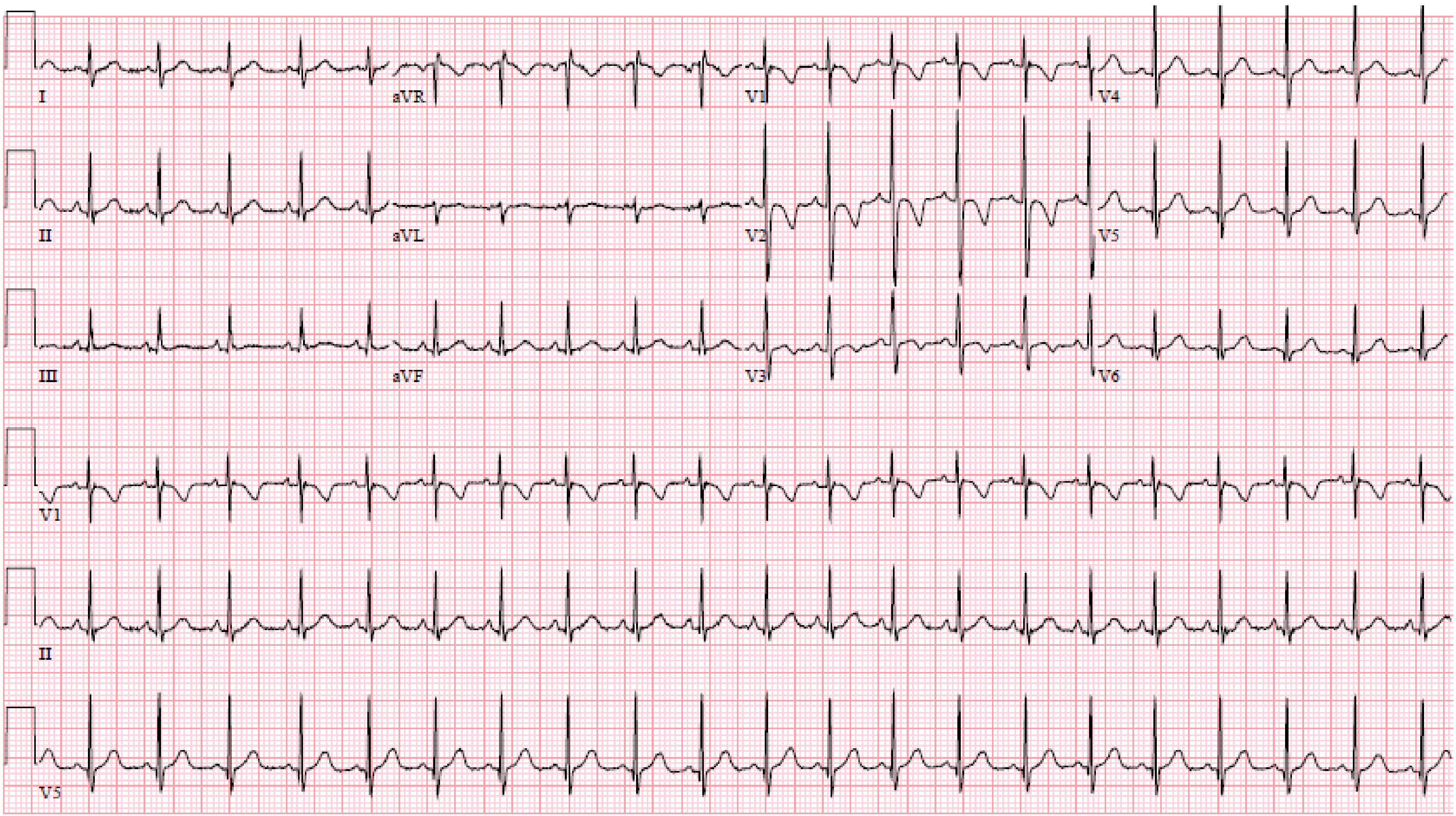
You are seeing a 1 year old girl in your clinic who has a history of a ventricular septal defect that closed spontaneously in infancy. You obtain a 12-lead ECG seen below.

1) What is the rate? How do you figure this out? (1 point)

2) Is the QRS axis normal? (1 point)

3) What is the rhythm? (1 point)



ECG of the Week Explanation

This week, we asked three basic questions that are the foundation of the approach to reading any ECG. We will ask these same questions on all future ECG's of the Week, so PAY ATTENTION FOR EASY POINTS!!! Save these slides for your future reference.

1) What is the rate? How do you figure this out?

- You can figure out the rate 2 basic ways:
  - To estimate the rate, have a look at how many "big boxes" (which are 5mm wide) there are between QRS complexes. One big box = 300 beats per minute (bpm), two boxes = 150bpm , three boxes = 100bpm, four boxes = 75bpm, five boxes = 60 bpm, six boxes = 50bpm, and so forth. In this ECG, there are between 2 and 3 big boxes between QRS complexes, therefore the rate is between 100-150bpm.
  - To determine the HR more specifically, count how many "little boxes" (1mm) between the QRS complexes and multiply by 0.04 (each little box represents 0.04 seconds). Then divide 60 by this number, and you have the heart rate. This is how it looks written out:

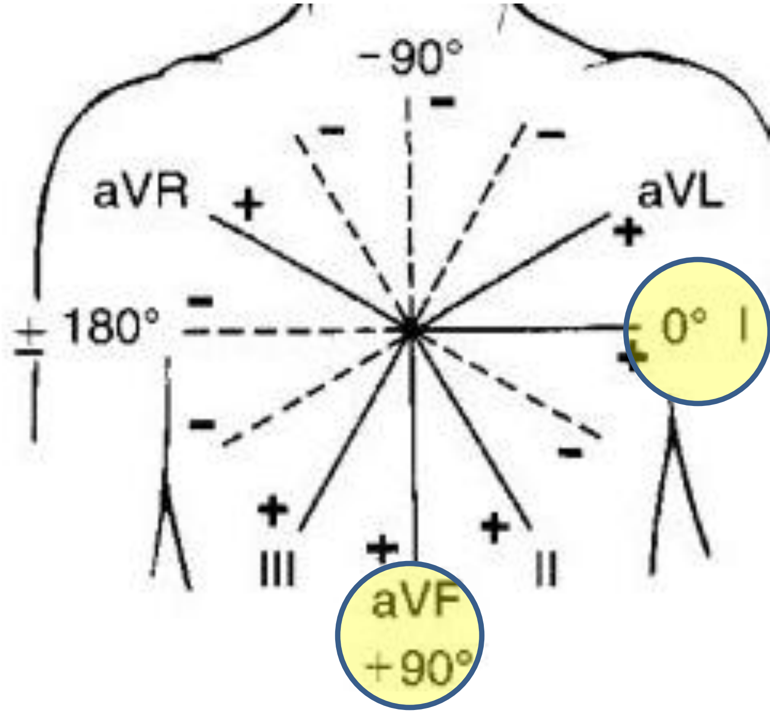
Heart Rate (in beats per minute) = 60 ÷ number of seconds between beats

For our patient, there are about 12.5 little boxes between QRS complexes (there is a bit of normal variability over the ECG), so the heart rate is:

60 ÷ (12.5 x 0.04) = 120 beats per minute

2) Is the QRS axis normal?

When we talk about ***axis,*** we are referring to the direction of the electricity in a ***frontal, or coronal plane.*** This plane is defined by the limb leads (aVR, aVL, and aVF) and bipolar leads (I, II, and III). **<u>To determine axis, you need to remember 3 things:</u>** 1) Lead I sits straight to the patient's left, and by convention we call this direction 0 degrees; 2) Lead aVF sits straight down, and by convention we call this 90 degrees; 3) Electricity moving toward a lead causes a positive deflection on ECG, while electricity moving away from a lead causes a negative deflection.



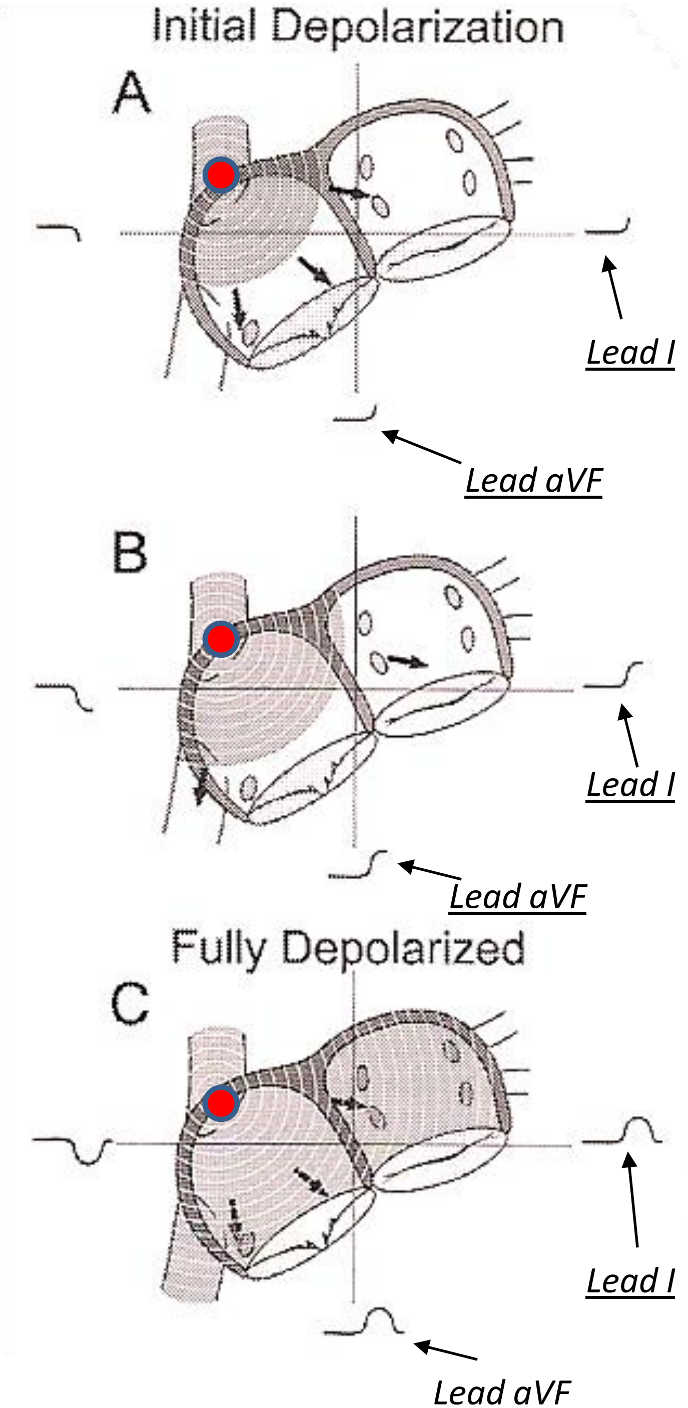
Generally speaking, when we ask "what is the axis?" we are referring to the QRS axis. However, you will also need to know what the P wave axis is to determine what the ***rhythm*** is (see next slide).

Since electricity flows top-to-bottom through both atria and ventricles, we would **expect both P and QRS to be upright in lead aVF**. How the QRS looks in lead I is very age-dependent. In the first few months of life, the right ventricle is relatively thick from all the work it did during fetal life. Since there is more myocardium on the right, this "pulls" the QRS axis rightward (QRS would be downward in lead I). In older kids, the left ventricle is dominant and this "pulls" the QRS axis to the left (QRS would be upright in lead I).

In our patient, the QRS is upright in leads I and aVF, and thus is **normal.**

3) What is the rhythm?

When we talk about rhythm, we are describing the cadence of the heart beating—what is dictating the cadence? Is it normal or abnormal?. "Normal sinus rhythm" means the cadence of the heart is dictated by the sinus node, at a normal rate. Thus, we need to figure out if the P waves look like they are coming from the sinus node, and we need to see that these P waves conduct normally to result in ventricular depolarization (that is, is there a P wave for every QRS?)



In the figure at right, we see that the sinus node (small red circle) lives in the high right atrium. Thus, when a signal is sent from the sinus node, electricity flows from the patient's right-to-left and from the patient's top-to-bottom. We see the corresponding signals in leads I and aVF this creates.

If we see P waves of normal morphology, at a normal rate, and that are associated with each QRS, we call this "normal sinus rhythm." Our patient's ECG is textbook normal sinus rhythm.