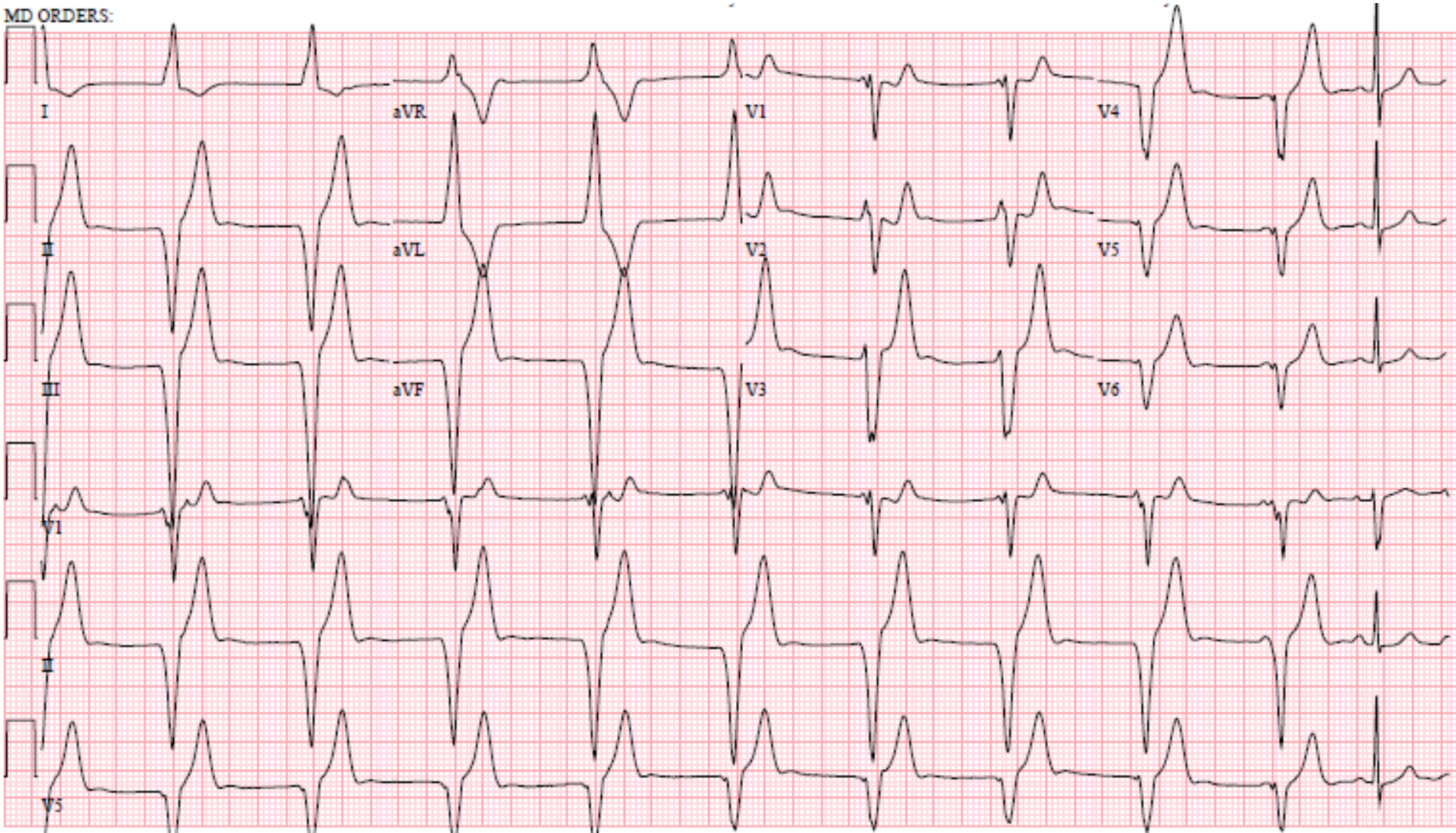
You are in the pediatric Emergency Department when a 17 year old comes in complaining of chest pain. He's describes it as a "sharp pressure" on the left side of his chest, and reports that it is a 3/10 on the pain scale. In the past 2 months, he has had two other episodes of similar pain that have occurred at rest and resolved after a few minutes. He has no associated symptoms. He is slightly bradycardic, but his vital signs and physical exam are generally normal. No significant past medical history, surgical history, family history, etc. You get a 12-lead ECG, seen below:

1) What is the rhythm here (e.g. sinus, junctional, heart block, etc.)? (1 point)

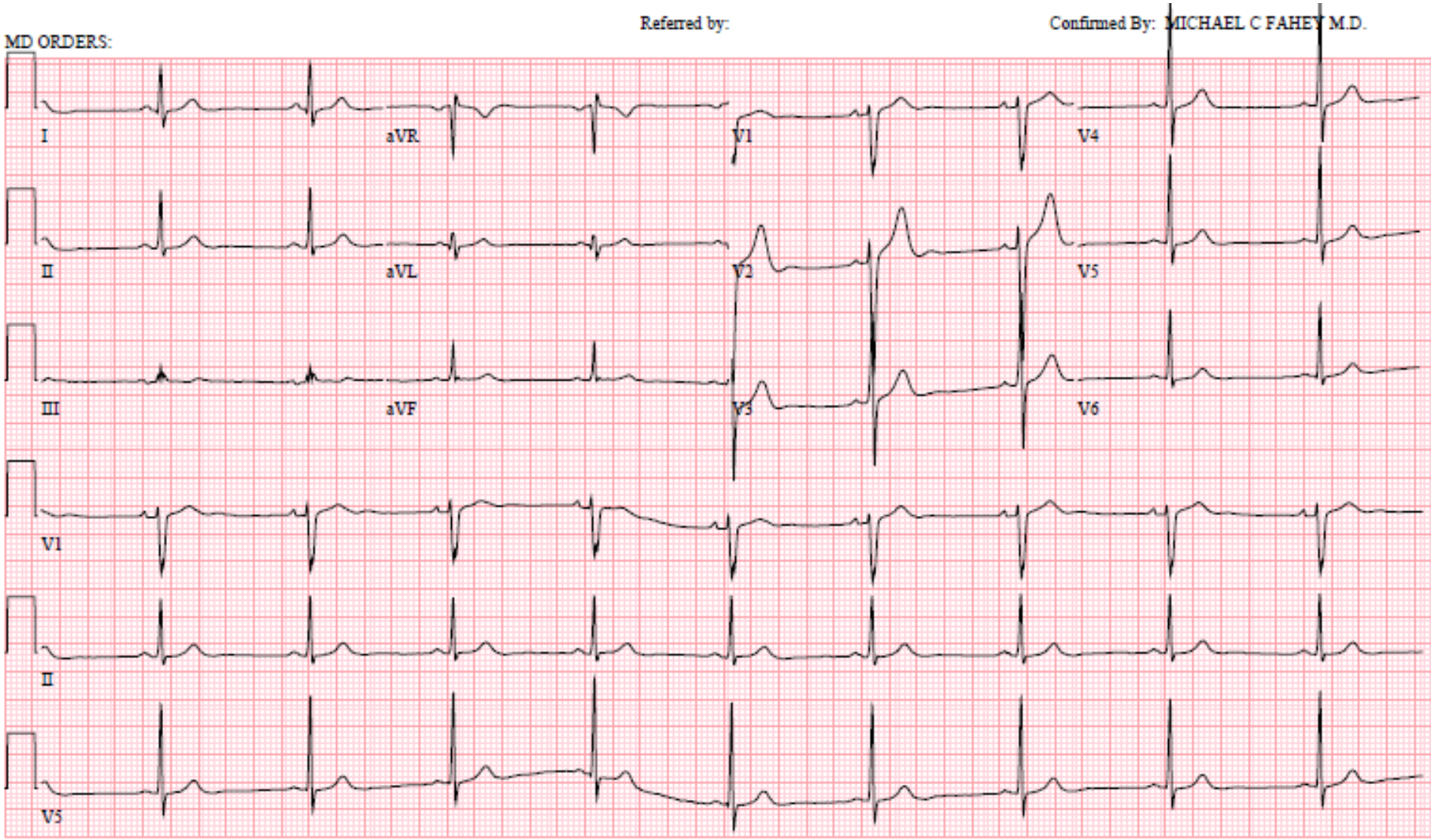
2) Does this teenager need to be cardioverted (i.e. shocked)? Why or why not? (1 point)

GO ON TO SLIDE 2!



You send off some labwork and discover he has a normal troponin I, normal electrolytes, a drug screen that is positive for cannabinoids but negative for other drugs. His thyroid function tests are normal. The nurse in the ER alerts you that his rhythm seemed to change on the monitor, and she obtained the 12-lead ECG seen below.

3) How does the ECG below and the information above help you in terms of your differential diagnosis? Are you more worried or less worried at this point? (1 point)



Solution to ECG of the Week 6-6-2011

- 1) What is the rhythm here (e.g. sinus, junctional, heart block, etc.)?
  - This is a **ventricular rhythm**, more specifically, an "accelerated ventricular rhythm," some might consider this a "ventricular escape rhythm"
    - Calling it a "ventricular rhythm" implies that the ventricles have become the pacemaker of the heart, just as in sinus rhythm the SA node is the pacemaker, and in a junctional rhythm the AV node is the pacemaker. We know it is a ventricular rhythm because first, there are no P waves; second, the QRS is very wide, which means that the His-Purkinje system is not being used (as it would be if the signal came through the AV node). Since the His-Purkinje system is not used, electricity conducts from myocyte to myocyte, which takes longer and stretches the QRS out over time.
    - Recall that all cardiac cells have automaticity—meaning that if left alone, they will spontaneously depolarize. Ventricular myocytes have automaticity, but they tend to fire at very slow rates (30-40 beats per minute). Calling this rhythm "accelerated" implies that the active pacemaker is firing off faster than it normally would, but at a non-tachycardic rate. An "escape rhythm" means the automaticity has been uncovered because the normal sinus rate is too slow or is getting blocked before reaching the ventricle. In this case, the ventricles are firing faster than a normal ventricular "escape" (ie faster than 30-40) but only generating a rate of about 60bpm. If they were firing at 150bpm, you'd call this ventricular tachycardia!
- 2) Does this teenager need to be cardioverted (i.e. shocked)? Why or why not?
  - No! The patient is hemodynamically stable and is NOT in V-tach. Furthermore, if you look at the last beat in the first ECG, there is a sinus beat there! This gives you a clue that this rhythm may be more benign than you might have thought on first glance.
- 3) How does the ECG below and the information above help you in terms of your differential diagnosis? Are you more worried or less worried at this point?
  - The negative troponin and lack of ST segment or T wave abnormalities reassure us there is no active myocardial ischemia or inflammation going on. We also now know that electrolyte abnormalities, hyperthyroidism, or cocaine/amphetamines are not to blame. The normal 12-lead ECG makes complex congenital heart disease and cardiomyopathies very unlikely, and also shows us that he has a low resting sinus rate. If his ventricles are automatically firing at about 60bpm, and his sinus rate is a bit slower than this, it's no wonder that he flips into an accelerated ventricular rhythm from time to time. In short, we are very reassured by these findings! *(Credit for any two elements noted here)*