

ELECTROCARDIOGRAM INTERPRETATION

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The meaning and importance of recording right-sided precordial leads

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This is the fourth installment in the electrocardiogram (ECG) interpretation series by Jerry W. Jones MD FACEP FAAEM for this journal. At first, he discussed simple atrioventricular (AV) dissociation versus AV dissociation caused by third degree AV block (1); then, he shares some very important pearls regarding ECG interpretation (2). And in latest one, he pointed to the importance of Hexaxial Reference Grid (3). For this paper, some valuable references were reviewed (4-6). Figure 1 shows an ECG that was recorded barely in time to capture the maximum amount of information available. The rhythm is sinus and regular except for one premature atrial complex. The rate is 75 beats/minute. There do not appear to be any sinoatrial (SA), atrioventricular (AV) or bundle branch blocks on the tracing.

Most noticeably, there is a lot of ST deviation on this ECG: ST elevation in Leads II, III, aVF, V1, and subtle elevations in V3R through V6R. If you are struggling to see ST elevation in Lead V1, I will get to that in a moment.

Let's look at the frontal plane leads first (I, II, III, aVR, aVL, aVF): there is an obvious acute inferior transmural ischemia present, indicated by the ST elevation in Leads II, III and aVF. We can see that the culprit artery in this case is the right coronary artery (RCA) and we know this because of three findings:

- The ST elevation in Lead III is greater than the ST elevation in Lead II.
- There is ST depression greater than 1.0 mm in Leads I and aVL (but particularly in Lead aVL).

- There is ST elevation in the right-sided precordial leads, specifically Lead V4R.

The rule that the RCA is the culprit artery if the ST elevation in Lead III > the ST elevation in Lead II is a very good rule and I use it a lot in my interpretations. But don't bet your paycheck on it because you will be wrong about 10% of the time. I have several ECGs in my collection that exhibit that finding but were proven to have culprit arteries other than the RCA.

ST depression in Lead aVL ≥ 1.0 mm is rarely caused by anything other than an occlusion of the RCA. However, distal occlusions of the left circumflex artery (LCx) or the left anterior descending artery (LAD) could conceivably result in inferior wall ischemia with ST depression in Lead aVL. Neither of them, however, is likely to be as profoundly depressed as we see in this ECG.

ST elevation in Lead V4R is the most reliable sign of an RCA occlusion proximally because this finding indicates an acute ischemia of the right ventricle. I say proximally because the arteries to the right ventricle branch from the mid-portion of the RCA. But, as I mentioned at the beginning of this article, this ECG was barely recorded in time to see the ST elevation in the right-sided leads. The wall of the right ventricle is much thinner than the wall of the left ventricle. Therefore, ischemias proceed to infarction much sooner – often before any intervention – with a more rapid resolution of the ST elevation in the right-sided leads.

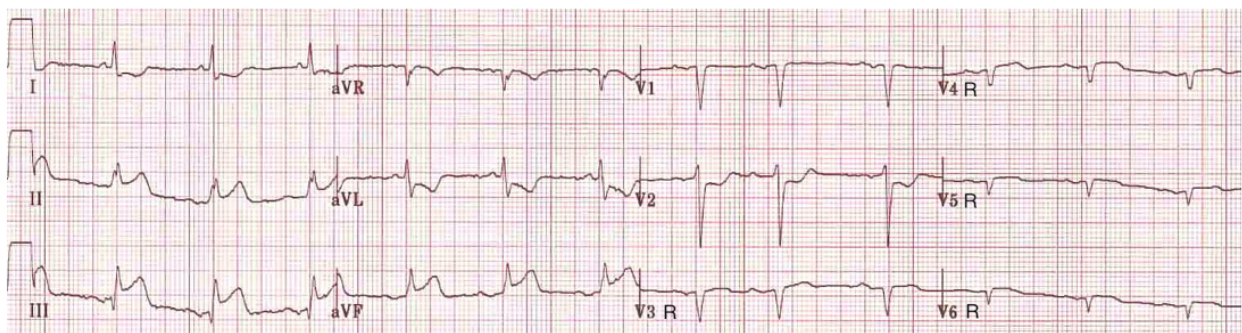


Figure 1 Electrocardiogram of a patient who presented with sub-sternal chest pain

Acute ischemia of the right ventricle will rarely be visible on the ECG beyond 12 hours from the onset of the occlusion. It is most imperative that right-sided leads be recorded immediately upon recognition of ST elevation in Leads II, III and aVF. And when you record right-sided leads, be certain to mark them as such on the ECG tracing (as in the tracing above). Not doing so can lead to unnecessary confusion.

Now let's return to the issue of the ST elevation in Lead V1. Yes, I know that the ST segment looks isoelectric. But that's my point! Look at the significant ST depression in Lead V2. Why doesn't Lead V1 have similar ST depression? If Lead V3 were on this tracing, it would likely manifest similar ST depression. The reason that you see nothing in Lead V1 is because the ST depression caused by the inferolateral wall ischemia is being cancelled by the ST elevation caused by the anterior right ventricular wall ischemia. Thus, ST elevation + ST depression (in the same lead) = isoelectric ST segment! It's worrisome, isn't it, that such serious ischemia in two different areas of the heart, involving both ventricles, can result in a totally normal-appearing ST segment? OK. look again at Lead V2 and then look once more at Lead V4R. Now look at Lead V1. Do you see the ST elevation now?

One of the greatest dangers of an acute inferior myocardial ischemia (STEMI) lies in the diagnosis itself, and the false sense of completion that you may feel in having made the diagnosis, because too many people stop right there! They look no further. When you diagnose an inferior myocardial ischemia, your work isn't done until you have ruled out any

involvement of the right ventricle! We used to think that right ventricular infarctions were a rarity, but we now know that up to 50% of inferior wall myocardial infarctions also involve the right ventricle. Up to 30% of those patients will suffer profound hemodynamic consequences and may not leave the hospital alive. It is a highly lethal condition and the diagnosis should not be missed!

References

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