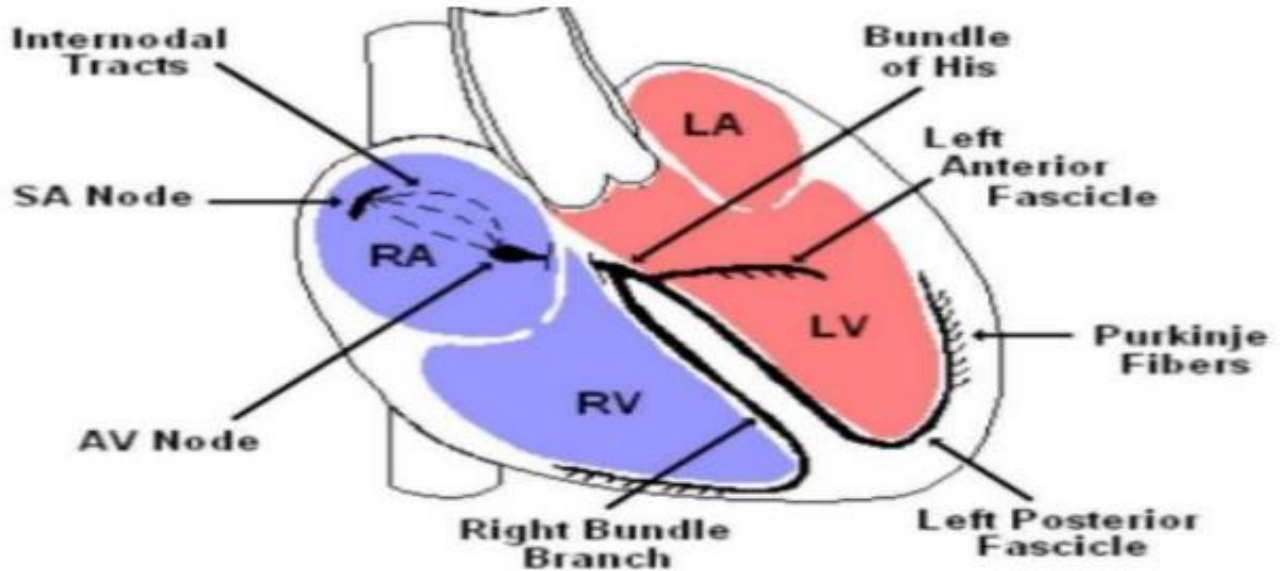


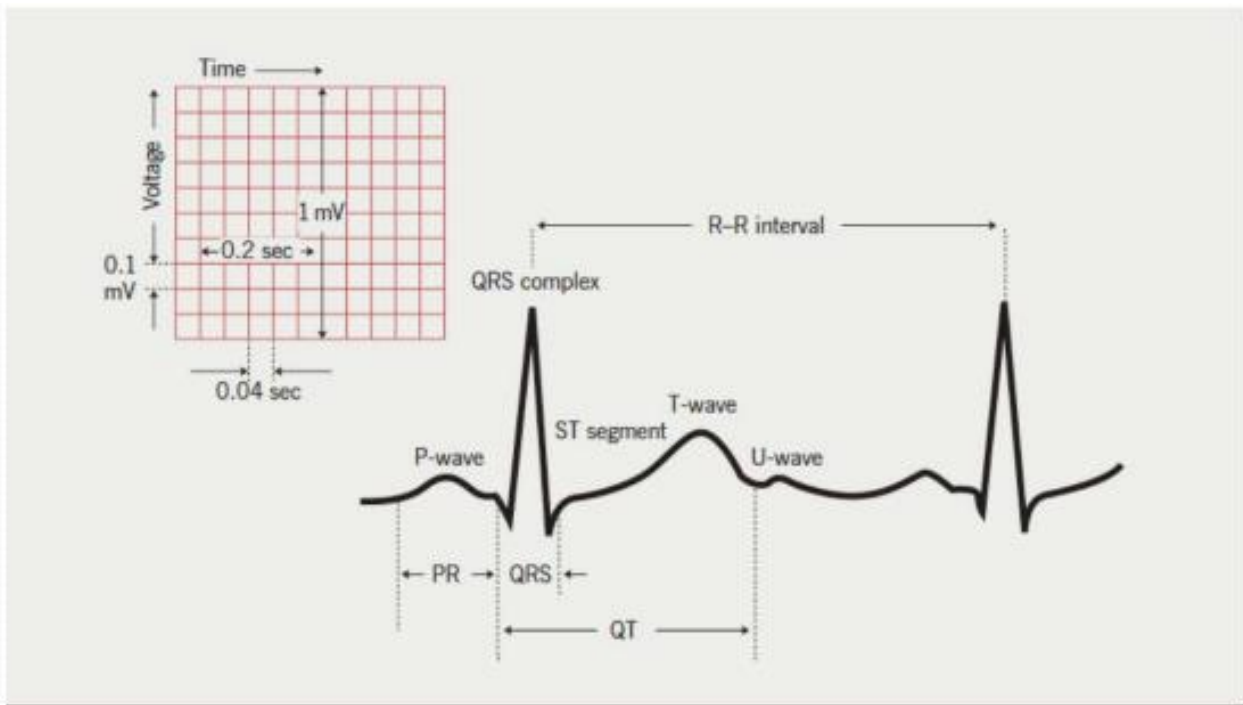


The Normal Conduction System



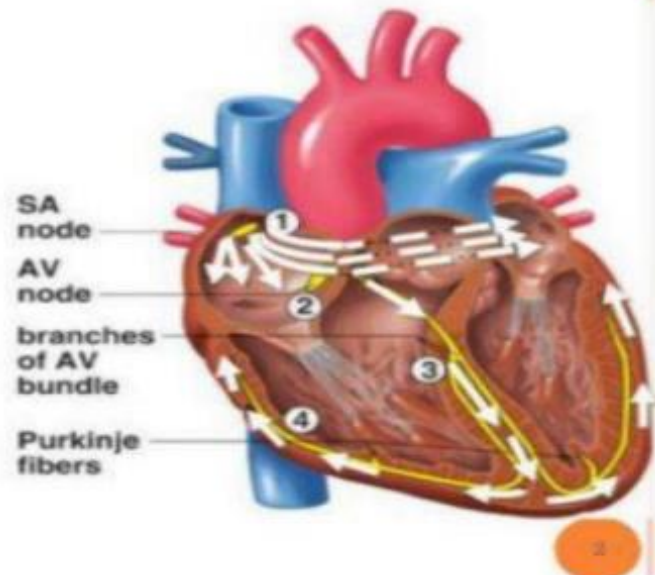
An **electrocardiogram** or ECG, records electrical activity in the heart. An ECG machine records these electrical signals across multiple heart beats and produces an ECG strip.

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lecturer.Waleed Khalid



SIGNAL PROPAGATION IN HEART

1. Stimulus originates in the SA node and travels across the walls of the atria, causing them to contract.
2. Stimulus arrives at the AV node and travels along the AV bundle
3. Stimulus descends to the apex of the heart through the bundle branches
4. After stimulus reaches the Purkinje fibers, the ventricles contract.





What are the components

- It is waveform components that consist of the electrical events during one heart beat.
- The waveforms are labeled as P, Q, R, S, T and U.

P wave

- P wave is the first short upward movement of the ECG tracing. It indicates that the atria are contracting, pumping blood into the ventricles.
- Amplitude: 2-3 mm high The P-wave should be 2–3 small squares in duration
Duration: 0.06 - 0.12 sec.

QRS complex

- The QRS complex, normally beginning with a downward deflection, Q; a larger upwards deflection, a peak (R); and then a downwards S wave. The QRS complex represents ventricular depolarization and contraction.
- Amplitude: 5-30 mm high
The QRS complex should be 1.5–2.5 small squares in duration, Duration: 0.06 - 0.10 sec.

PR interval ● The PR interval indicates the transit time for the electrical signal to travel from the sinus node to the ventricles. ● Duration: 0.012 - 0.20 sec ● The PR interval should be 3–5 squares in duration.

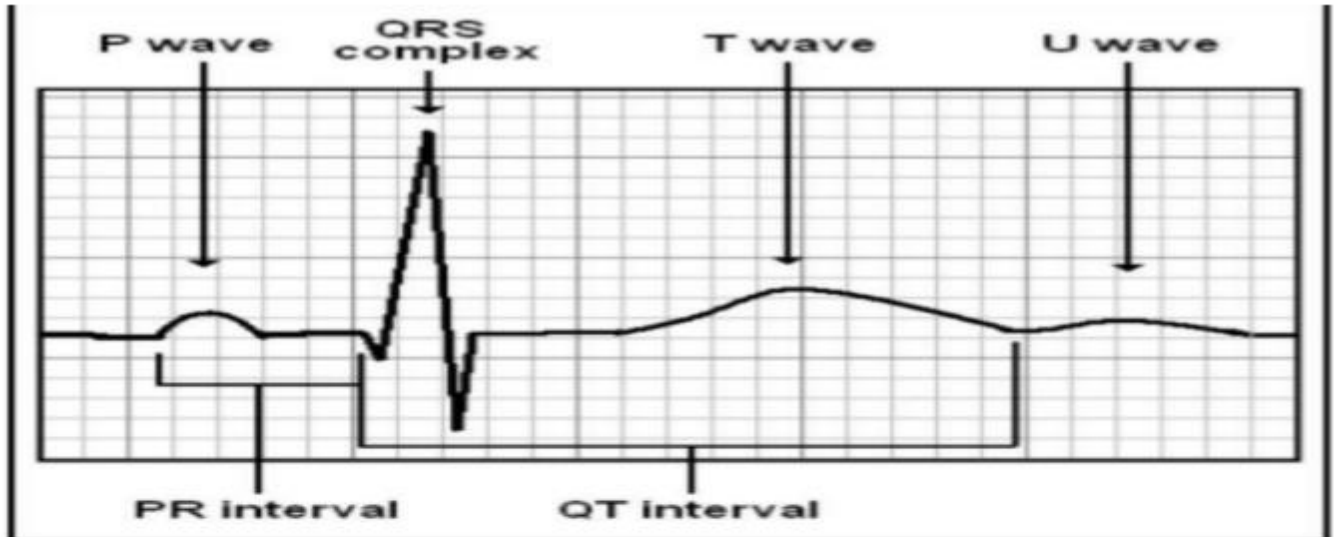
QT interval

- The QT interval should be 9–11 small squares

T wave ● T wave is normally a modest upwards waveform representing ventricular repolarization ● Amplitude: 0.5 mm in limb leads Duration: 0.1 - 0.25 sec.



Waveforms and Intervals



Normal ECG

5 waves : P, Q, R, S, T

- ❖ P wave : caused by atrial depolarization [Less than 2.5 small square (H&V)]
- ❖ QRS complex: caused by ventricular depolarization [< 2.5 small square]
- ❖ T wave :caused by ventricular repolarization
- ❖ Intervals :
 - ✓ P-R interval = 0.12 -0.2s (3-5 ss)
 - ✓ QT-interval = At normal HR: $QT \leq 11$ small square .



ECG Leads:

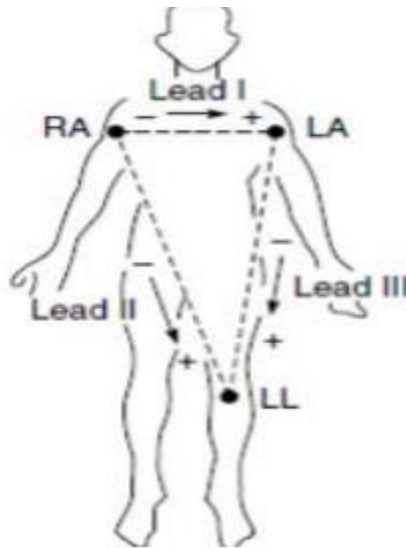
The electrocardiograph (ECG) is a device, which records the electrical activity of the heart. ECG provides valuable information about a wide range of cardiac disorders such as the presence of an inactive part (infarction) or an enlargement (cardiac hypertrophy) of the heart muscle.

→ The standard ECG has 12 leads: →

- 3 Standard Limb Leads

→ 3 Augmented Limb Leads

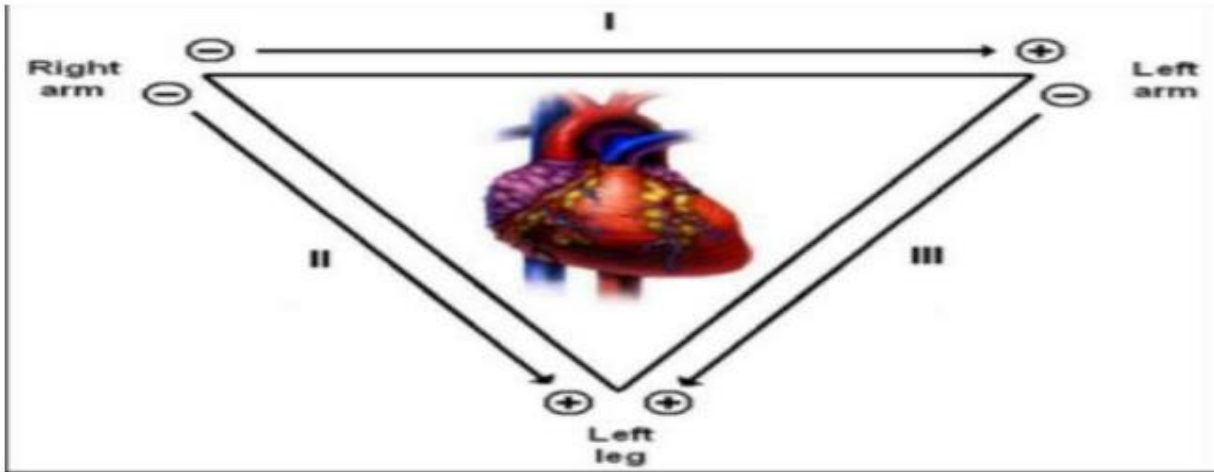
-6 Precordial Leads The axis of a particular lead represents the viewpoint from which it looks at the heart.



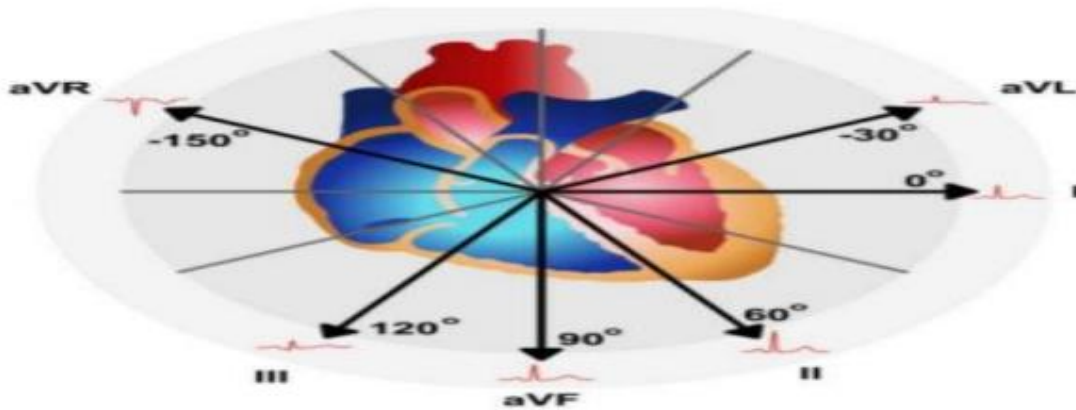
RA = right arm, LA = left arm, and LL = left leg with the right leg as the reference point



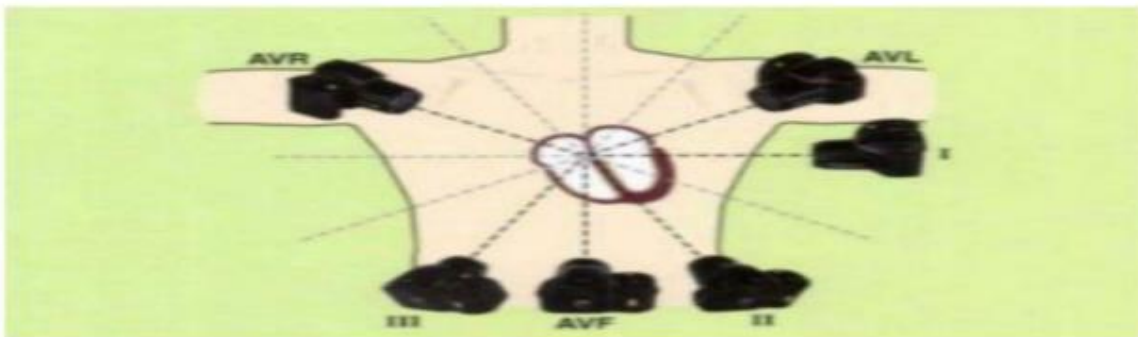
Standard Limb Leads



All Limb Leads



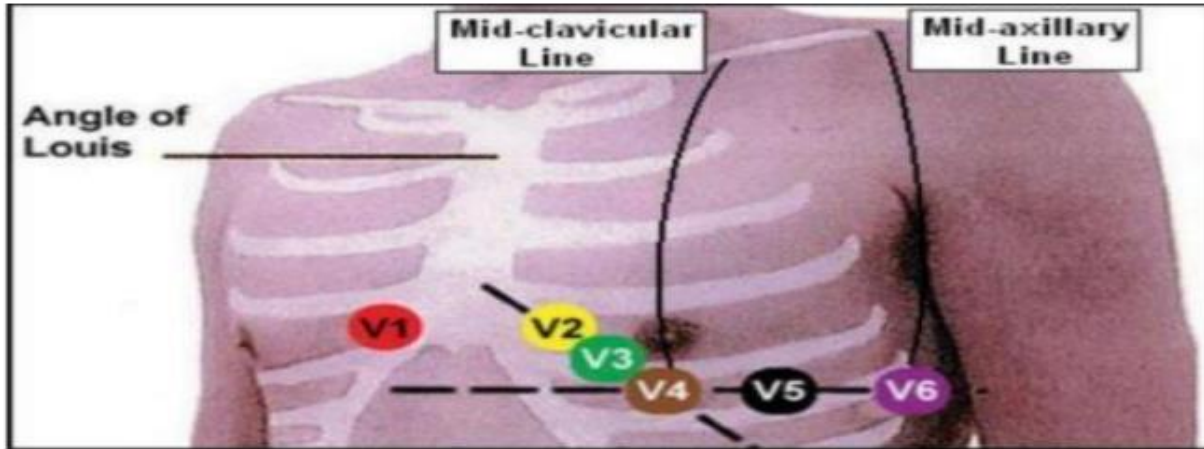
Limb leads as camera











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Precordial Leads



-  **V₁** 4th intercostal space to the right of the sternum
-  **V₂** 4th intercostal space to the left of the sternum
-  **V₃** Directly between the leads V₂ and V₄
-  **V₄** 5th intercostal space at midclavicular line
-  **V₅** Level with V₄ at left anterior axillary line
-  **V₆** Level with V₅ at midaxillary line
(directly under the midpoint of the armpit)

4 Limb electrodes

- | | |
|-----------|--------|
| Right Arm | Red |
| Left Arm | Yellow |
| Left Leg | Green |
| Right Leg | Black |



Lab 8.....2nd year



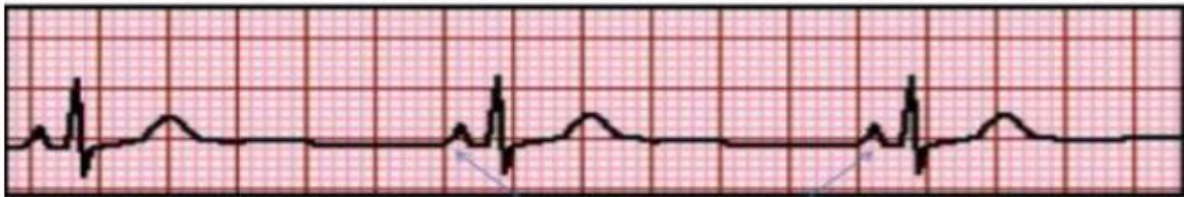
Determining the Heart Rate

- ❖ Rule of 300 for regular rhythm
- ❖ 10 Second Rule for irregular rhythm

Rule of 300

- Take the number of “big boxes” between neighboring QRS complexes, and divide this into 300. The result will be approximately equal to the rate
- Although fast, this method only works for regular rhythms

What is the heart rate?



$(300 / 6) = 50 \text{ bpm} = \text{sinus bradycardia}$

Normal heart rate = 60 – 100 bpm

The Rule of 300

- ✚ It may be easiest to memorize the following table:



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# of big boxes	Rate
1	300
2	150
3	100
4	75
5	60
6	50

10 second Rule

- As most ECGs record 10 seconds of rhythm per page, one can simply count the number of beats present on the ECG and multiply by 6 to get the number of beats per 60 seconds.
- This method works well for irregular rhythms .



Rate estimation cont. rule of 300

