



Physiology Lab -ECG

P. s : I intended writing a review before getting into the lab , as it may help you to have a full , better understanding .

Quick review :

- In ECG , **12 standard leads** are used which in turn help us to view the changing pattern of cardiac electrical activity from different perspectives as certain abnormalities are best seen with particular leads while not seen with others .

- **How to connect the 12 leads ?**

(1) **6** chest **unipolar** leads :

V 1 → 4th intercostal space , to the right of the sternum .(RV)

V 2 → 4th intercostal space , to the left of the sternum.

(Interventricular septum)

V 4 → 5th intercostal space , in the left midclavicular line .

(Anterior of LV)

V 3 → (between V2 and V4) in the 5th intercostal space to the left of the sternum.(anteroseptal of LV)

V 5 → 5th intercostal space , in line with AAL .(Anterolateral of LV)

V 6 → 5th intercostal space , in line with MAL.(Lateral of LV)

(2) **3** **unipolar** limb leads :

aVR → right arm .

aVL → left arm .

aVF → left foot .

(3) **3** **bipolar** limb leads :

Lead I → rt arm , lt arm .

Lead II → rt arm , lt leg .

Lead III → lt arm , lt leg .

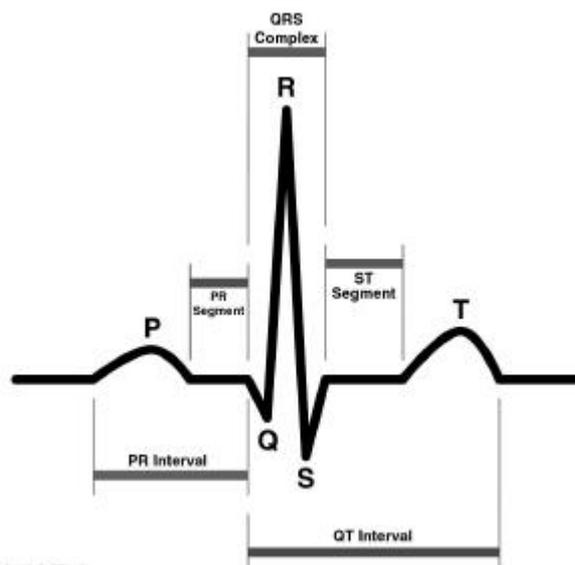
Colors of leads , you must be familiar with them :

- Left arm : **Yellow** .
- Right arm : **Red** .
- Left leg : **green** .
- Right leg : **Black** (Neutral) .

-Watch out , when connecting the leads to choose a **clean** , **hairless** area and make sure that the patient isn't wearing a metallic pieces as these things may affect the ECG recording , and there will be a noise .

-We must put some gel on the area where the electrodes are to be connected; as it **facilitates conduction** between the skin and the electrodes .

ECG paper :



Waves :

- P wave → atrial depolarization .
- QRS wave → ventricular depolarization .
- T wave → Ventricular repolarization.

Segments :

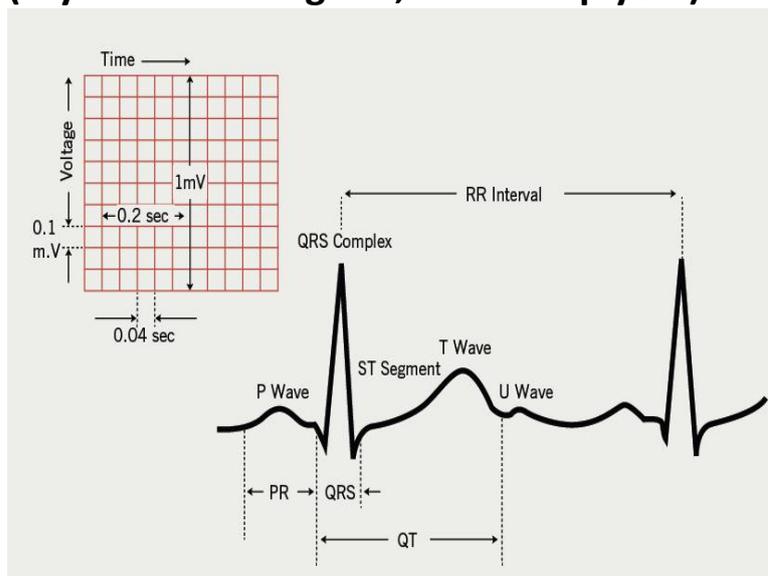
- PR segment → atrial plateau / atrial contraction.
- ST segment → ventricular plateau / ventricular contraction.

Intervals :

- PR interval (or PQ) → atrial depolarization , contraction , initial depolarization of ventricles .
- QT interval → ventricular action potential (depolarization + repolarization).
- TP interval → the region between the end of the T wave (ventricular repolarization or electrical inactivation) and the next P wave (atrial depolarization or electrical activation).

Calculations (HR + Voltage) :

(Try to use this figure , it will help you)



- Standard speed of ECG-machines is : **25mm/sec** .

So if each 25 mm → 1 sec , then each 1mm is → **0.04 sec** .

↓ you get the following ↓

Each small square (**1mm**) → **0.04 sec** .

Each large square is → **.2 sec** .

Voltage

The voltage is recorded from the leads is also standardized on the paper where **1 mm = 1 mV** (or between each individual block vertically) This results in:

5 mm = 0.5 mV (or between 2 dark horizontal lines)

10 mm = 1.0 mV

Heart rate calculation:

(1) Heart Rate = $1500 / \text{small boxes between QRS complexes}$.
(RR interval : 1 beat : between the QRS complexes)

(2) This method is much easier , in addition to the previous one : (Written in your theory slides , but explained here)

* Normal range at rest is between 60-100 (bpm).

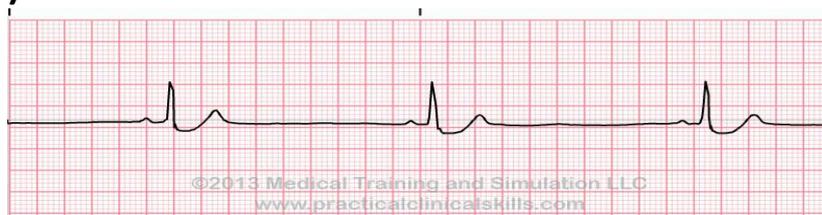
to go by RR interval, If it is 1 big box (0.2 secs) then the rate is $60 / 0.2 = 300$ bpm.

The rest of the sequence would be as follows.

- 1 big box = 300 beats/min (duration = 0.2 sec)
- 2 big boxes = 150 beats/min (duration = 0.4 sec)
- 3 big boxes = 100 beats/min (duration = 0.6 sec)
- 4 big boxes = 75 beats/min (duration = 0.8 sec)
- 5 big boxes = 60 beats/min (duration = 1.0 sec)

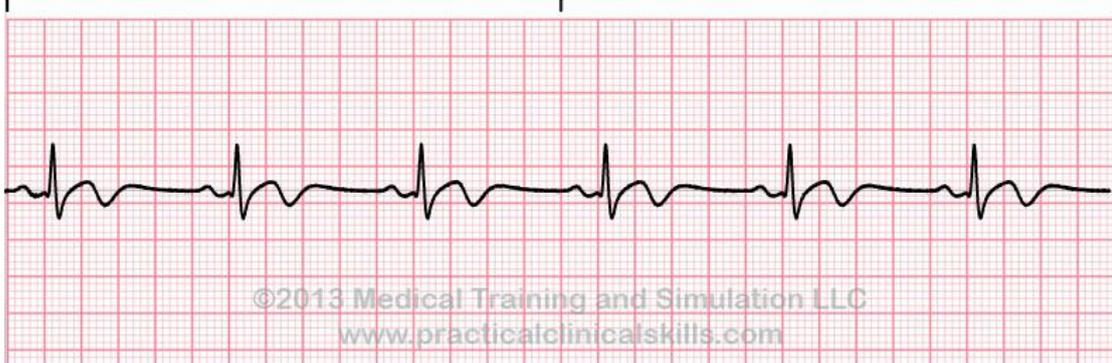
Try to figure out the HR in the followings , check your answers at the end of this sheet :

1)



- A. 30bpm .
- B. 50 bpm.
- C. 60 bpm .
- D. 70 bpm .

2)



- A. 80 bpm .
- B. 90 bpm .
- C. 60 bpm .
- D. 30 bpm .

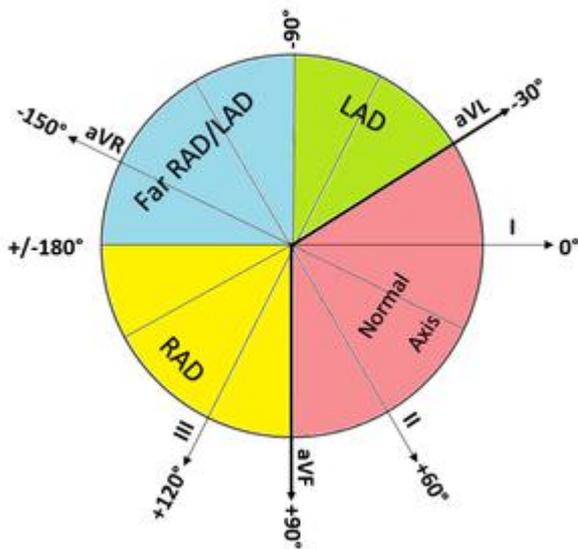
Heart Axis :

It is the major direction of the overall electrical activity of the heart .

- To determine the heart axis, the limb leads (not the precordial / chest leads) need to be examined .

P.s :

(This is very important for you to know , the **chest leads aren't used** in determining the axis . In addition , you will find in the majority of certified references that it is the bipolar limb used which used in determining the axis , and in others take it as limb leads in general both unipolar and bipolar **'the doctor used Bipolar limb leads not unipolar ones '**)



Normal Heart Axis = -30° to $+110^{\circ}$.

When it becomes abnormal ?

imagine if the LV is dilated ,the voltage in the LV will notably increase , so the axis goes to the left and this is called Left Axis Deviation (LAD) .

What if the the RV is dilated ? the opposite goes on , and you will have what's called Right Axis Deviation (RAD).

If both ventricles were dilated ?! The axis will be normal ! , but remember if the 2 Vs were dilated the patient will have very severe clinical manifestations , when you see it , you can easily know that he isn't physically stable (المريض تعبان جداً).

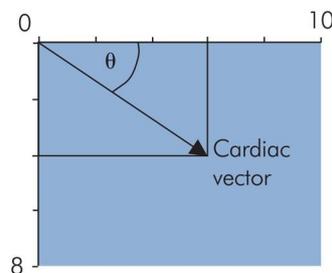
See this example , explained :



Lead I
QRS amplitude
 $= 8 - 2 = 6$



Lead aVF
QRS amplitude
 $= 5 - 1 = 4$



1. You must choose 2 leads at least , and you may work out the axis using the 3 leads , and remember chest leads aren't used .
2. You Calculate the positivity and negativity of the QRS wave , add them together , if the net is + , go to the right with steps equal to the net you get (ex , you get +4 you go to the right 4 steps and so on).
3. If it was negative , you go to the left .
4. Draw a perpendicular line from each point , and determine the convergence point of them together .
5. From this point you can draw the cardiac axis , and determine whether it is normal or there is a case of deviation according to the figure included here .

In future , you won't work out all of these calculations , with practice once you see the ECG-paper with very high R waves then the axis is going to the right , more negative then it is going to the left . You must be familiar with normal ECG , to be able to figure out whether what you see is normal or abnormal . (It is all about practice).

Answers :

1) A.

2) C .

End of this handout