**ECG Interpretation**

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**Introduction:**
An ECG is an electrocardiograph, and it is a test which measures the electrical activity of the heart. It is important to understand the ECG because nearly every patient who comes into hospital will have one done. Diagnostically, it is a simple way to detect arrhythmias - a treatable cause of cardiac arrest.

**Method:**
There are 4 limb leads, and 6 chest lead. It is important that these are attached to the correct places.

**Limbs leads:**
- Red → right arm (Red = Right)
- Yellow → left arm (yeLLow = Left)
- Green → left leg (grEEN= splEEN)
- Black → right leg

**Chest leads:**
- V1 → 4th intercostal space, right sternal edge
- V2 → 4th intercostal space, left sternal edge
- V3 → between V2 and V4
- V4 → 5th intercostal space, midclavicular line
- V5 → 5th intercostal space, anterior axillary line
- V6 → 5th intercostal space, midaxillary line

**Breakdown of an ECG:**

- P wave = depolarisation of atria
- PR interval = time taken for impulse to be transmitted from atria to ventricles via AV node
- QRS complex= depolarisation of ventricles
- T wave = ventricular repolarisation
How to Read an ECG:

1. Check patient detail and date and time of ECG (easy, but very important!)

2. Rate:
   - Count number of large squares between QRS complexes
   - 300 divided by this number = heart rate in beats per minute
   - For example: 4 large squares between QRS’s. 300 / 4 = 75, so heart rate would be 75 beats per min
   - Over 100 bpm = tachycardia
   - Under 60 bpm = bradycardia

3. Rhythm:
   - Is the distance between QRS complexes regular or irregular? If unsure use card method.
   - Regular rhythm + P wave followed by QRS suggests sinus rhythm
   - If irregular, is it irregularly irregular? Consider AF

4. Axis:
   - An easy way to do this is by looking at leads I and II
   - If they are both positive, then the axis is likely to be normal
   - If lead I is positive and lead II is negative (ie they are Leaving each other) then the axis is likely to be deviated to the Left
   - If lead I is negative and lead II is positive (ie they are Reaching for each other) then the axis is likely to be deviated to the Right

5. Presence of P waves:
   - If there are no P waves + irregularly irregular rhythm → AF

6. P-R interval:
   - Normal = less than 1 large square
   - Prolonged = 1st degree heart block
   - Is every P wave followed by a QRS? If not, think 2nd or 3rd degree heart block.

7. QRS complex:
   - Look at width and height
   - Normal width= 3 small squares
   - Wide= conduction problem
   - Fast + fat QRS = ventricular tachycardia
   - Fast + fat + irregular QRS = ventricular fibrillation
   - Normal height= up to 5 big squares
   - Higher = left ventricular hypertrophy

8. ST segment:
   - Normally isoelectric, so should be flat
   - Depression suggests ischaemia
   - Elevation = infarction
     - Inferior infarct = II, III and aVf
     - Anterior infarct = V1 - V4
     - Lateral infarct = I, aVl and V6

9. T waves:
   - Abnormal if inverted in I, II and V4 – V6
   - Peaked in hyperkalaemia
   - Flattened in hypokalaemia
Common brady-arrhythmias:

1. Sinus Bradycardia
   - Heart rate less than 60bpm
   - ECG otherwise normal
   - Can be normal in fit patients
   - Can be present if patient on beta-blockers

2. 1st degree heart block
   - PR interval is prolonged
   - Due to delayed AV conduction

3. 2nd degree heart block
   - Type 1 (Wenckebach / Mobitz type 1) = progressive prolonging of PR interval, until a QRS complex is ‘dropped’ ie missed out. Can be normal / asymptomatic.
   - Type 2 (Mobitz type 2) = a QRS complex is ‘dropped’ without previous prolonging of PR interval. Always pathological and can lead to cardiac arrest.

4. 3rd degree heart block
   - There is no relation between P waves and QRS complexes
   - I.e. the ventricles beat independently of atrial rate

Bundle branch blocks:

1. Left bundle branch block
   - QRS complex makes ‘W’ shape in V1 and ‘M’ shape in V6
   - Remember ‘WiLLiaM’

2. Right bundle branch block
   - QRS complex makes ‘M’ shape in V1 and ‘W’ shape in V6
   - Remember ‘MaRRoW’

Common tachy-arrhythmias:

1. Sinus tachycardia
   - Heart rate over 100bpm
   - ECG otherwise normal
   - Normal response to stress

2. Atrial fibrillation
   - No discernible P waves + irregularly irregular rhythm

3. Supra-ventricular tachycardia
   - Narrow QRS + regular rhythm

4. Ventricular tachycardia
   - Broad QRS + regular rhythm
   - Ie fat and fast

5. Ventricular fibrillation
   - Broad QRS + irregular rhythm
   - Ie fat, fast and irregular