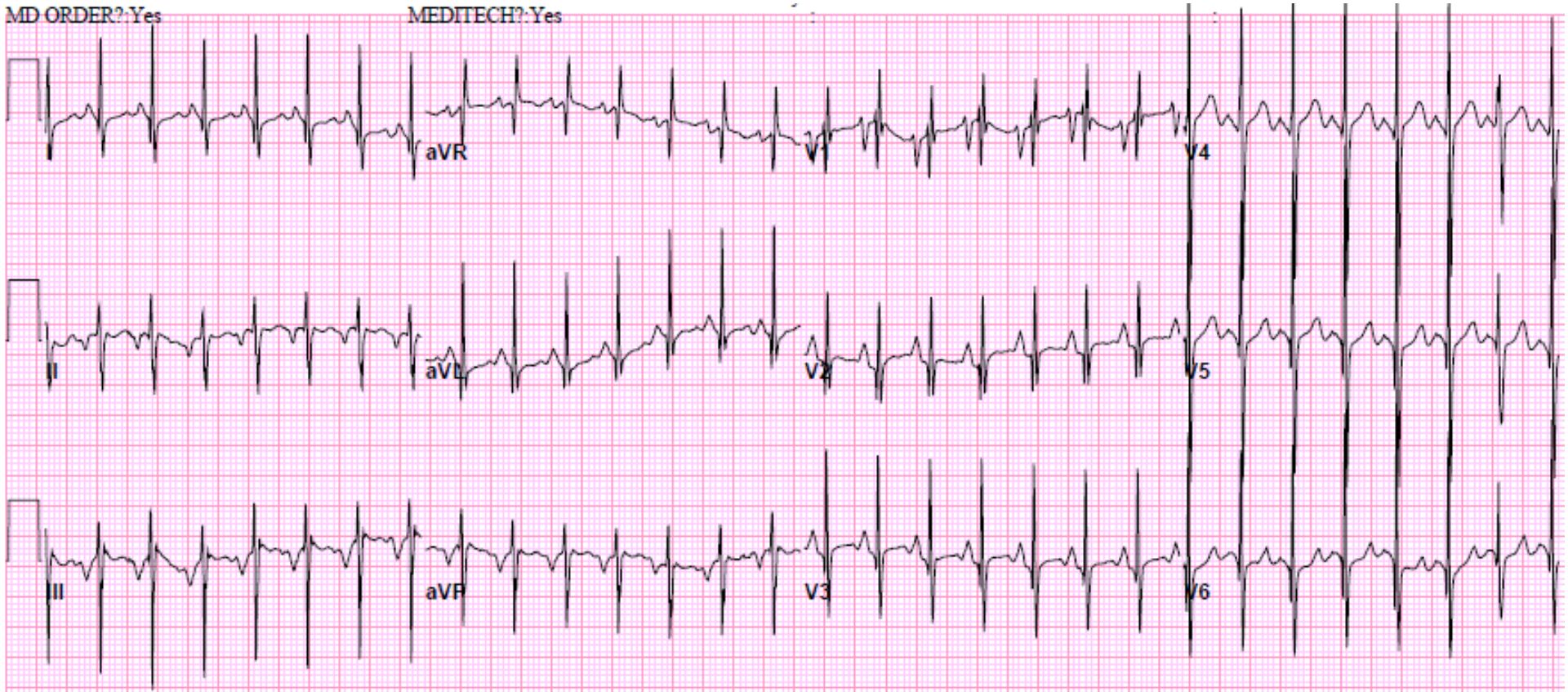
You are seeing a 2 month old patient in your clinic with a history of congenital heart disease. You find a 12-lead ECG in the chart. Your attending tells you “I’m not good with ECG’s, can you read this?”

……can you???

1) What is the rate, rhythm (ok to say sinus rhythm or not) and axis (just estimate within 90 degrees)? (Hint, look at last weeks’ solution)

2) Is there any evidence for atrial enlargement? If so, is it right, left, or biatrial enlargement?



PLEASE SAVE THIS EXPLANATION FOR FUTURE REFERENCE!!!

1) What is the rate, rhythm (ok to say sinus rhythm or not) and axis (just estimate within 90 degrees)?

--In order to determine **rate**, we look at the distance between QRS complexes. Roughly, the rate is between 150-300bpm. Specifically, **the rate is 60 (mm between QRS x 0.04 sec),** or
60 (8.5 x 0.04) = **176bpm.**

--In order to determine **rhythm,** we need to establish the P wave axis, and make sure there is a P wave for every QRS. Recall that the normal P wave should move from the patient's left-to-right (that means upright in lead I), and from patient's top to bottom (that means upright in lead aVF).

In this patient, the P waves are upright in lead I, but **downward in lead aVF!** This indicates the rhythm is being generated from somewhere other than the sinus node, in this case likely from somewhere low in the right atrium. This is NOT sinus rhythm!

--In order to determine axis (QRS axis, that is), we look at the QRS in leads I and aVF. Recall that in most kids, the QRS vector should move from right-to-left and top-to-bottom, much like the P wave. The exception to this rule was the child <2 months old who still may have right ventricular dominance and therefore a left-to-right QRS axis. Look at the tracings above. The QRS is mostly upright in lead I (normal), but **downward in lead aVF!** This means the QRS axis is directed leftward and upward, or between 270 (a.k.a. -90) and 0 degrees.

2) Is there any evidence for atrial enlargement? If so, is it right, left, or biatrial enlargement?

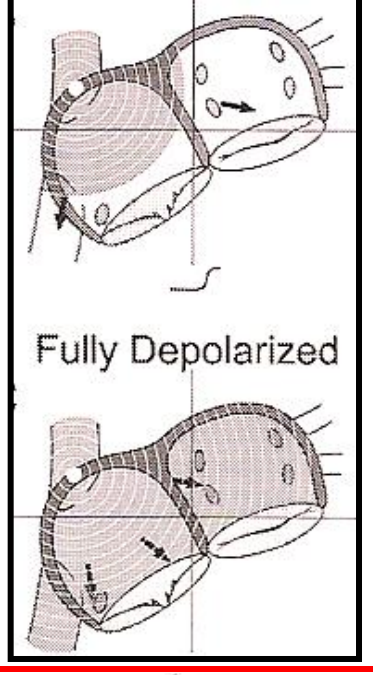
We need to think about how P wave would appear in the setting of right or left atrial enlargement.

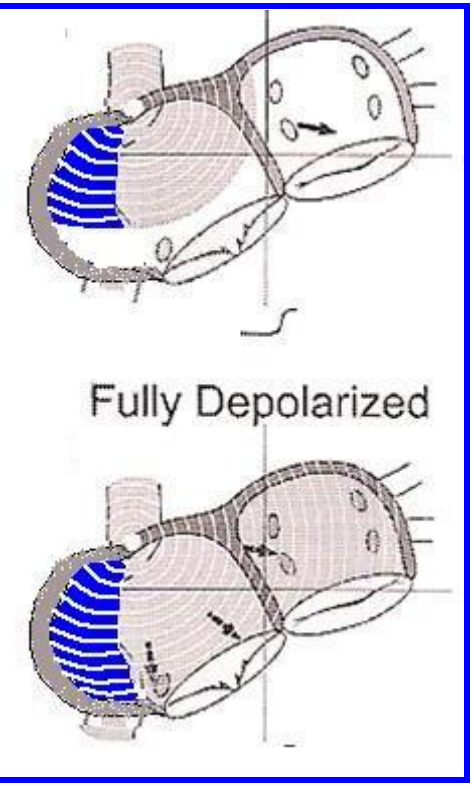
--In the setting of **right atrial enlargement,** there is more atrial tissue in the immediate area adjacent to the sinus node (or any right-sided focus, for that matter). As a result, when the atria depolarize the P wave should be of greater amplitude (i.e. taller).

--in the setting of **left atrial enlargement,** there is more atrial tissue but it is displaced over on the left side of the atria. As a result, the P wave amplitude may not necessarily be bigger, but it will take **longer** for all of that extra tissue to depolarize. Also, this last part of atrial depolarization is directed toward the left.

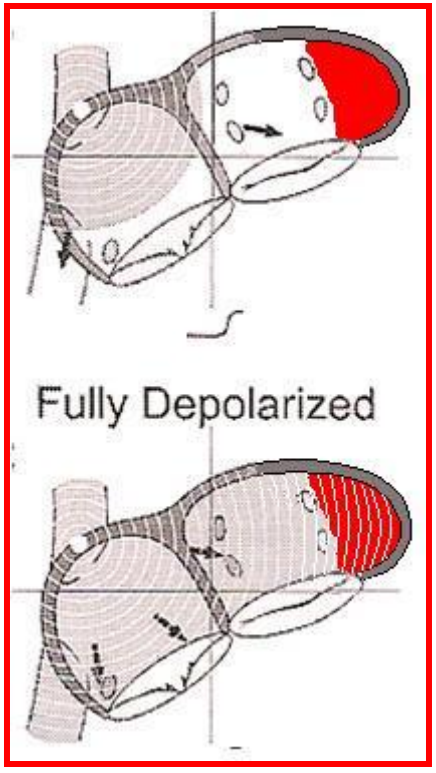
SEE NEXT SLIDE FOR CONTINUED EXPLANATION…

This picture shows **normal atrial depolarization**. Note that the wave of depolarization goes from the patient's top right to bottom left.





This picture shows right atrial enlargement (RAE). Compared to the normal, the atria depolarize in the same amount of time, but ***there is much more right atrial tissue that depolarizes (in blue).*** This creates a ***large amplitude P wave!*** We use a cutoff of a P wave that is 3mm (little boxes) tall for RAE.



This picture shows left atrial enlargement (LAE). Compared to the normal, the initial atrial activity is unchanged. At the end of atrial depolarization, however, there is ***extra left atrial tissue (in red) that prolongs the overall depolarization time.*** This creates a ***widened P wave (at least 2.5mm wide)!*** Also note that the end of the P wave will be ***unopposed left atrial force***, which creates a ***biphasic P wave***, with the latter half directed toward the left.

In our patient, there are a few leads that show a large P wave amplitude, consistent with **right atrial enlargement.** Look below at the sample from lead V2.

The P wave duration in our patient is not particularly prolonged. However, the P wave pattern in lead V1 is very characteristic of **left atrial enlargement.** Note that the P wave is biphasic (part up and part down), and that the latter part of the P wave is downward in lead V1, suggesting that it is moving away from lead V1 (i.e. toward the patient's left)! You could have read this either way with respect to LAE. It's possible the unusual P wave morphology in lead V1 is due to the fact that the patient has an ectopic atrial rhythm (see answer to Question 1).

Next week, we'll review how to evaluate ventricular hypertrophy!