

March 2024

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### Recommended Citation

Nypaver J, Libera R, Kundra A, Choxi R. New Onset Dyspnea in a Patient with Pacemaker, What Does the ECG Tracing Show?. *Transformative Medicine (T-Med)*. 2024; 3(1):20-22. doi: <https://doi.org/10.54299/tmed/uxbt6770>.

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# New Onset Dyspnea in a Patient with Pacemaker, What Does the ECG Tracing Show?

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Published March 2024

**KEYWORDS:** Pacemaker Syndrome, Dual-chamber Pacemaker, Cardiology, ECG Interpretation

## LEARNING OBJECTIVE

Pacemaker syndrome is a complication of dual chamber pacemaker devices which is hallmarked by AV dyssynchrony. It is important to evaluate for AV synchrony if patients have dual chamber pacemaker as lack of AV synchrony can cause pacemaker syndrome.

## CASE

A 69-year-old female with past medical history of 2:1 atrioventricular block status post Medtronic (Minneapolis, Minnesota) dual-chamber pacemaker implant 13 years ago and moderate to severe tricuspid regurgitation presented to the office with complaints of new onset shortness of breath and dyspnea on exertion. The patient is an active individual, and the symptoms started two days prior to the office visit. The patient also reported fluttering in the chest and fatigue. Vital signs demonstrated blood pressure of 100/70 mmHg and heart rate of 65 beats per minute. On physical exam, breath sounds were clear with no crackles or wheezes. Cardiac auscultation revealed normal S1 and S2. Patient was at baseline weight and appeared euvolemic. How would you interpret the patient's electrocardiogram (ECG) (*Figure 1*)?

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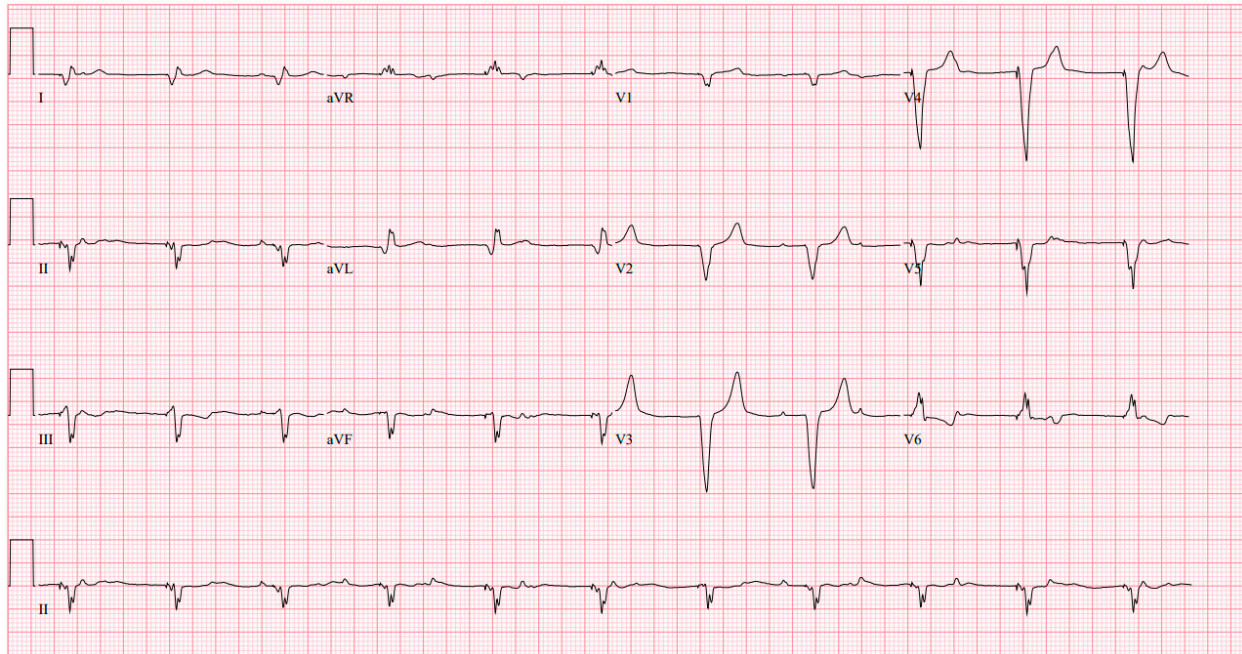
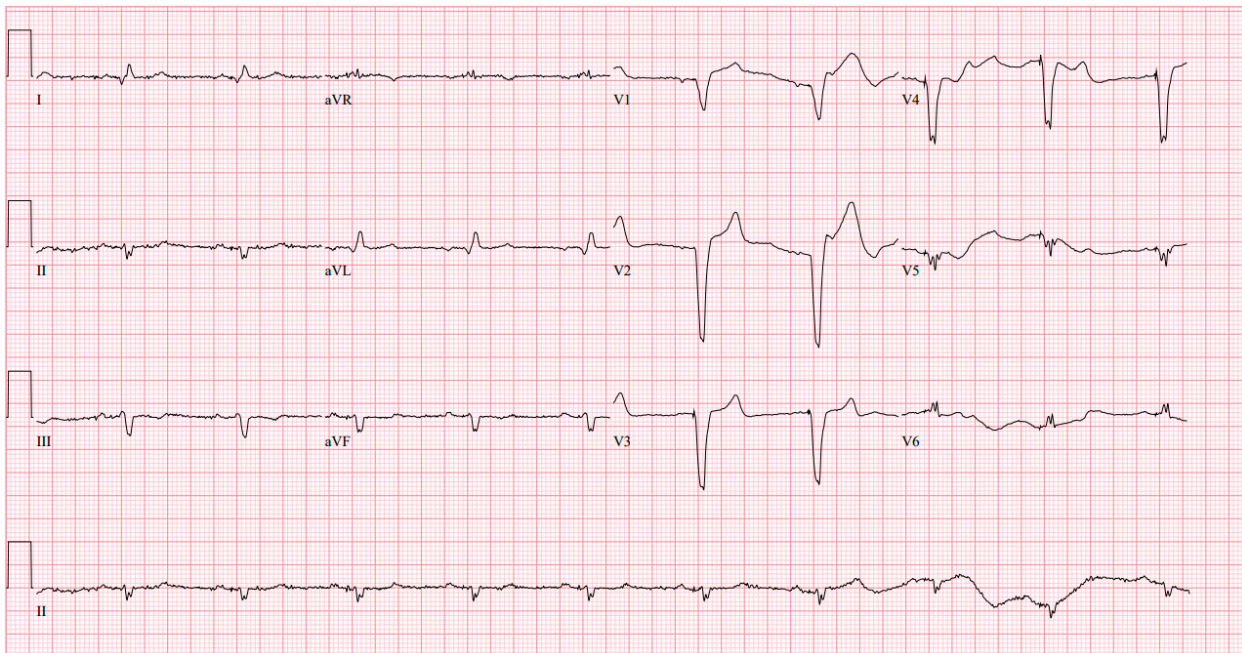
**Disclosure Statement:** The authors have no conflicts of interest to declare.

## ELECTROCARDIOGRAM INTERPRETATION

The ECG shows a ventricular rate of 66 beats per minute. There are pacing spikes prior to each QRS complex indicating ventricular-paced rhythm with left bundle branch morphology. There are identifiable p waves from sinus origin that are completely dissociated from the ventricular paced rhythm with more P waves than QRS complexes. Overall, there is ventricular paced rhythm with AV dissociation.

## DISCUSSION

In a patient with a dual chamber pacemaker, it is always important to understand and identify the presence or absence of AV synchrony. At first glance, the ECG would be interpreted as a ventricular paced rhythm with appropriate capture however on further review, identifying the lack of AV synchrony is paramount. Dual chamber pacemakers are typically programmed to sense the atrial impulse and pace the ventricular in DDD mode if a patient has underlying heart block. This ensures that there is synchrony between the atria and ventricle to optimize stroke volume. In this situation, either there was a problem with the atrial lead preventing adequate sensing of the P wave or the device was programmed in a different mode such as VVI. This tracing was immediately identified as abnormal pacemaker behavior for a typical dual chamber pacemaker and the next step was to perform a device interrogation. The interrogation revealed that the battery life was depleted in the device and in this situation, the atrial lead powers down to maintain battery life to the more important (RV lead). This ensures that there is constant pacing in the RV and prevents asystole. On the other hand, the abrupt termination of the atrial lead produces uncomfortable symptoms consistent with pacemaker syndrome. In pacemaker syndrome, the atria contract against a closed tricuspid valve which can produce significant

**FIGURE 1.** 12-lead electrocardiogram**FIGURE 2.** Post-operative ECG.

discomfort as well as the classic canon A waves on physical exam.

Pacemaker syndrome was first described in 1969<sup>1</sup>, it is a clinical diagnosis hallmarked by loss of AV synchrony and a reduction in stroke volume and cardiac output<sup>2-5</sup>. In the mode selection trial (MOST)<sup>6</sup>, there were a significant number of patients with sick sinus syndrome (SSS) and ventricular pacing that experi-

enced pacemaker syndrome which required cross over to dual chamber device. Pacemaker syndrome arises from mis-timed atrial contractions<sup>7</sup>. These mis-timed contractions lead to decreased cardiac output. Pacemaker syndrome can also occur with single ventricle (RV) pacing with a left bundle branch block, which can lead to mis-timed contractions of the ventricles against the septum. Signs and symptoms of

pacemaker syndrome are related to the hemodynamic compromise as a result of AV dyssynchrony<sup>4</sup> and may include fatigue, dyspnea on exertion, orthopnea, paroxysmal nocturnal dyspnea, peripheral edema, narrow pulse pressure, jugular venous distension, and syncope<sup>2, 3, 5, 8, 9</sup>.

In this case, there was no other identifiable cause for dyspnea on exertion. A high degree of clinical suspicion needs to be maintained for an accurate and timely diagnosis. If left untreated the symptoms can progress to the development of LV dysfunction, RV dysfunction, arrhythmias, and worsening symptoms<sup>10</sup>. Overall pacemaker syndrome carries a good prognosis, and symptoms are easily treated following correction of AV dyssynchrony<sup>5, 7, 10</sup>.

## MANAGEMENT

Four days after the patient was seen in the office the patient underwent a procedure for a pacemaker generator change. The post operative ECG (*Figure 2*) showed an AV dual-paced rhythm. The patients' symptoms resolved after the generator change.

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