What Do YOU See in This ECG? – My Comments.

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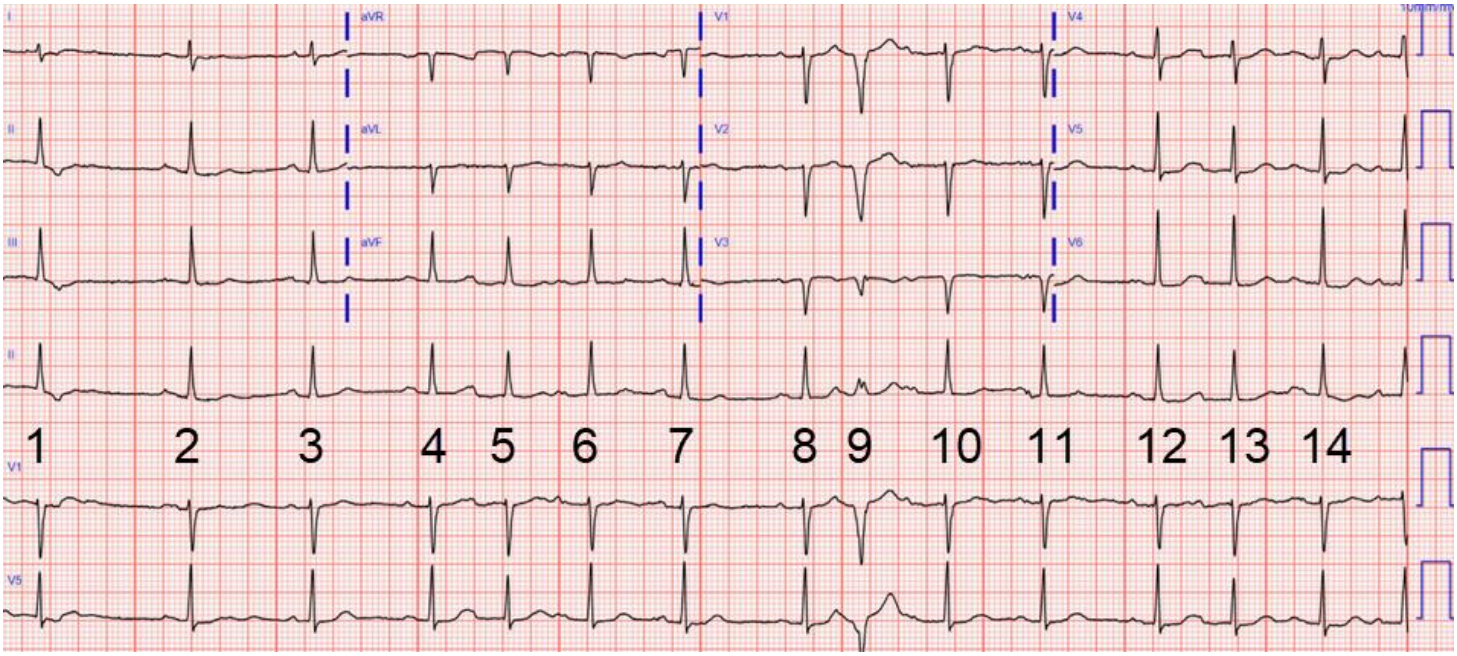

The first thing we do when we interpret an ECG (after assuring ourselves that there is nothing imminently lethal present on the ECG) is to determine the rhythm. OK… we've already encountered our first problem. Why is the rhythm so irregular? All the QRS complexes are narrow except for QRS #9. The first things one would consider are AV blocks – either Mobitz I or Mobitz II. No, it's not either of those. Sinus arrhythmia? No, there are different PR intervals (but none in a Mobitz I pattern). How about multiple PACs? I think that's getting close, but there is something unusual about those PACs – have you noticed? Looking at the Lead II rhythm strip, I can count at least 4 different P wave morphologies as well as the aforementioned difference in PR intervals. There's also a P wave in front of every QRS but the P-P intervals vary considerably – and not in any particular pattern. This rhythm is due to a *wandering atrial pacemaker!*

Look at the 4th beat in the Lead V5 rhythm strip at the bottom of the ECG. Compare its T wave with all the other T waves. It matches only one other – the T wave following the 12th beat. There are P waves hidden in those two T waves. Now notice the QRS complex that follows beats 4 and 12 – they are smaller than the other T waves. That's likely because the preceding PR interval is a bit longer, thus giving the bundle branches more time to recover. Why is the QRS smaller after the brief delay? I'm not sure, but with both bundle branches rested and ready to activate, perhaps there is more simultaneous depolarization leading to more cancellation of forces and, consequently, a smaller deflection.

Is beat #9 a PVC or an aberrantly-conducted PAC? Look at the preceding T wave and compare it to the T wave of beats #10 or #11 (look at the V1 rhythm strip, 3rd from the bottom). There is a P wave hidden in there that managed to conduct but found the left bundle branch still in at least a relatively refractory state. Now this is a teachable moment because how often do you see LBBB aberrancy following a PAC? It is rare and usually occurs in the presence of heart disease – either old scarring by a previous MI, increased fibrosis due to cardiomyopathy, left ventricular hypertrophy or simply fibrosis due to age.

The P wave following the wide QRS of beat #9 has a long PR interval. This delay likely occurred in the AV node and not the bundle branches. How do we know that? Because the previous P wave encountered refractoriness in the left bundle branch – yet there is no sign of refractoriness or aberrant conduction in QRS #10. That's because the delay in the AV node (with a much wider PR interval) allowed the bundle branches sufficient time to recover. There's even a name for this: the *gap phenomenon*.

This part is for the advanced nerds…

In this case the functional refractory period of the AV node is shorter than the effective refractory period of the bundle branches (or at least the left bundle branch). This allows an impulse to cross through the AV node before the bundle branches have had adequate time for recovery (i.e., they are still within their effective refractory period or very early relative refractory period). But as the impulse becomes more and more premature, what usually occurs is that although the impulse is still in the relative refractory period of the AV node, it is moving further in so that impulses with the same strength conduct with less velocity – thus prolonging the PR interval. That prolongation gives the bundle branches the time needed to recover.

PEARL…

The **effective refractory period** (ERP) and the **absolute refractory period** (ARP) are essentially the same. However… the **functional refractory period** (FRP) and the **relative refractory period** (RRP) are NOT at all the same, nor are they even similar! Look in "Dr. Jones's ECG Blog" on this website for a thorough discussion of **effective** and **functional refractory periods** as opposed to **absolute** and **relative refractory periods**. Just hover the cursor over "HOME" in the navigation bar and a submenu will appear. Click on "Dr. Jones's ECG Blog."