UNIT 01-INTRODUCTION

1.1 Definition & Introduction

As the name suggests" ECG" (electrocardiogram/electrocardiography). The etymology is derived from Greek language. In which "E" stands for electro, "C" for cardio /kardio and "G" stands for graphine – to write, imaging/recording.

As the electrocardiogram records only the electrical activities of the heart, it cannot give any idea about the mechanical function of the heart and is therefore, it gives limited information about the status to the heart.

However, it still is the most **basic** ,**non-invasive**, **fairly** informative and **routinemodality** and **bed sidedinvestigation**in all cardiac evaluation .

There is no **substitute**to the ECG with respect studying **disorders**that Manifests as changes in the electrical activity of the heart. For example, heart block, bundle branch, arrhythmias disorder of cardiac function, myocardial infarction heart attack etc.

Definition: ECG is the permanent graphical record, electrical impulses / activities of the heart on a thermo sensitive paper during the depolarisation and repolarisation in the myocardium. It is a bed sided and non- invasive procedure.

ECG Principle

ECG records only the electrical activities of the heart. It is based on heart beat that is produced and travel in the heart muscles through the conduction pathway and spread over the body surface where these impulses are detected or pickup by placing the electrodes on the body surface and measured by the galvanometer.

Depolarisation and repolarization of the heart muscles are electrical event, while cardiac contraction (**systole**) and relaxation (**diastole**) constitute mechanical events. However, it is true that depolarization just precedes systole and repolarization is Immediately after by diastole.

DEPOLARISATION OF THE HEART-The process in the heart muscles are stimulated to the contraction and then contract. During which the ions changed through the cell membrane. Which is recorded on ECG as P, QRS & T waveform.

Repolarization of the heart muscles: -The process in the heart muscles relaxed and recover by the previous contraction. Which is recorded on the ECG as ST segment and T wave.

Action potential:-Each muscle's cell of the heart (and throughout the body) is stimulated to contract (mechanical event) through and electrical process (electrical event) called the **action potential**. The ECG records the summation of the action potentials of the muscle cells in the atrial and ventricles as P-QRS-T.

A).

REPOLARIZATION (resting phase/polarized muscles cell) B) DEPOLARIZATION by a stimulus. When a stimulus is applied to the resting cell, it gets electrically activate and flow of ions occur i.e. Na^{+}&Ca^{++} move inside and K+ moves outside. There is reversal of polarity.
This is called the depolarization or phase "o" of the action potential can be recorded on the ECG waveform.

IN THE RESTING STATE, THE MUSCLES CELLS MEMBRANE BEARS A NEGATIVE

CHARGE (Cl^{-}) ON THE INSIDE AND POSITIVE CHARGE ON THE OUTER SIDE (Na^{+}) due to the K^{+} inside. K^{+} is leakage outside and maintains +ve charge outer side. When the muscle stimulated by an electrical impulse then the charges is altered by a shift of electrolytes (Na Cl) across a cell membrane.

Pacemaker's cell action potential:-Pacemaker cells have an inherent property to generate pace. The pacemaker cells are different than cardiac cells and they do not need stimulus for depolarisation as necessary for cardiac cells because they have inherent property of **spontaneous** depolarisation. The automatic depolarisation is followed by repolarization, which is similar to cardiac cells, and the cycle is completed and repeated.

SYSTOLE AND DIASTOLE ARE THE MECHNICAL EFVENT OFF THE HEARAT

SYSTOLE:-Systole is the contraction phase of the cardiac cycle in which the blood eject onto an Adjacent chambers or vessels.

ELECTRICAL SYSTOLE CAN BE RECORDED ON AN ELECTDROCARDIOGRAM (ECG).

a. **ATRIAL SYSTOLE: -**Atrial systole presents the contraction of myocardium of the left and Right atria. The atrial muscles contract and blood drawn into their respective ventricles during the ventricular diastole.

b. **Ventricular Systole:**-In which ventricles muscles contract and blood ejected into aorta and pulmonary artery and then pressure decries in the ventricles.

Diastole: Diastole is the relaxation phase of the cardiac cycle in which the blood fill in to the chambers

ATRIAL DIASTOLE: -The term diastole originates from the Greek word meaning dilation.
Diastole is the part of the cardiac cycle when the heart refills with blood following systole (contraction). While atrial diastole is the period, during which atria are relaxing.

a. **Ventricular diastole:** is the period during which the ventricles are filling and relaxing. During ventricular diastole, the pressure in the ventricles drops down. While atrial diastole is the period, during which atria are relaxing.

ELECTRICAL AXIS OF THE HEART

The electrical axis of the heart is the direction of total electrical activity in the frontal plane of the heart (mainly in the ventricles) e. g. Right, left and normal axis etc. This overall direction of travel of the electrical depolarisation through the heart is known as the electrical axis.

Electrical axis is of four types:

1) Normal electrical axis

2) Left electrical axis
3) Right electrical axis
4) Extreme electrical axis/ No man lands

Conduction System

The conducting system of the heart consists of cardiac muscle, cells and conducting fibres that are specialized for initiating impulses and conducting them rapidly through the heart.

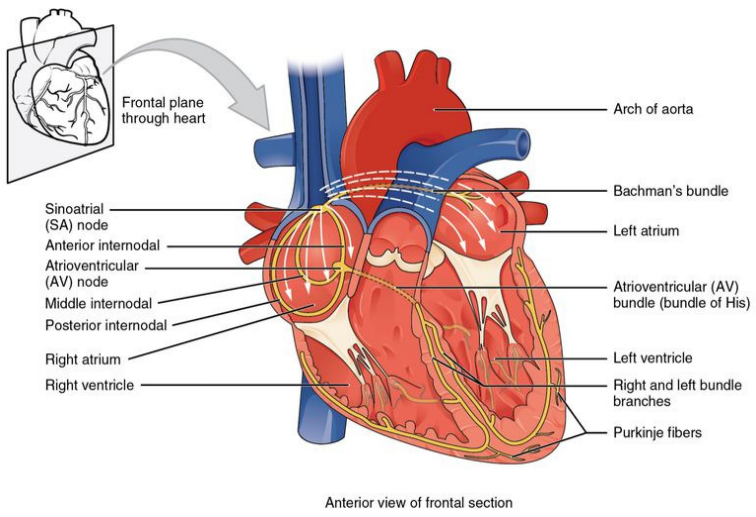


Figure-

Parts of conduction System

1. S. A. Node
2. Internal Nodal Pathway
3. A.V. Node
4. Bundle of His
5. Bundle of Branches (RBB & LBB)
6. Purkenje Fibres

S. A. Node

The conducting system of the heart consists of cardiac muscle, cells and conducting fibres that are specialized for initiating impulses and conducting them rapidly through the heart.

The Sinoatrial also commonly called the sinus node. It was first discovered by 'Martin flack and Arthur Keith'. Their discovery was published in 1907.

The sinus node is situated in the myocardium wall of the upper right atrium posteriorly where the superior vena cava opens and sinus venarum joints. It is consist of specialised conducting fibres but not nervous tissues.

It is called naturally primary pacemaker as it is capable to fire/ generate the electric impulses spontaneously at regular intervals, the rate of 60 to 80 beats per minute and typically 72 beats/minute. So it has no need of any stimulus for activation as necessary for other cardiac cells. i.e. depolarisation and repolarisation.

Blood Supply:SA node received blood supply from mainly SA node artery. Anatomically studies shows that It is also supplied with **right coronary**artery and left coronary, left circumflex artery.

Innervation:- It is innervated by parasympathetic and sympathetic activity of Vagus nerve.

A.V. Node

It is abbreviated from Atrioventricular Node. It was discovered by "Tawara" in 1906. It is located at the AV junction posteriorly in the lower part of intra atrial septum in right atrium Near the Tricuspid valve.

It is also consist of special conducting tissues that are capable to fire impulses at the slower rate that s node 40-60 beats per minutes.

It takes over the heart rhythm when the SA node is unable to maintain the heart rhythm. So it called subsidiary pacemaker.

It is innervated by left Vagus nerve. Its blood supply is maintain by mainly AV nodal artery partially left coronary and left circumflex artery.

Bundle of His

It was discovered by Sir, His in1893 but introduced in medical council in 1906.

AFTER AV nodal delay impulse reaches to the ventricles through a specilzed conductive system Called Bundle of His. It originates from AV node and situated in the intra atrial-ventricular septum and divides in to two part i.e. right bundle and left bundle branch.

It is also capable to initiate the electric impulse at a slower rate 30-40 beats per minute.

Purkenje Fibres

Purkenje fibres were discovered by JAN EVANGELISTA PURKENJE in 1839.These are the end terminal ramification of the conduction system and located in the inner ventricular walls an papillary muscles of the heart, just beneath in a pace of called the sub endocardium.

These are also specilzed conducting fibres larger than other cardiomyocytes (15 Meu) .

These are also capable to fire at a lowest rate **20-30** bmp other than above pacemakers. But these are able to conduct quickly and in efficient manner to the impulse. Tis causes ventricular muscles to contract and generate the force to pump out the blood. When purkenje does fires, it called premature contraction (PVC) or in other situation can be ventricular escape.

1.5Normal Cardiac arhythm, Blood Pressure. & Pulse rate

Normal Cardiac Rhythm:

Heart rhythm is the pattern of the heart beat. The periodically movement of the heart is called cardiac rhythm. It may be referred to as regular or irregular cardiac rhythm. If the heart beats at a regular intervals within a minutes called Regular rhythm. It can be determine by calculating R-R intervals in ecg.

It the heart beats at different intervals within a minute called Irregular heart rhythm.

If the heart beats by the impulse that originates from sinus node, rhythm called as Sinus rhythm. If the heart beats at a normal rate 60 to 80 beats per minute at a regular intervals then it called Normal rhythm.

BLOOD PRESSURE

Blood pressure is pressure of the blood that is exerted against the arterial walls. Normal blood pressure is 120/80 mmHg. Upper blood pressure represent to the Systolic blood pressure.
If the blood pressure is greater than 120/80 mmHg called High blood pressure or Hypertension.
If the blood pressure is less than 120/80 mmHg called low blood pressure or Hypotension.

Heart Rate

Heart rate is the rate of heart beat per minute (bpm). Normal heart rate is 60 to 80 beat per minute.

Typical rate is 72 beats per minute. If the heart rate is 60 or less than sixty beats per minute called **Bradycardia**. If the heart rate is 100 or more than hundred beats per minutes called Tachycardia.

Heart rate increases at exercise extraneous work, tension and decrease at rest.

Pulse Rate

Pulse is the pressure of elongation and distention of the wave that forms by the force of the contraction of the left ventricle.This wave forms when the left ventricle's force hits the blood in the aorta that is always full of blood. A pulse occurs when the beating of the heart pushes blood into the aorta; the impact of the blood hitting the elastic arterial wall creates a pressure wave that radiates along the arteries. The impact of the blood hitting the arterial wall is what is felt as a pulse. The number of the pulses within a minute called **Pulse Rate**. It should be week o strong. The pulse may feel when an artery passes over a bone. There are nine different point in body where the can be feel.

There are eight main pulse points in the human body. These pulse points are in the wrists, at the sides of the lower jaw, at the temples, on the side of the neck, on the inner biceps, behind the knee, in the groin and on the upper part of the foot. All arteries have a pulse, which can be felt where they run close to the skin.

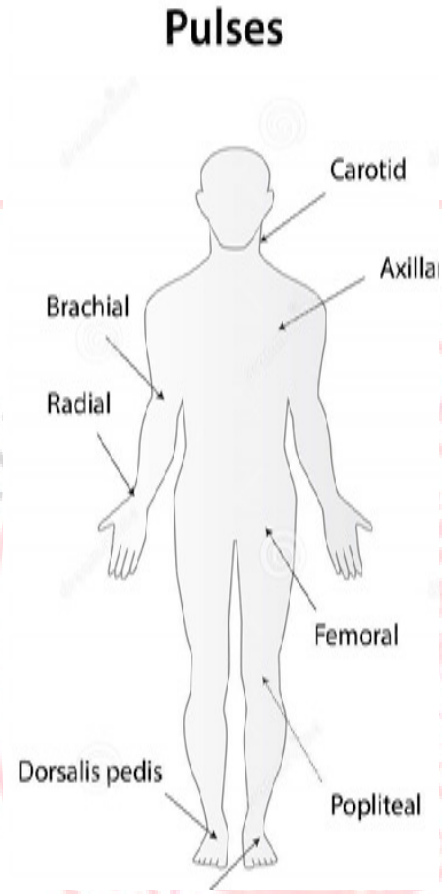


Figure-

1.6 Central Terminal of Wilson

Central terminal is the common point where the three limbs Right arm (RA), Left arm (LA) and left leg (LL) are connecting together in the ECG machine. This is called neutral electrode but actually, it is at zero potential.

This neutral electrode was discovered by Sir William Einthoven himself by connecting the three limbs to a common terminal in the original Einthoven' triangle. However, it was not put to any use. All chest leads are Unipolar leads.

INDICATIONS FOR ECG

1. Hypertension
2. Chest pain: *Either severe or dull (discomfortable).*
3. **The illness of the heart muscles:** This exam permits to detect many illness of the hart, first of all the myocardial (infarction MI), Myocarditis.

4: **Myocardial** name **Infarction:** The acute myocardial infarction is the medical for a heart attack. Heart attack occurs when the flow of blood to the heart becomes blocked.

The can cause tissue damage and can even be life-threating. While the **classic** symptoms of a heart attack are **Chest pain, and shortness of breath** the symptoms can be **varied**.

Unit 2. Basics of ECG Technique

2.1 Getting the Patient Prepared for ECG

Ecg is a non-invasive diagnostic tool. So there is not need of a consent form. Patient is not need of fasting.

Relax the patient in the normal conditions about 10 minutes. And explain the procedure & its reliability.

Ask the patient to remove all the metallic object e.g. mobile, chain, coins, keys, rings, belts ornaments etc.

Remove the excess hair (in male) & clean the chest

Ask the patient to remove the cloth from the chest in male and wear the gown in female with its opening in front.

The patient must be Lie comfortable and relaxed on the ECG table or bed in supine and hands extend parallel to the body. If the table is made up of metal then put a mattresses.

Do not allow the to talk with anybody during the ECG.

Explain the about the procedure to patient to remove mental stress.

If the patient is female and technician is male, stand a female attendant with the female patient

Instruct the patient to become relax and not to laugh, talk, smile, and move and explain the test and assure him about its safety and reliability

Apply the jelly on the skin before placing the electrodes. Jelly should not be dry and excess

If the limb is amputated then the electrode is placed on the amputated stump.

Place the electrodes at proper positions.

2.2 Application of Jelly

The jelly should be apply before placing the electrodes on the body surface for recording the ecg.Jelly is good conductor of electric current so the jelly should be placed where the electrode will stuck on the skin for ecg recording. It also reduces the skin resistance to conduct the impulse.

2.3 Placement of chest & Limb Leads

Lead: -Lead is the cable of wire, which contains a pair of electrodes and each electrode is designated as positive or negative across which the electrical potential is measured. It is used

to transmit the electric impulse to the ecg machine. Conventionally, there are 12 conventionalecg leads, which can be divided into frontal and Horizontal plane leads.

1. Bipolar /standard/classic limb leads.

2. Augmented Unipolar limb leads

3. Unipolar chest /precordial leads.

Frontal plane leads: - the six limb leads (Bipolar and augmented Unipolar leads)

Horizontal plane leads: - the six pericardial leads (V1 to V6)

FRONTAL PLANE LEADS:

The six limb leads (Bipolar leads-I, II, III, augmented Unipolar leads- aVR, aVL, aVF) called the frontal plane leads.

The limb leads view the heart in a verticals plane called the frontal lane leads. It can be viewed as

a giant ([alokik]) circle super- imposed on the body.

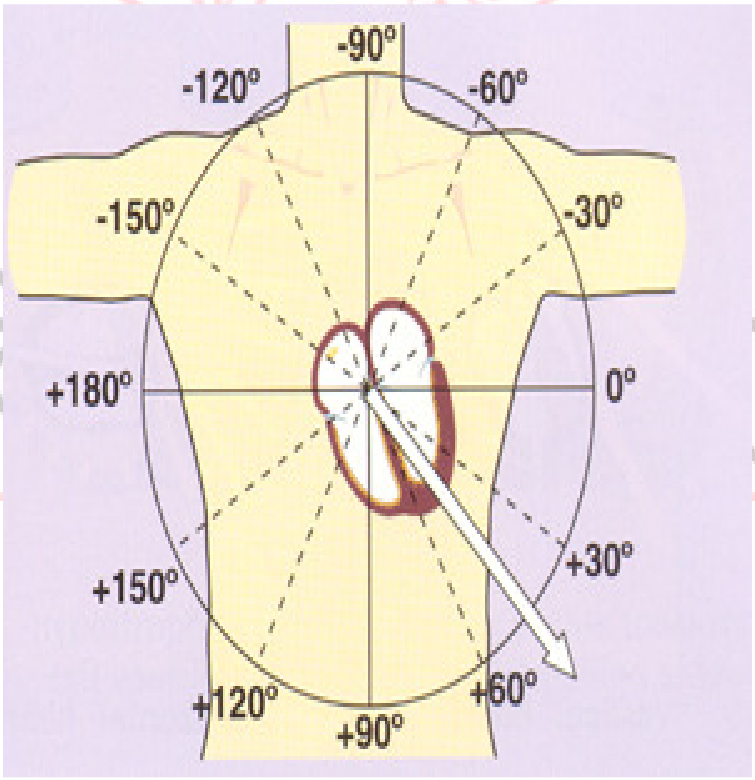


Figure-

The frontal plane limb leads

The circle is then marked off in degrees. The limb leads view waves of depolarization and repolarization moving up and right through this circle. To produce the six leads of the frontal plane, each of the electrodes is variably designated as positive or negative.

B IPOLAR/STANDARD (CLASSICAL) LIMB LEADS OF EINTHOVEN:-

Sir, William Einthoven, developed the bipolar leads.

The leads, which record the differences of electrical potential between two poles/extremities at a time. The limb leads require two active electrodes at a time to record the potential. One act as a positive and other as a negative electrode. The bipolar leads consist of leads I, II, III.

The electrodes are placed on the extremities respectively on right arm (RA), left (LA), and left leg (LL).

NOTES: - THE ELECTRICAL POTENTIAL RECORDED FROM ONE EXTREMITY WILL BE SAME, NO MATTER WHERE THE ELECTRODE IS PLACED ON THE EXTREMITY.

1).Lead I: - It records the differences of electrical potential between the **right arm ((RA)**, which contain red color electrode with negative charge **and** the left arm(LA) which contain yellow Color electrode with positive charge.

1) **Lead I (L_I) = LA (left arm) – RA (right Arm**

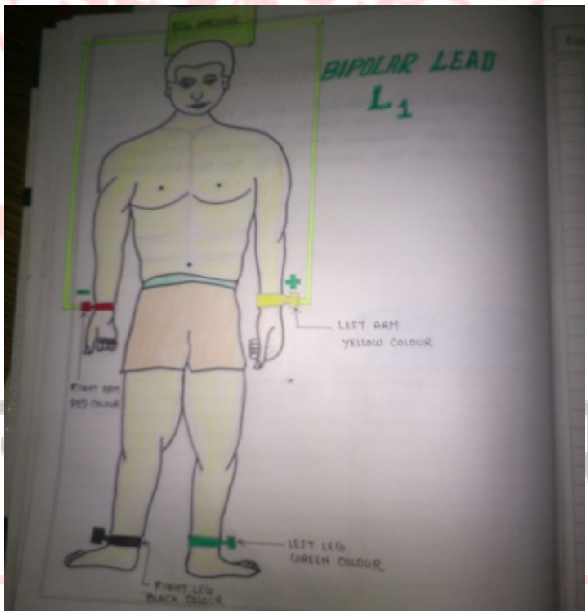


Figure-

2) **LEADS II:**- It records the differences of electrical potential between the right arm (RA), Which contain red color electrode with negative charge and the left leg (LL) which contain **green Color** electrode with positive charge.

Lead II = LL (left foot) – RA (right Arm)

3). LEAD III: -It records the difference of electrical potential between the left leg (LL), which contain green color electrode of positive charge and the left arm, which contain yellow Color of negative charge.

Lead III (LIII) = LL (left foot) – LA (left arm)

NOTE: - The electrical potential recorded from one extremity will be same, no matter where the electrode is placed on the extremity. If the limb is amputated then the electrode is placed on the amputated part or stump.

IMPORTANT NOTE:- Standard limb II is often used for cardiac monitoring as positioning most on analysis, it can be shown that at any given moment the sum of potentials in lead III

And I is equals to the potential in lead II, i.e.

Lead II = lead I + lead III

VF-VR = (VL-VR) + (VF – VL)

VF- VR = VF-VR.

Or

LL – RA = LA – RA + LL - LA

LL – RA = LL – RA. Etc.

EINTHOVEN' TRIANGLE: -

Einthoven's triangle: Sir William Einthoven placed the three standard limb leads on the chest

in place of limbs to monitoring the activities of the heart, then he observed that these lead axis /leads (I, II, III) form an equilateral triangle (in which the heart is in the centre) with the heart is called the Einthoven triangle.

LEAD AXIS: -An imaginary line joining the positive and negative electrodes of a lead is called lead axis.

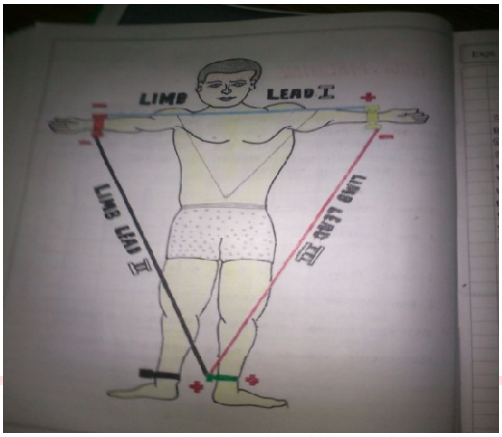
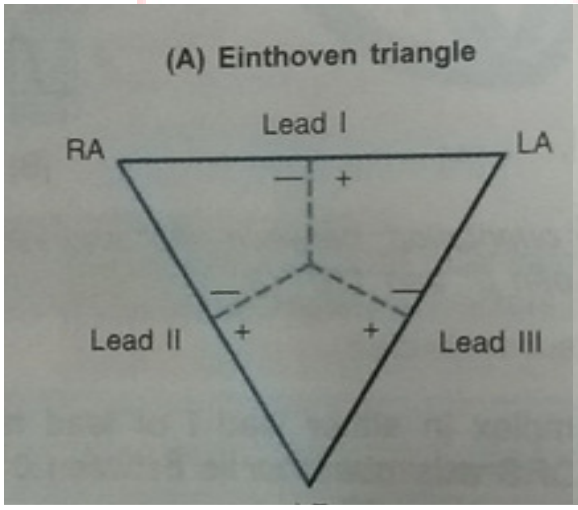


Figure- Einthoven Triangle

Triaxial reference system:

To facilitate the graphical representation of electrical forces, the three limbs of the Einthoven triangle can be redrawn in such a way that the three leads bisect each other and pass through a common central point. This produces a **Triaxial reference system**with each axis separated by 60^0 (degree) from the other, the lead polarity (+ or -) and direction remaining the same.
Triaxial Reference System

In an Einthoven triangle, if perpendicular is dropped from the mid-point of the sides of the equilateral triangle, the lines will intersect at the Centre of the electrical activity. Thus, the Einthoven triangle can be modified in such a way, that the leads intersect each other at the common central point without altering the mathematical relationship of the leads,



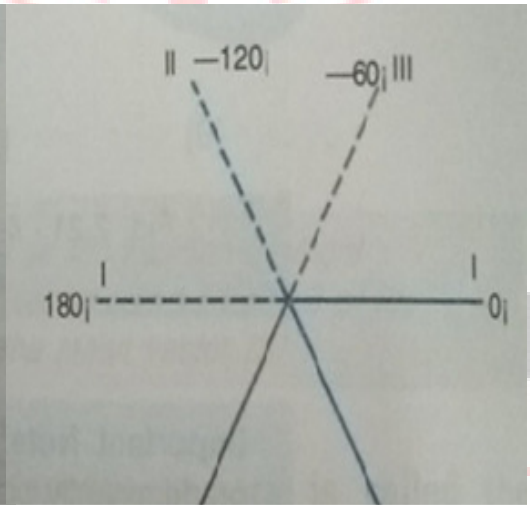


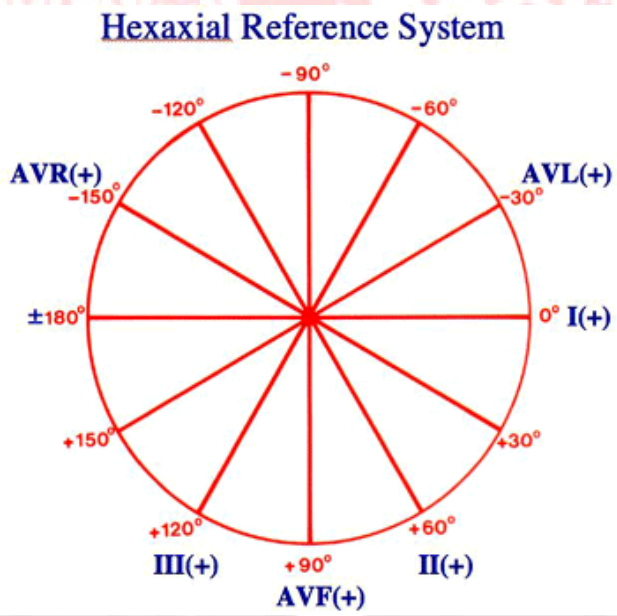
Figure- **Figure-**

The three augmented limb leads (aVR, aVL & aVF) also can be seen to form another reference system with each axis being separated by $60^0$from one another.

When this Triaxial Reference system of unipolar leads is superimposed on the Triaxial system of limb leads, we can derive a hexaxial reference system with each axis being separated by 30^0 from the other.
The direction of ventricular depolarisation in each lead is called lead axis.

When two triaxial reference systems of frontal plane leads are super imposed for viewing the cardiac electrical activities in frontal plane that is called Hexaxial Reference System.
The hexaxial reference system concept is important in determining the major direction of the heart's electrical forces. The Hexaxial reference system, better known as the **Cabrera system**, is a convention to present the extremity leads of the 12 lead electrocardiograms.

DIAGRAM OF TRIAXIAL REFRENCE SYSTEM



Figure

The Hexaxial reference system places all the six leads (three bipolar and three Unipolar) together into one picture so that a mean QRS axis may be determined. In this system, each lead is placed at an angle of 30^0 with respect to others.

HOW TO LABEL THE HEXAXIAL SYSTEM?

By convention, all the degrees in the upper hemisphere of Hexaxial system are labelled as negative **(-)** and in the lower hemisphere as positive (+). From the lead I (0^0), progressing counter clockwise, the leads are labelled as -30^0, -60^0, -90^0, -120^0 $-150^0$and -180^0, and progressing clockwise, from the same point, the successive leads are labelled as $+30^0$, $+60^0$, $+90^0$, $+120^0$, $+150^0$, $+180^0$.

From the Hexaxial reference system it is clear that **(+)** poles of leads I, II, III &aVR, aVL, aVR

axes are lie from -30^0 to $+120^0$except than negative pole (-) of aVR is located at $+30^0$.

And negative (-) poles of all frontal plane leads are lie in upper hemisphere - $60^0$to $+150^0$except aVR.

Remember that the positive pole of lead axes II, III, & I are placed at $+0^0$, 60^0, and $+90^0$

respectively. And negative poles at -180^0, -120^0, -60^0. While + poles of aVR, aVL, aVF lie at -150^0, -30^0& $+90^0$. And (–) poles at $+30^0$, $+150^0$, -90^0.

Note: note carefully that each of the six leads retains its polarity (positive and negative poles) and orientation (lead direction).

B. UNIPOLAR LIMB LEADS:

This achieved a few years later when Sir Wilson developed the Unipolar leads. A record obtained in this method is labelled letter V (called V- for voltage – leads). These leads record the difference of electrical potential from one limb/pole at a time. Here two electrodes are used for recording purpose: one is the active (exploring) Electrode, placed on the area of the body surface called positive electrode (active): and the other is the indifferent electrode, which is keep at 'zero 'potential by connecting three electrodes placed respectively on right (RA), and right arm (RA), Left arm (LA), and left leg (LL) to a central terminal through 5000 ohms resistance.

It was Wilson and Goldberger who used it to record complexes that represented electrical activity.

E.g. VL, VR, VF.

AUGMENTED UNIPOLAR LIMB LEADS OF GOLDBERGER:

1942, Emanuel Goldberger increase the voltage of Wilson's Unipolar leads by 50% and creates the augmented limb leads aVR, aVL and aVF. When added to Einthoven's three limb leads and the six chest leads.

limb/pole is chosen to be positive, and central terminal of other two remain limbs leads, contain neutral charge consider negative pole at a time.

Augmented limb leads are designated by prefixed 'a' represent augmented (enchased) to the name of the limb lead in the Unipolar lead.

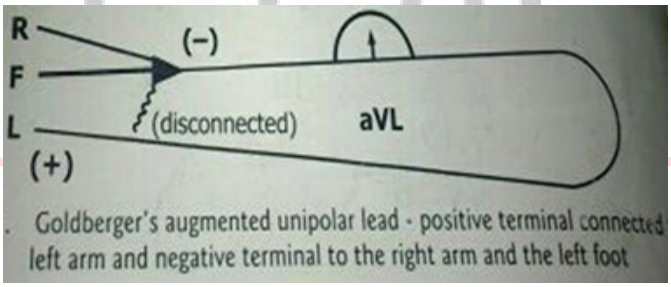


Figure-

aVR:- (augmented voltage right) it records the differences of electrical potential between right arm, which contain positive electrode of red color and the central terminal(LA, LL) called the indifferent electrode. It contain zero potential.

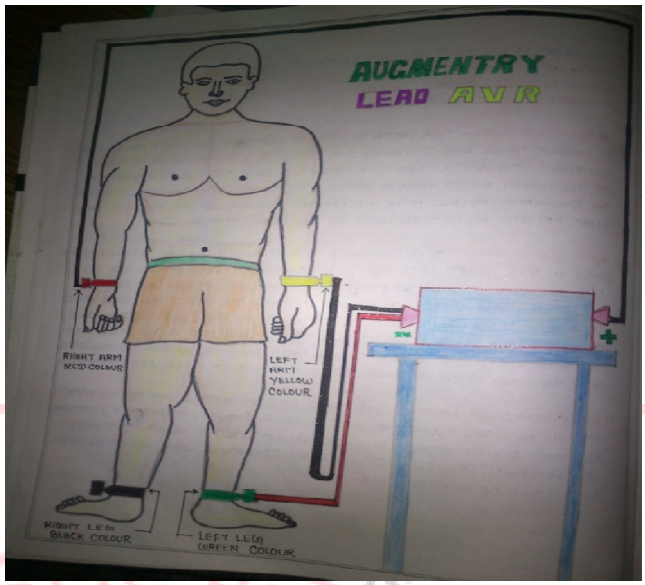


Figure-

aVL: (augmented voltage left) It records the difference of electrical potential between left arm and the central terminal.

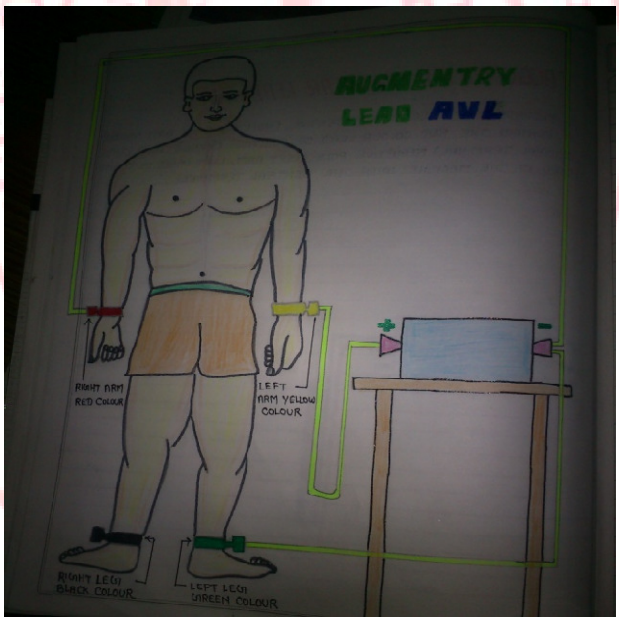


Figure-

aVF: (augmented voltage foot) It record the difference of electrical potential between leg and the central terminal.

G R O U N D I N G E L E C T R O D E

One electrode of black color is place on right foot /leg it served as ground electrode. Because it avoids interference from other, (non- cardiac) body currents. It was introduced by William Einthoven. The ECG machine is earthed to avoid electrical interference from its vicinity Color Coding of ecg leads

Monitoring cable connections		
Europe	Connect to:	U.S.A.
Red	Right Arm	White
Yellow	Left Arm	Black
Green	Left Leg	Red
Black	Right Leg	Green
White	Chest	Brown
Individual chest leads		
White / Red	C1 / V1	Brown / Red
White / Yellow	C2 / V2	Brown / Yellow
White / Green	C3 / V3	Brown / Green
White / Brown	C4 / V4	Brown / Blue
White / Black	C5 / V5	Brown / Orange
White / Violet	C6 / V6	Brown / Purple

HORIZONTAL PLANE LEADS: CHEST LEADS

THE SIX PRECORDIAL LEADS OF Wilson (V1-V6).

They are arranged across the chest in a horizontal plane and view electrical forces moving anteriorly and posteriorly. To make the six precordial leads each chest electrode contains positive charge called active electrode; these are as follows: The leads from v_1 to v_6 are placed as,

V1 : 4th right intercostal space near the sternum border.

V2 : 4th left intercostal space near the sternum border.

V3 : M id way between V2 and V4.

V4 : 5thleft intercostal space on mid-clavicular line (MCL).

V5 : 5th left intercostal space on anterior axillary line (AAL). Blow the Left nipple.

V6 : 5thleft intercostal space on mid auxiliary line (MAL).

2.4 Parameter for recording a good ecg

Place the electrodes at proper positions.

Set the ECG machine at proper parameter (SN, so that 1mV produces a deflection of 10 mm and there should not be over and under damping, SP, 25 mm per second so that the machine move the paper at the rate of 25 mm in one second, filter must be on)

Remove the cardiac monitor. Implant and artificial pacemaker can‘t be removed.

The temperature of the Stylus should be Optimum, excess high temperature will burn the paper and low Temperature will produce the dim tracing.

The base line of the ECG should be checked by adjusting the stylus.

While changing the electrodes positions in the chest leads the “INST” knob should be kept pressed.

The electrode should not loose and encrusted

The electrode should be away from the joints on the flashy and flat surface.

The ECG should properly labelled before handing over to the patient or Doctor.

The ECG record should be taken quickly and a lot of time should not waste of in attaching the leads.

The electrode should be properly cleaned after recording the ECG so that ECG jelly may not be dry on the electrodes.

The machine should not be charging during the ecg recording

The technician must be stand in left side.

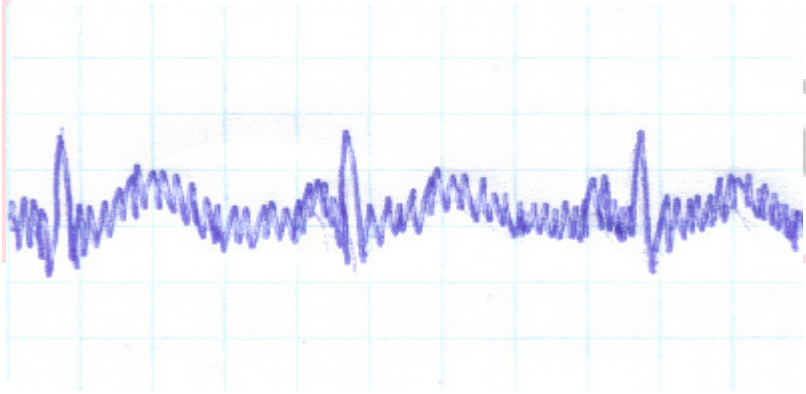
CAUSES OF POOR ECG
ARTIFACTS

ARTIFACTS IN ECG: -Artifacts are the artificial factors that distorted to the normal components of the EKG. That is defined as EKG abnormalities, which are a measured on the body surface but are not related to electrical activity of the heart.

1) In ECG, Artificial pacemaker: An electrical impulse of non-cardiac(artificial pacemaker) is recorded as a vertical spike on an EKG.

2) In ECG, stress testing, event monitoring and Holter recording, artifacts are loose as Electrical interference or, “noise,” that is recorded from sources other than the electronic signals of the heart.

Examples of Artifacts



3, Due to.respiration. The electrical activity of skeletal muscle and that of the heart muscle are cycle (60 Hz) noise that appears as, “fuzz,”all over the signal.

4.Muscle tremor / noise Low amplitude muscle tremor noise can mimic the baseline seen in atrial fibrillation.

Muscle tremors are often a lot more subtle than that shown in figure.

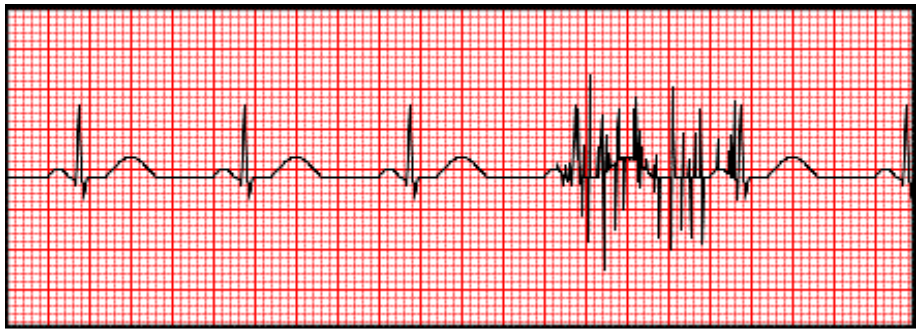


Figure : **Muscle tremors**

4. **Reversed leads / misplaced electrodes**

Electrode/lead placement is very important. If one were to accidentally confuse the red and Yellow lead cables (i.e. place the yellow one where the red one should go, vice versa).

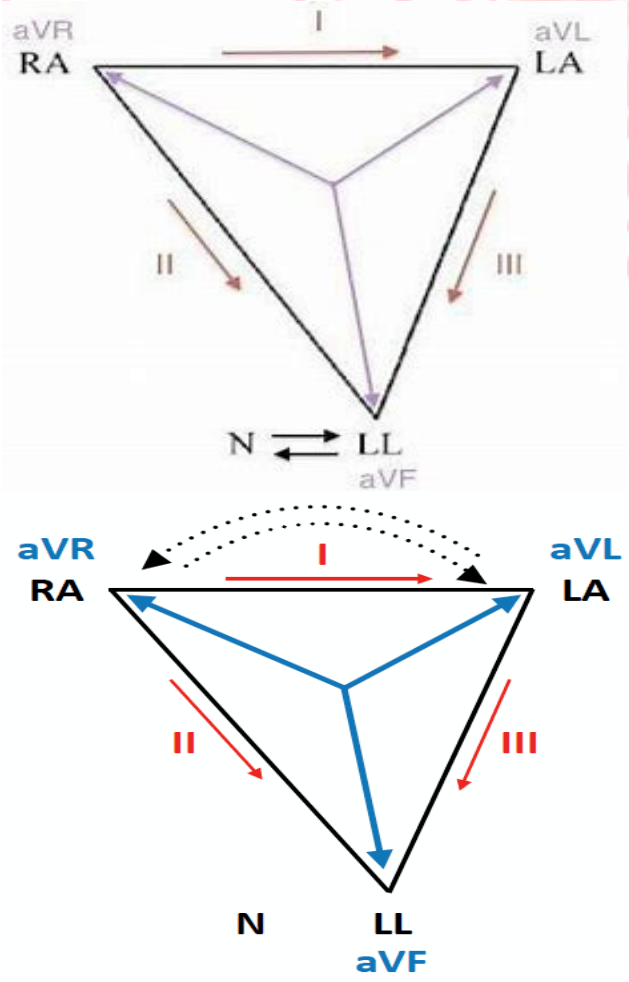
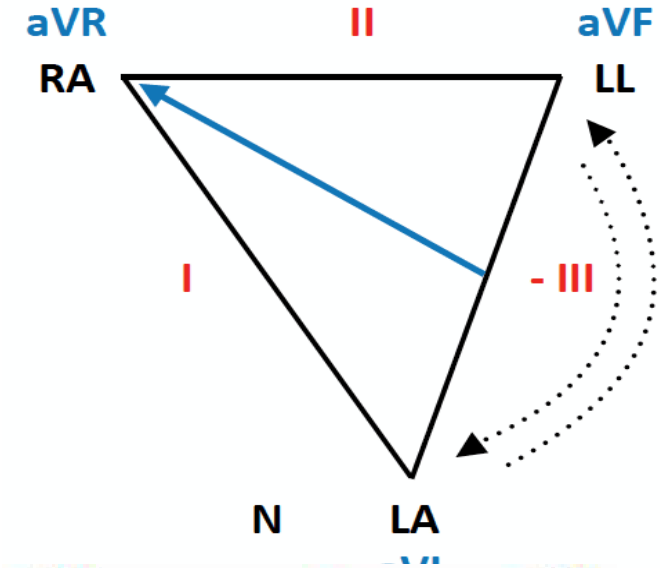


Figure- **Diagram of reversal of limb leads**



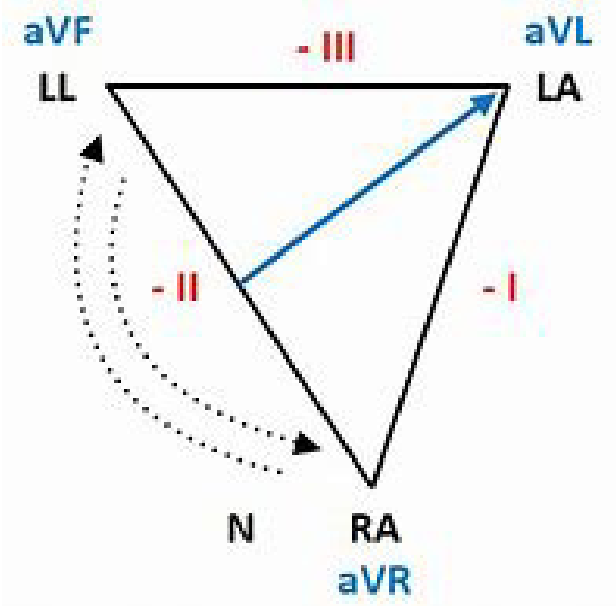


Figure- Diagram of reversal of limb leads

AC interference

Alternating current (AC) that we get from the wall. When an ECG machine is poorly grounded or not equipped to filter out this interference. If one were to look at this ECG line closely, he would see 60 up-and-down wave pattern in a given second (25 squares).

6) Movement artifacts: **Increasing movement artifacts in a Parkinson patient.**

Figure- **Baseline drift/** ABHIPRAY

This often occurs right after lead connection and after electric Cardioversion for restoring heart rhythm normal.

7). Absolute heart block

QRS complexes are wide and bottle-shaped and show no relationship with the P wave. It occurs very rarely, and even then. This should not be confused with the real arrhythmia complete heart block.

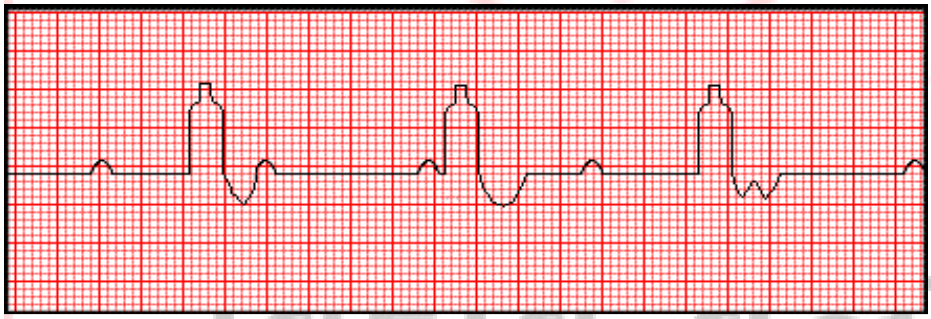


Figure `: **Absolute heart block**

8) Pacing spikes

These are seen in someone whose implanted pacemaker is firing. The sharp, thin spike seen in

figure ---- is an electrical signal produced by an artificial pacemaker.

The wide QRS complex that follows it represents the ventricles depolarizing. If a pacing spike is not followed by its intended response, we say that it has failed to capture.

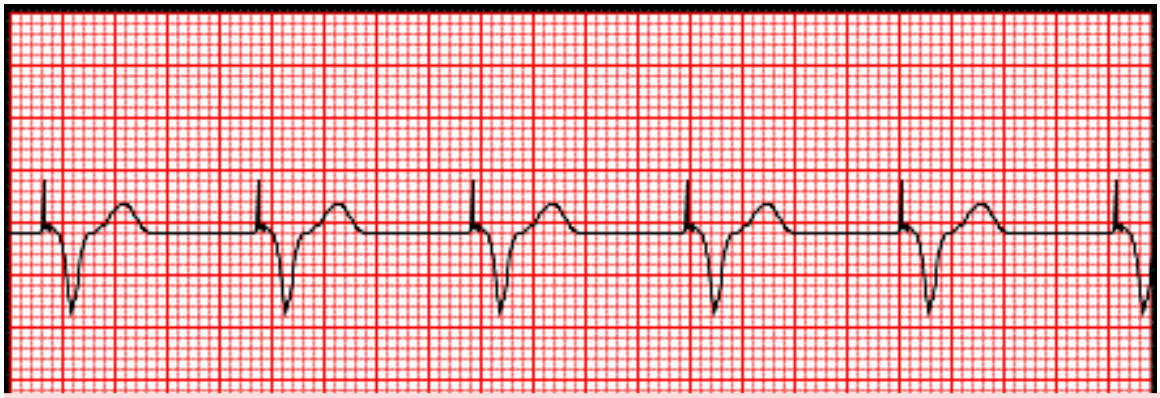


Figure-

Other Causes of artifacts: EKG artifacts can be generated by internal and external causes

Internal

These physiological causes could be due to:

Patient's motion: Does not allow electronic filtration.

Tremors and shivering cause motion artifacts.

Laughing and talking.

Simple movements such as brushing and combing the hair can produce EKG disturbances during ambulatory EKG monitoring. Muscular activity: Allows electronic filtration (small spikes).

External

These are non-physiological causes associated with other electrical devices attached to or implanted (e.g. deep brain stimulator) in the body and includes the following:

Electromagnetic interference: Power line electrical disturbances/ Light fixtures Electrocautery burn of tissues by electricity

Electrical devices in the room

Radiofrequency based commercial (e.g. mobile phones) products

Cable and electrode malfunction:

Insufficient electrode gel

Misplaced leads

Inappropriate filter settings

Broken wires

RELATED WITH PATIENTS: : **REMIDIES OF THE ARTIFACTS**

Oily, dirty and scaly skin : Clean the dirty skin

Excess hair : Remove the excess hair

Metallic objects (any jewellery, mobile, coins keys : Remove the metallic objects

Patient's movement : Stable the patient

Muscle tremor : Relax the patient

Patient talking and laughing : Instruct the pt. not take & laugh

Patient shivering : Give a blanket or on the heater

Uncomfortable/tensed : Comfortable& relaxed

Patient ungrounding : Grounding the patient

RELATED WITH ECG VMACHINE **REMIDIE S OF THE ARTIFACTS**

Faulty equipment : Change the equipment or repair

Ungrounded machine : Grounding the machine

Broken wire/ cable : Change the broken wire

Uncharged machine : Charged the machine

Off filter : Switch on the filter on the filter

Gain/STD and speed not set properly : Set the parameter

Dirty or encrusted electrode Clean the dirty &encrusted electrode

Dried conductive compound in the prejelled electrodes: Changed the electrode

Improper application of electrodes : Set the position of the elect.

Loose or dislodged (to move from

its place) electrodes : Tighten& fixed the elect.

Faulty grounding : Changed the faulty equipment

RELATED WITH ROOM

High or low Room temperate : Maintain the optimum temperature

High tension wire : Change the lab

Fluctuation of light & other appliances : Switch off the light &other appl.

X-Rays : Do not do the ECG in X rays room

Patient table of metallic : Place the mattresses or take wooden table

Dry and excess jelly : Take a new /wet jelly do not put excess jelly

Do not waste the excess time to place the leads : Do not waist the time to place the leads

UNIT-03
Manual ECG Machine

Part of manual ECG Machine

Charging socket

Lead socket

Main ON & OFF switch

Start & stop button

Reverse & Forwarded button

Gain / Standardization

Speed Button

Filter

Lead Button: - I, II,III, aVR, aVL, aVF,"V".

Mode of Function

Speed

Gain

12 Leads manual Mode

Advantages

It is easy to handling because there are only 5 electrodes.

All manual modes are under control directly by the operator. ECG record can be obtained as much long as the operator need.

There is no need taken the long lead separately. As all leads are taken long.

All chest lead can be recorder by selecting the "V" mode.

Only one electrode/ lead is capable to record all 6 chest leads.

To put the paper in the paper box is very simple. There is not any printing lock.

This machine of manual technology is capable to record the ECG when it is being charged.

The ECG roll is not wider so it takes very small space in machine. Moreover, easy to carry and store.

Disadvantages

This Manual Machine provides only ECG graph not ECG report.
All 12 leads are recorded one by one so a lot of time is waist.
All leads are read one by one. Because it is single channel ECG machine.
It waist a lot of paper to record the 12 ECG leads.

UNIT – 4. AUTOMATED CHINE

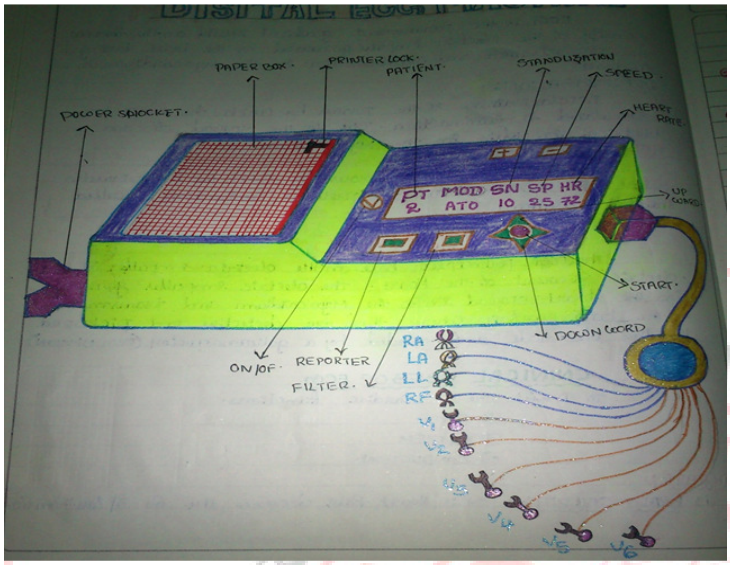


Figure-

ON/OFF SWITCH: This switch is used to input and out of electricity to the machine.

START/STOP: This switch is used to operate/stop the ecg machine during the recording.

POWER SOCKET: It is used to connect the electric cable or cord to the machine and electric power point to charge the battery of the machine.

LEAD SOCKET: This socket is used to connect the lead cable to the machine.

FILTER: This switch is used to filter the electric intervenes during ecg recording. This switch has to be "on" always. In addition, the filter sign will be display on ecg graph like this…

DISPLAY OF THE MACHINE:

Pt. Number: This displays the serial number of patient and record the data of ecg about 5 patients. We can retrieve the data of the ecg any time according the serial no after taking the ecg.

MODE (a way of doing things: - This machine contains the following mode of doing the ecg.

DIGITAL MODE

Auto mode: - this is used to take the ecg graph only not for report of the graph**.**

Acq Mode: - this mode is used to take the ecg graph and its interpretation/report also. And to measure **the waves, segments, and intervals.**

Fed Mode: - this mode is used to feed the data of ecg in the machine.

Apc mode:-on this mode, the machine can be connected with personal computer so that the ECG graph can be seen on the computer screen**.**

MANUALLY MODE

MNA mode: - On this mode the machine record only bipolar limb leads(L1,L2andL3) manually as long as we desire. And long lead L2 will be recorded extra.

MNB Mode:-On this mode the machine records only augmented Unipolar limb leads (aVR, aVL, aVF) manually and L2 lead also as long we desire**.**

MNC mode: - On this mode the machine records only V1, V2,V3 chest leads with long extra manually.

MND mode: - On this mode machine records only V4, V5, V6 chest leads manually with long lead L2.

SN (Standardization) /Calibration (CAL):- This is called STD/CAL of the machine. It means that when standardization lever of the ECG machine releases one mille Voltage (mV) current then machine records 10 mm upward deflection on the ecg paper at moving speed of the paper 25 mm/ sec. A sign is recorded on the paper, which is called square wave paper pattern like this…. It is used for good recording and interpretation of the ECG.

S**tandardization** of electrocardiograph is not done to rise up the square wave pattern but also to make the good interpretation. Over damping and under damping should be avoided, otherwise the normal shape and size of P, Q.R, S, T complex will become difficult**.**

OVERDAMPING:- It occurs when the stylus presses too much on the paper resulting its rounded corners. It leads to widening of the complex.

Underdamping (Overshoot):- It occurs when the stylus is too loose resulting in spikes at the corners. It results in increase in amplitude of the complex.

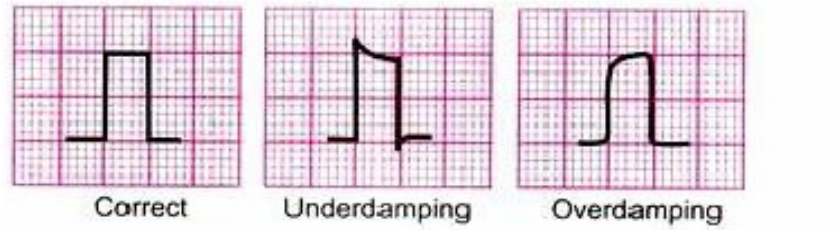


Diagram showing normal standardization, overdamping, and overshoot

Figure- Diagram of Standardization (Calibration)

Note -By mean of standardization, voltage of complex can be increased or decreased.

Double standardization: _ It is used when the complexes are too small and make interpretation difficult. To obtain normal voltage the complex height is divided by two.

Half standardization: - Here voltage is reduced to half, therefore to obtain normal voltage of a complex; two multiplies the complex height.

SPEED: -Every ecg machine has a provisional of a speed. Normal speed of the machine is 25 mm/ sec. A faster option speed of 50 mm/sec may be employed occasionally to visualize wave deflection better and for quick recording the ecg. It is written on the paper.

HEART RATE: -This digital machine display and records the heart rate of patient/sec.

Reporting switch: - This switch is used to take the ECG with report. First of all machine receive the electrical impulses and record on the graph paper then interpret ate or prepare the report of the ecg, when some graph paper will move outside from the paper box then we have to press the report switch. Therefore, this produces the ECG with report.

Moving switch: -I) this machine has the option to move in the display from left to right or right to left with the help of the moving switch.

ii) This machine also has the provisional to select the particular option from the display and find out. its contents by up and down switch around the stop/start button.

ECG LEADS: - there are only 12 ecg leads (6 limb leads and 6 chest leads) in which ten electrode are hanging down from machine which form 12 leads of red, black, green and yellow Color and also white Color for chest.

PAPER BOX AND ECG PAPER: - There is paper box in which ecg thermo sensitive paper of black background with wax and chemical coated, drawn the horizontal and vertical lines, is inserted in it. A roller move the paper upward and there is also a printer lock to tight and loose the roller. Before start the machine, we have to lock the printer lock.

BATTERY DISPLAY INDICATOR: - This indicates about status of battery. That how much Percentage has been charge and how much percentage is empty.

Advantages of Automatic ECG Machine

It provides report also with the ECG graph. It is 3 channel or 12 channel ECG machine so the consumption of paper is very less& easy to handling and in reading. There is no waste of time to attach the leads. Because there are 10 electrode in this type of Machine. It contain ALSO manual mode, ECG can be recorded long lead.

ECG Electrode

An electrode is a conductive pad in contact with the body that makes an electrical circuit with the electrocardiograph by detecting the heart's electrical signal at the surface of the skin

Floating or disc type: -These may be disposable or reusable. Disposable type is prejelled adhesive discs, which can be applied to the skin. Other types are to be fixed with adhesive after applying electrode jelly.

Needle electrodes: -These are small 25 gauge needles, which can be inserted under the skin.

Note: -In ecg electrodes are placed above the limbs and chest wall or alternatively on shoulders and lower abdomen near the Junctional of each limb with trunk.

In an amputed limbs it is placed above the amputed stump. The right leg electrode acts as a ground electrode for all the leads.

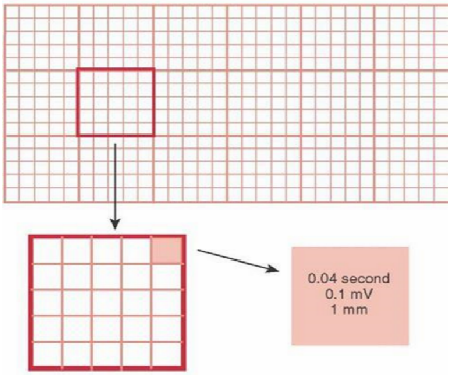
UNIT-5. ECG LEADS, JELLY & PAPER

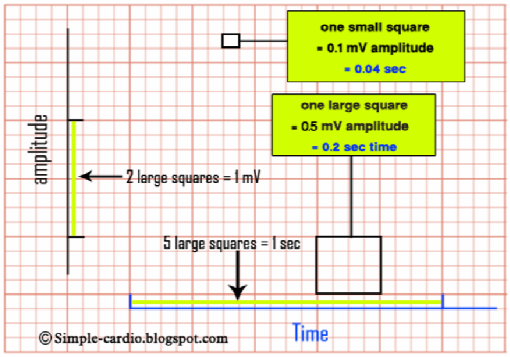
ECG PAPER

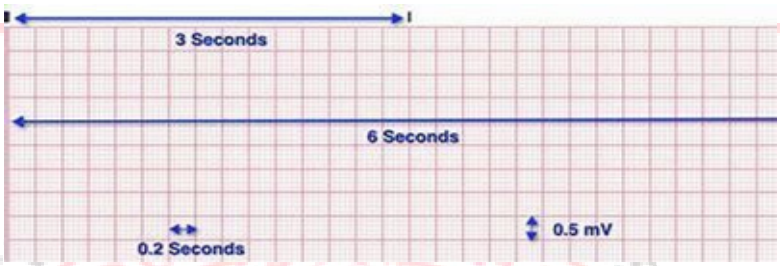
1. Electrocardiography paper is made in such a way that it presents a graph paper.
2. ECG paper is a thermo sensitive paper. Therefore, the ecg paper is recorded by moving of tip of a heat stylus over the moving paper.
3. Its background is black.
4. It has a fine coated of wax or chemical.
5. ECG paper is marked like a graph, consisting of Horizontal and vertical fine lines, marked 1 mm apart while every fifth line is marked bold. The bold lines are placed 5 mm apart.

On X – axis are present horizontally and Y-axis are present on vertically moving on paper.

6. Horizontally & vertically Fine & dark lines are drown on it.
7. Time is measured along the horizontal axis in second (sec).
8. Voltage is measure along the vertical axis in millimetre (mV). All waves, complexes, intervals are measure mm/sec. The length of the paper is 20 – 30 meter
9. Normally, 25 mm of paper is recorded within one sec. As the normal speed of the machine is 25 mm/sec.
10. Horizontally, 1 mm in width = 0.04 sec is measured in second. Vertically, 1 mm in height. 12.One big square contain 5 small square of .2 sec in width (horizontally) and .5 mV in height (vertically).
13. **One big square contain 5 small square of .2 sec in width (horizontally) and .5 mV in height (vertically).**







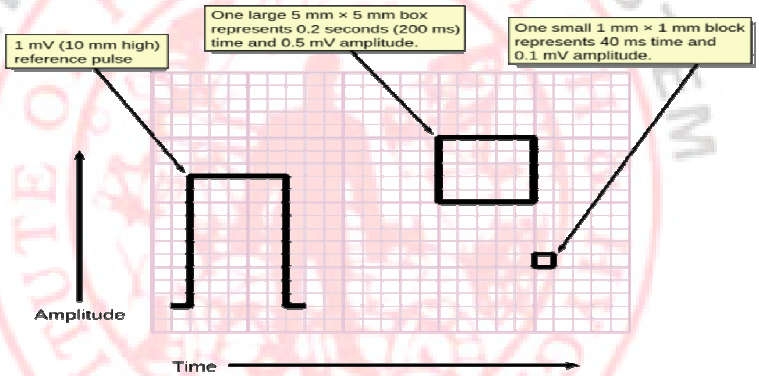


Figure-

ECG Jelly

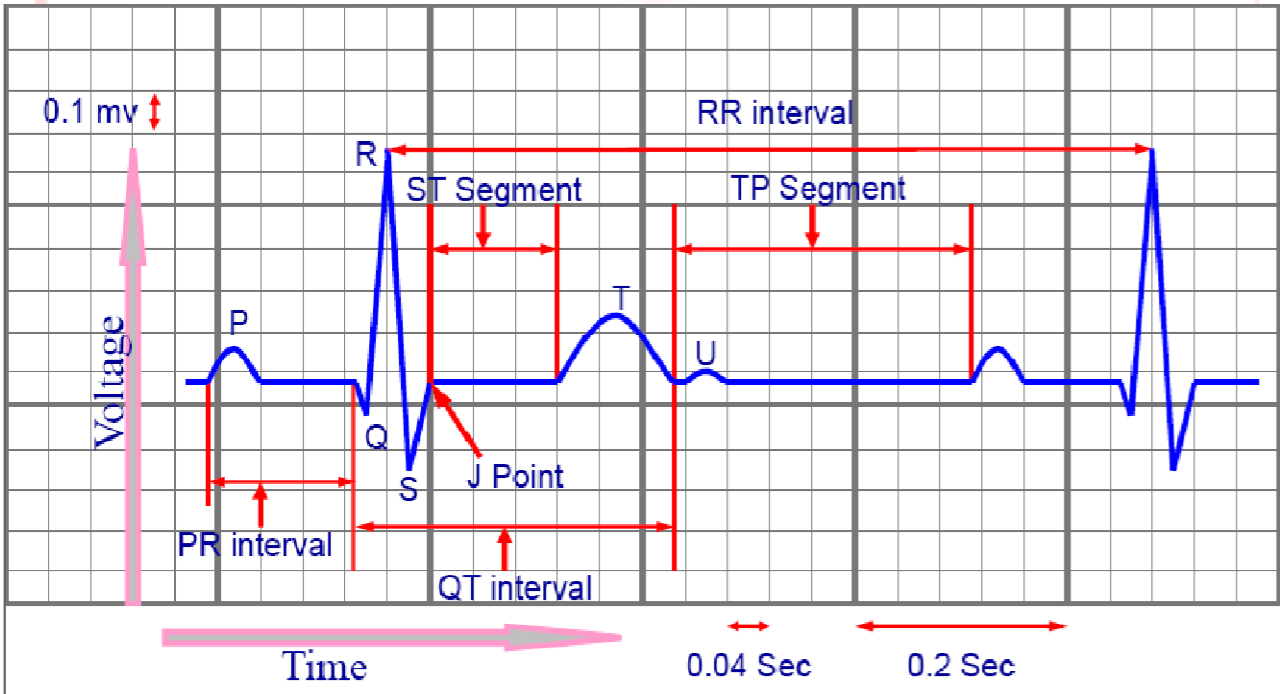
Figure- EMG Electrode Conductive Gel

Conductive gel is extremely useful when you use electrodes to record electrical activity on the surface of your skin. The outside layer of skin you see every day in the mirror is really made up of dead skin cells. These skin cells act as a good resistor, meaning that it makes detecting electrical activity difficult for your EMG electrodes.

1. Conductive Gel is usually viscous and salty; this acts as a conductive liquid medium to put between the skin and the electrode. In other words, the gel helps the electrodes detect the electrical activity under the skin.
2. It is composed of NaCl& gel with water. It makes it good conductor of electricity.
3. It makes easier the contact of electrode with skin.
4. It reduces/lowers the resistant between skin and electrode.
5. It fills the gap between skin and electrode. So that the electrode can pick up the electric signal better.
6. It is very easy to spread over the skin.
7. It is easy to clean with cotton/ tissue paper**.**
8. It is highly transparent gel with optimum viscosity. Therefore, that it does not pour /flow on the skin.
9. It has no corrosive formula. Therefore, it is not toxic and irritating.
10. It can be used for a long time.
11. It has no lubricant / greasy.
12. Its PH value is zero (neutral).

Components of ecg

ECG consists of waves, complexes, segments and intervals



• PR interval 0.12 – 0.20 sec • QRS duration 0.08 – 0.10 sec	• QT interval 0.4 – 0.43 sec • RR interval 0.6 – 1.0 sec

WAVES:- P, Q, R, S, T, U. If the deflection is above the baseline then wave will be positive, and if the deflection is blow the baseline then wave will be negative. The nomenclature of the waves done by Sir William Einthoven arbiturly as all word in alphabet were used and this series were empty so sir William choose these wards for the waves. There is not any full for of the waves.

Complexes: -QRS, A complex is the combination of two or more aves. QRS complex is combination of Q, R and S waves. There may be only two waves i.e. QS or RS.

Segment: A segment is the period between a wave or complex and another wave or complex. Normally, it is a straight (isoelectric line) line, that is electric intervene during cardiac cycle and no any deflection occur i.e. P-Q/PR, S-T,T-P.

Interval: An interval is the period between two points on the ECG that includes a wave, a complex or both. E.g. P-R,Q-T,,R-R/P-P.

Normal intervals

The recording of an ECG on standard paper allows the time taken for the various phases of electrical depolarisation to be measured, usually in milliseconds. There is a recognized normal range for such 'intervals':

PR interval (measured from the beginning of the P wave to the first deflection of the QRS complex). Normal range 120 – 200 ms (3 – 5 small squares on ECG paper).

QRS duration (measured from first deflection of QRS complex to end of QRS complex at isoelectric line). Normal range up to 120 ms (3 small squares on ECG paper).

QT interval (measured from first deflection of QRS complex to end of T wave at isoelectric line). Normal range up to 440 ms or 0.44 sec (though varies with heart rate and may be slightly longer in females).

UNIT-06 NORMAL ELECTROCARDIOGRAPHY

Normal "P" Wave presents

1. The P wave represents the both atrial depolarization. And the time taken by atria to empty their blood into their respective ventricles.

It is the sum of right and left atrial activation, the right atrium being activated first since the pacemaker is located in right atrium and then left.

Morphology

The shape of a P-wave is usually smooth and slightly rounded. It looks like a small hump protuberancelike camel upwards from the baseline. It is precede just before the QRS Complex. Normal P-wave Morphology – Lead II

It is upright in most leads (except aVR, & V1). It is constant in morphology, beat to beat It has single peak and is not notched.

The right atrial depolarization wave (brown) proceeds before to be that of the left atrium
(blue).

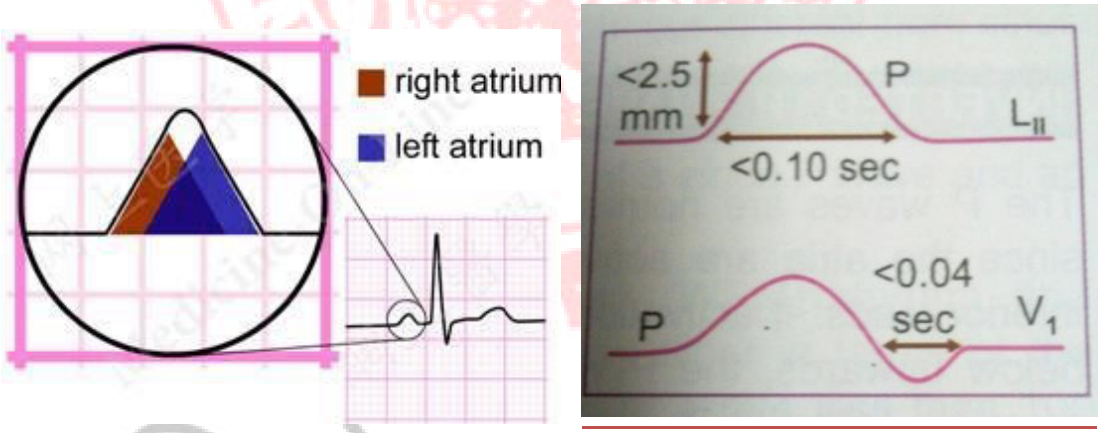


Figure-

First positive half represent the right atrial activation as the electric impulse comes toward to the lead V1 in right atrium and second negative half represent the left atrial activation as the electric current goes away towards the lead V1 in left atrium. Therefore, it is negative.

Normal values of P wave:

The P wave meets the following criteria:

It is less than 2.5 mm (0.25mV) in height. It is less than 2.5 mm (0.100 sec) in width. Duration and amplitude < 120 ms Normal duration is 0.06-0.10 seconds (>1.5 to 2.5 small boxes) in width. Normal P-wave Morphology – Lead V1

The P wave is typically biphasic in V1, with similar sizes of the positive (2.5 mm) =(1.5 mm or .06 sec) and negative deflections (1.0 mm or 0.4sec).

Best Seen; - Atrial abnormalities are most easily seen in the inferior leads (II, III and aVF) and lead V1, as the P waves are most prominent in these leads.

Normal QRS Complex

The QRS complex is the major positive deflection on the ECG with sharp peak.

The QRS complex is produced by the both ventricular depolarization. Normally QRS complex is narrow.

The "QRS complex" is the combination of the Q wave, R wave and S .This term can be confusing, since not all ECG leads contain all three of these waves, While the Prototypical (having the typical qualities of a particular group) QRS complex consists of three wave components, one or two of these components may be missing. Yet a "QRS complex" is said to be present regardless careless/headless.

For example, the normal QRS complex in lead V1 does not contain a Q wave, but only R wave and S wave, yet the combination of the R wave and S wave is still referred to as the QRS complex for this lead.

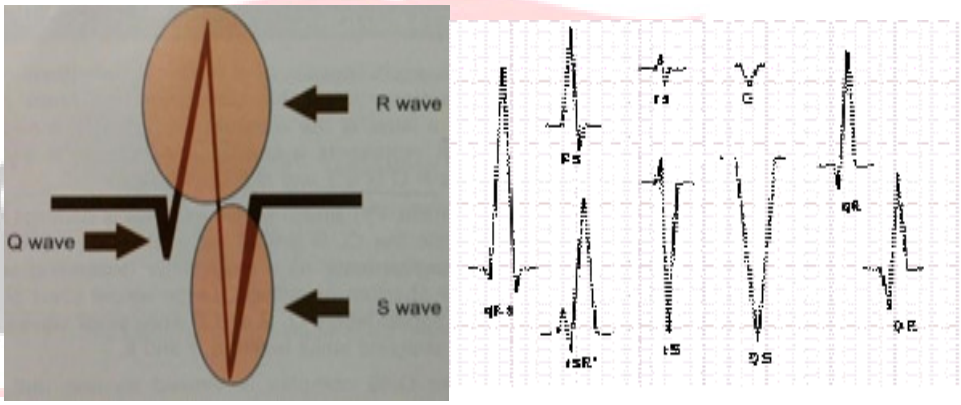


Figure-

NORMAL Q WAVE

Origin of the Q Wave

The Q wave represents the normal left-to-right depolarisation of the Interaventricular septum by the septal branch, which is originated from left bundle branch.

The Q wave is not visible in all ECG leads. Physiological Q waves may be observed in leads L1, aVL, V5 and V6 if the left ventricle is directed towards the lateral leads (horizontal heart).

And if the left ventricle is directed towards the inferior leads (II, III, aVF (vertical heart).

Deeper Q waves (>2 mm) may be seen in leads III and aVR as a normal variant. Different shape and size. A physiological Q wave meets the following criteria. They do not exceed 0.04 sec (1 mm) in duration.

They do not exceed one-fourth of R wave height. Or 25% in the same lead. Under normal circumstances, Q waves are not seen in the right-sided leads (V1).

Q waves are considered pathological if:

> 40 ms (1 mm) wide, > 2 mm deep, > 25% of depth of QRS complex in the same lead. Seen in leads V1-3

Pathological Q waves usually indicate current or prior myocardial infarction. Loss of normal Q waves

The absence of small Septal Q waves in leads V5-6 should be considered abnormal. Absent Q waves in V5-6 is most commonly due to LBBB.

Normal R Wave

The R wave is the first major deflection in QRS complex. It is upright in most leads xceptaVR where the P and T wave are also inverted.

In limb leads, R wave voltage is normally at least 5 mm while in the precordial leads; R wave voltage exceeds 10 mm. Under normal circumstances, the R wave voltage gradually increases as we move from lead V1 to lead V6. This is known as normal R wave progression in precordial leads.

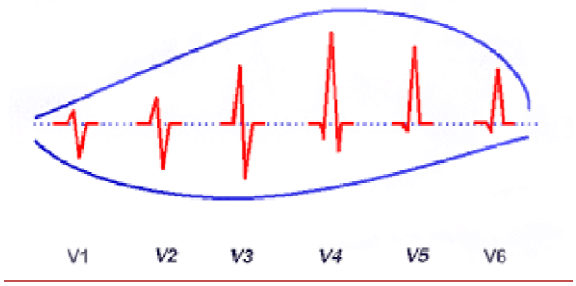


Figure-

IN the setting of a right bundle branch block there may be two R waves present giving the classic “bunny ear” appearance of the QRS complex. In this setting, the second R wave is termed R’ or “R prime”.

Normal value of R wave:

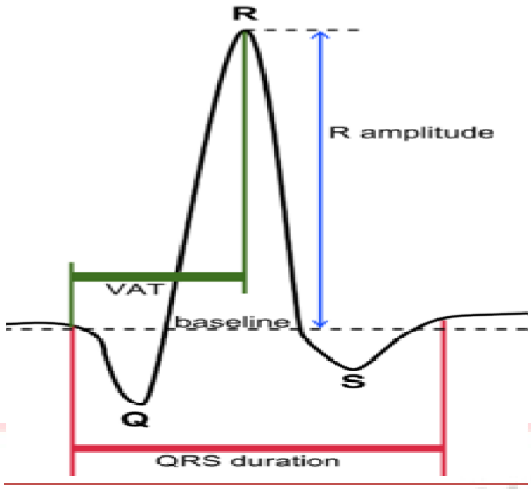
In the limb leads R wave voltage is normally 5 mm while in the precordial leads R wave voltage exceeds 10 mm. And less than this normal value the QRS complex knows as low voltage complex. In lead V1 R wave is 4 mm while in lead V5-6 is 25 mm. The R wave is smaller than the S wave in lead V1 and R wave is taller in lead V6 than S wave.

Representation:

In lead V5-6 it reflects left ventricular activation while in lead V1-2 it reflects right ventricular activation.

BEST SEEN: All chest leads

It is the time taken by an impulse to travel from endocardium to epicardium(also called the time of onset of intrinsicoid deflection). It is measured from the beginning of ‘Q’ wave to the peak of the ‘R’ wave. Normally it is 0.02 sec in right oriented leads (e.g. V1) and 0.04 to 0.05 sec in left oriented leads (e.g. V6).



Ventricular activation time (VAT).

It is the time taken by an impulse to travel from endocardium to epicardium. It is measured from the beginning of 'Q' wave to the peak of the 'R' wave. Normally it is 0.02 sec in right oriented leads (e.g. V1) and 0.04 to 0.05 sec in left oriented leads (e.g. V6).

Low Voltage ecg

If the voltage of the tallest R wave in the limb leads is less than 5 mm and that in the precordial leads is less than 10 mm, the electrocardiogram obtained is called is low voltage graph/low voltage ecg. When the R wave remains small in leads V4 (smaller than the S wave), the term "poor R wave progression" is used and is depicted below.

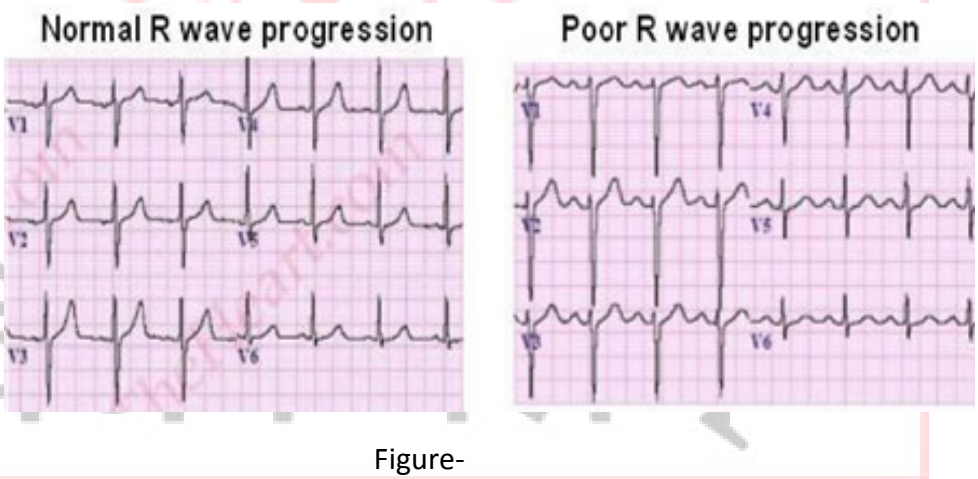


Figure-

The causes of poor R wave progression or PRWP are as follows:

The magnitude of the R wave depends upon the quantum of electrical forces that are generated by the left ventricle as well as on the extent to which these electrical forces are transmitted to the recording electrode.

Therefore, a low voltage graph may be obtained if the myocardium is diseased or if an abnormal substance or tissue intervenes between the epicardial surface of the heart and the recording electrode.

Causes

Specific causes of low voltage include:

Fluid

Pericardial effusion : fluid in pericardial.
Pleural effusion escape of a fluid into a part of the body

Fat

Obesity: Adipose tissue in obesity. Due to intervening substance/tissues

Air

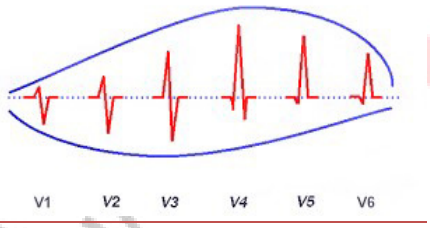
Emphysema : Air in pulmonary. Emphysema (destroy of lungs and air passage and dilation)

Normal S wave

The S wave is the first downward deflection of the QRS complex that occurs after the R wave. An S wave may not be present in all ECG leads in a given patient. In the normal ECG, there is a large S wave in V1, which progressively becomes smaller to the point where almost no S wave is present in V6.

Representation:

S wave represents the terminal portion/ basal part of the ventricular depolarisation.
The second negative deflection after S wave is called S' (s prime).



In lead V1 the S wave (capital) reflects the left ventricular activation while in V6, S wave (small) reflects right ventricular activation. The presence or absence of the S wave does not have major clinical significance.

Normal value

In lead V1 it is of less 27 mm in depth and in V6 less 7 mm.

J-point

The point where the QRS complex meets the ST segment is the J-point. The J-point is easy to identify when the ST segment is horizontal and forms a sharp angle with the last part of the QRS complex. However, when the ST segment is sloped or the QRS complex is

wide, the two features do not form a sharp angle and the location of the J-point is less clear.

Normal T Wave

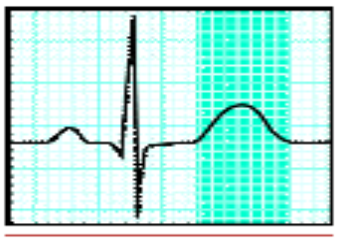


Figure-

In electrocardiography, the T wave represents the repolarization of the ventricles.

Characteristics of the normal T wave

The T wave is the positive deflection after QRS complex. **The normal T wave fulfils the following criteria:**

It is upright in most leads (exceptsaVR, Liii and V1). It is taller in V6 than V1 and taller in L1 than in lead Liii. It does not exceed 5 mm in height in the limb leads and 10 mm in precordialleads.

A negative T wave is normal in lead aVR. Lead V1 may have a positive, negative, or biphasic (positive followed by negative, or vice versa) T wave. The T wave is considered to be the most unstable component of the ECG graph. Therefore change in polarity of the T wave or T wave inversion is one of the most common ECG abnormalities. It is sensitive to cold water, heavy meal, smoking and most variable. wave in ECG. THEREFORE, it is most variable wave.

Normal U Wave

The U wave is a small (0.5 mm) deflection immediately following the T wave, usually in the same direction as the T wave. It is best seen in leads V2 and V3.

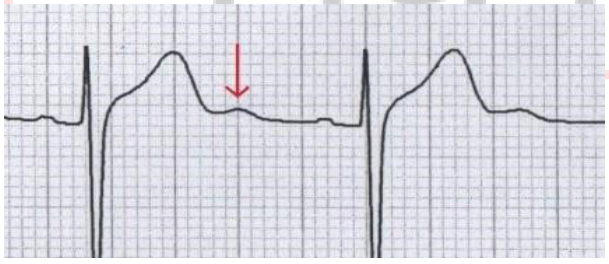


Figure-

Normal U Wave, Source of the U wave

The source of the U wave is unknown. The common theories regarding its origin are:

Delayed repolarization of Purkinje fibersProlonged repolarization of mid-myocardial "M-cells" Features of Normal U waves.

The U wave normally goes in the same direction as the T wave. U -wave size is inversely proportional to heart rate: the U wave grows bigger as the heart rate slows down

U waves generally become visible when the heart rate falls below 65 bpm The voltage of the U wave is normally <25% of the T-wave voltage: disproportionally large U waves are abnormal

Summary of ecg& their Significance

Waves	Significance	Time period	Abnormalities
P wave	Depolarisation of both atrium Time taken by atria to empty their blood into their respective ventricle	1.5 to less than 3 mm o.06to less than 0.12	Absent, Hidden, Tall (Pulmonale), Broad (P mitral), More than One, Negative, F flitter or fibrillation waves.
QRS Complex	Depolarisation for ventricles	0.08 to .1 sec (2 to 2.5 mm) less than 0.12 sec.	Prolonged (wide) QRS Complex indicates abnormal conduction through the ventricles (bundle branches block)
S-T Segment	Complication of depolarization of ventricles	less than .20 sec	Depression of S-T segment represents ischaemia Elevation represents infarction of cardiac muscles

T wave	Repolarisation of both ventricles and complete electrical recovery of the vent.	less than 0.20 sec (5 X 5 mm) Greater in L1than Liii Greater in V_{5-6} than in V1-2	Flat T wave indicates Hypokalaemia Inverted T indicates Ischaemia (symmetrical) Tall and spiky T wave indicates elevated serum potassium (Hyperkalaemia)
Q-T interval	Total activation time of ventricles (dep+ Rep)	.040 to .43 sec	

Calculation of Heart Rate in ecg

On a regular rhythm

1500/R-R INTERVALs. E.g. If the R-R interval is as

1500/10 = 150 bpm

1500/15 = 100 bpm

1500/20 = 75 bpm

1500/25 = 60 bpm

The above figure shows that if the R-R intervals increase then heart rate decrease. And If the R-R interval decrease then heart rate increase.

When the heart rate is irregular

Count the QRS complexes in 6 seconds and multiply the number by 10 to get the patient's heart rate per minute (30 large blocks are equal to 6 seconds

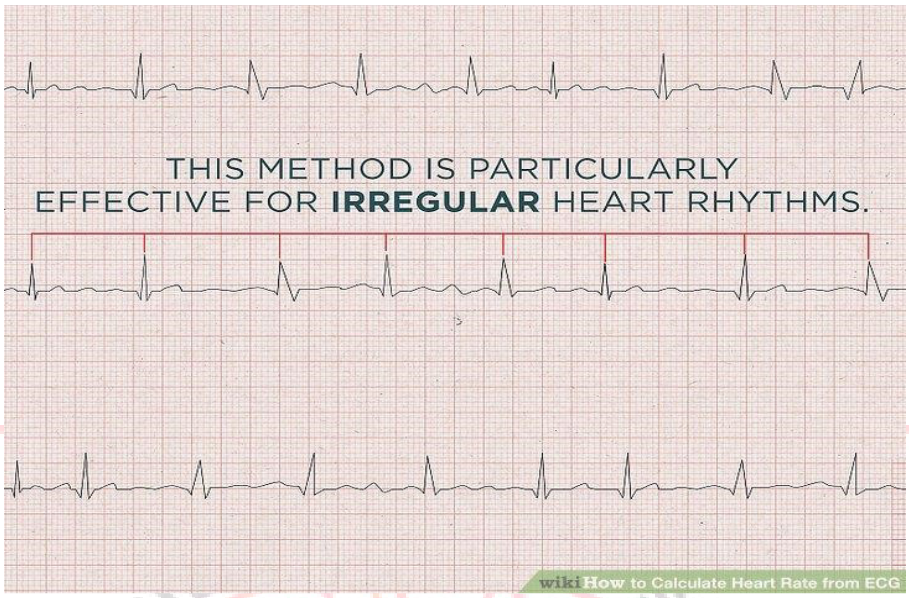


Figure-

To make a quick determination of the heart rate, count the number of large squares between consecutive R waves on the ECG and divide 300 by this figure. It is found:

If 1 large square is between R-R intervals then the heart rate is 300 beats per minute.

If 2 large square is between R-R intervals then the heart rate is 150 beats per minute.

If 3 large square is between R-R intervals then the heart rate is 100 beats per minute.

If 4 large square is between R-R intervals then the heart rate is 75 beats per minute.

If 5 large square is between R-R intervals then the heart rate is 60 beats per minute.

If 6 large square is between RR intervals then the heart rate is 50 beats/min.

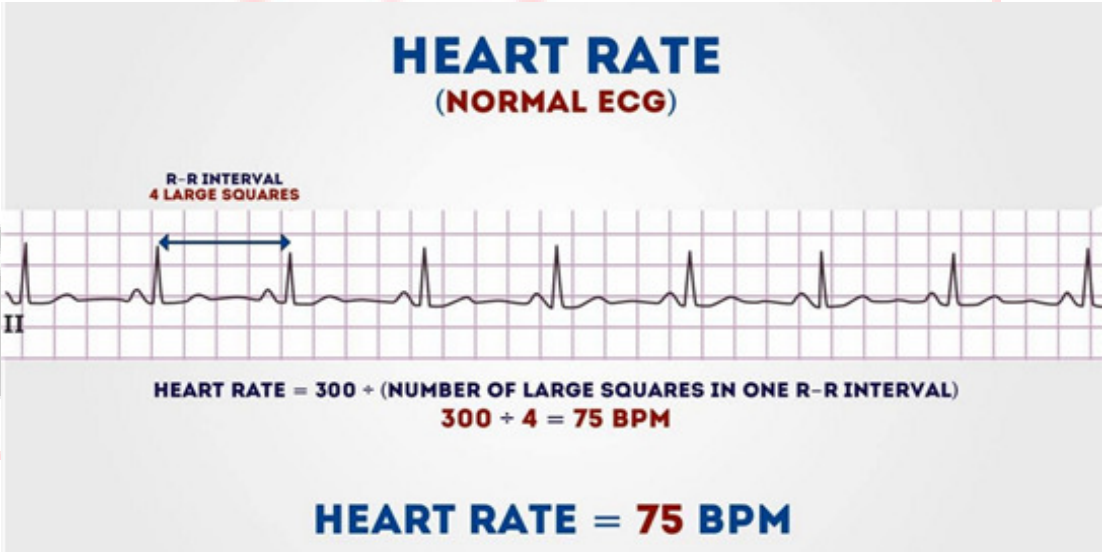


Figure-

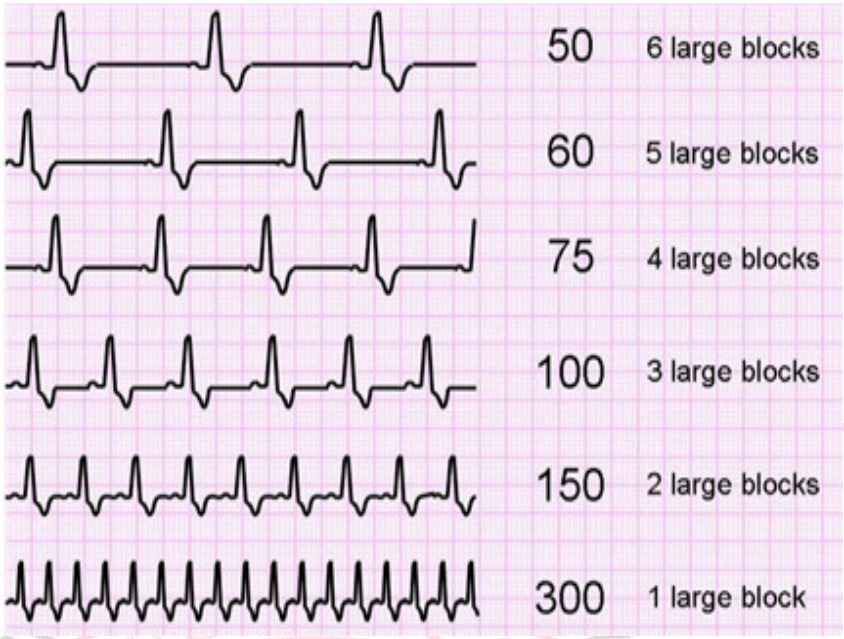


Figure-

Identification of Cardiac rhythm inecg

The rhythm or regularity of the heart beat is determined by comparing the duration of the R-R interval in an ECG strip. If all the R-R intervals are equal, the rhythm is considered to be regular. If one or more R-R intervals are not equal to each other, the rhythm is said to be irregular.