

Pauses, Interpolations and Definitions... *Oh My!*

One of the questions that pops up in my classes quite often is “What is the difference between *compensatory pauses*, *non-compensatory pauses* and *interpolated PVCs*. And that is a very good question indeed!

First, as I mentioned in an article I wrote for *EPLab Digest*, “it’s all about the P waves!” Too many people have the idea that one measures from QRS complex to QRS complex to determine these pauses or phenomena. That is *completely* wrong! You can find this *misinformation* in various articles explaining “How to Read an ECG” and even on some very popular ECG websites. Compensatory pauses, non-compensatory pauses and interpolation of ectopic beats are ALL ***based on the effect the ectopic beat had on the sinus node***. You remember – the node that produces... **P WAVES!**

Before we begin, a definition and an explanation: For these phenomena, we are **measuring from the conducted sinus P wave that appears just BEFORE the ectopic beat to the first conducted sinus P wave AFTER the ectopic beat**. In all my reading and research, I have seen this interval *described* many, many times – but I have *never seen an official term* for it. It needs one since it is referenced so frequently. I have taken the liberty – *in my teaching and writings* – to refer to it as the ***INCLUSIVE INTERVAL***. I will do so in this article as well.

Of the three interruptions of the rhythm by ectopic beats (compensatory pause, non-compensatory pause and interpolated beat), only ONE has any effect on the sinus node – the *non-compensatory pause*.

Ectopic Beat with Compensatory Pause: The ectopic beat causes a P wave to either *fail to appear* (**PAC**) or *fail to conduct* (**PVC**), but the sinus node itself is never affected. The pause *compensates* for the interruption of the sinus rhythm (for one beat) and thus it is called a *compensatory* pause. Since the firing of the sinus node is never affected, the *inclusive interval* is always equal to TWO regular P-P intervals.

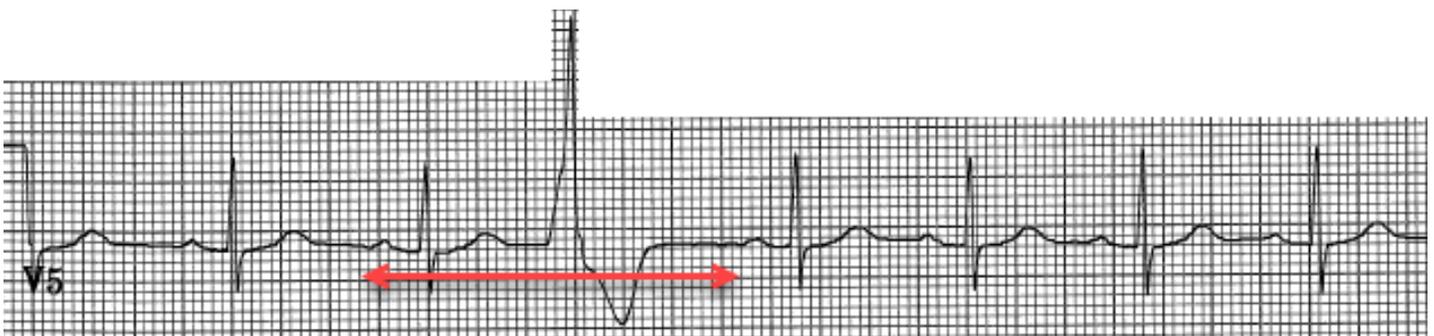


Figure 1 – PVC with Compensatory Pause



Figure 2 – PAC with Compensatory Pause

Ectopic Beat with Non-Compensatory Pause: The ectopic beat manages to enter the sinus node and reset it. “Reset” means it discharges the sinus node at whatever point it is in its spontaneous depolarization (you can’t see any evidence of this because all the surrounding myocardium is refractory), and then the sinus node begins – once again – its spontaneous Phase 4 depolarization. When it reaches threshold, it fires and produces a sinus P wave. This cycle length is typically the same interval as the P-P intervals BEFORE the ectopic beat. So, what does the *inclusive interval* consist of? It is comprised of the interval from the sinus P wave to the point at which the ectopic beat reset the sinus node, PLUS one regular P-P interval. **The ectopic beat appeared early, so we know the interval from the first sinus P wave to the reset of the sinus node is going to be LESS than one regular P-P interval.** Make sure you understand this before going any further. OK... so we have one short interval PLUS a regular P-P interval. That is going to produce an *inclusive interval* that is *longer* than ONE regular P-P interval... but *shorter* than TWO regular P-P intervals. When the *inclusive interval* is longer than one P-P interval, but shorter than TWO P-P intervals – that is typical for a *non-compensatory pause*. (A non-compensatory pause can also be *longer* than two regular P-P intervals, but that’s for another post.)

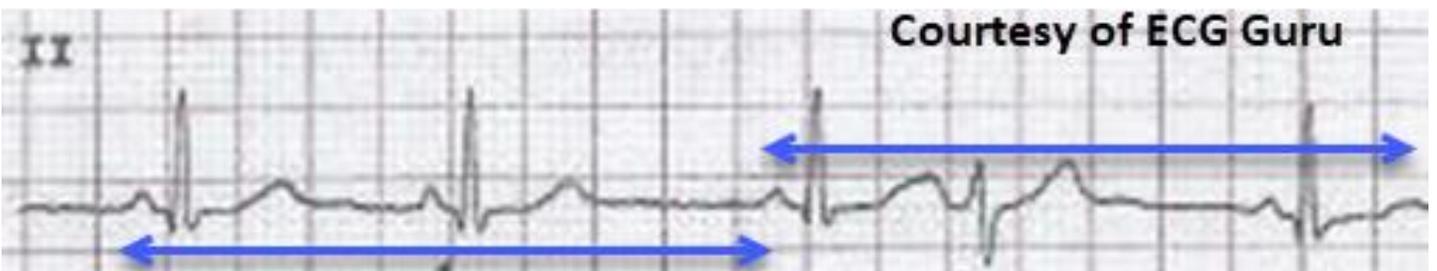


Figure 3 – PAC with Non-Compensatory Pause (Inclusive Interval < 2 regular P-P intervals)

Ectopic Beat with an Inclusive Interval EQUAL to One P-P Interval (Interpolation): The ectopic impulse appears early enough that the next sinus P wave is *neither hidden nor blocked*, but does appear on the ECG tracing and also *succeeds in conducting to the ventricles*. This is where one could get into problems if measuring the R-R intervals. When an ectopic beat is **interpolated**, the following P wave appears right on time (exactly ONE P-P interval), but... its PR interval is usually significantly *prolonged*. That causes the QRS to appear *later* than anticipated. In Figure 4, note that the two P-P intervals (red arrows) are the *same* while the two R-R intervals (blue arrows) are *not*! **Do not measure R-R intervals in determining these pauses!**

Just remember: none of the aforementioned phenomena have anything to do with the ventricles – “it’s all about the P waves!”

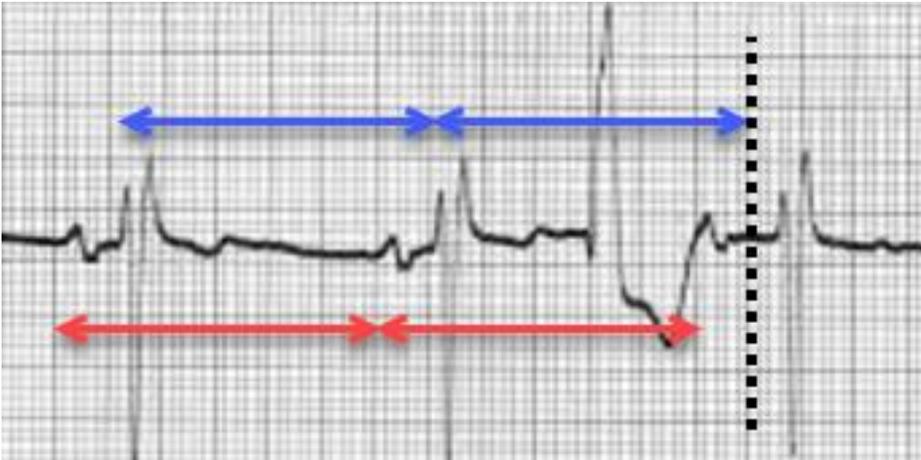


Figure 4 – Interpolated PVC

So, in a “nutshell:”

Compensatory Pause – 2 regular P-P intervals

Non-Compensatory Pause – 1+ regular P-P interval

Interpolated Ectopic Beat – 1 regular P-P interval

Now, for those *medical, nursing* and *PA students* that need a little clarification (I *really* enjoy this because I always enjoyed teaching as an attending):

Review of Systems

Here, you are looking for **SYMPTOMS**: cough, fever, diarrhea, weakness, depression. How far back, you ask? I would say one to two months – no more. However, more serious symptoms should be followed up with a more specific inquiry about the duration. If the patient says she’s been having black, tarry stools – you will *definitely* want to know *exactly* when that began. Just remember **SY**stems and **SY**mptoms.

Past Medical History

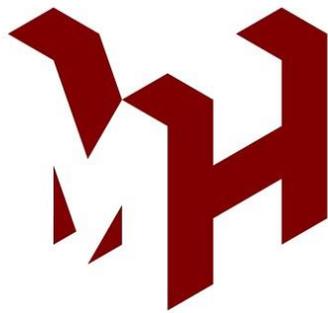
Here you are looking for a **SPECIFIC ILLNESS, TRAUMA, MEDICAL or SURGICAL PROCEDURE, or an INCIDENT** that may have had a direct impact on the patient’s well-being: pneumonia, rheumatoid arthritis, appendectomy, broken hip, cardiac cath with PTCA, colonoscopy, sexual assault, etc. Don’t forget about mental illness. It’s not enough to ask if a patient has *considered* suicide. Ask questions *about what may lead up to someone wanting to harm themselves* (or someone else). Some of this may sound more like “social history” but it’s much more important. Was the patient ever bullied in school, by a sibling or parent, by a spouse, for instance? Was there ever a sexual assault? PTSD? Loss of a loved one?

One more thing that I would have taught you had you been one of *my* students or residents when I was an attending physician... when you ask a *sensitive* question, ***ask it clearly and maintain eye contact with the patient throughout the question; then give the patient time to think about his/her response before answering.*** Asking a sensitive question in a hurried manner with your face buried in a laptop in order to avoid eye contact tells the patient you *don't want to hear a positive response* and/or that you *couldn't care less* about what the response would be anyway. ***Maintaining eye contact tells the patient your concern is genuine, their response matters and it will be taken seriously!***

For those of you who were having some confusion over pauses – I hope this has helped.

For you medicine, nursing and PA students – I hope my distinction between ROS and PMH has also helped.

To learn more about my ECG classes, visit my website: <https://medicusofhouston.com>



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