Challenges in Clinical Electrocardiography

An Elderly Woman With a Pause—Never Miss a Beat

Ahlam A. Al Awadhi, MBBS; Omar Al Falasi, MBBS, MD; Moutaz El Kadri, MD, MSc, PhD

A woman in her 80s was admitted to a telemetry-monitored bed after sustaining a mechanical fall. She had no relevant medical history. The rhythm strip shown in **Figure 1** was recorded on telemetry during the night. The patient reported no symptoms during these episodes because she was asleep. Similar traces were recorded several times during the night.

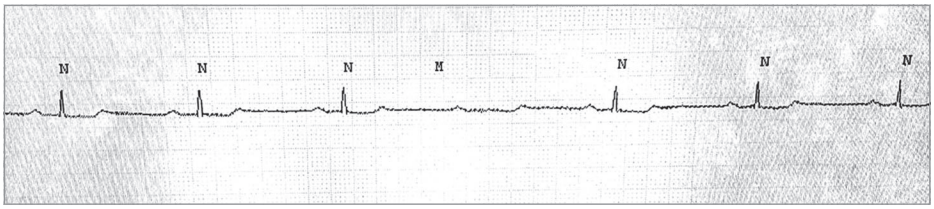
Question: What is the most likely explanation for the missed beat?

Interpretation

The rhythm strip showed sinus rhythm with a pause owing to an apparent absence of the QRS complex after the fourth P wave. This raises the possibility of intermittent Mobitz II atrioventricular (AV) block. However, another low-amplitude, positive deflection could be seen about 500 ms after the fourth P wave. While this could be a blocked premature atrial contraction (PAC), this is unlikely. First, a PAC is likely to reset the sinoatrial (SA) node and perturb the timing of next sinus P wave, which did not happen in this case. Second, although not impossible, it is too much of a coincidence that these PACs occurred only after the apparent AV block on every trace recorded. From a mechanistic point of view, an atrial automatic focus should not be affected or linked to the previous P wave passing through the AV node.

The correct diagnosis could be reached by carefully measuring the P-P and T-T intervals on the trace (**Figure 2**A). This clearly shows that while the first positive deflection at the area of interest was a P wave, the second one was in fact a T wave. The presence of a T wave

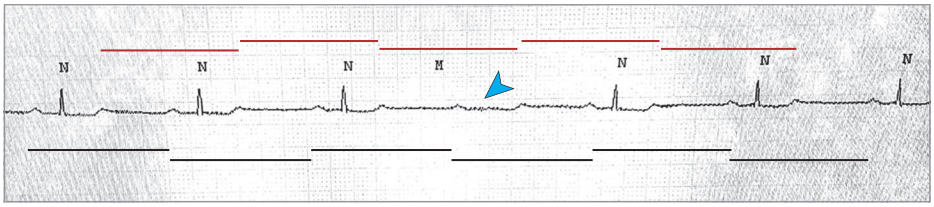
Figure 1. Telemetric Findings



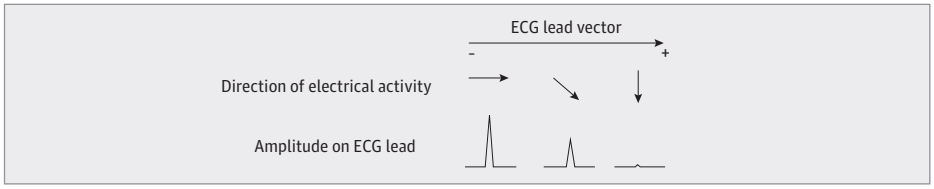
Telemetric findings show a missed QRS complex.

Figure 2. Telemetric and Electrocardiographic Findings

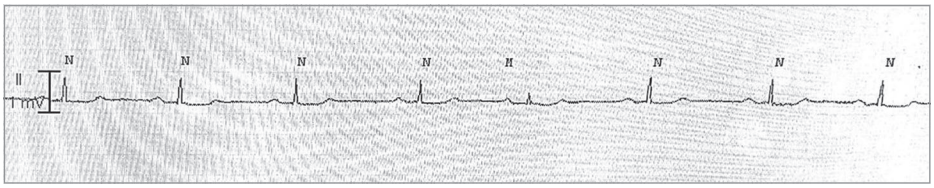
A Telemetry recording with intervals marked



B Relationship between electrical activity direction and wave amplitude



C Telemetry recording showing transient change in QRS amplitude



A, Telemetric recording with intervals marked. The black bars indicate P-P intervals; the red bars show T-T intervals; the blue arrow shows the site of the artifact. B, the relationship between electrical activity direction and wave amplitude on a bipolar electrocardiogram (ECG) electrode. C, Another telemetry recording from the same patient at a different time showing transient change in QRS amplitude.

implies ventricular repolarization, which can only happen after the ventricle has depolarized. Therefore, the only plausible explanation in this case is that the apparent pause was owing to an artifact caused by an isoelectric QRS complex in this lead. A transient change in QRS axis (for example due to fascicular block) could make the vector of ventricular depolarization perpendicular to the axis of the lead, thereby significantly reducing the amplitude of the QRS complex.

Clinical Course

Careful analysis of ECG trace established that the correct diagnosis was artifact and not Mobitz II AV block. A detailed clinical history also clearly documented a mechanical cause (patient tripped). The patient was therefore treated conservatively from a cardiac point of view.

Discussion

The axis and amplitude of the waves displayed on an electrocardiogram (ECG) lead depends on the relationship between the wavefront direction and the axis of the bipolar electrode. If the propagation of the wave is parallel to the lead and toward the positive pole, the electrical activity will be displayed as positive deflection with maximal amplitude. On the other hand, if the propagation of depolarization is perpendicular to the lead, there will be minimal deflection as demonstrated in Figure 2B.[1]

Causes of sudden change in QRS axis could be related to alteration of the heart orientation in the chest owing to respiratory variation or changes in body position.[2,3] However, it is unlikely in this case, as the shape of the P and T waves remains unchanged. A more plausible explanation is the development of transient fascicular block leading to a sudden shift in QRS axis.

It is important to display multiple simultaneous ECG leads whenever possible on the telemetry system to avoid a similar scenario. The QRS is unlikely to remain invisible on more than 1 lead because they have different axes. If the telemetry system setup does not allow for more than 1 ECG channel (as in this case), scrutinizing telemetry recordings at other times is key to reaching the diagnosis (Figure 2C).

Take-Home Points

- Change in QRS axis can be transient.
- Mapping cardiac intervals such as P waves, QRS complexes, and even T waves, can significantly aid in establishing the correct diagnosis.
- The relationship between the QRS axis and ECG lead vector determines the amplitude of a QRS in any given lead.
- Artifacts on ECG traces can easily mimic real conditions. Displaying several ECG leads simultaneously is paramount to reduce this risk.

ARTICLE INFORMATION

Published Online: December 21, 2020. doi:10.1001/jamainternmed.2020.7064

Conflict of Interest Disclosures: None reported.

Author Affiliations: Institute of Cardiac Sciences, Sheikh Khalifa Medical City, Abu Dhabi, United Arab Emirates.

Corresponding Author: Ahlam A. Al Awadhi, MBBS, Institute of Cardiac Sciences, Sheikh Khalifa Medical City, PO Box 51900, Abu Dhabi, United Arab Emirates (dr.alawadhiahlam33@gmail.com).

REFERENCES

1. Petty BG. *Basic Electrocardiography*. Springer-Verlag New York; 2016.doi:10.1007/978-1-4939-2413-4

2. Carey MG, Al-Zaiti SS, Kozik TM, Schell-Chaple H, Pelter MM. QRS amplitude variation during monitoring. *Am J Crit Care*. 2016;25(1):97-98. doi:10.4037/ajcc2016791

3. Supreet K, Anuj C. Effect of change in body position on resting electrocardiogram in young healthy adults. *Nig J Cardiol* 2016; 13(2):125-129. doi:10.4103/0189-7969.187711