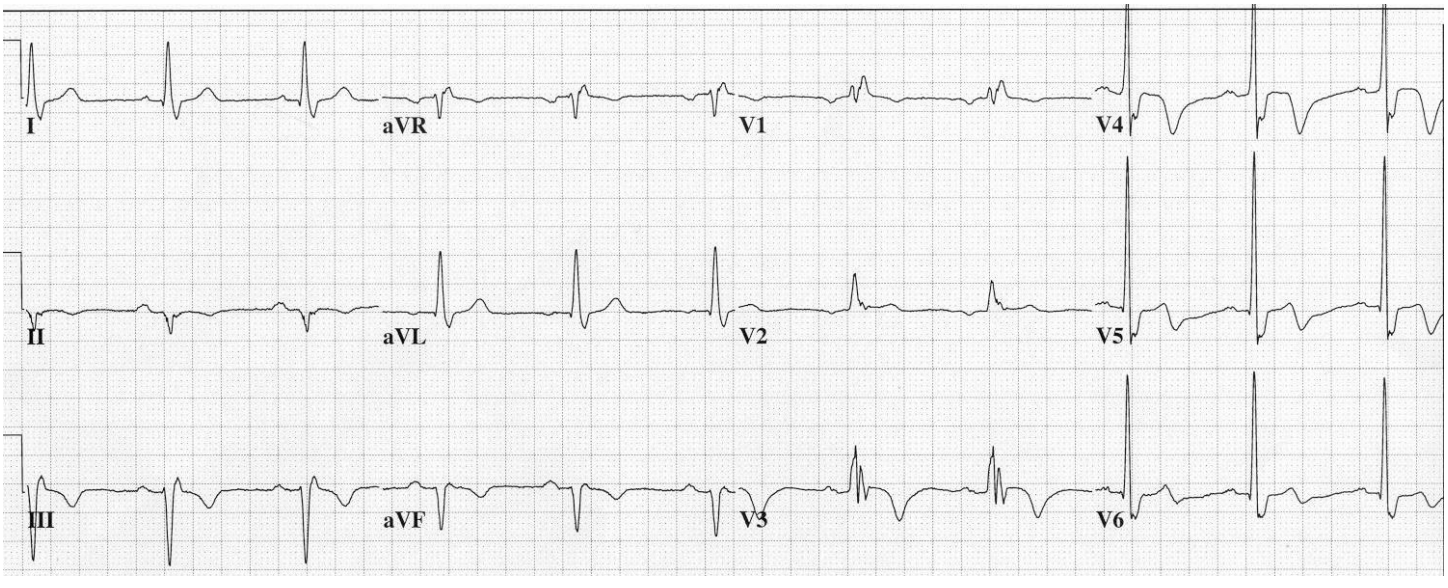
ST Elevation Is NOT the ONLY Sign of an Acute Myocardial Infarction

1. Wellens Syndrome

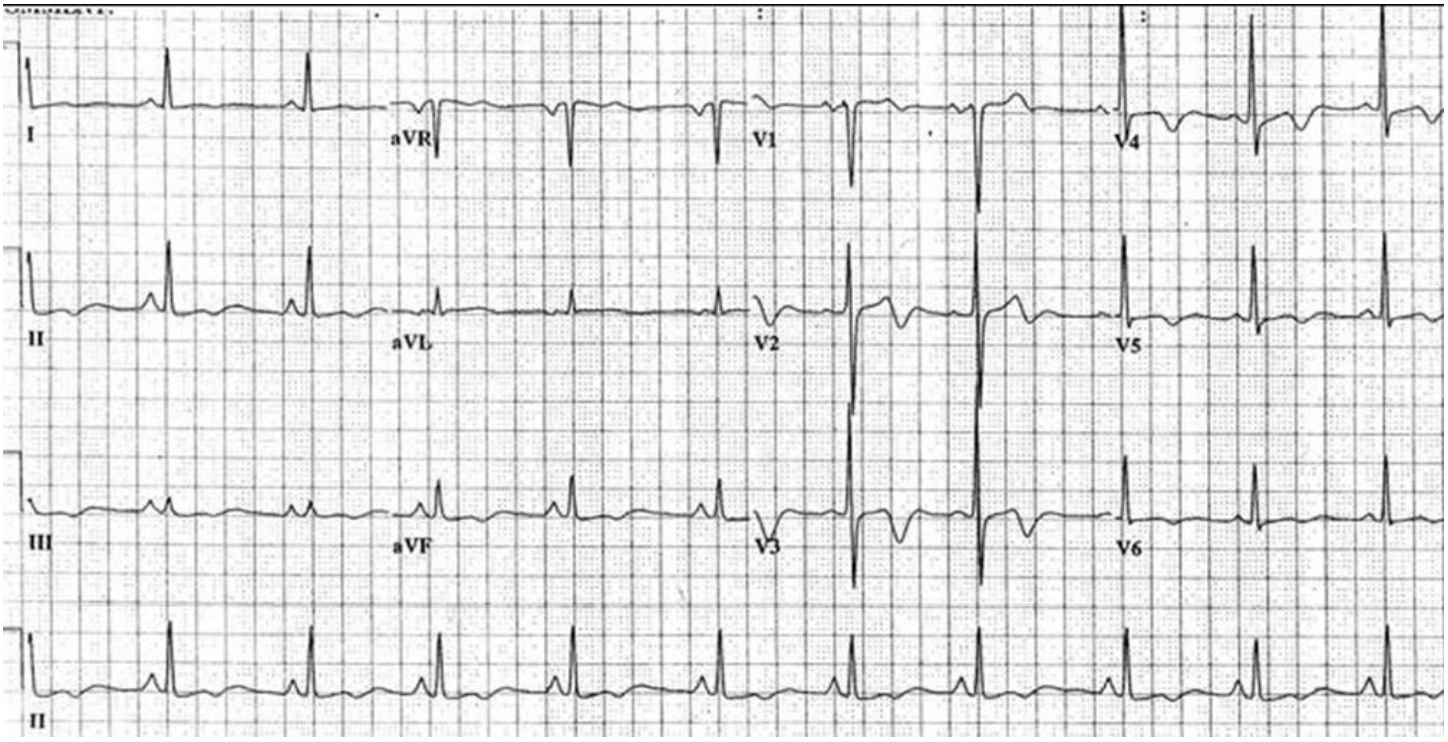
Wellens Syndrome is a proximal occlusion of the left anterior descending artery (LAD) that has spontaneously reperfused. On the 12-leads ECG it is represented by the appearance of reperfusion T waves – inverted T waves in the mid-anterior precordial leads. Initially, there was a distinction between full inversion or just terminal T wave inversion. No explanation was ever given for distinguishing between the two morphologies, so I just don't worry about it. One would think the partially-inverted T waves represented reperfusion closer to the time the patient is seen.

But there's *more* to Wellens Syndrome than just the T wave inversions – there must be an *appropriate patient history* as well. *This is very important*. A typical Wellens patient had onset of *ACS-like chest pain* and its associated symptoms which *completely resolved* by the time the patient is seen (usually in an emergency department). The main issue is that in many – if not most – cases the occlusion will occur again and it could be at any moment. Think about that: the patient had a temporary complete occlusion of the proximal LAD! This patient should not be sent home without evaluation by a cardiologist. And he/she certainly should *not* be stressed on a treadmill.

Here's something else to consider: how many of these patients are written off as a NSTEMI or just angina pectoris? Here is an example of Wellens Syndrome…

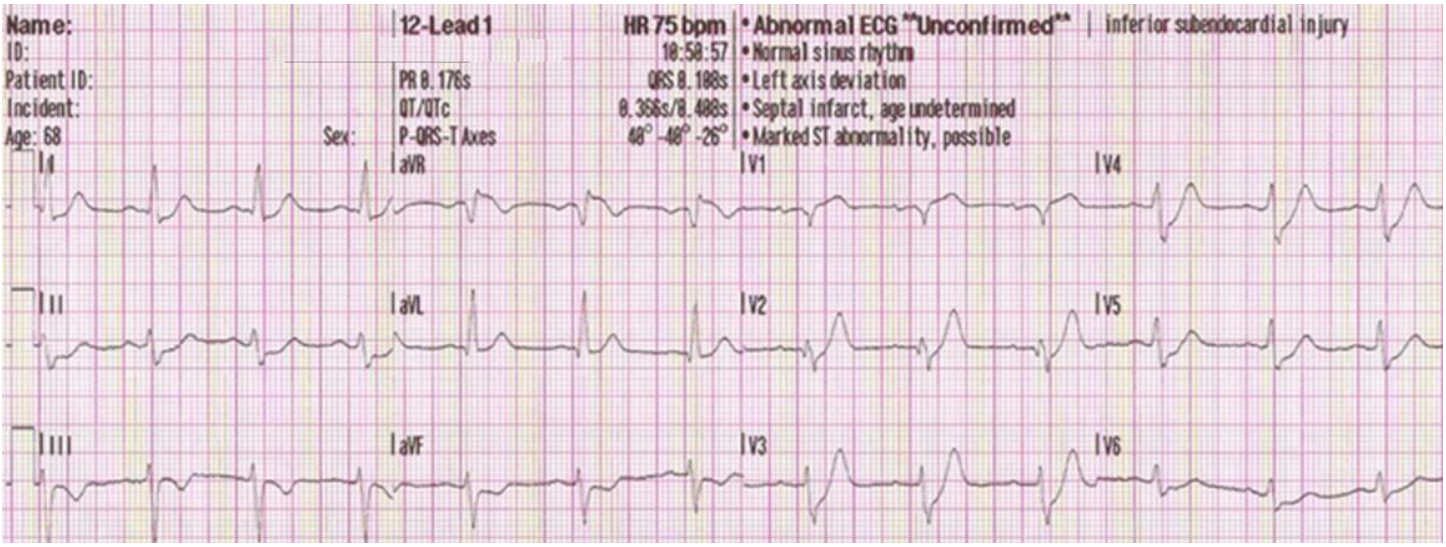


Here is another example…

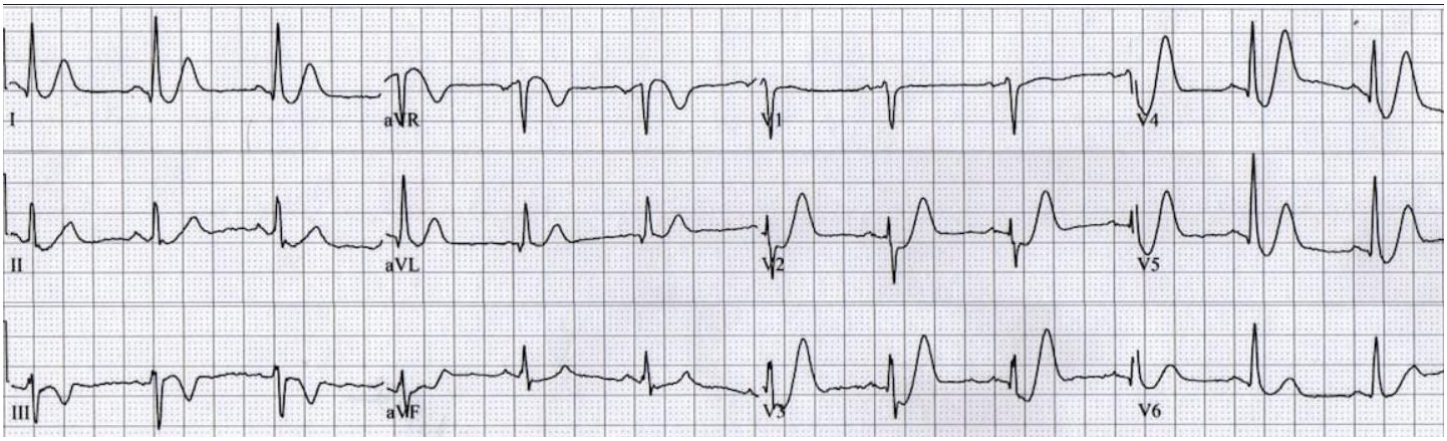


2. De Winter T Waves

De Winter T waves also represent either a proximal occlusion of the LAD or an occlusion that is about to become transmural. It demonstrates an upward-sloping ST depression followed by tall, hyperacute T waves. There is typically some *ST elevation in Lead aVR* also (OK, but it's not where you would expect it. This is not just subendocardial ischemia – it is an indication of *an occlusion or imminent occlusion of the proximal LAD*. Here is an example of De Winter T waves…



Here's another example of De Winter T waves…



3. Inferolateral MIs

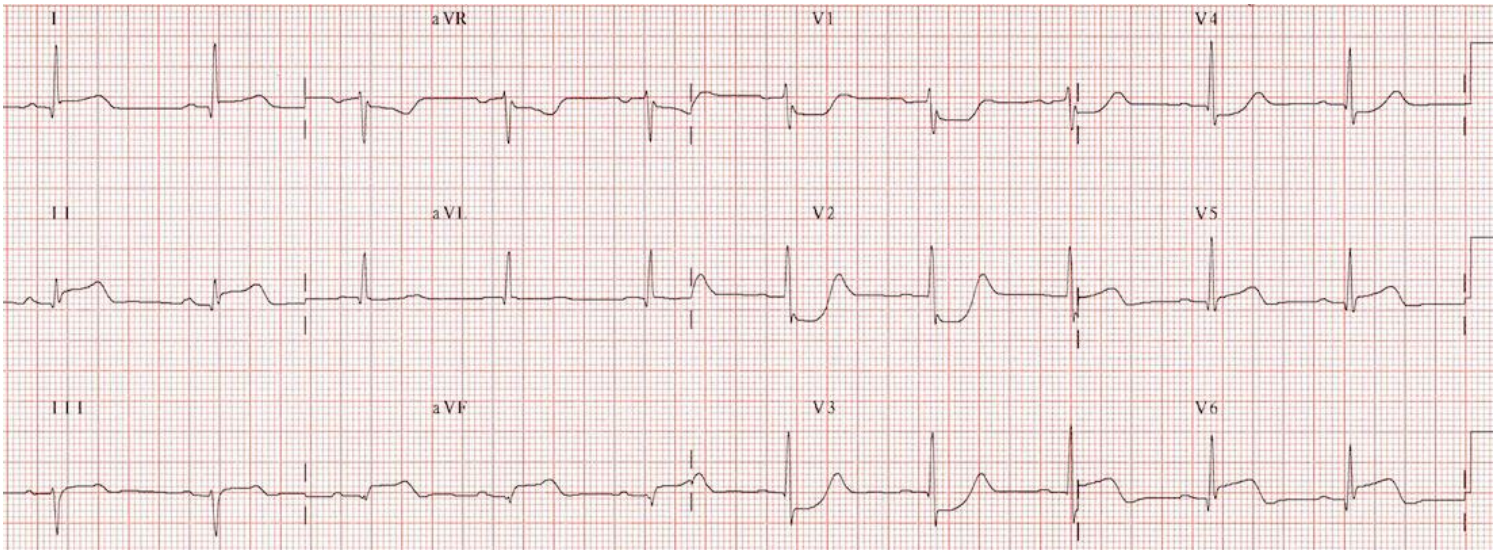
This is what we used to call a "posterior MI." We now know that is an acute ischemia of the *lateral wall of the left ventricle* which also happens to be located posteriorly in the chest – *not* laterally. Terms used currently include *posterolateral* and *inferolateral*. If one records Leads V7 – V9, ST elevation may be very apparent in those leads – or it may be very subtle! On the 12-lead ECG, inferolateral infarctions typically present with ST depression in Leads V1 – V3 (or V4). The ST depression tends to be flat, rather than sloping up or down.

Now here's where a lot of misunderstanding occurs: if the ischemic changes are acute, you will not see much of an R wave – it may be enlarged slightly but not much – if at all! The T wave will be inverted. Now, you may say, "But Dr. Jones, aren't we supposed to see a tall R wave and upright T wave in Lead V1? Isn't that the classic form of an inferolateral (formerly posterior) MI?"

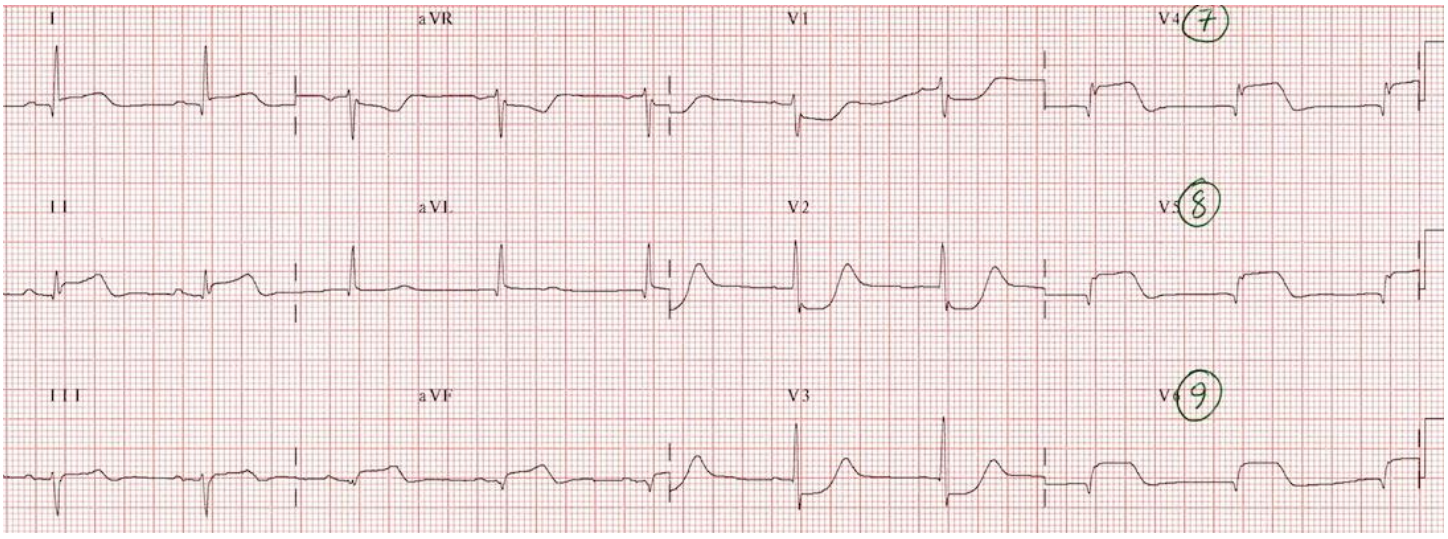
My response is that you are describing a completed, reperfused MI – *not* an *acute lateral wall epicardial ischemia*. Dr. Perloff – who authored the original paper on diagnosing inferolateral MIs – made a significant mistake: he failed to consider the fact that he was seeing everything in Leads V1 – V3 *in reverse*! So, what he described in the original paper was a completed infarction – something that is too late for you to intervene.

But here's what I have noticed over the years: in *acute* ischemia, I sometimes see inferolateral MIs with tall R waves and upright T waves in Leads V1 – V3, but – at

the same time – I see *other areas with definite acute changes*. I just treated *everything* as acute in those cases. Here is an example…

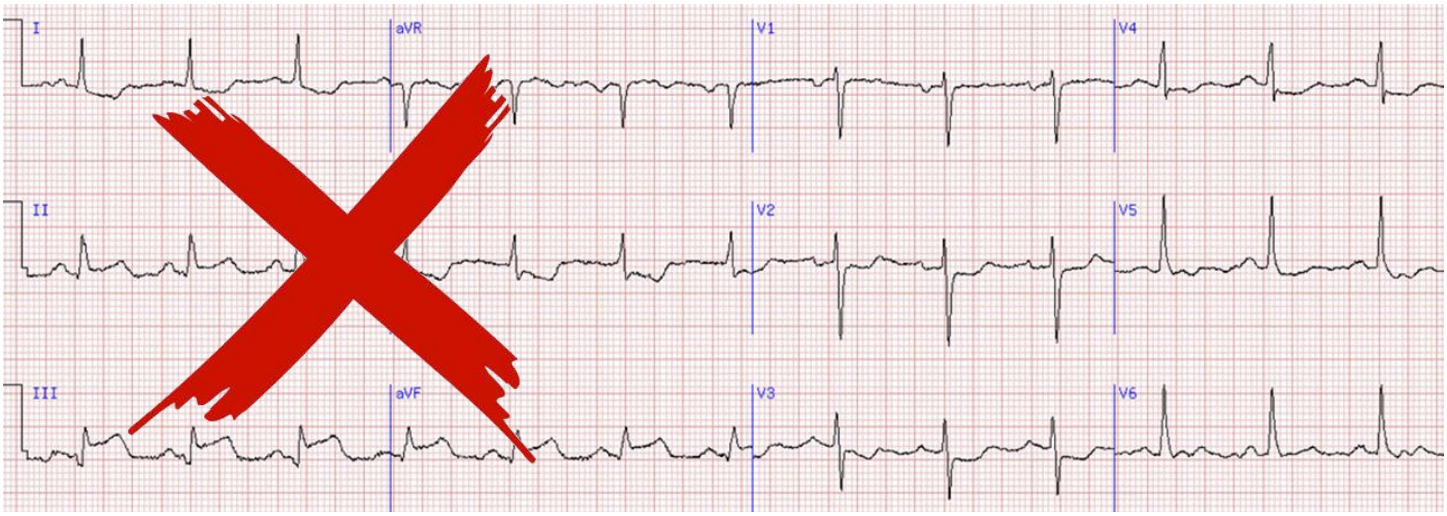


In the above example, there is a concurrent acute inferior MI; however, occlusions of the left circumflex artery (LCx) can produce a pure inferolateral MI without any inferior ST changes. Thus, you would have an acute MI with no ST elevation (unless you recorded posterior leads). Posterior leads were recorded on this patient…



4. Some Right Ventricular Infarctions

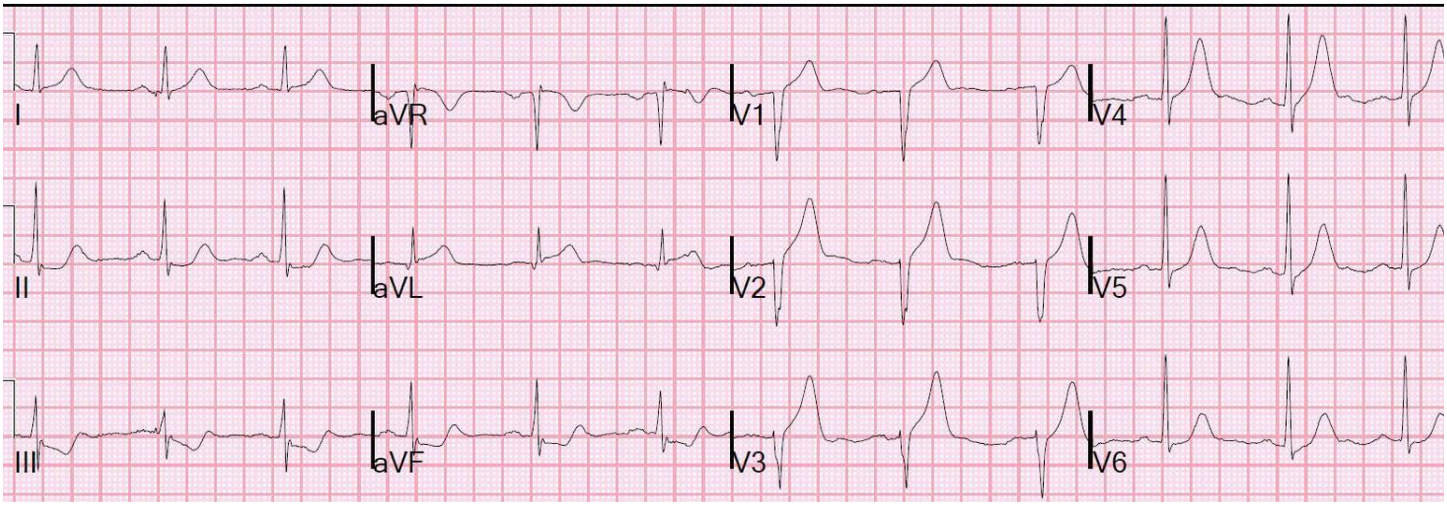
This one is a bit tricky. In this case, there *are* frequently signs of ST elevation in the inferior leads – *but NOT in the leads indicating a right ventricular infarction*. And a right ventricular infarction (with 30% in-hospital mortality) is much more dangerous than an inferior MI. Here's an example of a very dangerous right ventricular MI *not* appearing on the 12-lead ECG (unless, of course, you know what to look for)…



Yes… there IS an inferior MI present. I assume all of you saw it. But did you see the right ventricular MI that is considerably more dangerous and life-threatening? You mean you didn't see the ST elevation in Lead V1? The reason you didn't was due to a cancellation of forces. It's there! A devasting MI but no ST elevation to spot it.

5. Proximal Type 3 LAD Occlusions

More cancellation of forces. You know that ***80% of LADs are Type 3***, or "wraparound" LADs. These LADs supply up to 25% of the circulation of the inferior left ventricular wall. A proximal occlusion can cancel most of the injury vectors so that what you see is a small, anterolateral MI. But, unknown to YOU, there is a massive MI occurring. Here is a possible example…



In this ECG*, we see hyperacute T waves throughout the precordial leads along with subtle ST elevation in Leads I and aVL. There is "reciprocal" ST depression in the inferior leads. My point here is that most people – including very experienced electrocardiographers – may fail to understand that a proximal occlusion of a type 3 LAD has occurred. Such proximal occlusions – through *cancellation of forces* – frequently cause ST elevation in the inferior leads to present as either normal ST segments or even mild ST depression, simulating a "reciprocal change."

How do you recognize such occlusions on the 12-lead ECG? You don't. This will likely be a cath lab diagnosis. Just be aware that acute anterior MIs may actually be very, very large MIs covering the anterior, lateral and inferior surfaces of the left ventricle.

*I really have no idea if this ECG is an *actual* example – but this is definitely what it would look like.

6. Proximal LCx Occlusions

I really don't have anything to show you here except to remind you that the same thing could happen with a proximal occlusion of the LVc.

7. **And Those With ST Elevation That Isn't ST Elevation Because They Don't Meet STEMI Criteria**

And you've all probably seen patients with classic chest pain, but the initial ECG just gives "hints" of ST elevation with no elevations reaching 1 mm. Remember: ***in many cases, the only thing differentiating these NSTEMIs from a STEMI is the 20 minute interval between the first ECG and the repeated ECG!***

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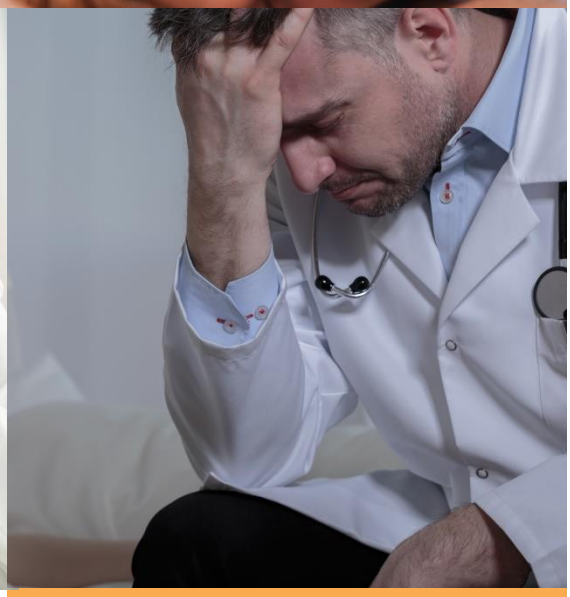

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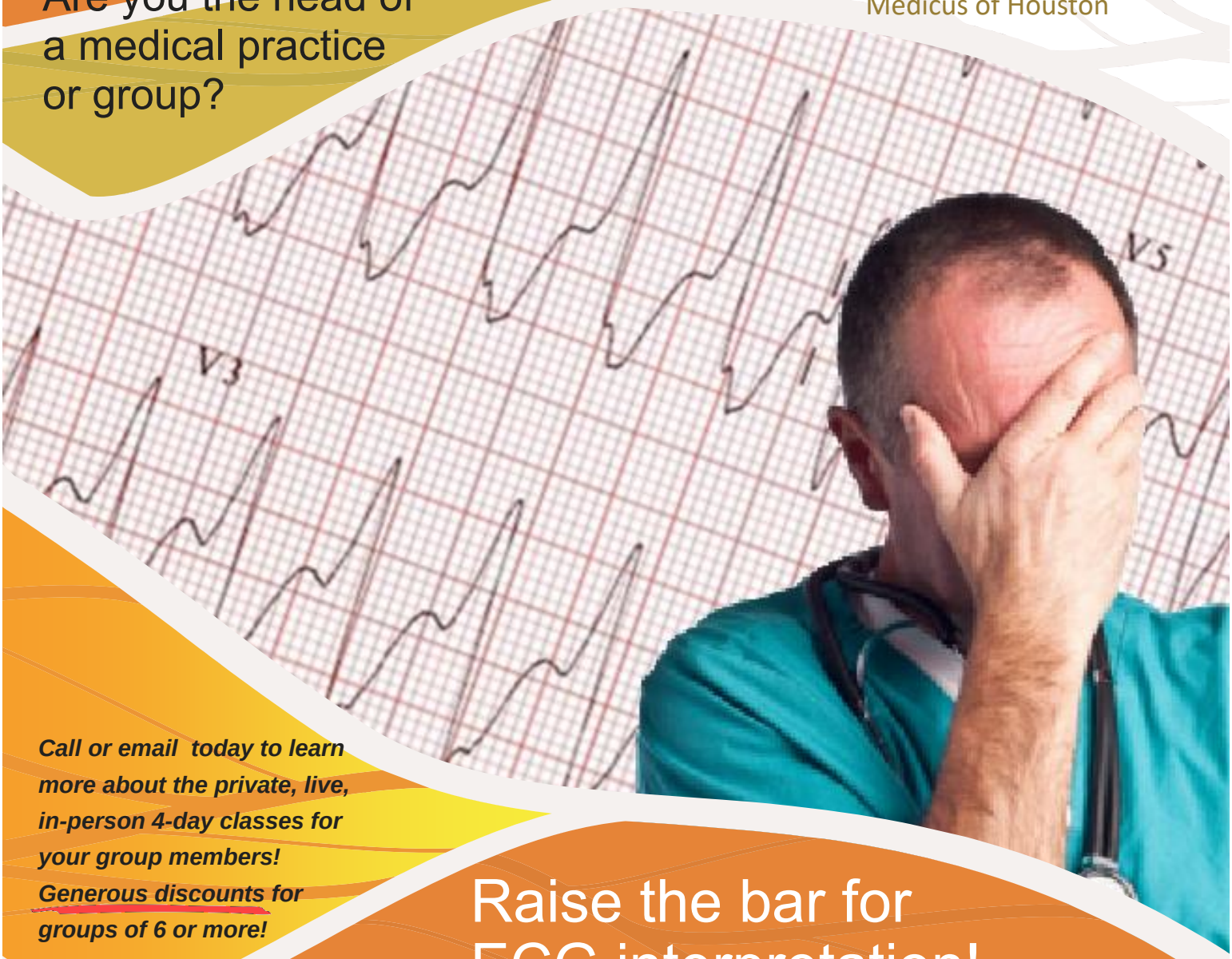

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