

Something Is Not Quite RIGHT on This ECG... But What Is It?

Discussion

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Male

Vent. rate	72 bpm
PR interval	144 ms
QRS duration	84 ms
QT/QTc	398/435 ms
P-R-T axes	51 0 19

Sinus rhythm with premature atrial complexes
Otherwise normal ECG

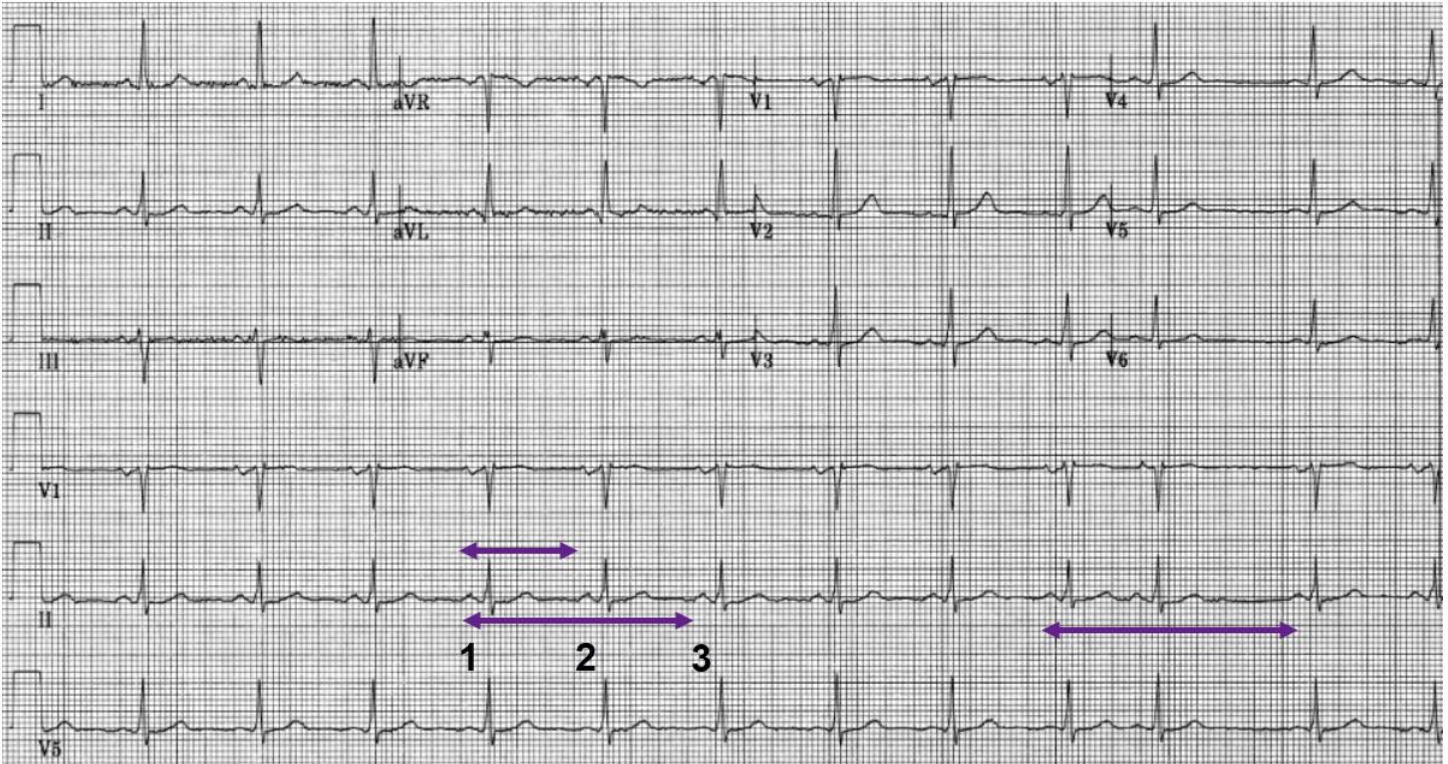


Figure 1

This is a normal appearing ECG except for the fact that there is a single premature atrial complex present toward the end. That's not too unusual... normally. But there is something unusual about THIS ectopic beat!

Most – but not all – premature ectopic beats are followed by a **post-ectopic pause**. Post-ectopic pauses are divided into *compensatory* and *non-compensatory*. Why do we do that? What does it mean? Who cares?

The terms *compensatory* and *non-compensatory* indicate whether the dominant pacemaker was interrupted and reset – or not! If compensatory, the pause indicates that the pacemaker (in *this* case, the sinus node) was not affected – it was not reset. If the pause is non-compensatory, the pacemaker (sinus node) was breached and reset.

So what constitutes a compensatory pause. Because the sinus node was NOT reset, the sinus node continues to produce P waves right on time. If the premature ectopic beat happens to be a large, bizarre-looking PVC, then one of the P waves may be hidden by that

deflection – but the sinus rhythm continues unaffected by the ectopic beat and all the remaining P waves will appear exactly on time. There is no interruption of the sinus rhythm.

However, if the premature ectopic beat *does* succeed in entering the sinus node, thus resetting it, there will be an interruption of the sinus rhythm detectible between the last P wave *before the ectopic beat* and the first P wave *after the post-ectopic pause*.

How do you decide? By measuring P-P intervals! **Do NOT measure from R wave to R wave!** That is totally incorrect! I've seen this presented on multiple websites and in printed articles but that is totally wrong!

If the duration from the onset of the last P wave BEFORE the premature ectopic beat to the first P wave AFTER the post-ectopic pause is EQUAL (or very nearly equal) to two normal P-P intervals (measured BEFORE the ectopic beat), then there was no interruption in the sinus rhythm and the pause is *compensatory*. But if the duration is LESS THAN two normal P-P intervals, then the pause is *non-compensatory* and the sinus node was breached and reset.

Somewhat infrequently, the ectopic beat appears between two P waves *without* interrupting the sinus rhythm. That is called an *interpolated* beat. You may encounter one occasionally, but it won't be very often.

Another warning, there is some more misinformation circulating on the web that PACs always result in non-compensatory pauses and PVCs always result in compensatory pauses. That is pure BS! Either ectopic can result in either type of pause.

OK... let's measure two normal P-P intervals before the ectopic beat (I've done that for you between numbers 1 and 3). Using calipers, see how that compares with the arrow between the P wave before the ectopic beat and the P wave after the ectopic pause.

Well, it's not the same length (or duration) so it can't be a compensatory pause. But if it were a non-compensatory pause, the duration would be LESS than two normal P-P intervals. But it's not THAT, either! The duration is LONGER than two P-P intervals! What is THAT called?

It's called a *non-compensatory pause*! Yes! Whether the duration is shorter OR longer than two normal P-P intervals – it is still called a *non-compensatory pause*. How does that happen? Let's look at how compensatory and non-compensatory pauses develop...

If the ectopic beat fails to have any effect on the sinus node, the sinus node continues to produce P waves right on time and without any disruption of the sinus rhythm or rate. Thus, the duration from the last P wave BEFORE the ectopic beat to the P wave AFTER the ectopic pause will *always* be TWO normal P-P intervals. It's as though the ectopic beat was never there. The pause is *compensatory*.

But if the ectopic beat does enter and reset the sinus node, the sinus node is discharged back to its resting membrane potential before the Phase 4 spontaneous depolarization. Thus the post-ectopic pause will be equal to the duration between the last P wave before the ectopic beat to the ectopic beat itself PLUS one normal P-P interval that occurred AFTER the sinus node was reset. So a non-compensatory pause will consist of a normal P-P interval plus a shorter interval from normal P wave to the ectopic beat. That is why non-compensatory pauses are USUALLY shorter than two normal P-P intervals.

But... sometimes, when the sinus node is reset, it is reset to a membrane potential far more negative than its usual resting membrane potential. Thus, during recovery, the sinus node must depolarize from a more negative membrane potential and this will take longer. In such cases, the non-compensatory pause – which is still *due to a resetting of the sinus node* – may take LONGER than two normal P-P intervals.

Three concepts to remember here:

1. Post-ectopic pauses are always measured from P wave to P wave. They are *never* measured using the R waves when the sinus node is involved.
2. PVCs and PACs are BOTH capable of producing compensatory AND non-compensatory pauses. The type of pause cannot be used to distinguish one ectopic beat from the other.
3. Compensatory pauses are EQUAL to two normal P-P intervals. Non-compensatory pauses are NOT equal to two normal P-P intervals – but they can be either *shorter* (typical) or *longer* (infrequent).