ventricular stimulation following the next As or Ap, such that 2 consecutive missing Vs events are not permitted; however, single dropped beats occur before the switch to DDD(R).[2]

The tracing in Figure 1 shows sinus rhythm, with a dynamic PR interval ranging from 210 to 220 ms, complete right bundle branch block, and intermittent missed QRS complexes (full arrows) compatible with Mobitz 2 second-degree AV block; this was directly followed by As Vp (A sensed, V paced) events (dashed arrows) with a sensed PR interval of 120 ms as programmed (Figure 2). Thus, it was obvious that the intermittent missed QRS complexes were a normal process consecutive to the function of the MVP algorithm.

Unnecessary ventricular pacing is known to be detrimental, especially when the right ventricle lead is located in the right ventricular (RV) apex and when the baseline hemodynamic condition is compromised.[3] Apical RV pacing leads to ventricular dyssynchrony, with subsequent detrimental effects, yielding a higher risk of adverse clinical outcomes such as atrial fibrillation and heart failure on long-term follow-up.[4,5]

Accordingly, specific pacemaker algorithms, which minimize RV pacing, allow reduction of the negative effects of RV pacing and may prevent clinical deterioration.[4] Enhancing intrinsic AV conduction is beneficial, and most pacemaker manufacturers have equipped their devices with algorithms that avoid unnecessary ventricular pacing. However, it is necessary to know the function of these algorithms, to avoid misinterpreting a rhythm as pacemaker malfunction.[2] Moreover, the activation of such algorithms must be based on a case-by-case indication; specifically, activating these algorithms is beneficial in patients with isolated sinus node dysfunction, asymptomatic first-degree AV block and asymptomatic patients with intermittent second-degree AV block. Conversely, it is not recommended to activate these algorithms in cases of complete AV block or in cases of high-grade second-degree AV block, especially when the patient is symptomatic.[2,4]

Conclusions

Electrocardiogram tracing of patients with pacemakers having algorithms dedicated to enhancing intrinsic AV conduction may show intermittent dropped beats related to P waves nonfollowed by QRS complexes. It is important to know the

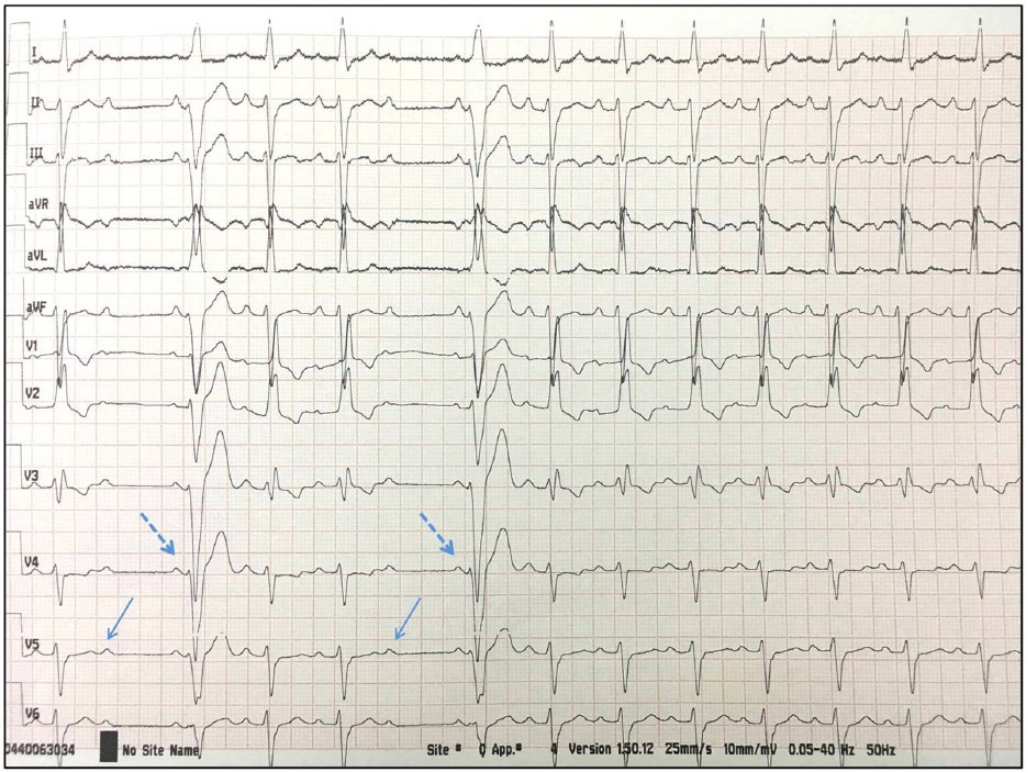

Figure 1. Sinus rhythm, intermittent missed QRS complex (full arrows), followed by AsVp (A sensed, V paced) events (dashed arrows).

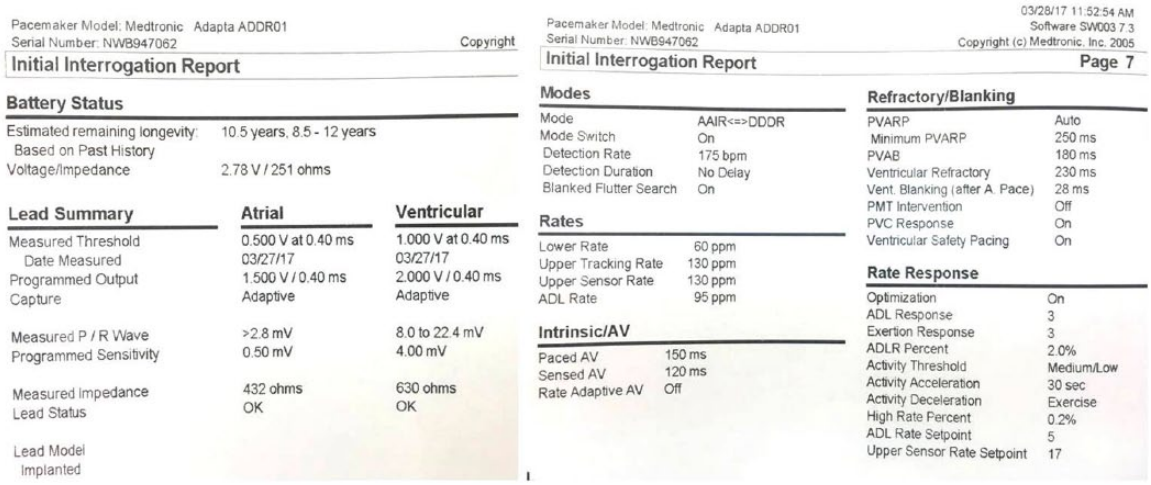

Figure 2. Device interrogation showing normal longevity, normal sensing and pacing parameters with MVP algorithm active (AAIR <==>DDDR).

function of such algorithms, to avoid misinterpretations and raised suspicion of pacemaker malfunction.

Author Contributions

Conceived and designed the experiments: AK. Analyzed the data: AK, HH. Wrote the first draft of the manuscript: AK. Contributed to the writing of the manuscript: AK, HH. Agree with manuscript results and conclusions: AK, HH. Jointly developed the structure and arguments for the paper: AK, HH. Made critical revisions and approved final version: AK, HH. All authors reviewed and approved of the final manuscript.

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