* **PRACTICAL ELECTROCARDIOGRAPHY**  
    
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* **OBJECTIVES**
* Recording of electrical events in heart
* Established electrode pattern results in specific tracing pattern
* Health of heart i. e . Anatomical consideration
* Blood supply of heart
* Effect of drugs
* Effect of ions
* Artificial pace makers
* **The Principle of Electrocardiograph;**-

is a modified galvanometer in which the recordings are made by electrodes placed on the body surface, sensing the electrical impulses of heart

**ECG Paper :**

is actually a black paper on which a heat sensitive, white or rose substance is coated This coating is erased by the heated stylus Black paper

* **Principle of recording**
* Positive/upward vs. negative/downward deflection
* “wave of depolarization” = “wave of positive charge”
* Wave of depolarization moving towards positive electrode = positive deflection and vice-versa
* Lead axis if parallel maximum deflection and vice-versa
* 12 leads minimum required – different views of the same electrical activity
* **Electrical = Mechanical activity**
* SA node – silent
* P wave = atrial contraction, Atrial DP

3. AV node, His bundle, Purkinje fibers – PR interval

4. PR segment = allows time for blood to pass from atria to ventricles

5. QRS- Ventricular depolarization

6. Ventricular isoelectric

7. period (initial – plateau of ventricular repolarization) – ST segment

8. Ventricular repolarization – T wave

9 J point is the point at which the S wave ends and the ST segment begins J point elevation

5. Atrial repolarization during QRS

* **Electrocardiogram**
* Summation of AP of cardiac cells
* Force vector = direction and magnitude
* 12 lead EKG - “Views”
* Bi-polar limb leads – FRONTAL I, II & III
* Uni-polar chest leads –
* Augmented voltage; aVF, aVL, aVR
* Transverse V1 – V6
* Augmented Voltage Leads

Wilson central terminal (WCT) is formed by connecting a 5000Ω resistance to each limb electrode and interconnecting the free wires; the CT is the common point.

represents the average of the limb potentials. Because no current flows through a high-impedance voltmeter, Kirchhoff's law requires that   
IR + IL + IF = 0.

**2.UNIPOLAR LIMB LEAD**

1 positive and remaining 2 leads combine negative lead

* aVF (LF+,RA-,LA-)
* aVL (LA+,RA-,LF-)
* aVR (RA+,LA-,LF-)
* **3.Uni-polar chest leads – Transverse V1 – V6**
* **Basic EKG – 6 Chest Leads**

Cover heart in normal anatomical position

Horizontal or Transverse plane

* V1, V2 = right chest
* V3, V4 = inter-ventricular septum
* V5, V6 = left chest

NOTE;- deflection changes from V1 to V6

* Electrocardiogram?
* **Standardization**
* Rate
* Rhythm
* P wave
* PR interval
* QRS duration
* QRS morphology
* Abnormal Q waves
* ST segment
* T wave
* QT interval
* Axis
* **Standardization**
* Time recorded on X axis (25 mm = 1 sec)
* Voltage recorded on Y axis (10 mm = +1 mV)
* Smallest divisions are 1 mm by 1 mm
* Heavy black lines = 5 mm square
* Amplitude vs. deflection
* 1 mm = 0.04 sec; heavy lines = 0.2 sec
* 3 sec marks = bottom/top of paper
* **Rate calculation**
* Cardiac cycles per minute
* Methods –
* Triplets; (5X60)300, 150, 100, 75, 60, 50
* < 60 bpm; # cycles per 6-sec strip, add 0
* Methods – calculator
* Divide (25X60)1500 by # of square between Ps or Rs (0.04 sec x 1500 = 60 sec): VARIABLE – not good with irregular rhythms
* Measure mm between several complexes; divide (1500/mm)\*cycles: SUMMARY – better
* Sinus Bradycardia = sinus rhythm < 60 bpm
* Sinus Tachycardia = sinus rhythm > 100 bpm
* Rhythm
* Different to rate!
* Is there a clear P wave before each QRS? (lead II)
* Regular vs irregular
* Tachyarrhythmias vs bradyarrhythmias
* Commonest rhythm is SR (ie. normal)
* Commonest arrhythmia is AF
* NORMAL ELECTROCARDIOGRAM
* PR interval
* Start of P wave to start of QRS
* Normal = 0.12-0.2s
* Too short – can mean WPW syndrome (ie. an accessory pathway), or normal!
* Too long –means AV block (heart block) - 1st/2nd/3rd degree
* QRS complex
* Should be <0.12s duration
* >0.12s = BBB (either LBBB or RBBB)
* ‘Pathological’ Q waves can mean a previous MI
* >25% size of subsequent complex
* Q waves are allowed in V1, aVR and III
* ST segment
* ST depression
* Downsloping or horizontal = abnormal
* Ischaemia (coronary stenosis)
* If lateral (V4-V6), consider LVH with ‘strain’ or digoxin (reverse tick sign)
* ST elevation
* Infarction (coronary occlusion)
* Pericarditis (widespread)
* T wave
* Peaked (hyperkalaemia or normal young man)
* Inverted/biphasic (ischaemia, previous infarct)
* Small (hypokalaemia)
* QT interval
* Don’t worry about too much…
* Start of QRS to end of T wave
* Needs to be corrected for HR
* Various formulae
* eg. Bazett’s:
* Computer calculated often wrong
* Long QT can be genetic (long QT sy.) or secondary eg. drugs (amiodarone, sotalol)
* Associated with risk of sudden death due to Torsades de Pointes
* **Basic Axis – 6 Limb Leads**
* Standard & augmented leads
* Divide chest into 30 degree “views”
* “lateral leads” – I & aVL
* “inferior leads” – II, III & aVF
* I = 0 degrees (+), 180 = (-)
* aVF = +90 (+), -90 (-)
* **Axis**
* Direction of the movement of depolarization
* Vector – indicates direction and magnitude
* Mean QRS Vector = summation of small vector direction and magnitude
* AV Node is center
* Clinical Importance:

Normal axis =-300 to + 110 0

Analyze quadrant with Lead I and aVF

Two thumbs up = POSITIVE

* **Classic Triad of MI**
* Ischemia
* Reduced blood supply
* Inverted symmetrical T waves OR ST segment depression
* Check chest leads!
* Injury (acute or recent infarct)
* ST segment elevation
* Earliest EKG sign of an infarct
* Infarction
* Presence of Q wave
* 1 mm wide or 1/3 QRS complex
* Myocardial Damage Location

Limb Leads:

L2, aVF, L3: Inferior

L1, aVL: Lateral

aVR: Cavity

Chest Leads:

V1, V2: Anterior

V3, V4: Septal

V5, V6: Lateral