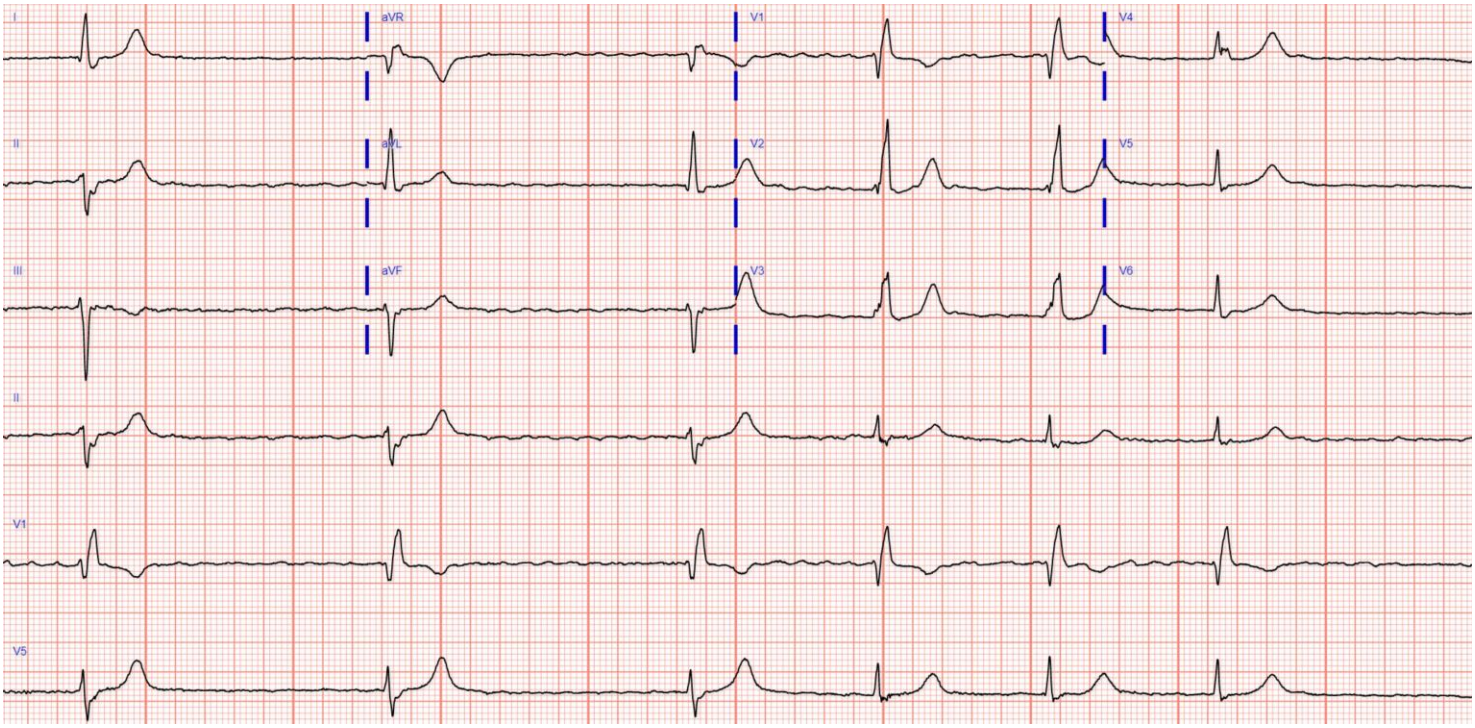
What Is This Rhythm? - Discussion

Jerry W. Jones, MD FACEP FAAEM



There are multiple problems on this ECG that have combined to result in this rhythm. That's what a *complex dysrhythmia* is – a combination of blocks and rhythm disturbances!

So, what do you notice about this ECG? And note that – because this is a *rhythm problem* – we are interpreting a *12-lead ECG* and NOT only a *rhythm strip!*

Where are the P waves? There are none. What produces a rhythm without visible P waves? P waves are missing with *SA arrest*, *3rd degree SA block*, *fine atrial fibrillation*, and *hyperkalemia*.

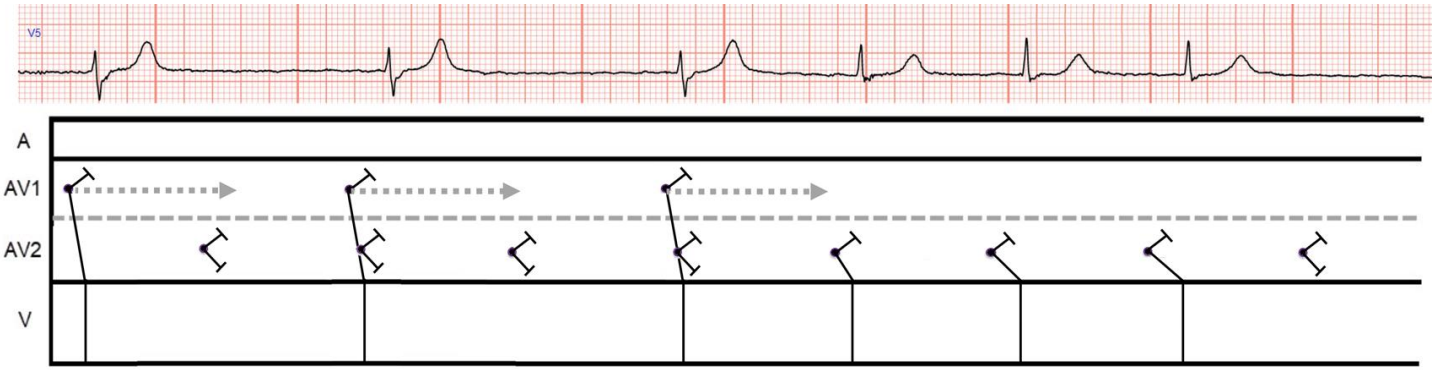
What else do you notice? How about the fact that – despite the abrupt changes in rate – the *rhythm appears remarkably regular!* We still don't know why there are no visible P waves, but if that is due to a fine atrial fibrillation… then *something else* must be present. *Third degree AV block!* If there is a reasonably regular rhythm in the presence of atrial fibrillation, then there is an obligatory third degree AV block present; otherwise, the rhythm would be characteristically chaotic.

This is a six channel ECG (there are six "lines" present). The bottom three channels are Lead II, Lead V1 and Lead V5 rhythm strips that were simultaneously recorded with the upper channels. Look at them closely and see if you see a problem within each lead.

You should have noticed that the first three QRS complexes in each lead are different than the last three complexes. Sure… the morphology is *similar* – but you should be able to see a difference. If you haven't seen a difference, don't go any further. Keeping comparing the QRS complexes until you see the difference (you should be comparing only the QRS complexes located in the same lead). Look at the Lead V1 rhythm strip. All the QRS complexes have a classic RBBB morphology… but look at the width of the small s waves: the last three are thinner! In the Lead V5 rhythm strip, the first three QRS complexes have substantial S waves while the S waves in the last three QRS complexes are very small! Also compare the T waves. The T waves of ectopic beats are usually different from the T waves of sinus-conducted beats. You should note that the two junctional foci are producing different T waves. Junctional beats are often said to be indistinguishable from sinus-conducted beats. Actually, they aren't always indistinguishable, but when they are you can usually distinguish them by the difference in the T waves!

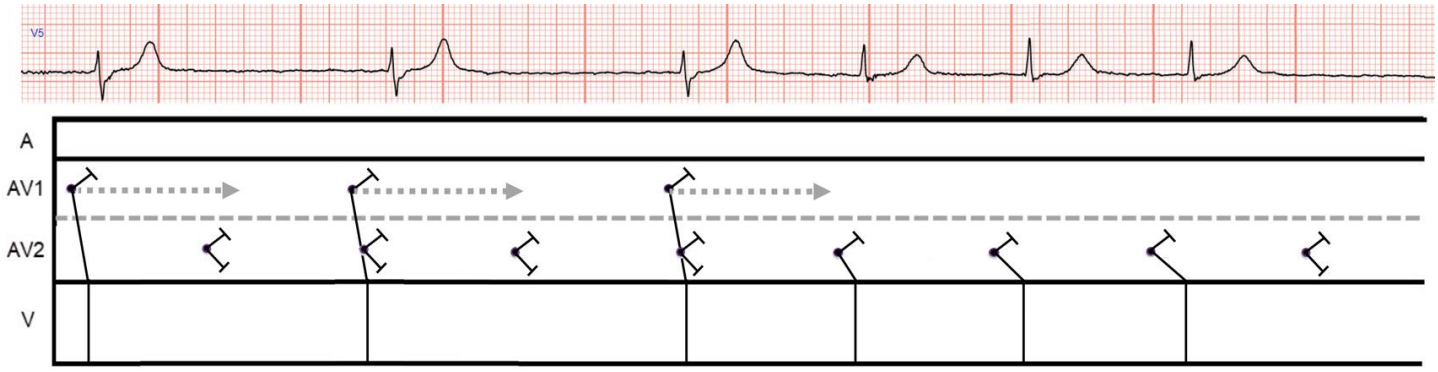
The morphology of the QRS complexes and the T waves make hyperkalemia most unlikely. Unfortunately, it cannot be *completely* disregarded (but for teaching purposes, let's rule it out now). We can be fairly certain of the presence of a third degree AV block. Why?

The wavy baseline is very suggestive of a fine atrial fibrillation. Because there is some orderliness to the ventricular rhythm, we can be reasonably certain that a bidirectional third degree AV block is present *above* a junctional ectopic pacemaker. Why a junctional pacemaker? The QRS complexes are too narrow and well-formed to be ventricular ectopic beats. Why is the AV block bidirectional? Because there are no retrograde P' waves indicating a retrograde block and no chotic disruptions of the ventricular rhythm which implies an antegrade block.



OK… here is where the two populations of QRS complexes come into play. *There are two separate junctional pacemaker foci – an upper focus and a lower focus!* The upper focus is slower than the lower focus. At the beginning of the ECG the slow junctional pacemaker is seen on the recording. The faster junctional pacemaker (lower focus) cannot be seen because it is firing during the refractory period (dotted arrows) left by the slower pacemaker. Eventually the faster pacemaker is able to fire just outside the refractory period

of the slower pacemaker focus and it becomes manifest, thus controlling the ventricular rhythm. But after three beats it stops! Why?



If you look at the last three QRS complexes, you will see that the R-R intervals are decreasing… and then the faster pacemaker rhythm stops! Is the faster junctional focus (H') firing faster and faster? NO! It is most likely firing at the same rate – but there is a Mobitz I block in the exit path of the faster junctional focus (H')… specifically, a *4:3 Mobitz I exit block*. As the H'-R interval widens, the R waves will appear closer and closer to one another – just as in a standard Mobitz I AV block. But this block has nothing to do with the AV node! The faster junctional pacemaker focus then reaches the end of its Mobitz I episode and there is a pause. The ECG ends before we can see the slower H' focus resume.

For you very advanced ECG nerds, there is another possibility: the upper (slower) pacemaker focus may have managed to fire but was still blocked from entering the ventricles. Although it would not be manifest on the ECG recording, it could have reset the lower pacemaker focus (thus extending the pause) and then the upper focus could have taken back control of the ventricular rhythm.

Please note that the faster rate is *not* a multiple of the slower rate. There is no integral ratio between them.