

Increased threshold in nonselective His-bundle pacing suspected to be caused by amiodarone



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Introduction

Recent data suggest that in patients with advanced heart block and an implanted permanent pacemaker (PPM), permanent His-bundle pacing (PHBP) may reduce deleterious effects of right ventricular pacing. However, PHBP is not without some disadvantages, the most common being increased pacing threshold. We report a case of a patient with increased His-bundle pacing threshold that was associated with the administration of amiodarone.

Case report

A 68-year-old woman presented to the emergency department (ED) with fatigue and presyncope. Her symptoms started about 1 month prior to presentation but had been progressively increasing in frequency. An electrocardiogram (ECG) was normal, but while the patient was on telemetry, intermittent and frequent 2:1 atrioventricular (AV) block was noted. There was no apparent reversible cause. An echocardiogram demonstrated normal left ventricular function, and she underwent implantation of a dual-chamber PPM. Nonselective PHBP was achieved (Figure 1). The postoperative course was unremarkable. She presented to the outpatient office 2 weeks later and was feeling well. Paroxysmal atrial fibrillation (AF) was noted on interrogation but the overall burden was low and she denied symptoms. Anticoagulation was initiated. The bipolar His-bundle pacing threshold was 1.5 V at 1 ms and the lead output was set to 3.5 V at 1 ms. The bipolar lead impedance was 456 ohms and sensed amplitude was 1.1 mV.

Seven months after implant, she presented to the outpatient office because of mild weakness. She had undergone left carotid endarterectomy several weeks prior and it was unknown if her weakness was due to deconditioning after surgery or another cause. Interrogation of the pacemaker showed stable parameters but there was a slight increase in

KEY TEACHING POINTS

- Direct His-bundle pacing has taken a foothold as an option for patients who have indications for pacemaker implant. The behavior of the His lead is unlike atrial or ventricular leads.
- Amiodarone is known to have complex and multiple effects on the cardiac conduction system and myocyte.
- The effect of amiodarone on direct His-bundle leads is unknown and amiodarone should be used cautiously.

the frequency and duration of AF. Amiodarone was prescribed with the goal of reducing AF burden and improving symptoms. Two weeks after initiation of amiodarone, she presented to the ED again with presyncope. Initial ECG was normal but interrogation showed 2:1 capture of the His bundle at 3.5 V at 1 ms (Figure 2) with stable 1:1 capture between 4 V and 5 V at 1 ms. The underlying rhythm was complete heart block with occasional premature ventricular contractions. The lead impedance and intrinsic amplitude were unchanged. An anteroposterior chest radiograph (CXR) showed that the positions of the pacemaker leads were normal and unchanged from the immediate postimplant CXR. The pacing output was increased to 8 V at 1 ms and lead revision was recommended. Overnight, reliable capture was noted. However, it was Mother's Day and the patient and her daughter decided to postpone the procedure. Concern about her safety was shared but they were willing to accept the risks and the patient was discharged. Incidentally, amiodarone was discontinued on discharge since there was no change in AF burden.

The patient returned to the outpatient office 2 weeks later and interrogation showed that the threshold was back to 1.5 V at 1 ms. The bipolar lead impedance and sensed amplitude were unchanged. This could not be explained, and concern about the lability of lead parameters was shared and discussion about lead revision was revisited. However, the temporal relationship between the initiation and cessation of amiodarone suggested that it may be playing a

KEYWORDS Amiodarone; Antiarrhythmic; His bundle; Non-capture; Pacemaker; Threshold
(Heart Rhythm Case Reports 2019;5:112–114)

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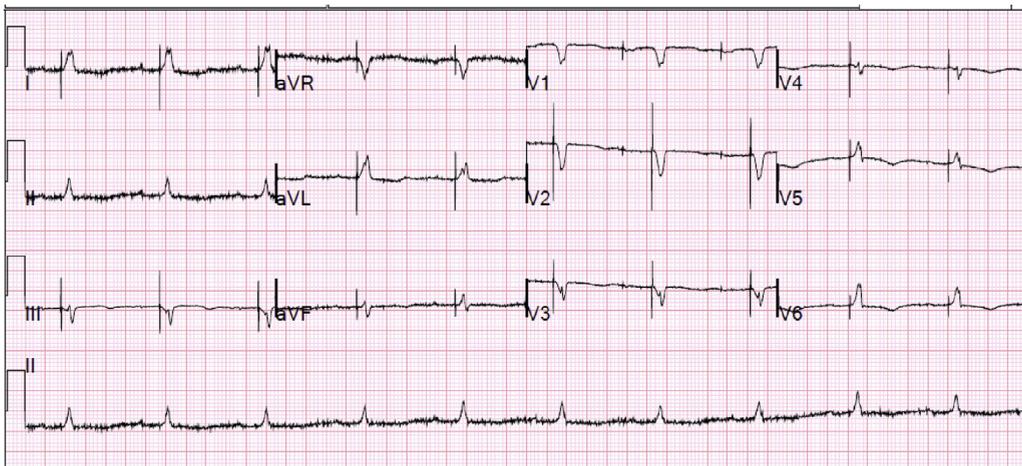


Figure 1 Electrocardiogram showing nonselective His-bundle capture at 3.5 V at 1 ms at implant.

role in the sudden and transient increase in His-bundle pacing threshold. After lengthy discussion, the pacing output was left at 8 V and the decision was made to follow her closely without revision. She was seen 1 and 2 months later, still off amiodarone, and the pacing threshold remained at 1.5 V at 1 ms with unchanged impedance and sensed amplitude.

Discussion

We present a case of a patient who underwent implant of a dual-chamber pacemaker for advanced AV block. Seven months after implantation, there was a marked increase in His-bundle pacing threshold about 2 weeks after amiodarone was prescribed for paroxysmal AF. When amiodarone was stopped, there was a return to the baseline pacing threshold. This temporal relationship suggests an association between amiodarone use and the rise in pacing threshold.

The stimulation threshold of cardiac myocytes is known to change in various circumstances, among them the use of antiarrhythmic medications. Flecainide is known to increase ventricular stimulation threshold.¹ Propafenone is reported to increase atrial pacing threshold.² Encainide was found, in a small study, to increase pacing threshold.³ Although the effect of amiodarone on defibrillation threshold is well described, its effect on myocardial stimulation threshold is not well established. Huang and colleagues⁴ showed that amiodarone had no effect on ventricular pacing threshold

in the canine ventricular myocardium. However, there have been case reports of amiodarone associated with changes in the pacing threshold of atrial leads.^{5,6} The mechanism by which amiodarone effects myocardial tissue is not known and the cause has only been postulated. Yabek and colleagues⁷ determined that amiodarone has a complex effect on myocardium. Using a rabbit model, they found that there was an increase in the action potential duration and effective refractory period in atrial and ventricular myocardium. However, in Purkinje fibers, there was a decrease in APD and ERP. This effect does not explain what was observed in our patient.

Kennedy and Batsford⁸ determined that amiodarone can induce intra-Hisian delay or infra-Hisian block. This finding could explain why 2:1 capture was noted on presentation to the ED and 1:1 capture was seen with higher pacing output; it is conceivable that at the lower pacing output, there was block below the level of capture whereas with the higher pacing output, there was capture of a greater area that included an area below the level of block. This would be unlikely. Shenasa and colleagues⁹ noted that amiodarone prolonged intra-Hisian conduction time and refractoriness of the His-Purkinje system. This datum could not explain why 2:1 capture was noted on presentation to the ED and 1:1 capture was seen with higher pacing output. Lastly, the possibility exists that amiodarone simply increased the threshold of His-bundle and myocardial excitability. However, this has not been previously described, to our knowledge.

In our patient, there was no change in the performance of the atrial lead as seen in other case reports. However, as observed in those case reports, there was a clear temporal relationship between amiodarone administration and elevation in pacing threshold. The mechanism by which amiodarone would cause such an effect is not clearly known to the authors, and we are unaware of any previously described amiodarone-associated changes to direct His-bundle pacing threshold. Additionally, in the ECG in Figure 1, there is nonselective His-bundle capture; although not shown here, there is ECG evidence that at lower pacing output, there is



Figure 2 Pacemaker interrogation during emergency department visit, showing 2:1 capture on the His lead at 3.5 V at 1 ms.

basal ventricular capture alone, without His-bundle capture. This would suggest that amiodarone increased both His-bundle and ventricular pacing thresholds or that there is another mechanism that is not understood. In either case, with the emergence of direct His-bundle pacing and its increase in clinical utilization, better understanding of amiodarone and its effect on the His-Purkinje system is needed. Additionally, caution should be exercised when administering amiodarone in patients with direct His-bundle pacing and significant AV block.

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