

The ECG at 2am

The Rules:

1. Be obsessive – do it the same way EVERY single time
2. When you see the obvious diagnosis immediately, refer to rule 1
3. This assumes your patient is conscious and you have time to look at an ECG rather than needing to call the crash-team.
4. This is just a guide to reading ECGs, not making diagnoses

*Remember, ECGs have to be simple otherwise Cardiologists wouldn't understand them. As you go through each step, **write** down the answer to each part. Get into this habit. When you read it all out at the end you will be impressed at how knowledgeable you sound for somebody without a clue*

I recommend buying a book of ECGs. There are several of these.

The Steps:

1. Rate
2. Rhythm
3. Axis
4. The p-wave and 'p-r' interval
5. How wide is the 'qrs' complex?
6. How tall is the 'qrs' complex?
7. The 's-t' segment
8. The 't' wave

Once you've practice with lots of ECGs, you can then add the last step

9. The small-print annoying stuff

Get your ECG and Start on the next page:

1. Rate

- Fast or Slow? Extremes of speed? – check rule 3 again.
- Count the number of large squares between two ‘r’ waves. Divide this number into 300 to get your beats per minute.

2. Rhythm

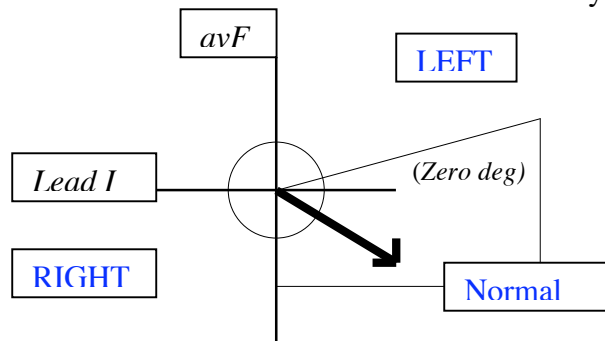
- Regular or Irregular? Get a piece of paper and mark on it three successive ‘r’-waves. Move it along the ECG and if it is regular the other r-waves should line up each time with the marks on your page. **DO THIS ON EVERY ECG.**
- Are there any ‘p’ waves – check lead II – (if none, consider a. fib)
- Does a ‘qrs’ complex follow each ‘p’ wave?
- Do you have too many ‘p’ waves? (consider atrial flutter)

3. Axis

This is made stupidly complex in the books. For 98% of the time, this will do.

Take the two perpendicular leads and construct an x-y axis like you do in maths.

- Label these ‘Lead I’ on the x-axis, and ‘Lead avF’ on the y-axis
- You are going to plot the net deflection above (positive) or below (negative) the iso-electric line. This is the ink line between beats when the machine just runs on until the next beat. Count the number of tiny squares above the line and subtract the number of little squares below the line in a ‘qrs’ complex. Plot the result on your graph.
- X-axis (Lead I) – is the same as the old maths graph – positive is towards the right
- Y-axis (avF) – is the reverse – you plot positive deflections **below** the X-axis.
- Plot the resultant vector line. This is the axis of the heart on your ECG. (*see diagram*)



Notes:

- A **normal** axis lies anywhere between +30 degrees backwards to 270 degrees (or –90 degrees).
- RIGHT** axis deviation is past 270-180 degrees.
- LEFT** axis deviation is from 30-90 degrees
- Once you’re into 90-180 degrees this is extreme axis deviation either way & refer to rule 3
- Please note where the zero degree reference point is on this graph

AGAIN, **DRAW THIS OUT** WITH EVERY SINGLE ECG YOU PRACTICE.

4. The ‘p’ wave & the ‘p-r’ interval

- Is this present and normal shape? *If you are interested in different shapes then see the footnotes below but only having doing hundreds of ECGs first.*

The ‘p-r’ interval is the time from the start of the ‘p’ wave to the tip of the ‘r’ wave. It should be a maximum of 5 small squares (or 1 large one, or 0.2 sec)

You look for the longest one on your ECG and if longer than it should be AND there is NO missing ‘qrs’ complexes then you consider 1st degree heart block.

- If you are missing ‘qrs’ complexes then see what is happening with the ‘p-r’ length. If it is getting longer and longer each time until it gets so long that you get the next ‘p’ wave before the ‘qrs’ had a chance to come in, this is 2nd degree heart block, Type 1 (Wenkebach). If the ‘p-r’ interval is the same length each beat and then suddenly you’re missing a ‘qrs’, this is 2nd degree heart block, Type 2

If there is no relationship between the ‘p’ wave and the ‘qrs’ complex, but they both seem to be beating away regularly – this could be 3rd degree heart block (a.k.a. complete heart block). The chambers are beating independently of each other and at their preferred rates – about 90 for the atria and 40 for the ventricles. *This rhythm needs pacing.*

5. How wide is the ‘qrs’ complex?

If you can’t see ‘p’ waves at all and the rhythm is 120 or more, this is the only time you are allowed to skip forward to this part in order to answer this one question:

Is the ‘qrs’ broad or narrow?

The ‘qrs’ should be no longer than 3 small squares. If it is a **broad complex tachycardia** then check consciousness of patient & call for help immediately.

Look at the shape of the ‘qrs’ on the chest leads (the ‘v’ leads – V1-V6)
Think of the words William and Marrow.

V1	V6
W i LL ia M	
M a RR o W	

Does the ‘qrs’ shape in V1 seem like a ‘w’ changing to look like an ‘m’ when you reach V6? This is LEFT bundle branch block.

The best thing about this is that one you’ve spotted it, you can confidently say “Left bundle branch block – no further interpretation of the ECG is possible!” BUT, in a person with chest pain, always assume this is a new development (i.e. indicating an evolving heart attack).

If the ‘qrs’ starts off in V1 like an ‘m’ and finishes in V6 looking like a ‘w’, then this suggests RIGHT bundle branch block.

6. How tall is the 'qrs' complex?

The size of the spike is in proportion to the amount of muscle in the relevant ventricle. Get suspicious if you see large spikes.

- RVH affects the **R**ight **H**and **S**ide (**RHS**) of the heart. You add together the number of small squares of the R-wave in V1 and the S-wave in V6 (or V5). Greater than **12.5** is suspicious. Look for **RIGHT** axis deviation.
- LVH is a **S**iniste**R** process, and luckily for us, **S**iniste**R** is Latin for 'Left'! This time you add the s-wave in V1 and the r-wave in V6 (or V5). More than **40** small squares is suspicious. Look for **LEFT** axis deviation.

The R-wave should get progressively bigger as you go from V1 to V6, starting around V3. It represents LV muscle mass. Poor r-wave progression means no muscle, & this suggests an old MI.

7. The 's-t' segment

- Simple – either up (infarction) or down (ischaemia – assuming no reciprocal changes elsewhere in the ECG). The infarct (i.e. elevated 's-t' segment) can look a little like a tomb-stone – not ideal to see on one's ECG...

8. The 't' wave

- Again, normal or inverted (think infarction or ischaemia).
Tall or *high* 't' waves – *high* potassium. "Hi T!", "Hi K!"

Finally....

Digoxin can cause ANY rhythm disturbance

Suggest Amiodarone as an answer to everything in the viva! Cardiac Domestos.

STOP HERE!

DO NOT read any further. Go away.

**Practice with lots of ECGs before reading the next
page**

No, seriously, STOP reading now. Go and practice ECGs
You're only going to confuse yourself if you haven't practiced...

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The small-print annoying stuff

This is pattern recognition. You learn these and run through them at the end of all of the above.

WPW – Wolff-Parkinson-White Syndrome

- This is where you have a very short ‘p-r’ interval. Look for it particularly in the lateral chest leads (i.e. V4, V5 & V6). It can be so short that it becomes part of the ‘qrs’ complex leading a slurred upstroke that looks like the Greek letter ‘delta’.
- This is because the atrial impulse isn’t delayed as normal in the Atrio-Ventricular node, but instead can be conducted down a quicker accessory path to the ventricles. The danger here is that an atrial tachycardia (e.g. atrial flutter) can be conducted directly (without any block) to the ventricle resulting in a ventricular tachycardia of the same rate and possibly ventricular fibrillation.
- NEVER EVER give these people digoxin, because it blocks the AV node and makes the problem much worse for the above reason.

S-I, Q-III, T-III

- A prominent S-wave in Lead I, a deep q-wave in Lead III and t-wave inversion also in Lead III might suggest a Pulmonary Embolism. This is rare, but everybody seems to know about it. **In actual cases of pulmonary embolism, the commonest change noted on ECG is simply a tachycardia – beware.**

Long Q-T Syndrome

- Congenital or acquired.
- Low K^+ , Mg^{2+} and Ca^{2+} cause it & drugs (oddly enough, a lot of antiarrhythmics). These people are more predisposed to a form of ventricular fibrillation (called torsades des pointes) & sudden death.

p-wave abnormalities

- This is really nit-picking here....
- Look at Lead II and Lead V1.
- Right atrial enlargement is dead easy – a large p-wave in both leads – more than 2.5 small squares
- Left atrial enlargement:
 - the p-wave has a bifid appearance in Lead II (like an ‘m’ or a McDonalds golden arches) and is wide (3 small squares)
 - you get a biphasic p-wave in V1. This is a p-wave which has a positive phase above the iso-electric line (like a normal p-wave) & then ALSO has a negative deflection below the line (this part must measure 1 small square deep x 1 small square long)