Department of Anesthesia Techniques

Title of the lec4: ECG and Arrhythmia

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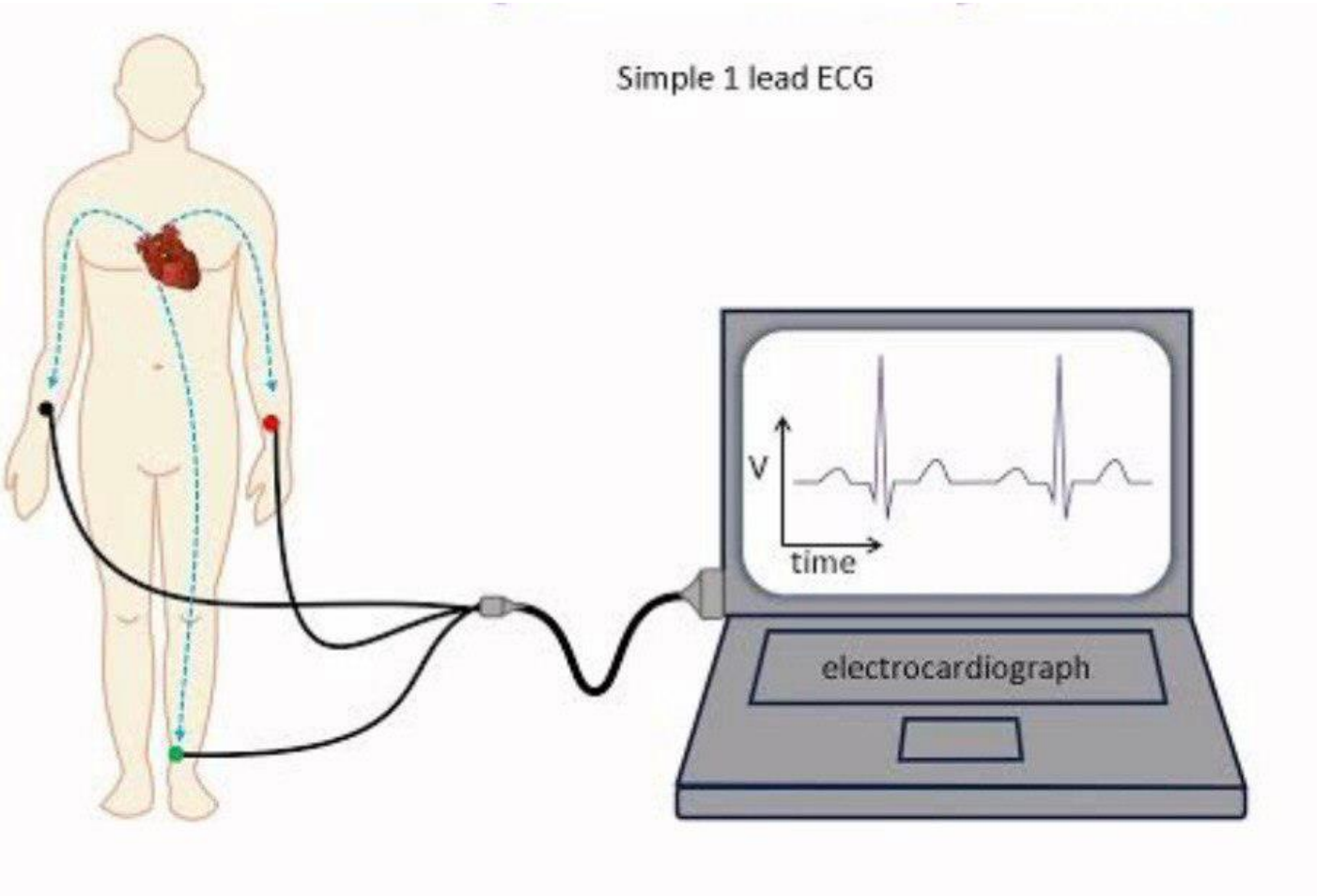
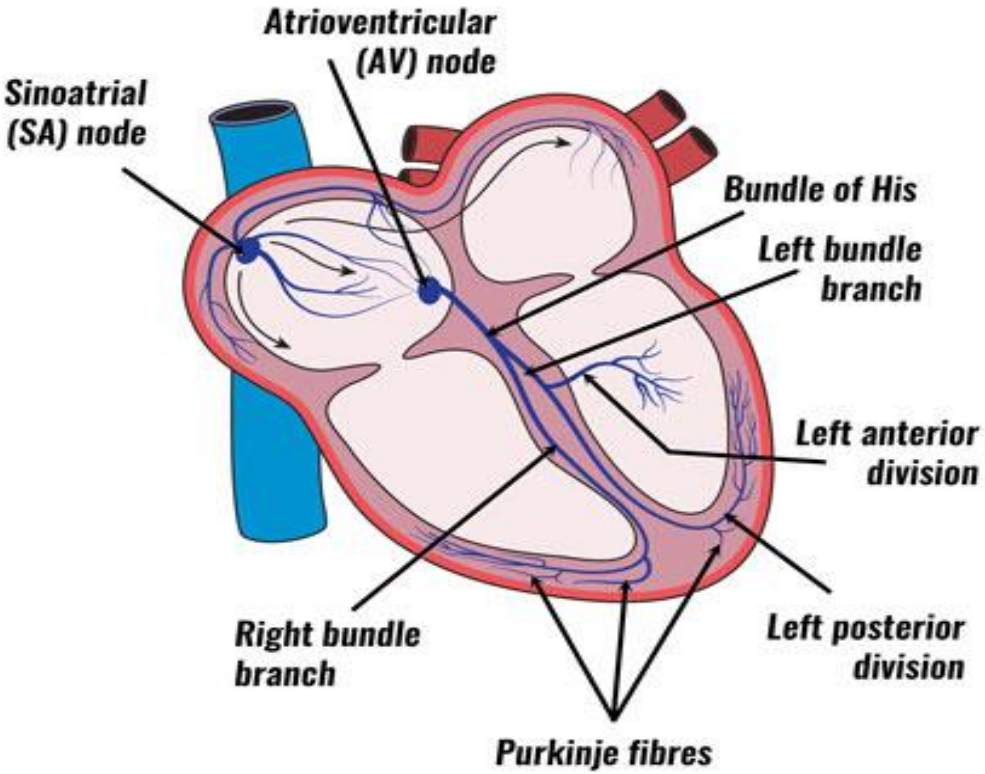
Electrocardiogram (ECG)

- Electrocardiography is a process of recording electrical activities of heart muscle at skin surface. The electrical current spreads into the tissues surrounding the heart, a small of these spread toward the surface of the body.
- Most the electrocardiograph machines amplify and record the electrical activity on a moving strip of paper. The record from this procedure is termed an electrocardiogram.



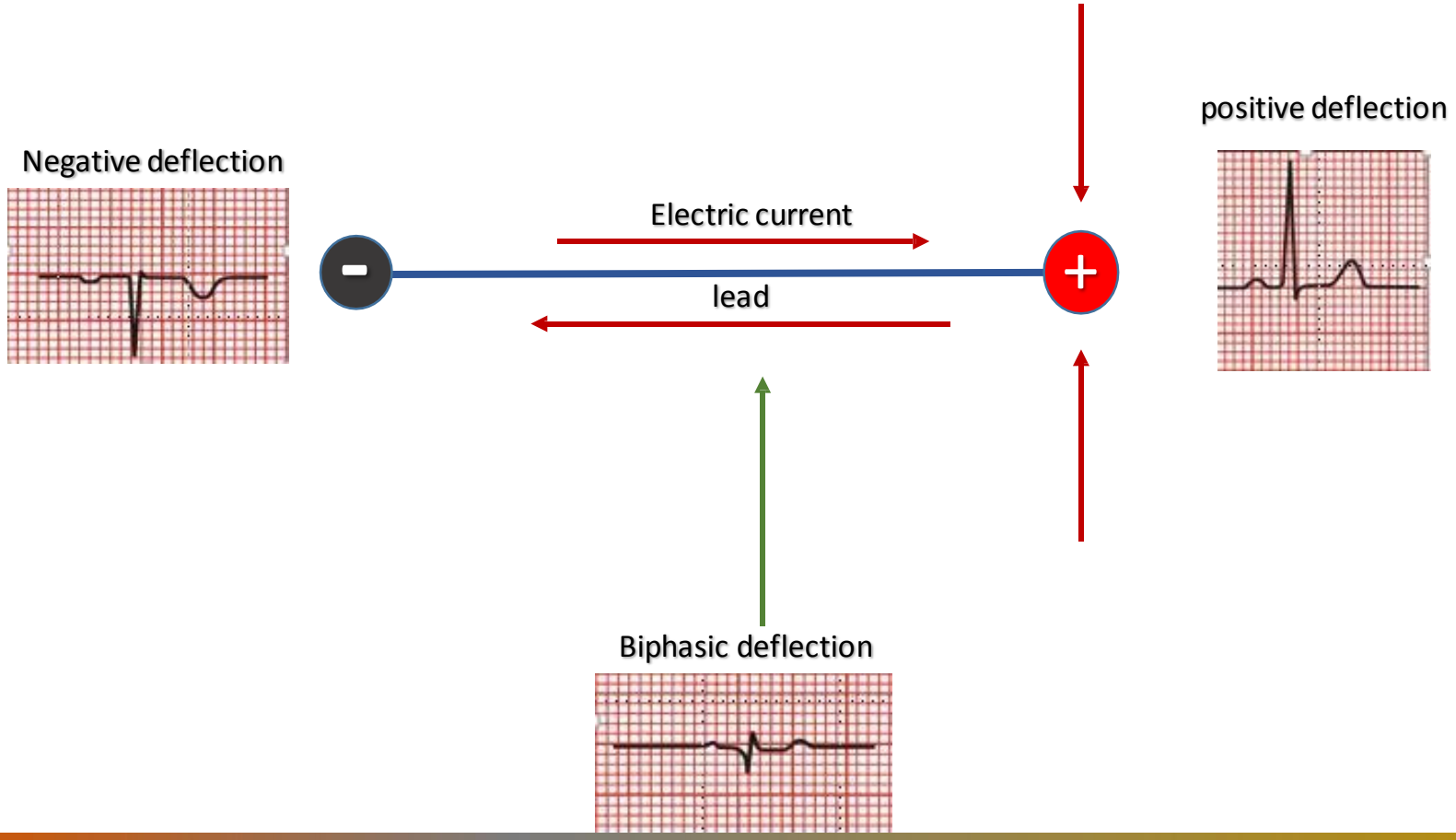

Simple 1 lead ECG
V
time
electrocardiograph

Electrical Conduction System of Heart



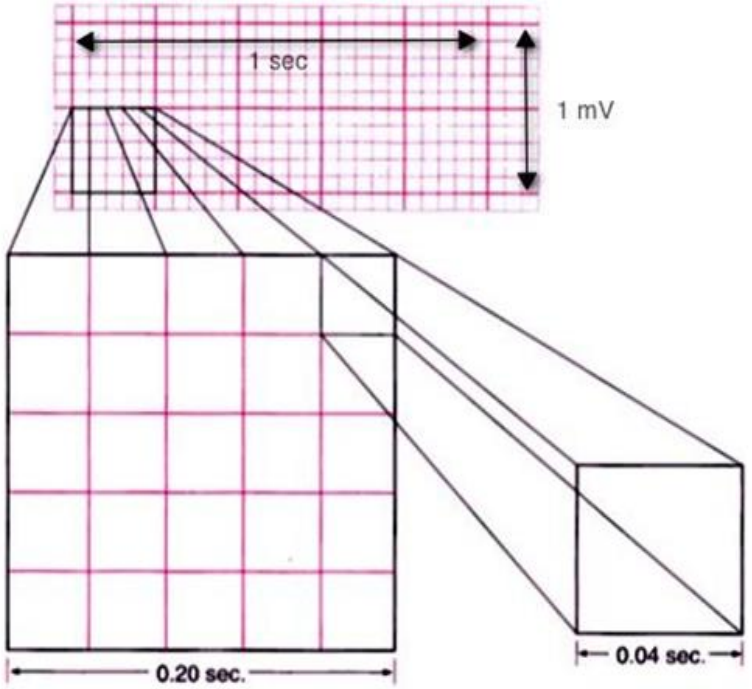
Introduction

- Depolarization moving toward an active electrode produces a positive deflection, whereas moving in the opposite direction produces a negative deflection
- The magnitude of depolarizing wave is determined by mass of tissue.

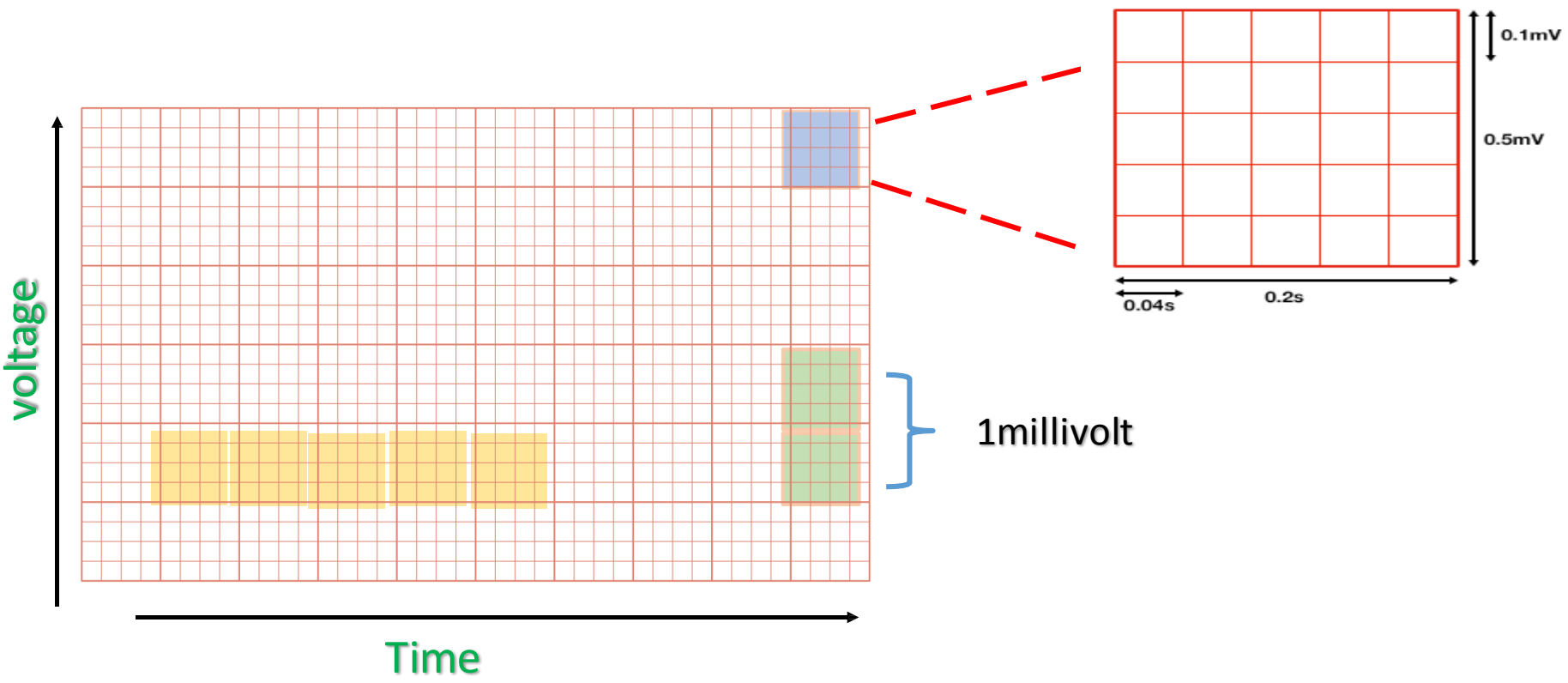

Negative deflection
Electric current
lead
positive deflection
Biphasic deflection

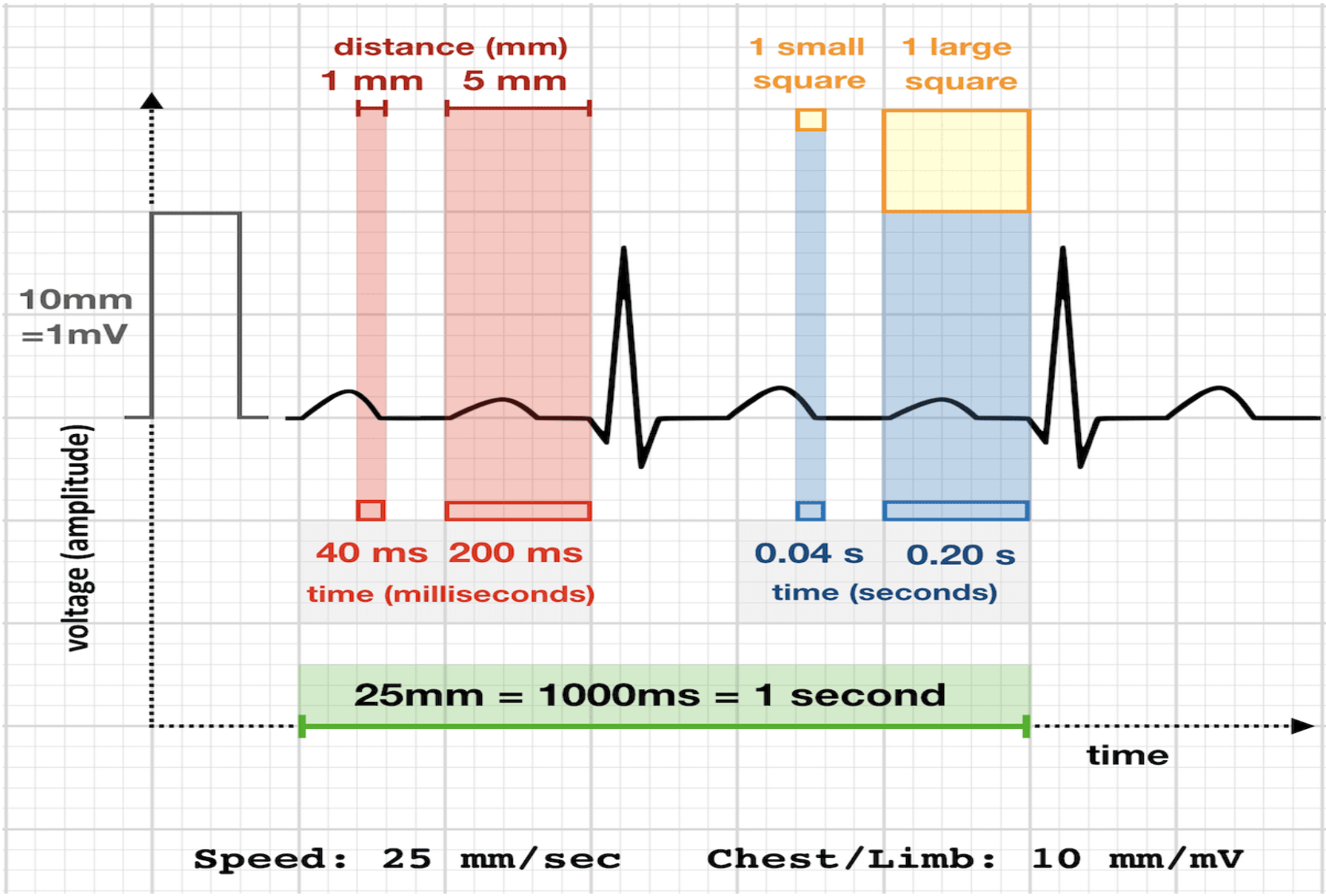
Introduction

- The horizontal axis of the ECG paper records time, each 25 millimeters (5 large squares) in the horizontal direction is 1 second, and each 5 millimeters (5 small squares) represents 0.20 second.
- The 0.20-second intervals are then broken into five smaller intervals, each of which represents 0.04 second.
- The vertical axis records ECG amplitude (voltage).



ECG paper




distance (mm)
1 mm
5 mm
1 small square
1 large square
10mm =1mV
voltage (amplitude)
40 ms
200 ms
time (milliseconds)
0.04 s
0.20 s
time (seconds)
25mm = 1000ms = 1 second
time
Speed: 25 mm/sec
Chest/Limb: 10 mm/mV

The normal electrocardiogram of one cardiac cycle is composed of:

1- P wave is produced by atrial depolarization.

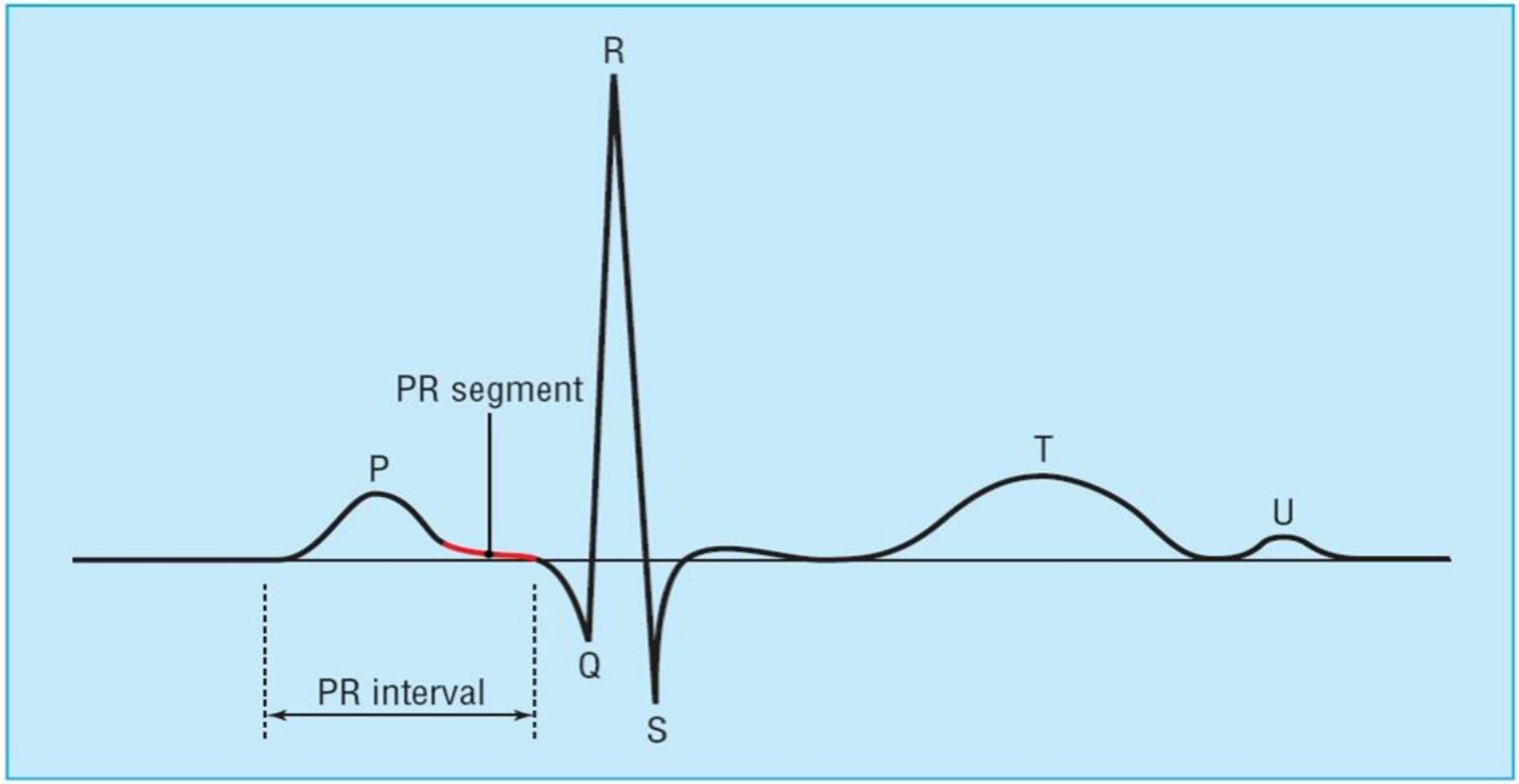
2- PR segment is isoelectrical, between end of P wave and beginning of QRS wave. It is due to delay in conduction of cardiac impulse through AV node.

3- PR or PQ interval is between the beginning of P wave and beginning of Q or R wave (0.12 – 0.2 s).

4- QRS complex wave represents the ventricular depolarization (1 mv, not exceed 0.12 s). The atrial repolarization wave is usually obscured by much larger QRS complex wave.

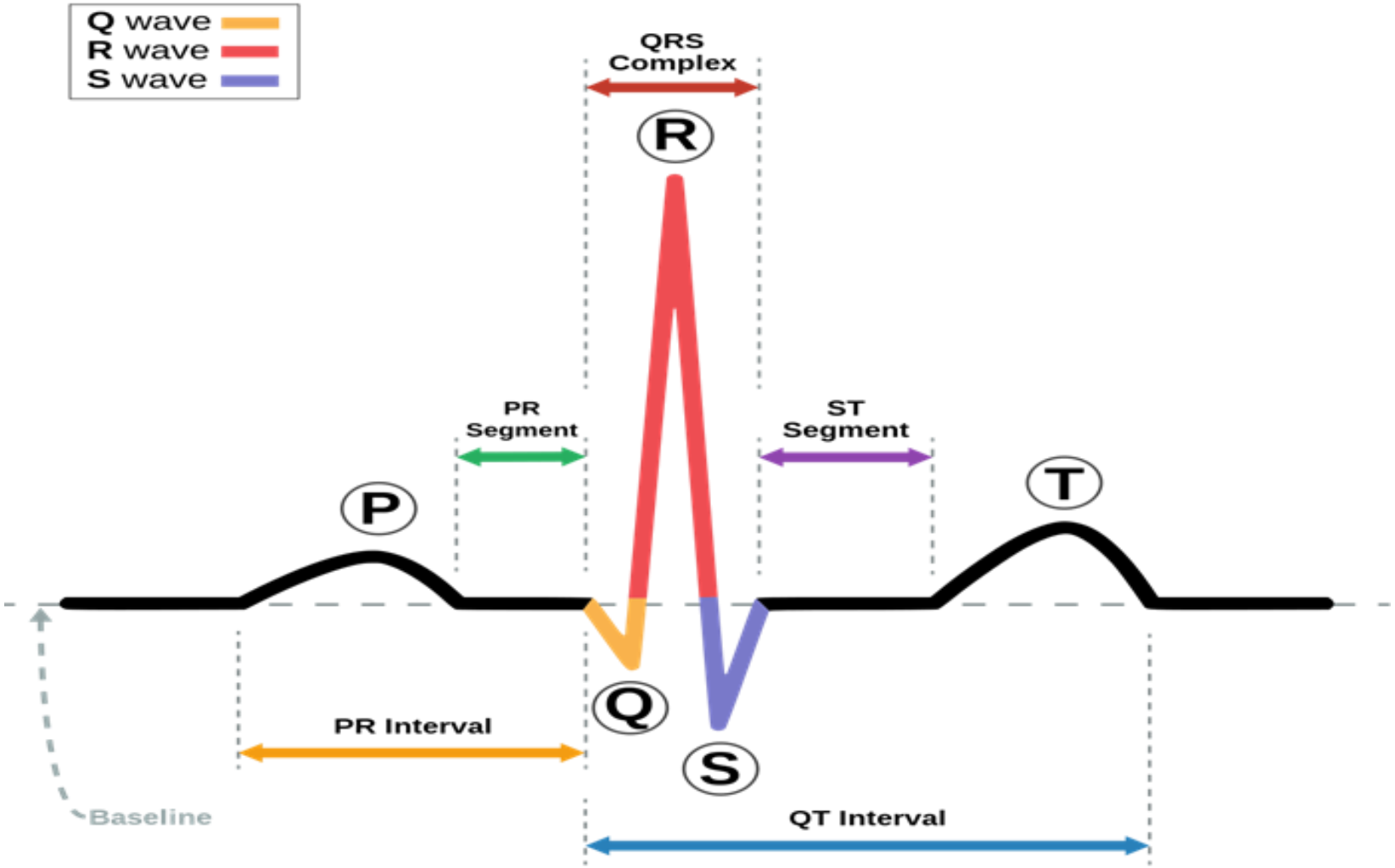
5- ST segment is from end of S wave to beginning of T wave. It is coincides with the plateau of ventricular action potential.

6- QT interval which is measured from the onset of QRS complex to end of the T wave. (0. 35 – 0.45 s).

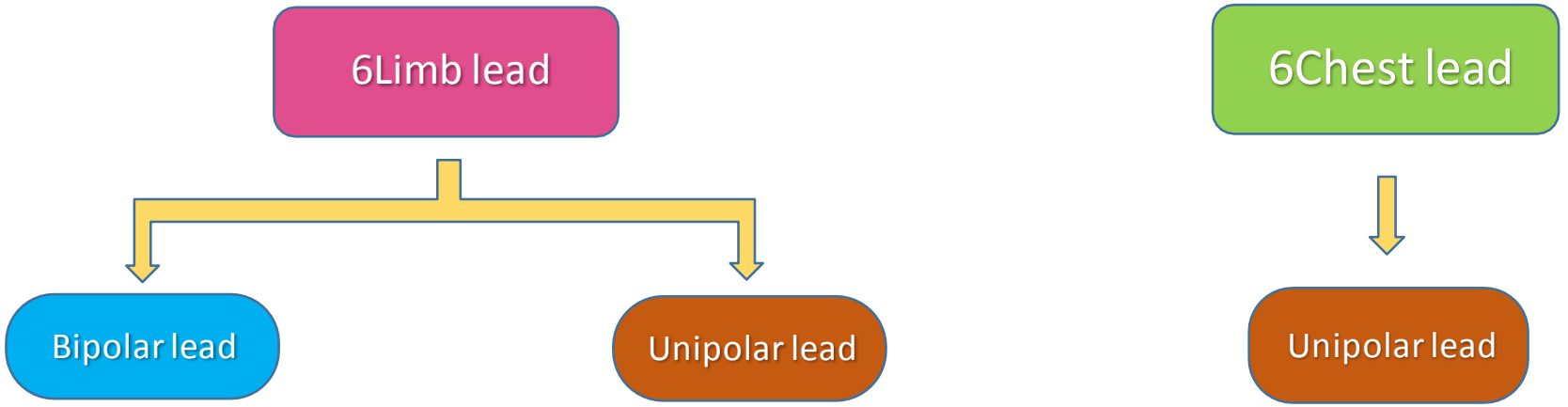


Normal duration of PR interval is 0.12-0.20 s (three to five small squares)

The normal electrocardiogram of one cardiac cycle is composed of:



The standard ECG is composed of six limb leads and six chest leads



Lead I
Lead II
Lead III

Augmented voltage right arm(AVR)
Augmented voltage left arm(AVL)
Augmented voltage left foot (AVF(

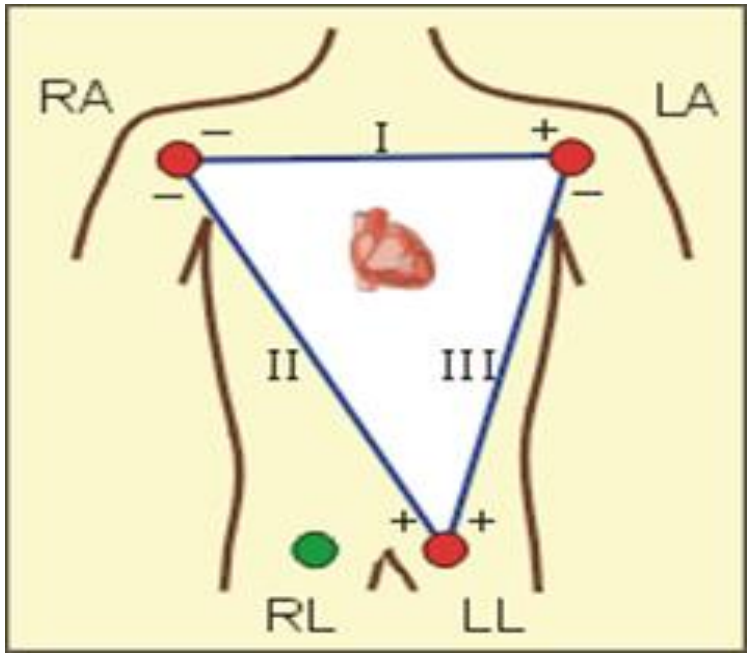
V1.V2
V3.V4
V5.V6

Types of leads:-

1- Bipolar limb leads: Bipolar leads were used before unipolar leads were developed. The standard limb leads —leads I, II, and III

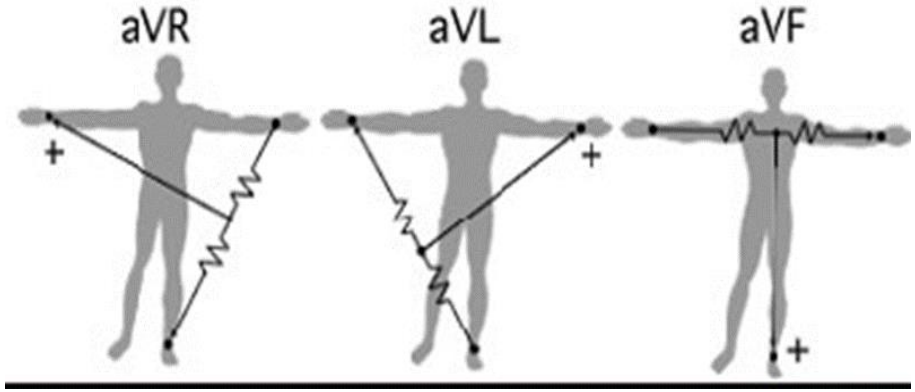
- each record the differences in potential between two limbs.

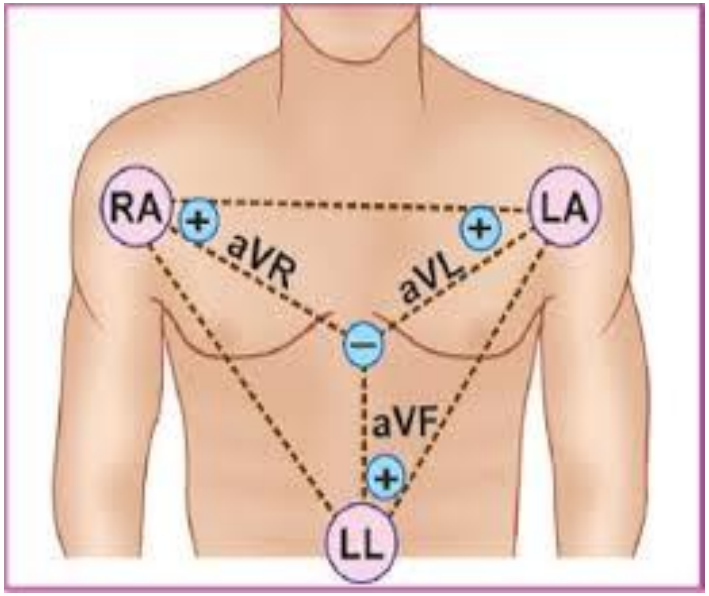
- **LI** (between right arm and left arm).
- **LII** (between right arm and left leg).
- **LIII** (between left arm and left leg)



Types of leads:-

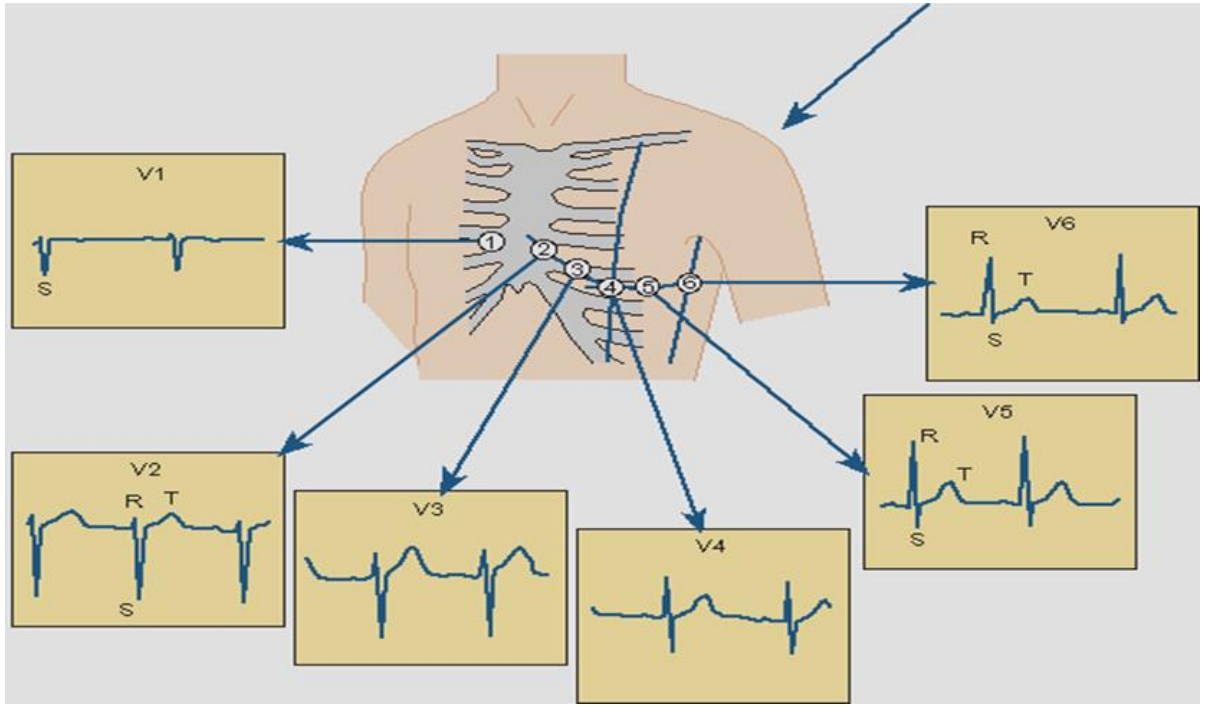
2.Unipolar limb leads. three unipolar limb leads: VR (right arm), VL (left arm), and VF (left foot).These Augmented limb leads, designated by the letter a so they are written as (aVR, aVL, aVF)



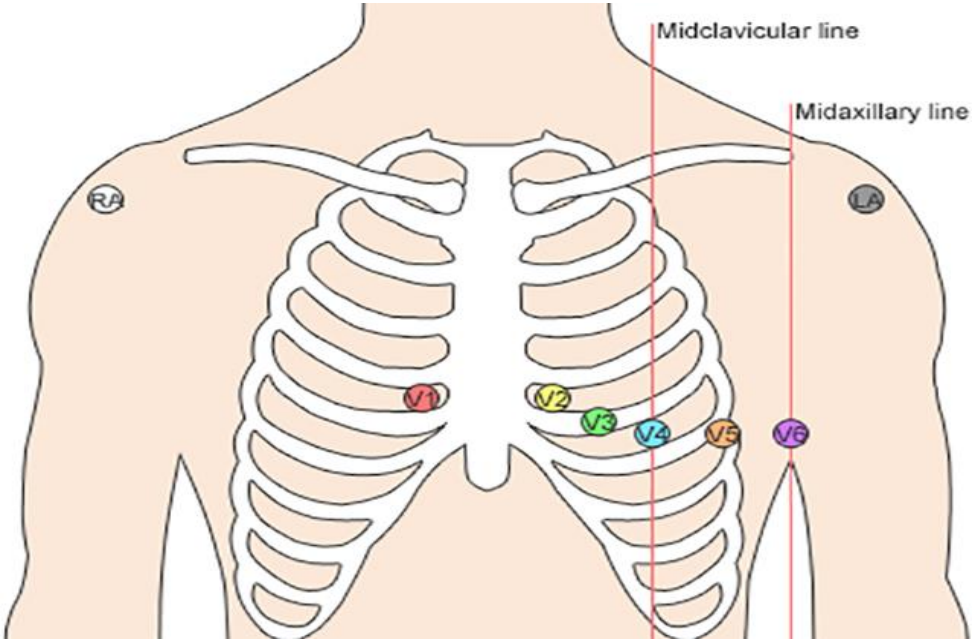


Types of leads:-

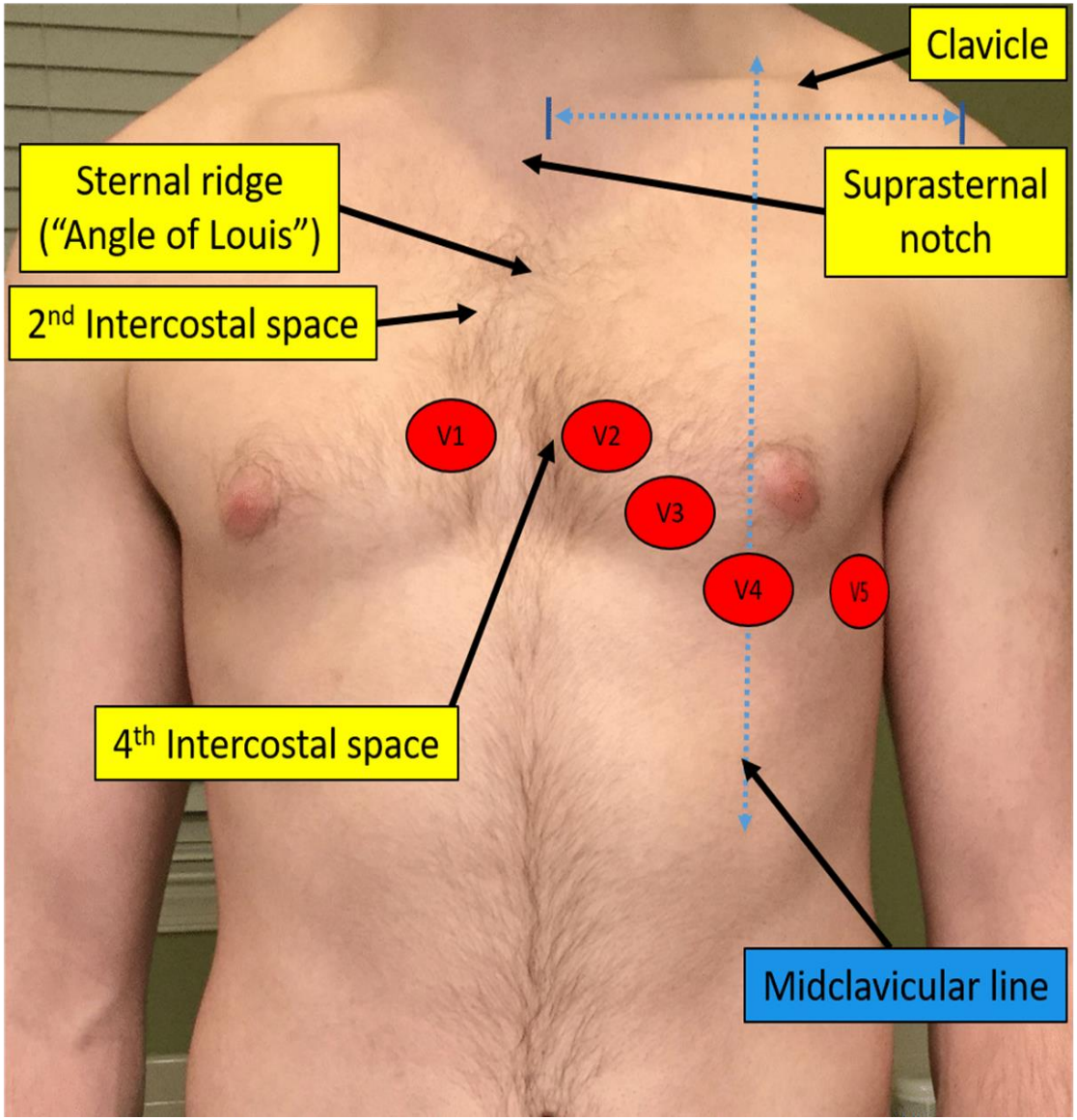
3- Unipolar chest leads: There are six unipolar chest leads (precordial leads) designated V 1 –V 6

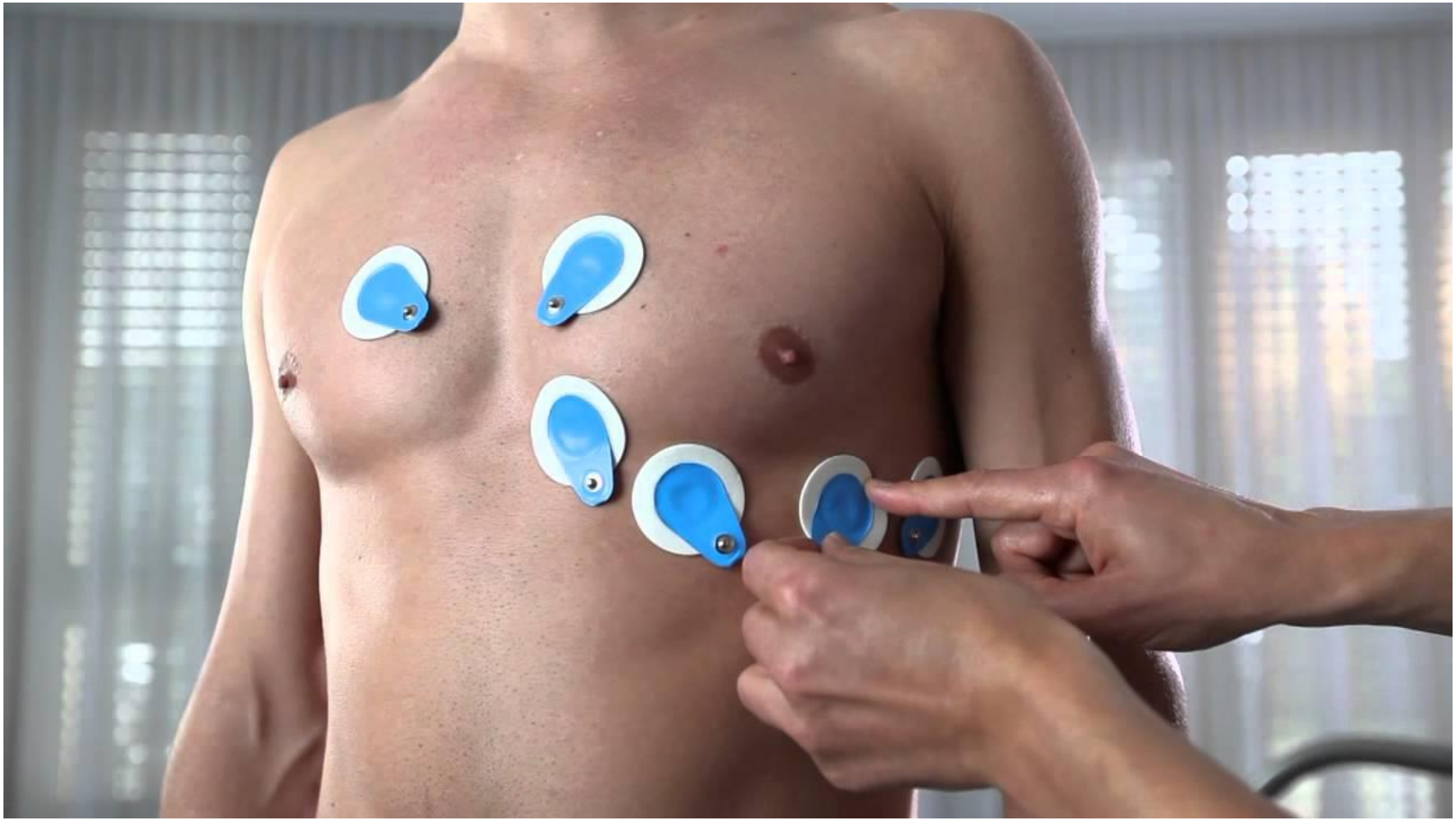


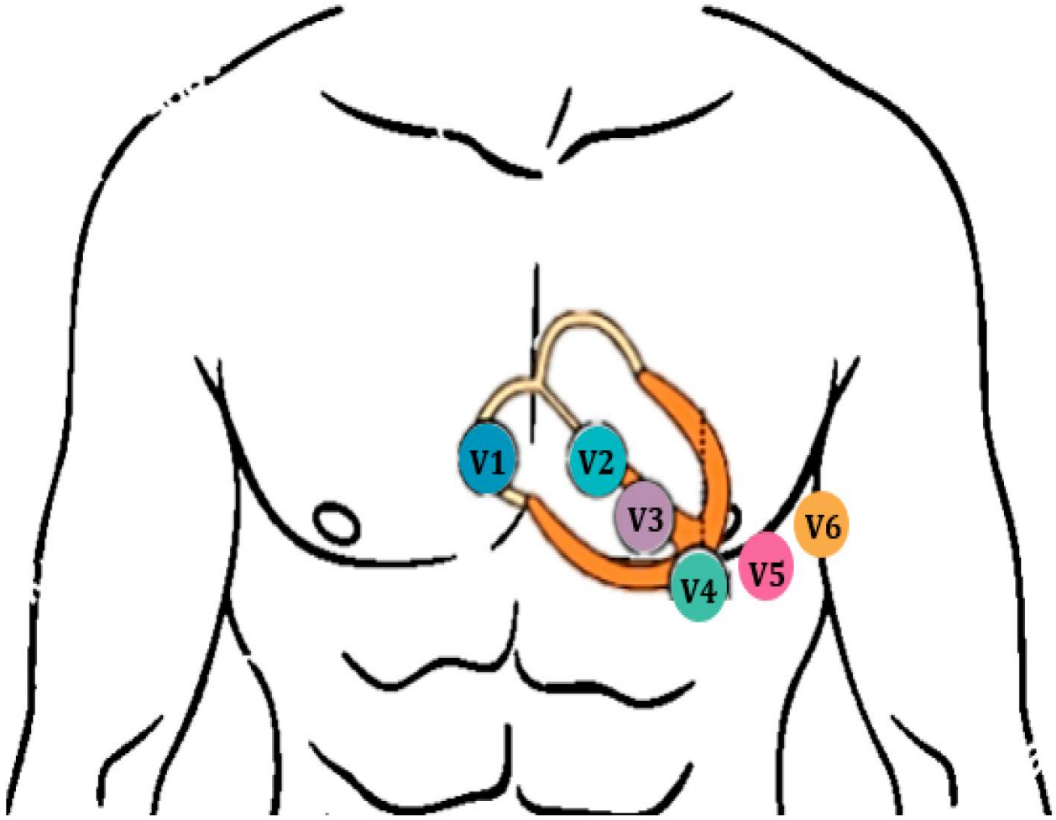
sites of chest leads

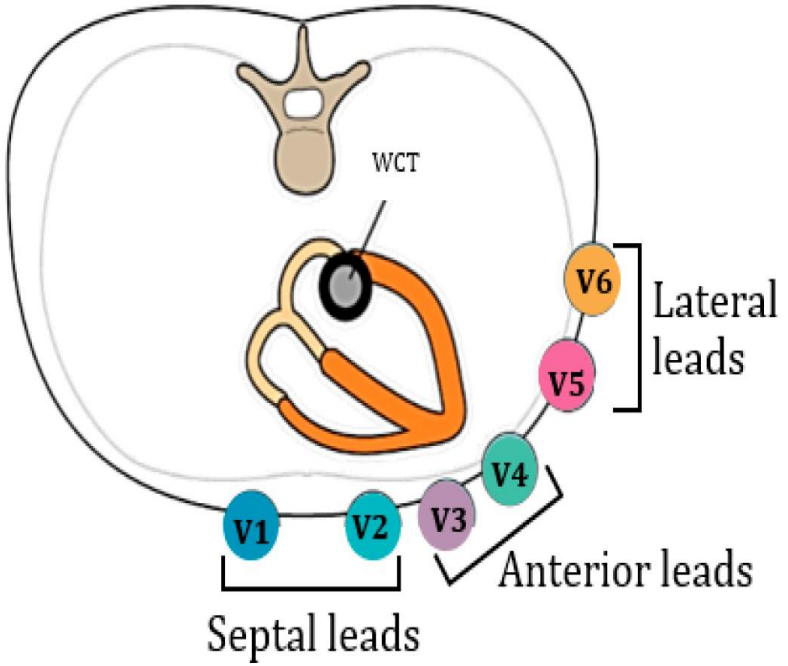


- So, sites of six chest leads are:
- V1: right 4th intercostal space.
- V2: Left 4th intercostal space.
- V3: midway between V2 and V4.
- V4:Left 5th intercostal space, at left mid clavicular line.
- V5: Left 5th intercostal space, at left anterior axillary line.
- V6: Left 5th intercostal space, at left mid-axillary line.

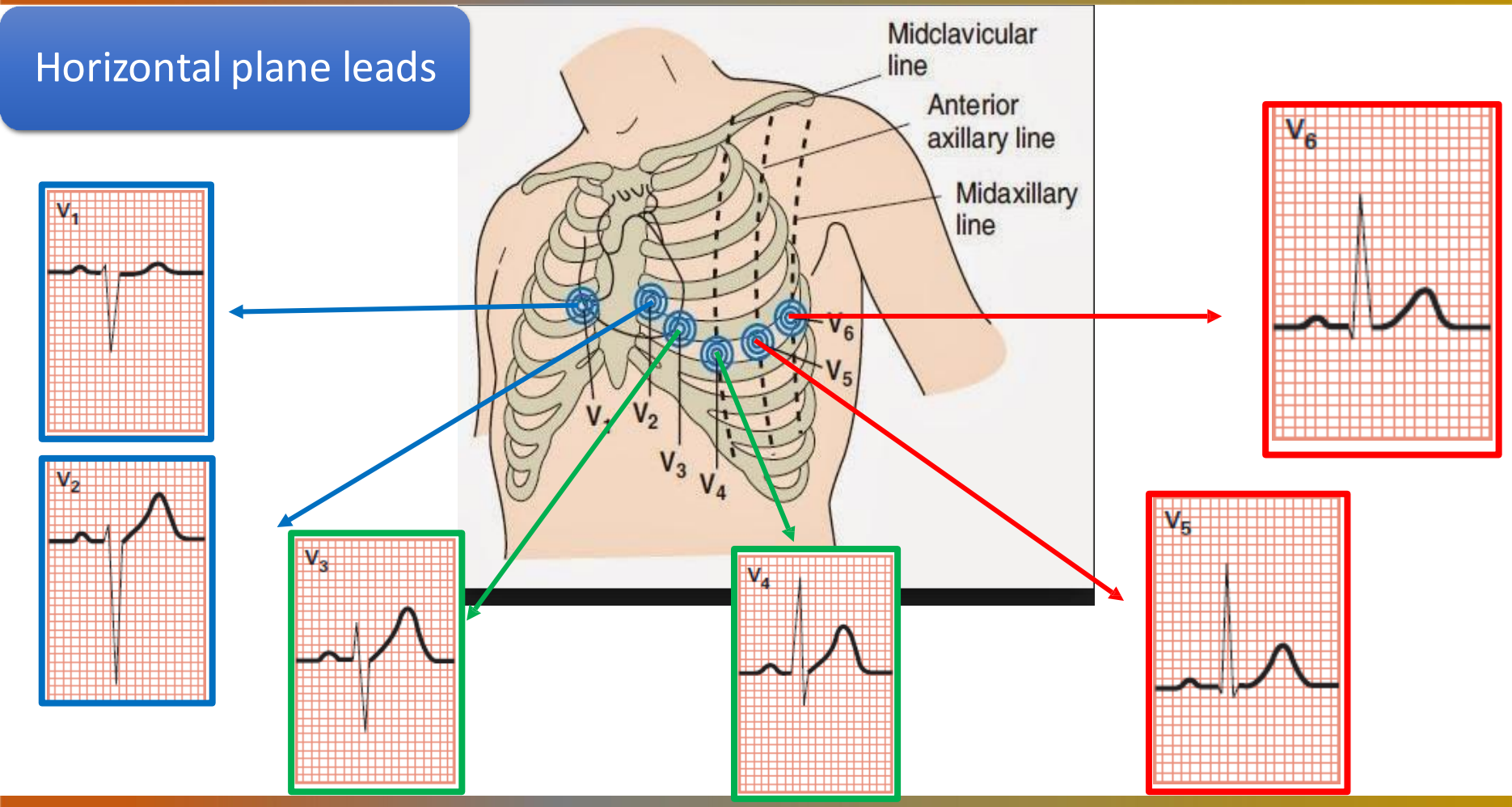

Clavicle
Sternal ridge ("Angle of Louis")
Suprasternal notch
2nd Intercostal space
V1
V2
V3
V4
V5
4th Intercostal space
Midclavicular line

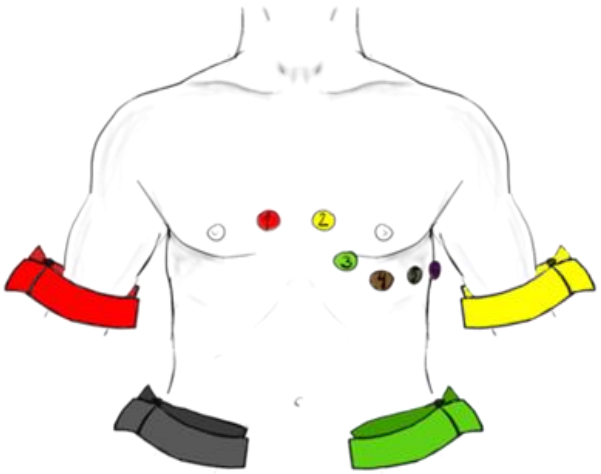



V1
V2
V3
V4
V5
V6


WCT
V6
V5
V4
V1
V2
V3
Lateral leads
Anterior leads
Septal leads

Horizontal plane leads

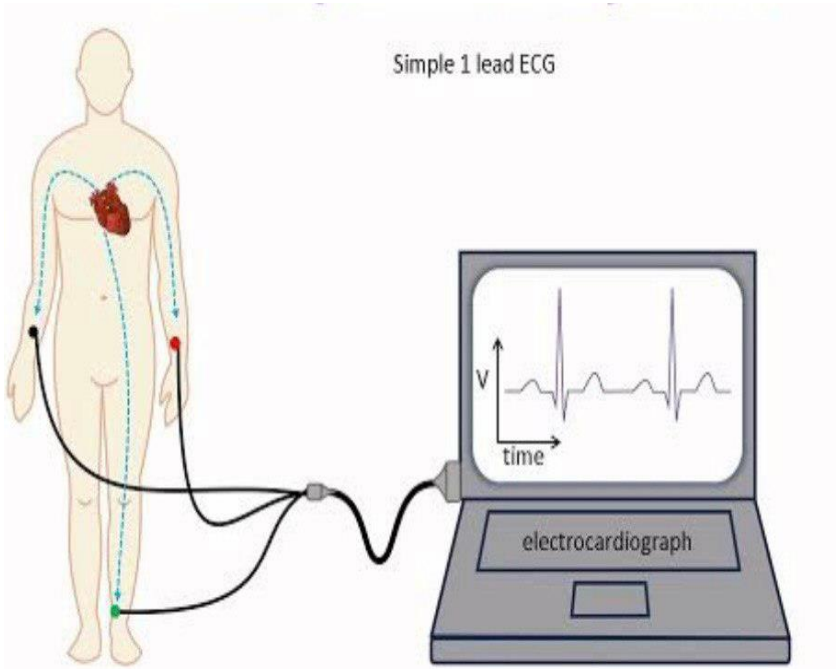


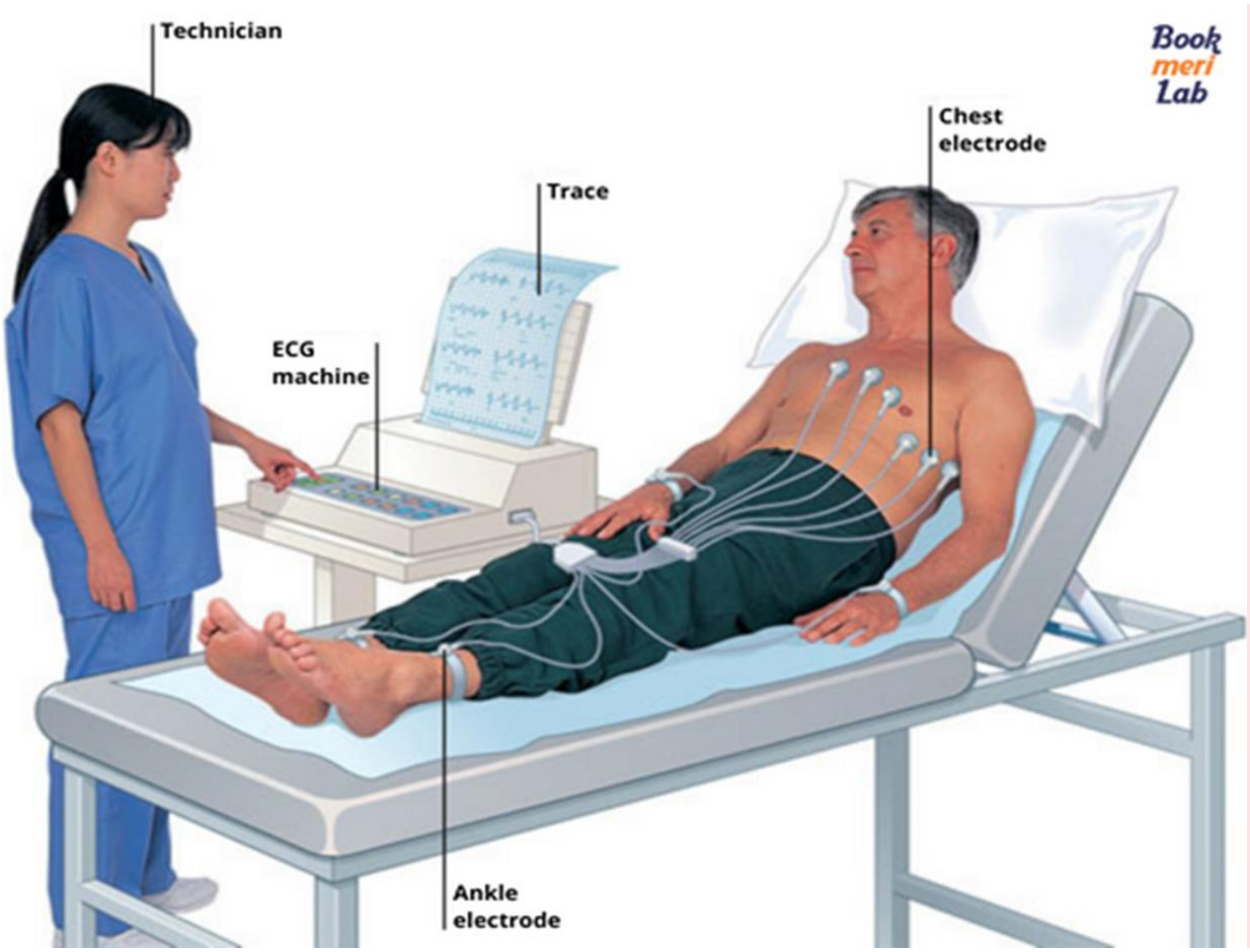


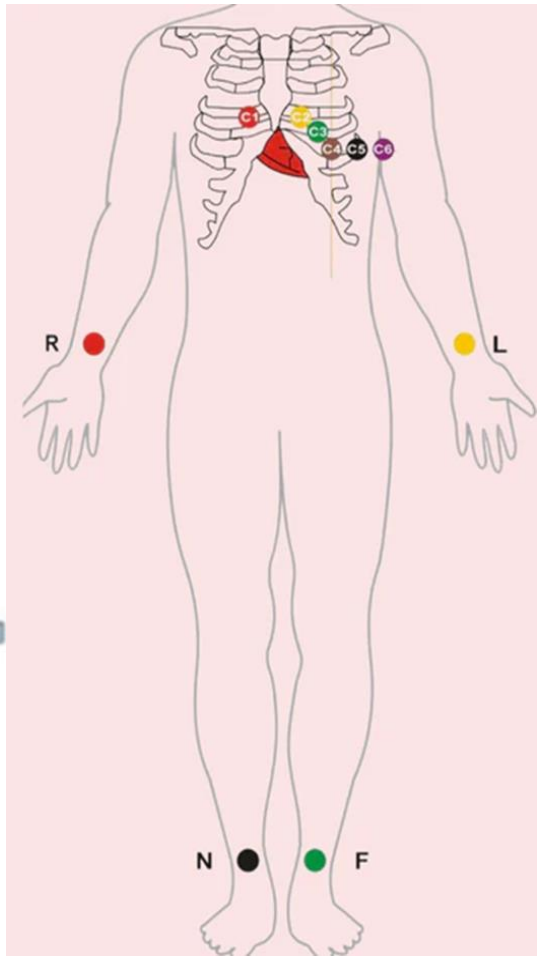
ECG/EKG Suction ball electrode
胸吸球

Universal ECG/EKG Electrodes
通用心电电极

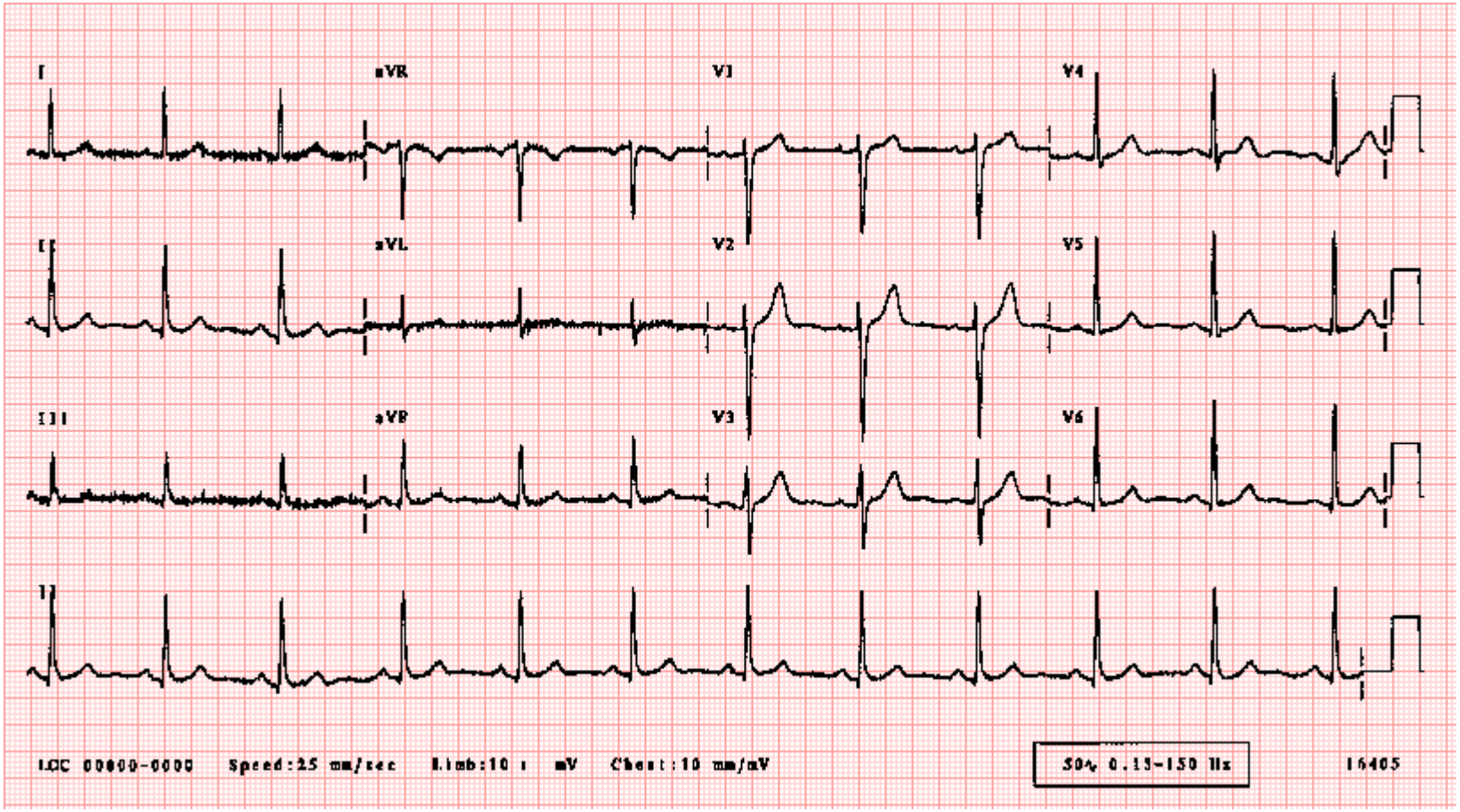
Limb Clamp Clip Reusable Electrodes
肢体夹




Technician
Trace
Chest electrode
ECG machine
Ankle electrode
Book meri Lab

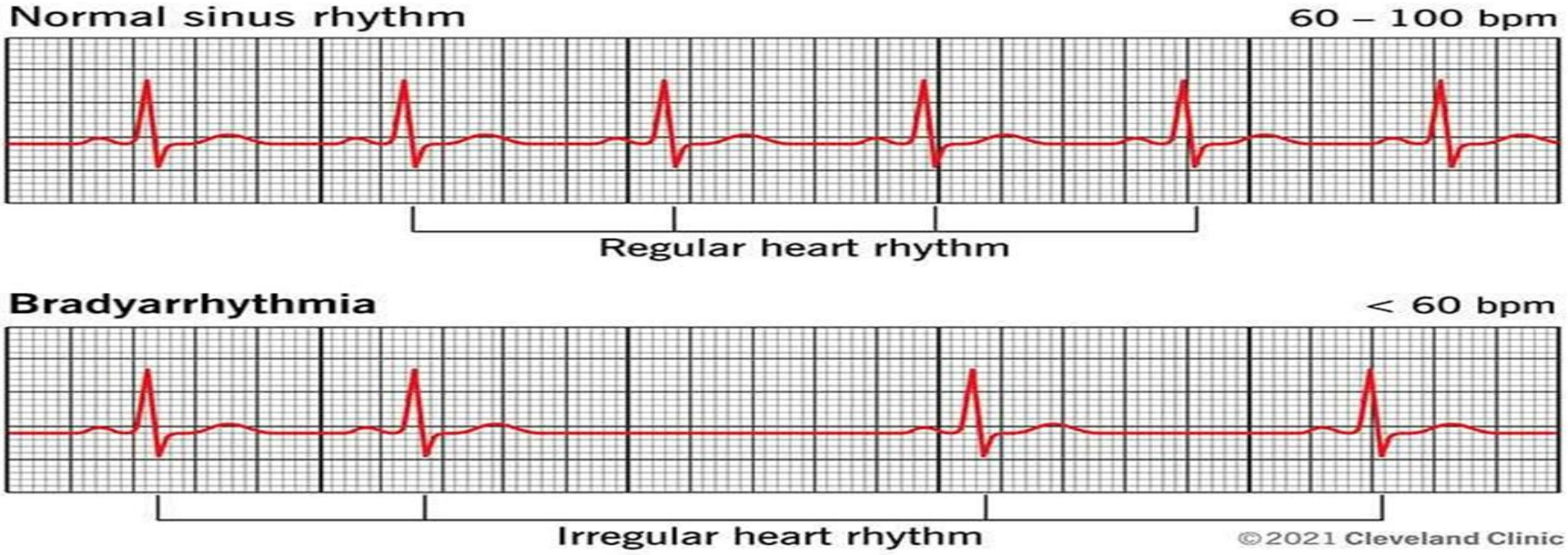

C1
C2
C3
C4
C5
C6
R
L
N
F

Normal electrocardiogram of 12 leads:-



Analysis of the ECG

- 1. Rhythm : Heart rhythm can be either regular or irregular .This can be determined by looking at the R-R wave interval.
- If the R-R interval is inconsistent then the rhythm considered as **irregular.** An irregular rhythm with no distinct p waves suggests atrial fibrillation.

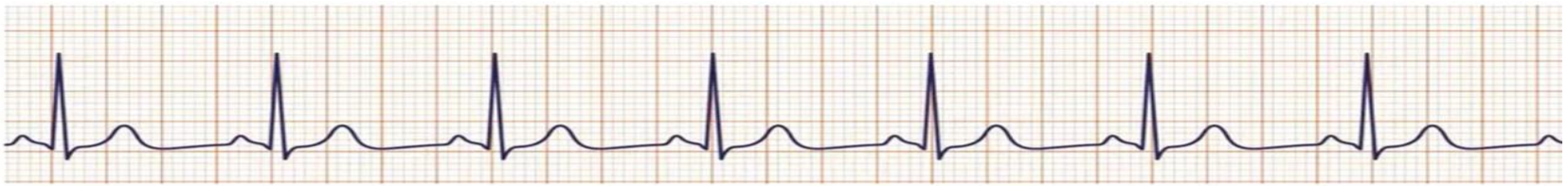


2. Heart rate:

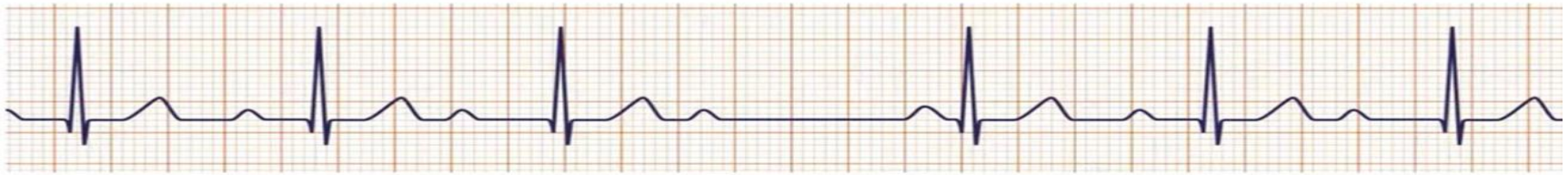
The heart rate is a number of heart cycles per minutes.

-When the rhythm is regular: by counting the number of large squares between two consecutive R waves and dividing this into 300 (عدد المربعات الكبيرة بالدقيقة الواحدة).

When the rhythm is irregular (ex. atrial fibrillation) numbers of QRS complex are counted in 5 second (25 large squares) in the strip multiplied by 12 (I minute) to get the HR/minute.



$$HR = \frac{300}{4} = 75\ bpm$$



$$HR = 6 \times 12 = 72\ bpm$$

HEART RATE

(NORMAL ECG)

HEART RATE = 300 ÷ (NUMBER OF LARGE SQUARES IN ONE R-R INTERVAL)

300 ÷ 4 = 75 BPM

HEART RATE = 75 BPM

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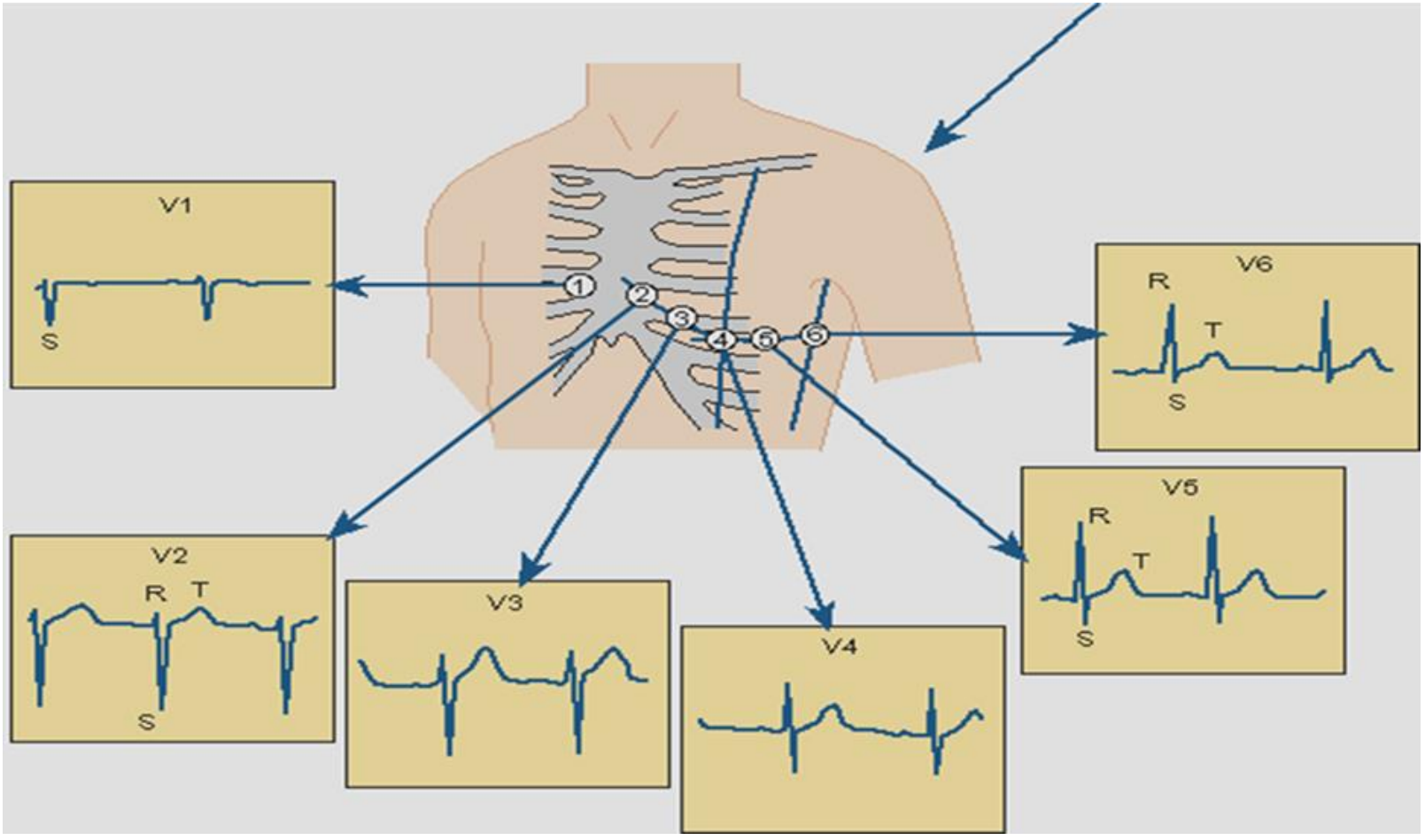
3- Cardiac axis :

The QRS of the normal heart are negative in leads V1 and V2,.

On other hand, the QRS complexes are positive in leads V4, V5 and V6



Heart arrhythmia

An arrhythmia (also called dysrhythmia) is an abnormal heartbeat.

Arrhythmias can start in different parts of the heart and they can be too fast, too slow or just irregular.

How serious is a heart arrhythmia?

- Some types of arrhythmia are harmless and don't require treatment. Others can put human at risk for cardiac arrest. Many are in between these two extremes.

Heart arrhythmia symptoms may include:

1. Heart palpitations.
2. Dizziness or lightheadedness.
3. Fainting episodes.
4. Shortness of breath.
5. Chest discomfort.
6. Weakness or fatigue.
7. A cardiac arrhythmia may be “silent” and not cause any symptoms.

Arrhythmia causes :

1. Coronary artery disease.
2. congenital heart defects.
3. High blood pressure.
4. Diseases of heart muscle (cardiomyopathy).
5. Valve disorders.
6. Electrolyte imbalances in your blood.
7. **Drugs**
8. **Excessive alcohol use**

This can increase the chance of developing atrial fibrillation.

9. Caffeine, nicotine or illegal drug use, Stimulants can cause tachycardia. Illegal drugs, such as amphetamines and cocaine, may greatly affect the heart. Some may cause sudden death due to ventricular fibrillation.

10. Other medical conditions like thyroid diseases.

What are the types of arrhythmia?

Arrhythmias are described by where they start.

1. "**Supraventricular arrhythmias**: These begin in your atria (your heart's upper chambers)." means above your ventricles or lower chambers of your heart.

2. Ventricular arrhythmias: These begin in ventricles

3. Bradyarrhythmias : These can happen because of issues in the heart's conduction system, such as the sinoatrial (SA) node, atrioventricular (AV) node or His-Purkinje network.

FAST HEARTBEAT, CALLED TACHYCARDIA

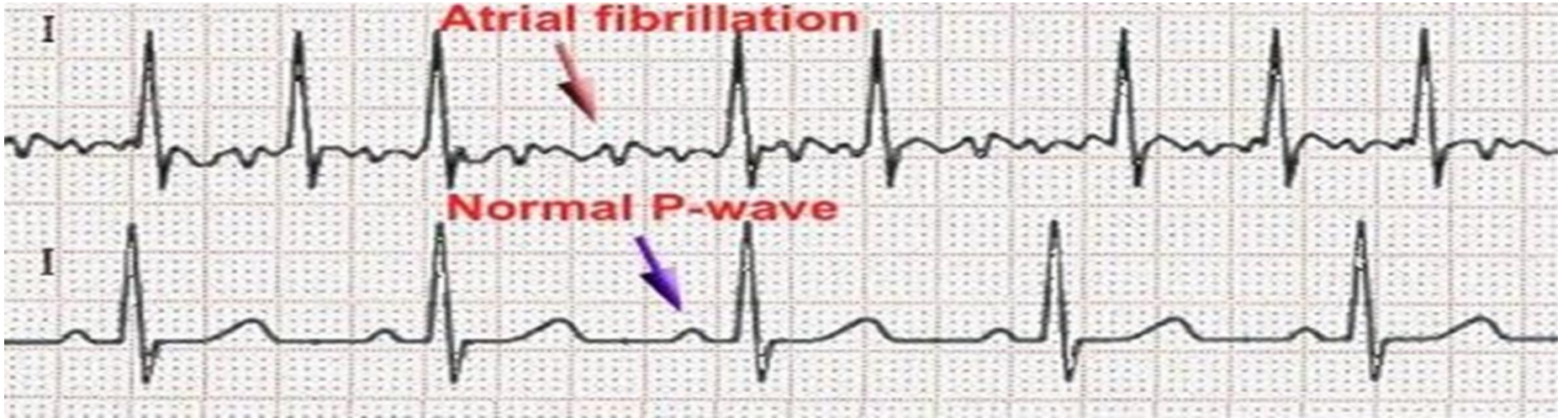
A. Arial tachycardia include:

1. Supraventricular tachycardia: This includes irregular heartbeats that start above the ventricles. Supraventricular tachycardia causes episodes of a pounding heartbeat that start and stop suddenly

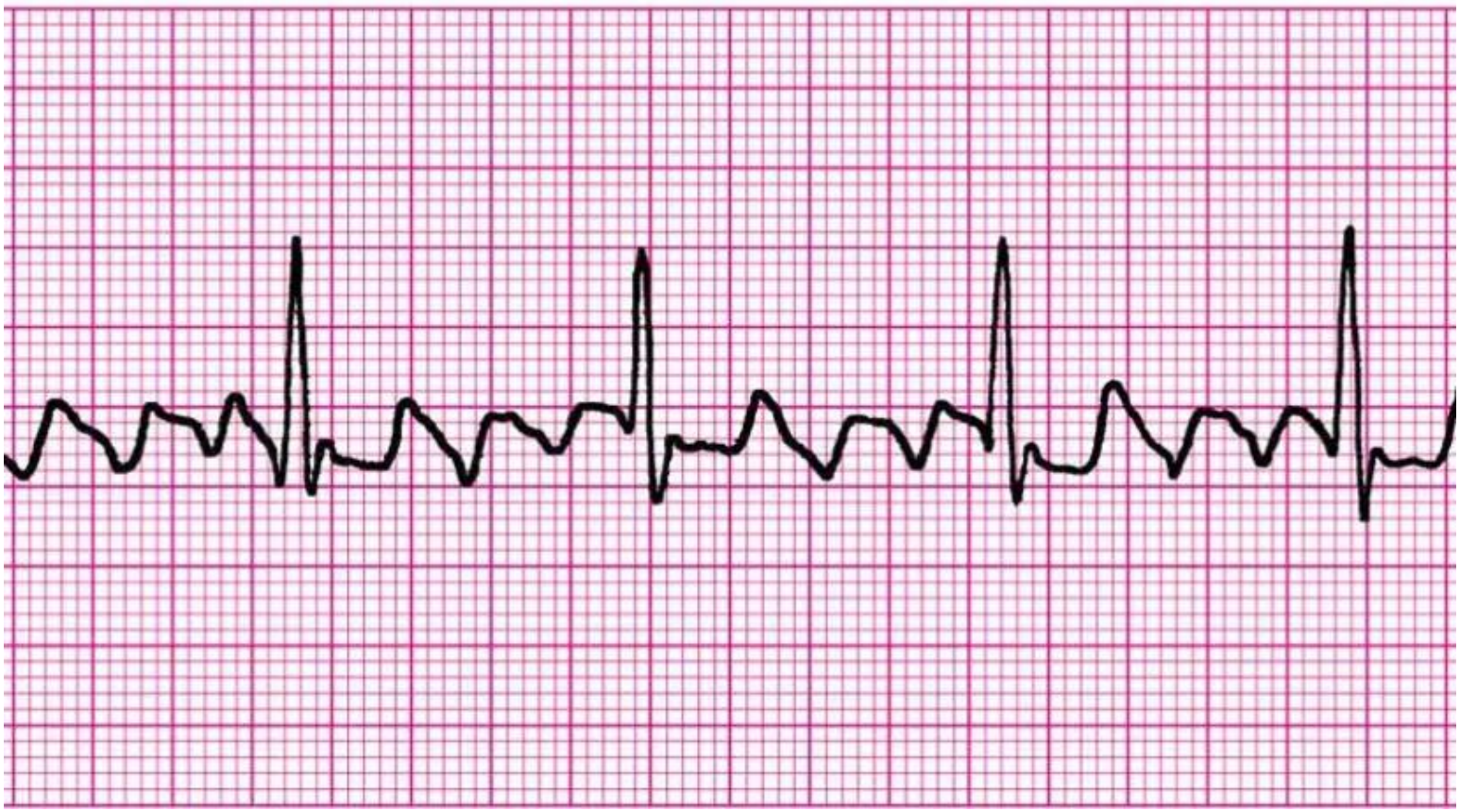
2. Atrial fibrillation (AF): causes a rapid, uncoordinated heartbeat.

AFib may be temporary and start and stop on its own. But some episodes may not stop unless treated.

3. Atrial flutter: Atrial flutter is similar to Atrial fibrillation (AFib), but the heartbeats are more organized.



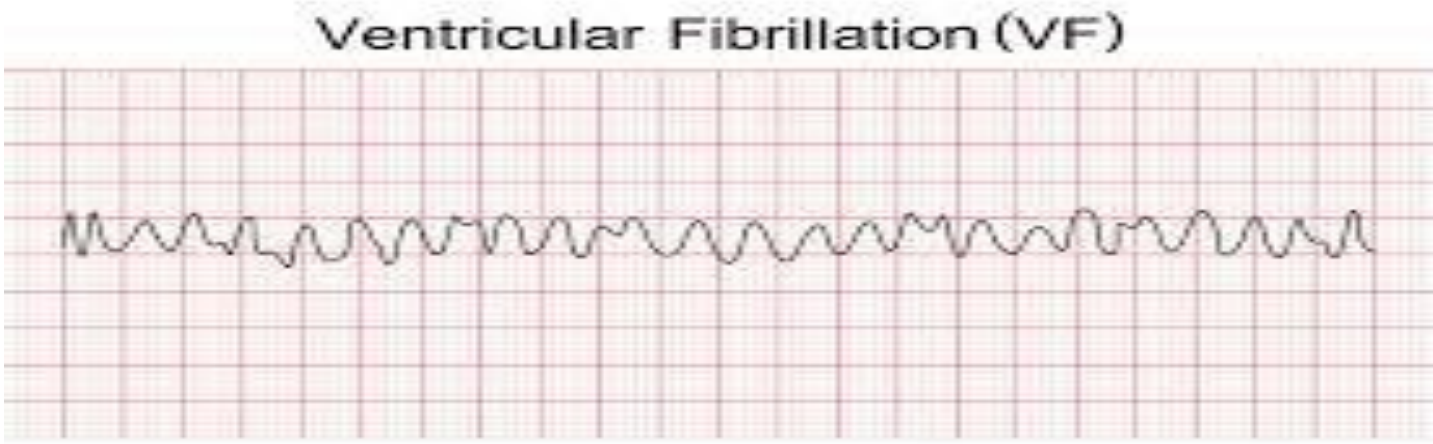
Atrial flutter



B. Ventricular tachycardia:

This rapid, irregular heart rate starts in the ventricles. The rapid heart rate doesn't let the ventricles properly fill with blood. So, the heart may not be able to pump enough blood to the body.

Ventricular fibrillation: This serious problem can lead to death if a regular heart rhythm isn't restored within minutes. Most people with ventricular fibrillation have an underlying heart disease or had a serious injury.

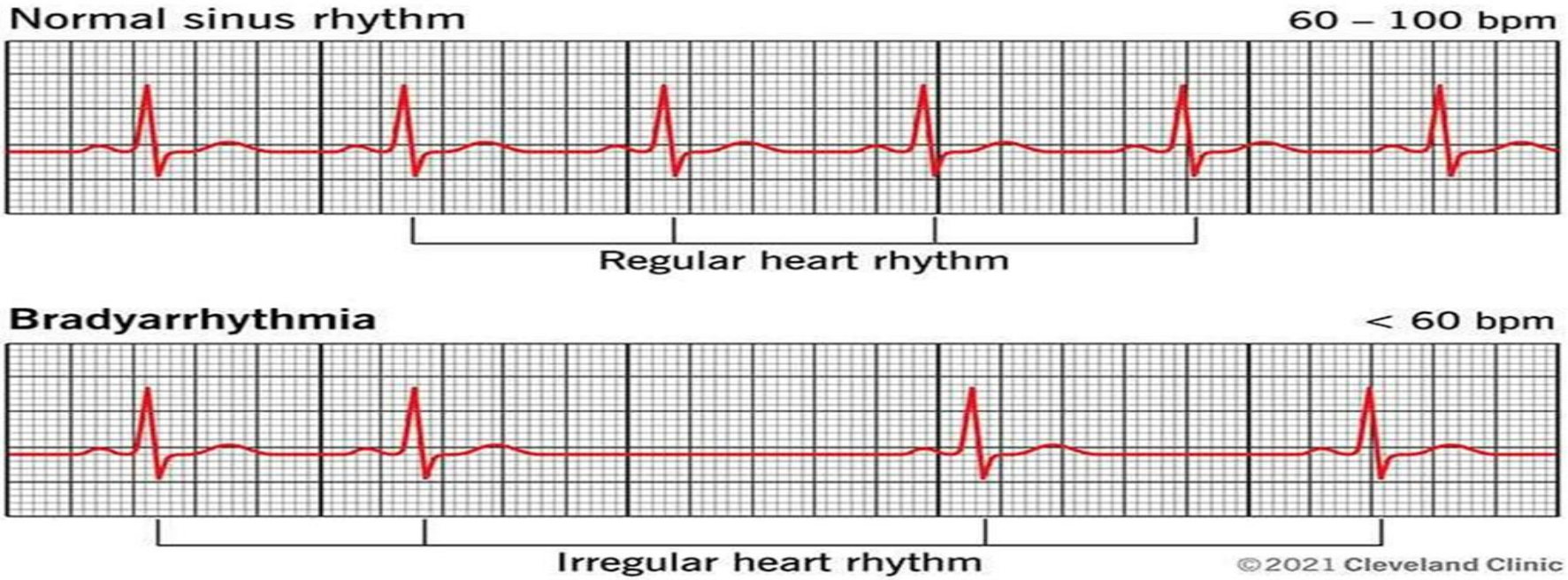


BRADYCARDIA

SLOW HEARTBEAT

• A heart rate below 60 beats a minute is considered bradycardia.

But a low resting heart rate doesn't always mean there's a problem cased by either **Sick sinus syndrome or conduction block**.




Thank You