What Is YOUR Diagnosis?
Discussion

Jerry W. Jones, MD FACEP FAAEM

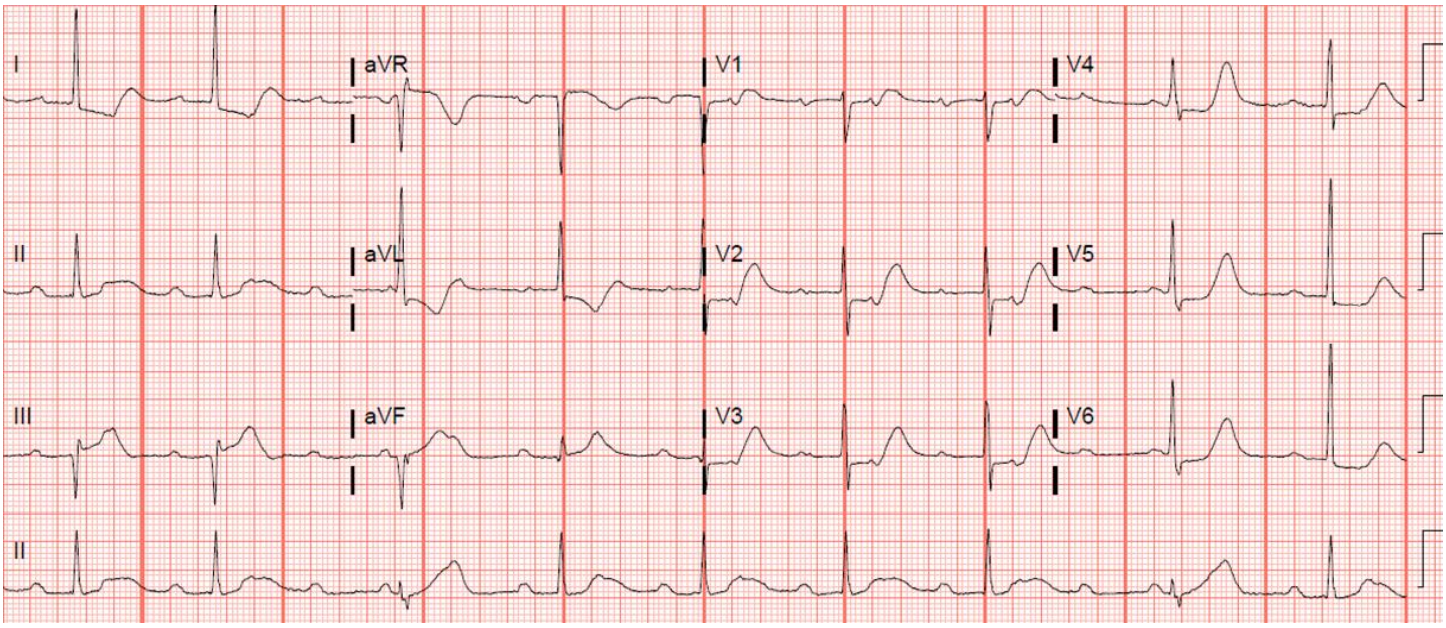

Figure 1

There's a lot going on with this ECG.

First, what is the rhythm? Careful! You are actually looking at TWO ECGs here – an atrial ECG and a ventricular ECG. Unfortunately, the two ECGs are superimposed on each other. When you are dealing with a dysrhythmia and someone asks, "What is the rhythm?" – assume they are asking a trick question. Respond with, "Which rhythm – the atrial rhythm or the ventricular rhythm?"

The P waves are upright in both Leads I and II and Lead II has the largest P waves. The P wave in Lead V1 is a positive/negative biphasic deflection which is what we expect. The atrial rhythm is sinus.

OK… so the atrial rhythm is sinus – what is the sinus *rate*? Kudos if you noticed that many of the T waves look rather odd! That's because there are P waves hidden in those T waves. Actually, there are P waves hidden in ALL the T waves, but some T waves do a better job of hiding the P waves than others. The true sinus rate is easy to see in Lead V1. By measuring the P-P interval in Lead V1, we learn that the first "bump" in the large, wide T waves are really P waves. The cycle length of the sinus rhythm is approximately 250 msec which

makes the sinus rate around 120 beats/minute or so (we don't have to be perfectly exact for this).

OK, we have a sinus rhythm with a rate of around 120 beats/minute. What is driving the *ventricular rhythm?*

All the QRS complexes are very narrow and very well-formed. That indicates that the source of the ventricular rhythm must be located *above* the division of the bundle of His into the right and left bundle branches. Therefore, we must be dealing with a *junctional rhythm*. The junctional pacemaker is firing right at 60 beats/minute. This is the upper limit for a *junctional escape rhythm*. Above 60 beats/minute is considered an *accelerated junctional rhythm* which is very *abnormal*.

What we are seeing is a junctional parasystolic rhythm. Its pacemaker is independent of the sinus node. And the parasystolic pacemaker – or *focus* – is protected from interference caused by the sinus rhythm due to an entrance block." Parasystolic rhythms create, of course, *AV dissociation*. And occasionally they produce *fusion beats*. Do you see any fusion beats on this ECG? How about the third QRS in the Lead II rhythm strip at the bottom of the ECG? Could that be a fusion beat?

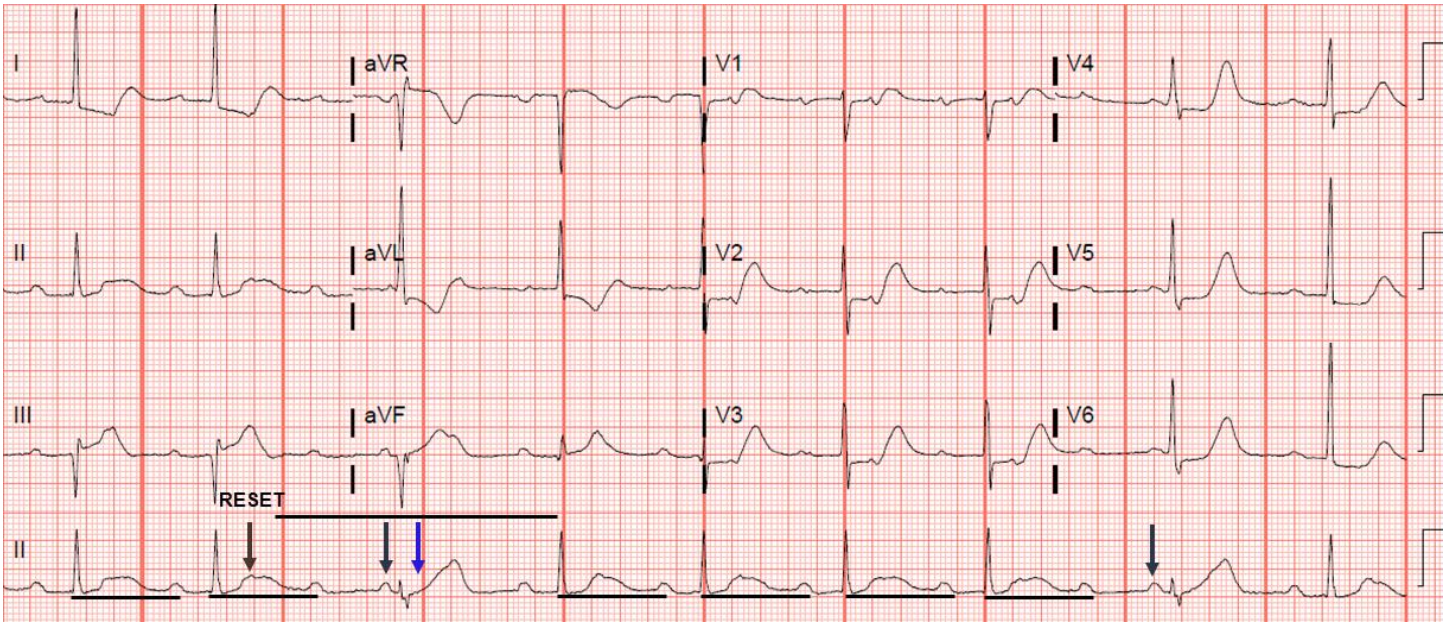

Figure 2

No. It isn't a *fusion beat*. It's a sinus *capture beat*. But this isn't like the capture beats we see in a ventricular tachycardia, for instance. Those capture beats always appear earlier than the dominant rhythm. This one appears later… *or does it?*

This next part is for the ADVANCED to EXPERT-LEVEL ECG nerds.

Obviously, the sinus P waves do not appear to be successful in entering the ventricles. Why is that? Is the block occurring in the AV node, or lower down in the His bundle (i.e., the junctional area)?

In Figure 2 I've drawn some horizontal lines BELOW THE BASELINE of the Lead II rhythm strip representing a *presumed refractory period* of the area of the junctional ectopic focus. Any sinus P wave appearing during that refractory period is not going to conduct through the junctional area. The block is probably *not* in the AV node – but that *is* a possibility. Realistically, the presumed refractory period lines should start about 2 or 3 small squares in front of the QRS complex (which consists of a monophasic R wave) since the QRS is a *product* of the firing of the junctional ectopic pacemaker – not the actual firing of the pacemaker focus itself. Frankly, it was just too tedious trying to draw it that way.

How could the block be in the AV node when the junctional pacemaker is *below* the AV node? Remember: an ectopic junctional pacemaker sends an impulse *down to the ventricles* and another impulse *up to the atria*. We usually do not see the retrograde P' wave because it occurs simultaneously with ventricular depolarization or it is blocked in the AV node. Even if it is blocked in the AV node, it will leave the AV node refractory and subsequent sinus P waves may not be able to pass through.

But this leads us to another problem: even if the P waves are blocked, why doesn't a junctional QRS appear on time? The blue arrow indicates where there *should* be a junctional QRS complex based on the previous junctional rhythm – but there is none! What happened?

For the answer to that, we must back up a bit to our definition of *parasystole*. I told you that parasystole involves a pacemaker that is firing independently of the sinus node. That is true! I told you that parasystole results in AV dissociation (when the second pacemaker is below the AV node). That is true! And I told you that the parasystolic pacemaker is protected from interference by the sinus rhythm due to an entrance block. That is… not exactly *always* true. The parasystolic focus *can* be breached by the dominant pacemaker (in this case, the sinus node impulses) and blocked and/or reset.

The first downward arrow you see is indicating the sinus P wave that entered the ectopic junctional pacemaker and reset it. Therefore, the next expected junctional QRS does not appear on time, i.e., in rhythm with the previous junctional QRS complexes. Again, the downward blue arrow is showing you where it should have appeared – but didn't. It should have appeared there *even after having been reset – but it didn't!* Why?

It fired on-time but it couldn't manifest because a sinus P wave that fell entriely outside the refractory period of the junctional ectopic pacemaker managed to conduct through to

the ventricle leaving the tissue surrounding the ectopic junctional focus too refractory for the junctional beat to exit its focus. However, the next junctional QRS appears right on time (following the reset). So the capture beat in this case actually *did* appear *before* the next expected junctional QRS!

PEARL | When an independent pacemaker focus suddenly fails to manifest a deflection (in most cases a QRS) on time, there are two things to consider:

1. A Mobitz I or Mobitz II exit block from the ectopic pacemaker focus, or
2. The pacemaker focus was entered by the sinus impulse which reset it.

Want to learn more about advanced ECG interpretation? Then come join us in one of my Masterclasses!