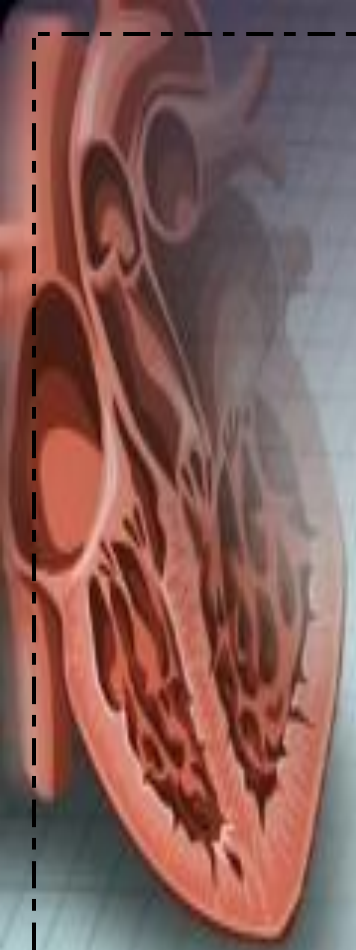

Cardiovascular Block

Physiology Team 430

4th Lecture

ECG

Practical

This Lecture is Done By :

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❖ What is ECG?

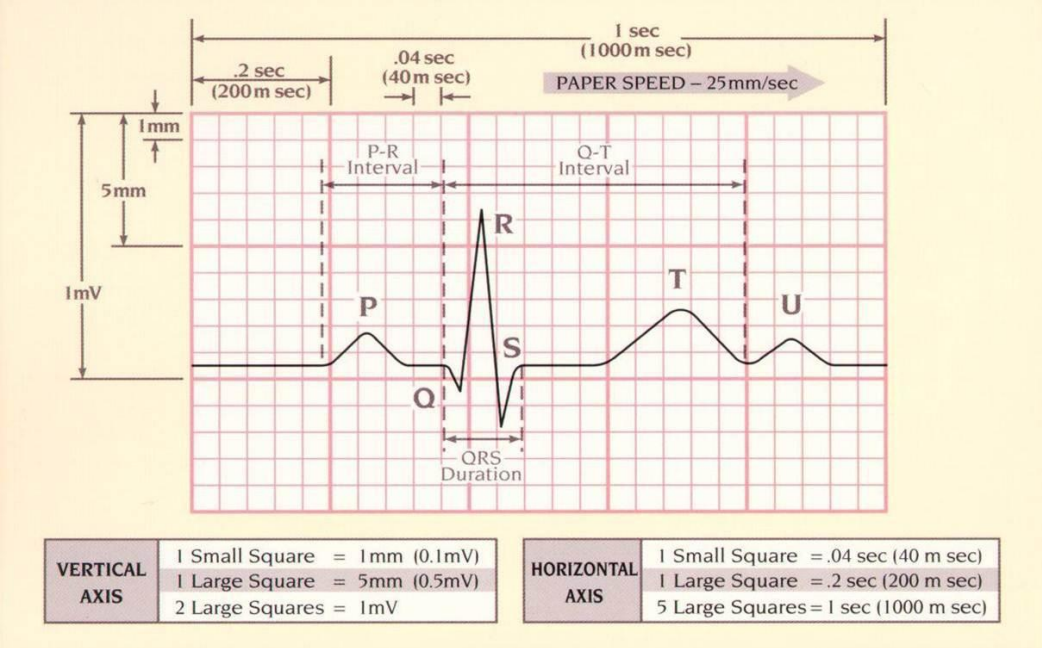
The Electrocardiogram: ECG is a recording of the electrical activity of the heart. ECG is the algebraic sum of all electrical activities produced in the heart.

❖ Why do we use ECG?

From ECG we can calculate heart rate, rhythm and cardiac axis and also can detect myopathies, electrolyte imbalances, ischemic heart diseases and conduction abnormalities.

❖ ECG paper, waves , intervals and segments

- ECG has a special paper and doesn't use the ink to write, it uses the heat to write. The speed of ECG paper is 25 mm/sec.



- The normal ECG includes the following :
  - P wave: Represents atrial depolarization
  - QRS complex: Represents ventricular depolarization Normal duration is between 0.08-0.1 sec.
  - T wave: Represents ventricular repolarization.
  - No atrial repolarization wave, Because atria repolarize during ventricular depolarization, so the wave is obscured by the large QRS complex .
  - The U wave caused by repolarization of papillary muscle. Not always seen in a normal ECG. If we see it, it can be due to hypokalemia (less K^+ in the blood).
  - Intervals and segments :

segment	From - to	Cause	Duration
P – R interval	**beginning of P wave to beginning of Q wave or R wave if Q wave is absent.**	**Atrial depolarization & conduction through AV node**	**0.12 – 0.2 second**
Q – T interval	**Beginning of Q wave to end of T wave**	**Electrical activity of ventricles**	**0.4 - 0.44 second**
S – T Interval	**End of S wave to the end of T wave**	**Plateau phase of Ventricular Action Potential and Ventricular repolarization**	**0.32 – 0.36 second**
QRS Duration	**beginning of Q wave to the end of S wave**	**Ventricular depolarization**	**0.08 – 0.1 second**

❖ How to calculate the Heart Rate (HR)

- Normal ECG paper has 1500 small squares in 1 minute.

  (1 small square = 0.04 second, so 5 small squares = 0.2 second, so 25 small square = 1 second, so 1500 small squares = 60 seconds or 1 minute)

- HR is calculated by measuring the number of small squares between 2 successive R waves and then dividing 1500 by the number of small squares between the R waves.

$$Heart\ rate = \frac{1500}{Number\ of\ small\ squares\ between\ R-R}$$

❖ The 12 ECG leads :

- ECG is taken from 12 different positions in the body.
- We have 6 limb leads and we always put 3 leads on the limbs only because the other 3 leads will be calculated by the machine mathematically.
- The 6 chest leads look at the heart in the horizontal plate but the other 6 leads (limb leads) look in the vertical plate.
  - **ECG leads** :

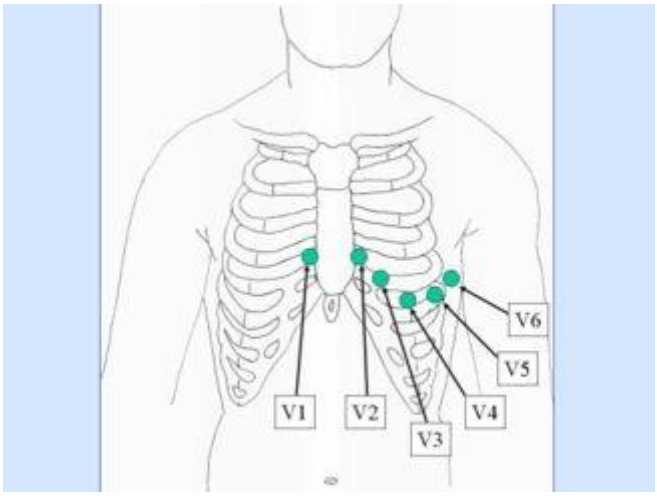
1- There are 3 standard bipolar limb leads called I, II & III.

→ Lead I: Between right arm (negative electrode) and the left arm (positive electrode)
→ Lead II: Between right arm (negative electrode) and the left leg (positive electrode).
→ Lead III: Between left arm (negative electrode) and left leg (positive electrode).

2- The augmented unipolar limb leads : aVR, aVL, aVF
It is a unipolar so one electrode active and the other inactive = zero

→aVR: the active electrode connected to the right arm while the inactive electrode at the apex of the heart .
→aVL: the active electrode connected to the left arm while the inactive electrode at the apex of the heart .
→aVF: the active electrode connected to the left leg while the inactive electrode at the apex of the heart .

3- Chest leads: (V1, V2, V3, V4, V5, and V6)



Electrode	Position
V1 (C1)	Fourth intercostal space at the right sternal edge
V2 (C2)	Fourth intercostal space at the left sternal edge
V3 (C3)	Midway between V2 and V4
V4 (C4)	Fifth intercostal space in the mid-clavicular line
V5 (C5)	Left anterior axillary line at same horizontal* level as V4
V6 (C6)	Left mid-axillary line at same horizontal* level as V4 & V5

❖ Heart rhythm:

- It is the time interval between heart beats.
- Normal sinus rhythm - heart rhythm controlled by sinus node at a rate of 60-100 beats/min; each P wave followed by QRS and each QRS preceded by a P wave.
- Sinus Bradycardia - a heart rate that is lower than 60 beats/minute and each QRS is preceded by a P wave.
- Sinus Tachycardia - a heart rate that is higher than 100 beats/minute and each QRS is preceded by a P wave.
- What is the sinus arrhythmia: it is an irregular cardiac rhythm in which the heart rate usually increases during inspiration and decreases during expiration. It is common in children and young adults and has no clinical significance except in elderly patients.

Incomplete AV Block:

Note: (Normal P-R interval = 0.12 – 0.20 second)

Type	P-R interval	Features
1st Degree Block	**> 0.20 sec**	- prolonged - a delay of conduction from the atria to the ventricles BUT not actual blockage of conduction
2nd degree block	**0.25 – 0.45 sec (Progressively prolonged P-R interval till QRS is missed or Normal P-R interval with frequently missed QRS)**	- only few impulses pass to the ventricles - atria beat faster than ventricles - dropped beat of ventricles (there will be an atrial "P" wave BUT no "QRS-T" wave sometimes)
3rd Degree Block		- complete AV block - Complete dissociation of P wave and QRS waves

❖ Cardiac axis :

The ECG can be used to identify the direction of travel of the wave of depolarization through the heart.

How to calculate the cardiac axis:

You should have the ECG paper and you will look mainly at the QRS complex in Lead I & Lead III or AVF. But first determine which thumb is for lead I and which is for lead III. Then see the QRS complex in lead I, check if it positive (upwards) or negative (downwards) .You will place your thumb upward if it was positive and so on .This way , you will have one of the three results below :

1. Normal Axis :
   Both lead I & lead III are positive, therefore both your thumbs will be directed upwards
   Normal cardiac axis is usually within - 30 to + 110

2. Left axis deviation:
   Also called (divorce phase) - Lead I will be positive but lead III will be negative; therefore your thumbs will be in opposite directions.

⊡ Causes of left axis deviation :
- ✓ Left bundle branch block:
- ✓ Left ventricular hypertrophy (hypertension).

3. Right axis deviation :
   Also called (kiss phase) - Lead I will be negative but lead III will be positive; therefore your thumbs will meet.

⊡ Causes of right axis deviation :
- ✓ Right bundle branch block:
- ✓ Right Ventricular Hypertrophy.