

## Much Ado About Nothing – on the Scene of Electrocardiography

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### Abstract

This observation is focused on a challenging electrocardiogram. Interatrial block, first degree atrio-ventricular block, and atrial bigeminy were the main abnormalities on the tracing, that were followed prospectively along a favorable course.

**Keywords:** atrial bigeminy; premature atrial beats; interatrial block; atrio-ventricular block

### Introduction

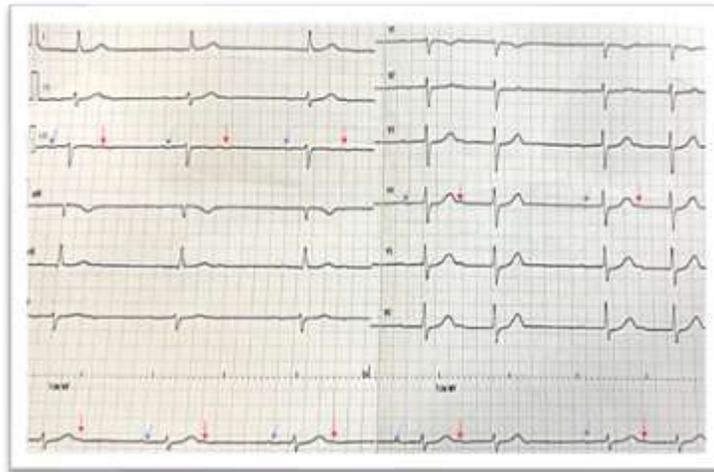
Premature atrial beats (PABs) are very common in the general population, often precipitated by intercurrent illness or stress [1]. On the electrocardiogram (ECG), PABs show as abnormally shaped P waves that occur before the expected normal sinus beat and are followed by a compensatory pause. PABs rarely cause hemodynamic compromise, except when associated with bradycardia [1,2]. In the case to be presented, much apprehension raised from by the patient's severe bradycardia at the time of admission and when the ECG was interpreted as Mobitz 2 atrio-ventricular block.

### Case history

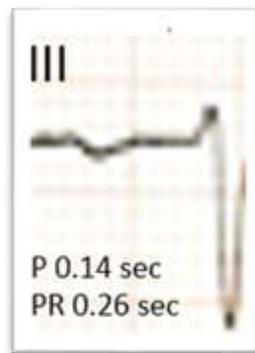
An 84-year-old woman was transferred from the department of medicine for geriatric rehabilitation having recovered from severe pneumonia. On admission to our ward, she was alert and oriented, with no distress. Her body temperature, blood pressure, respiratory rate and oxygen saturation were normal. Her heart rate was 34 beats per minute. Her medications were aspirin 100 mg, lecanidipine 10 mg, bisoprolol fumarate 5 mg, atorvastatin 20 mg, and enoxaparin 40 mg (all medications were once daily). Significant medical

history to be noted was arterial hypertension, chronic renal failure stage 3b, and hypercholesterolemia.

On the admission ECG (**Figure 1**) there was a segment of regular sinus bradycardia 35 bpm followed by a segment with bigeminy. P waves originating in the sinus node had an odd shape (**Figure 2**). The initial component of the P wave was positive in leads II, III and aVF, indicating the vector's orientation about +60 degrees: these features indicate that the waves originate in the sinus node. The terminal, also longer, portion of the P wave was negative in leads II, III, and aVF, exhibiting a change of the atrial depolarization vector, at this time oriented upward. The duration of the P wave was 0.14 sec, while the duration of a normal P wave does not exceed 0.12 sec. Such wide, biphasic P waves, with an initial positive deflection followed by a negative deflection in the inferior leads, are diagnostic of advanced interatrial block. The PR interval was 0.26 that is consistent with first degree atrio-ventricular block.



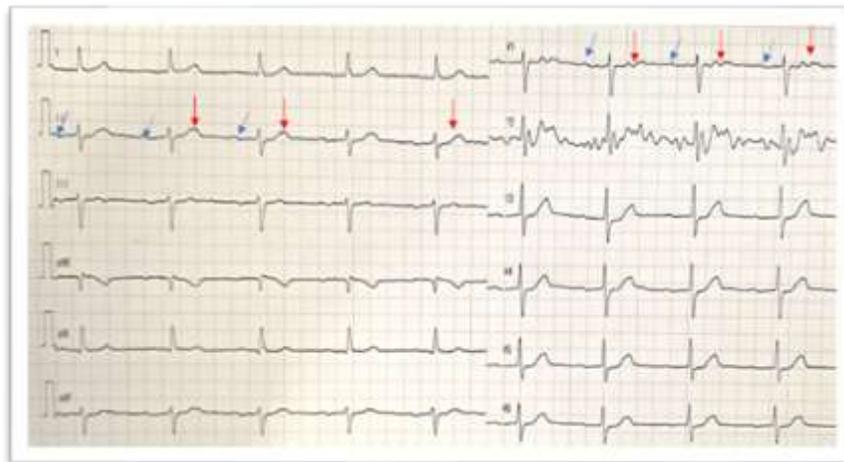
**Figure 1:** The ECG on admission, showing sinus rhythm, interatrial block, first degree atrio-ventricular block, and PABs, some blocked others conducted. Blue arrows point to P waves of sinus origin; red arrows point to PABs.



**Figure 2:** By zooming in on a segment of the tracing in lead III, the features of P waves and the PR interval can be well seen.

P' waves, marked by red arrows, are best appreciated in the continuing recording on the bottom of Figure 1 as well as in lead V4. P' waves arise before the expected sinus beat and differ in morphology from P waves; as such they are PABs. Some of the PABs are blocked in the atrio-ventricular junction and do not elicit ventricular depolarization. The PABs discharge the sinus node, delaying the forthcoming beat, and resulting in sinus bradycardia. Other PABs elicit ventricular depolarization. The conducted PABs like non-conducted PABs discharged the sinus node, resulting in a compensatory pause. The P'R interval was 0.48 seconds consistent with first degree atrio-ventricular block.

In being aware that sinus bradycardia in the patient might be a consequence of beta blocker treatment, bisoprolol was discontinued under hemodynamic and ECG monitoring. During the ensuing days the heart rate increased, and the patient's condition was stable. An ECG recorded on day 4 showed sinus rhythm 60 beats per minute (bpm), advanced interatrial block, first degree atrio-ventricular block, and atrial bigeminy with blocked PABs (**Figure 3**). In the following days the ECG featured variants of the tracing shown in Figure 3, with the heart rate in the range 60-66 bpm.



**Figure 3:** Four days after the ECG in Figure 1 was recorded, the ECG shows sinus rhythm 60 bpm, the interatrial block unchanged, the first degree atrio-ventricular block unchanged, and atrial bigeminy with all PABs blocked.

## Discussion

“Much Ado About Nothing”, is the title of Shakespeare's enjoying play. With certain limitations, “Much Ado About Nothing” can be referenced to the present ECG challenge. Much concern, but with some expertise, a favorable outcome can be anticipated as to features of the ECG: interatrial block, first degree atrio-ventricular block, and atrial bigeminy.

Interatrial block is easily recognized on standard ECG. Under normal sinus rhythm, the conduction from the left to the right atrium ensues usually through Bachmann's bundle, the major interatrial connection; depolarization of both atria follows a downward direction. With complete block of Bachman's bundle, the left atrium is depolarized late, after the right atrial impulse has reached the atrio-ventricular junction, then the depolarization moves upward through the left atrium. Consequently, the P waves in inferior leads are biphasic: positive at the beginning and negative at termination [3]. Bayés de Luna et al. classified interatrial blocks as partial or advanced. Partial interatrial blocks are characterized by monophasic wide P waves that equal or exceed 120 msec. Advanced interatrial blocks are recognized as biphasic P waves in inferior leads, positive at the beginning and negative at termination, their duration being  $\geq 120$ ms [4]. Advanced interatrial block is a common occurrence, found in about 10% of young adults. The interatrial block may be an isolated defect without background cardiac abnormality, but often it is associated with left atrial enlargement. Interatrial blocks are independent predictors of supraventricular arrhythmias [3]. In the present case, interatrial block was concurrent with PABs and first degree atrio-ventricular block.

Atrial PABs in the patient occurred in fixed coupling with sinus rhythm, i.e., atrial bigeminy [1]. At first impression, atrial bigeminy in our patient was confused with Mobitz type 2 atrio-ventricular block, to which it may vaguely resemble. However, the clinical implication of the two conditions is very different, and the two conditions should not be confused with each other. The pathology of Mobitz type 2 atrio-ventricular block is usually infranodal and there is a significant risk for progression to third-degree atrio-ventricular block [1]. At a difference, atrial bigeminy is usually caused by reentry in a small area of an atrium [5]. Atrial bigeminy may occur in people with normal hearts or with any type of organic heart disease. Atrial bigeminy rarely causes hemodynamic compromise, except when causing severe bradycardia

[6]. Yet, atrial bigeminy sometime anticipates occurrence of atrial fibrillation [7]. There are features in the ECG allowing them to distinguish between the two conditions. With Mobitz type 2 atrio-ventricular block, the conducted as well as uncondacted P waves are identical, and PP' intervals are equal with P'P intervals. With atrial bigeminy, P wave morphology and P' morphology differ, and PP' intervals are unequal with P'P intervals.

Treatment of symptomatic PABs makes use of beta blockers if not otherwise contraindicated. In the present case, discontinuation of beta blocker was helpful, in disinhibiting the sinus node, yet, without interfering with atrial ectopy. In conclusion, attention to detail in the interpretation of the ECG was important by rejecting the first, erroneous diagnosis, and in predicting a favorable outcome.

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