- **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 $I_R + I_L + I_F = 0$.

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 =-30^0 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