

# Importance of symptom–rhythm correlation in patients with arrhythmias: lessons for first year medical students in primary care settings

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## Abstract

In primary care settings, cardiac arrhythmias can prove difficult in their diagnosis and management because many patients present with symptoms that are variable, transient, and nonspecific. Developing an approach to the recognition, diagnosis, and management of arrhythmias is an important learning experience for medical students early in their training. In this article, several lessons are highlighted through a case example of a 57-year-old male presenting to their primary care provider with pre-syncopal episodes, shortness of breath, and chest discomfort. The case focuses on the steps in the management of the patient's symptoms in a local emergency department, and eventually in a tertiary care facility where a permanent pacemaker was deemed necessary for symptom resolution. This case emphasizes important lessons for medical students related to the diagnosis and treatment of arrhythmias, which can be in turn, applied to a general approach to all medical conditions.

*Keywords:* cardiology, arrhythmia, primary care

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## Introduction

The diagnosis and management of arrhythmias can be challenging. In general, arrhythmias are defined as any rhythm that is not normal sinus rhythm with normal atrioventricular conduction.<sup>1</sup> They can manifest in various ways, including bradycardic arrhythmias (sinus bradycardia, sinus pause, sinus arrest, sinoatrial nodal exit block, and chronotropic incompetence), tachycardic arrhythmias (atrial fibrillation, atrial flutter, and supraventricular tachycardia), and mixed arrhythmias (tachycardia–bradycardia syndrome). Clinically, patients often present with nonspecific symptoms which may include light-headedness, syncope, palpitations, dyspnea, chest discomfort.<sup>1</sup> Additionally, abnormal electrocardiogram (ECG) tracings are commonly observed. Arrhythmias are often found in older individuals with comorbidities and risk factors such as hypertension, higher body mass index, and prior cardiovascular events. Because symptoms can be variable, nonspecific, and often transient, in a primary care setting it can be difficult to connect the patient's symptoms to a specific rhythm disturbance. The challenge of arrhythmia

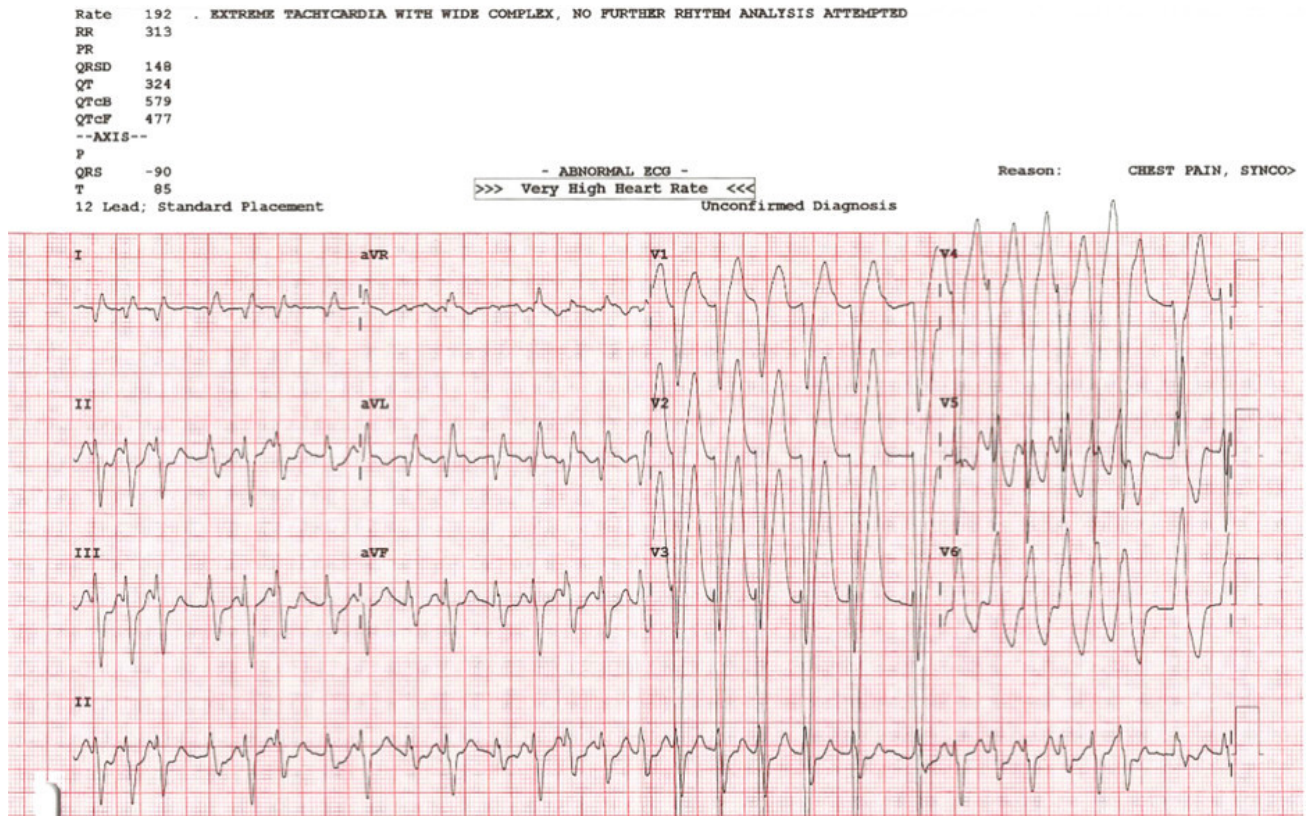
diagnosis and treatment provides an excellent learning opportunity for medical students to gain experience in the process of assessing diseases that can present with non-specific symptoms, correlating patient symptoms with clinical signs, and the careful consideration of initial treatment and management options.

## Case history

The following case is a 57-year-old male with a past medical history of hypertension and gastroesophageal reflux disease that presented to his primary care provider in July 2021 after a presyncopal episode that occurred while he was climbing a ladder. Luckily, he did not lose his balance and was able to safely descend after the episode passed. The patient had a known one-year history of recurrent presyncope that was being actively investigated. During these episodes, the patient would not lose consciousness but experience blurred vision, light-headedness, and occasionally, chest discomfort and dyspnea. He reported that these episodes tended to occur when he was feeling anxious or stressed but were unrelated to exertion.

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**Figure 1.** Initial ECG presenting wide complex tachycardia

Physical exam was unremarkable, including a normal heart rate and blood pressure measured in the primary care clinic, no abnormal heart sounds or murmurs, and no carotid bruit, or focal neurologic signs. However, the patient had also been monitoring his heart rate at home since symptom onset, and the monitor often reported an irregular pulse with bradycardia (typical readings ranging between 30–40 beats per minute [bpm]). These lower readings did not correlate to the patient's episodes of presyncope. Immediately after the pre-syncope episodes, the patient's self-recorded heart rates ranged from 80–90 bpm.

The results of several prior investigations were available. An ECG performed in April 2021 showed left bundle branch block (LBBB). The patient was subsequently referred to a cardiologist and ultimately underwent myocardial perfusion imaging (MPI) to assess for ischemia. MPI showed a fixed perfusion defect in the septum and adjacent segments, normal ejection fraction, mild left ventricular enlargement, and no signs of ischemia. These findings are nonspecific in the context of a LBBB.

The primary care physician referred the patient for a same-day ECG due to the detection of atrial fibrillation using an event recorder (KardiaMobile EKG monitor [AliveCor Inc., San Francisco, CA, USA]) that was applied in the office. The initial ECG report showed a wide complex tachycardia with a ventricular rate of 200 bpm (Figure 1). The patient was sent to the local emergency department where a repeat ECG demonstrated

sinus rhythm with LBBB and heart rate of 42–62 bpm (ECG unavailable). The patient's potassium was found to be elevated at 6.8 mmol/L (normal range: 3.5–5.0 mmol/L), and he was treated for hyperkalemia. After being shifted, he converted to atrial fibrillation at a rate of 123 bpm. He was successfully reverted into sinus bradycardia (29 bpm) after treatment with oral and intravenous metoprolol and diltiazem. At this time, the patient was diagnosed with sinus node dysfunction (SND) with tachycardia.

Due to the difficulties in managing the changes between bradycardia and tachycardia, the patient was transferred to a tertiary care center for further management. He was assessed by an electrophysiology team, and it was determined that a permanent pacemaker (PPM) was needed. The PPM was inserted during the same admission without complications. On follow-up with the primary care provider three weeks later, the patient reported no recurrence of presyncope.

## Discussion

For medical students early in their training, this case highlights the difficulties associated with the diagnosis and management of conditions that present with symptoms that are nonspecific and transient. The first lesson highlighted in this case is the importance of a thorough investigation and workup to rule out life-threatening causes for the patient's presenting symptoms (i.e., for presyncope, myocardial ischemia, or stroke). After im-

mediate life-threatening causes have been ruled out, additional tests can be ordered to further explore the patient's symptoms. In the case example, ECG and MPI investigations were unable to fully explain the patient's symptoms. The inability to correlate patient symptoms with test results highlights the challenges in diagnosing cardiac arrhythmias, which can be transient. Regularly reassessing the patient as new information becomes available is important to arrive at an appropriate diagnosis.

The second lesson highlighted by this case is to consider medication side effects as potential causes of a patient's symptoms. The diagnosis of SND is normally due to age-related loss of sinoatrial node cells and atrial fibrosis;<sup>2</sup> however, it can also result from the use of pharmacological agents. Beta blockers, calcium channel blockers, digoxin, antiarrhythmic medications, and acetylcholinesterase inhibitors used in the treatment of Alzheimer's disease have all been shown to influence heart function.<sup>3</sup> Medical students need to be aware of the common drug interactions which can impact heart function. Early identification of reversible causes of diseases can lead to improved health of patients and there should be a high index of suspicion when addressing difficult diagnoses. The patient in the highlighted case was neither using any prescription medications linked to arrhythmias; however, the use of medications while in the local emergency department to correct the tachycardia may have played a role in the severe bradycardia that the patient experienced after the correction.

The third lesson that is highlighted by this case is the difficulty associated with treating the symptoms of an undiagnosed condition. This is especially difficult in the treatment of arrhythmias because treatment for one condition may make another worse. For example, the patient in the case example presented with alternating tachycardia and bradycardia. The highlighted case, PPM was the definitive treatment for the patient because of an inability to manage the condition with medications in the long-term.<sup>4,5</sup> Making sure to identify situations where typical treatment options might not be beneficial comes with experience, but it is important for medical students to begin to identify these potential situations – and know how to utilize available clinical resources—to develop an appropriate management plan. It is also important to know when to seek the help of subspecialists, or when a patient requires resources only available in a tertiary care setting.

Finally, the fourth lesson that this case highlights is the role of home monitoring equipment. Caution needs to be advised when relying on the accuracy of at home monitoring information as blood pressures and heart rates can vary depending on the time of day, circadian rhythms, and extrinsic factors that depend on the patient and equipment to accurately take the measurement.<sup>6</sup> The patient in the case example monitored their own blood pressure and heart rate at home using a commercial blood pressure monitor when they began experiencing their presyncopal episodes. Although the patient had a past medical history of hypertension, they

had higher systolic blood pressures at home relative to those measured in their primary care clinic. This discrepancy caused the physician to consider a transient arrhythmia and prompted further investigation using as an event recorder. Although regular home monitoring of vitals cannot be relied upon for all patients, having this information available can be used to help provide additional context for health care providers.

## Conclusion

The presented case emphasized the importance of establishing clear symptom–rhythm correlation to provide the proper management of a patient presenting with arrhythmias. First, it is important to rule out immediate life-threatening causes of the arrhythmia. Secondly, to consider the patient's past medical history including the effects of medications to identify any reversible causes of the patient's symptoms. Thirdly, there are difficulties that can come with the management of symptoms without a unifying diagnosis, and it is important to identify these situations while having alternative management strategies available if the initial treatment fails. Finally, incorporating information about a patient's home vital monitoring can be useful to provide hints into the next steps in the investigation. Although this information must be taken in context with the patient's clinical picture, it can provide additional guidance for healthcare providers. These are lessons that can be applied to all clinical encounters.

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