

SNS COLLEGE OF ALLIED HEALTH SCIENCE
Affiliated to The Tamil Nadu Dr MGR Medical University, Chennai



DEPARTMENT OF CARDIAC TECHNOLOGY

COURSE NAME : Basic Electrocardiography

UNIT : Basic Principles of ECG

TOPIC : Electrocardiographic lead systems

FACULTY NAME: Kavipriya S

EMPATHIZE – Understanding the Clinical and Learning Need

Objective:

Recognize how proper ECG lead placement and understanding of the **Einthoven's triangle** are essential for accurate cardiac diagnosis.



Fundamental Concept: The Basis of ECG Recording

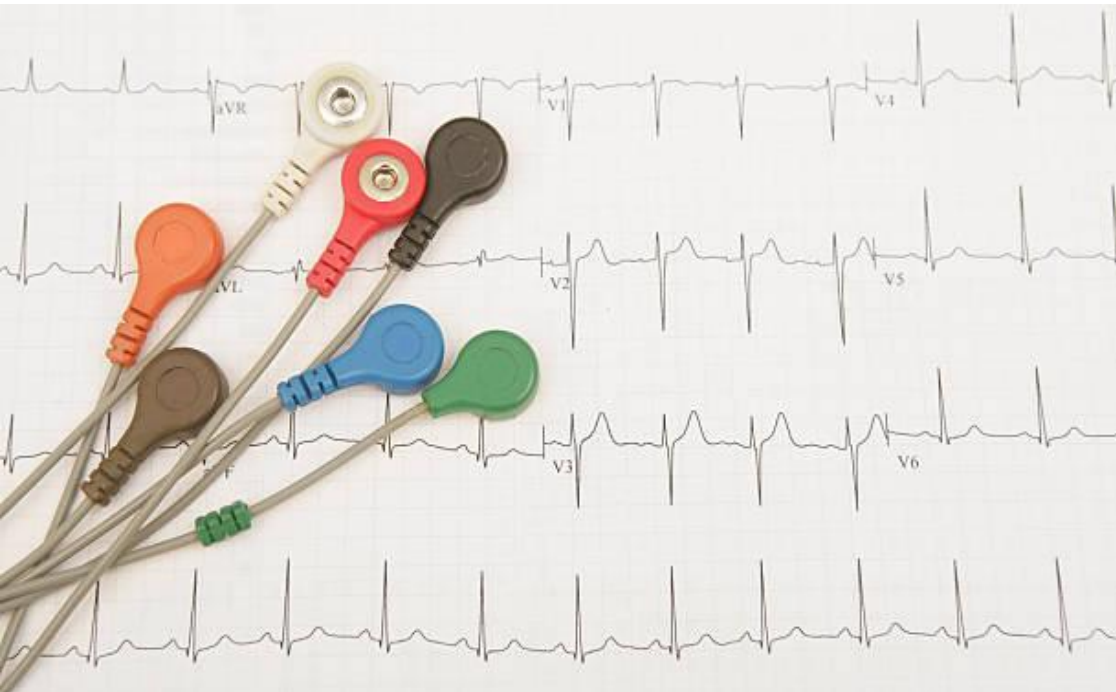
- The **heart's electrical activity** spreads through the body fluids and is detected by **surface electrodes** placed on specific body sites.
- Each lead records the **difference in electrical potential** between two or more electrodes.
- The direction of current flow relative to the electrode determines whether the ECG tracing is **positive or negative**.



DEFINE – Identifying the Problem

Problem Statement:

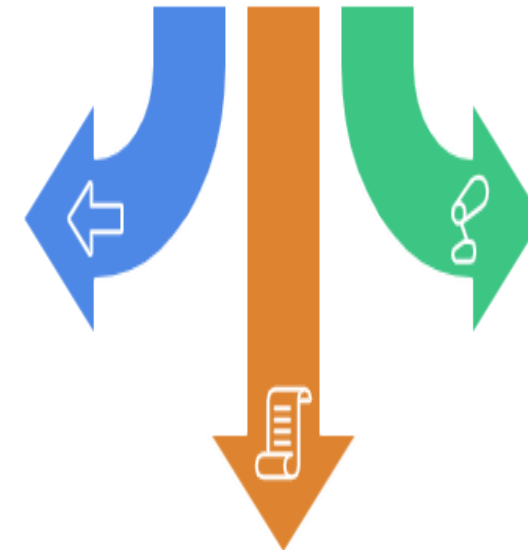
How might we ensure accurate recording of cardiac electrical activity by properly understanding and applying the concept of Einthoven's triangle, lead systems, and correct electrode color placement?



Understand Einthoven's Triangle

Learn the geometry to avoid misinterpretation

How to overcome challenges
in ECG interpretation?



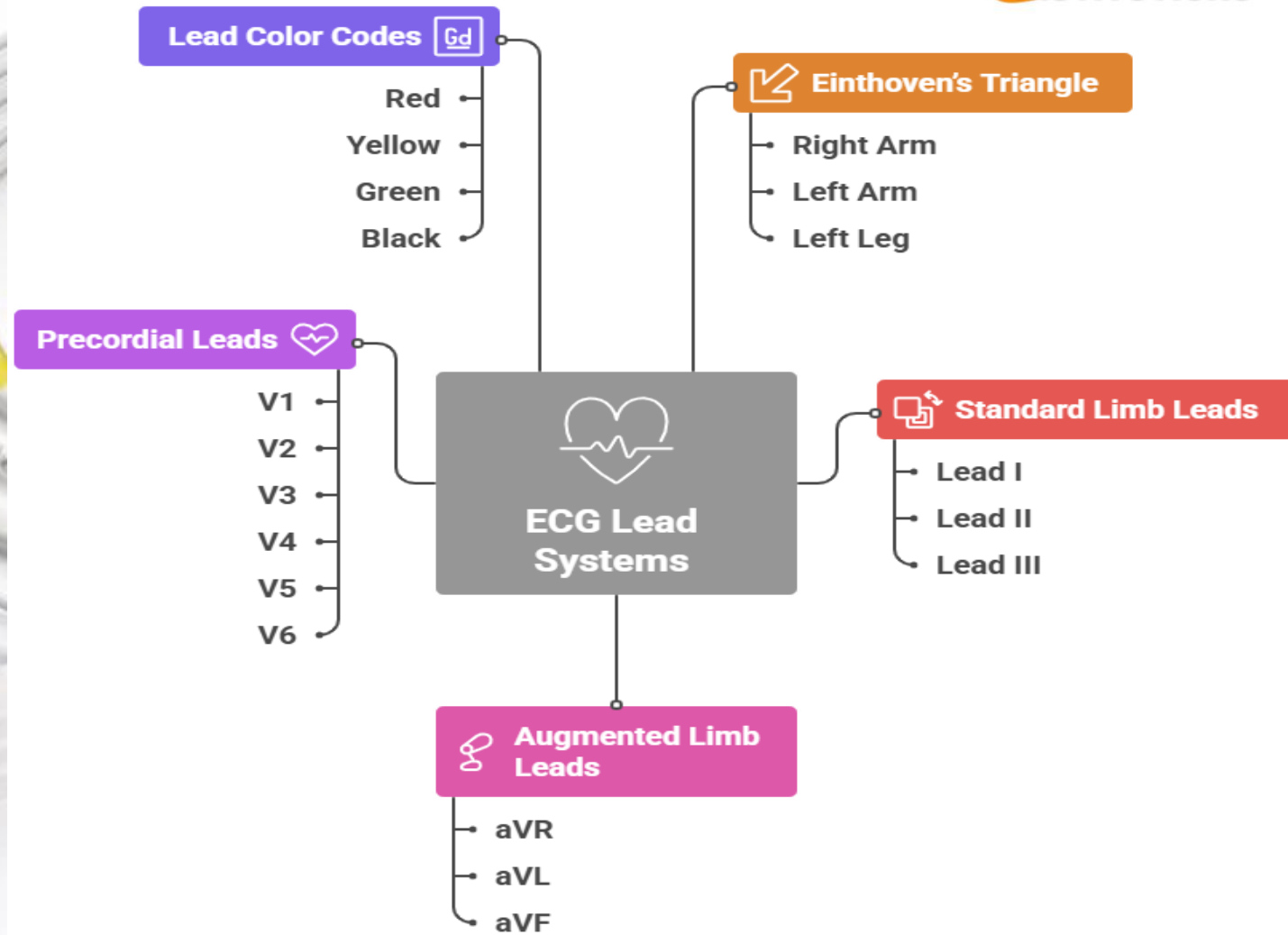
Master Standard Limb Leads

Recognize lead positions for accurate heart view

Identify Color Codes

Use color coding to prevent polarity confusion

IDEATE – Leads & colour coding system



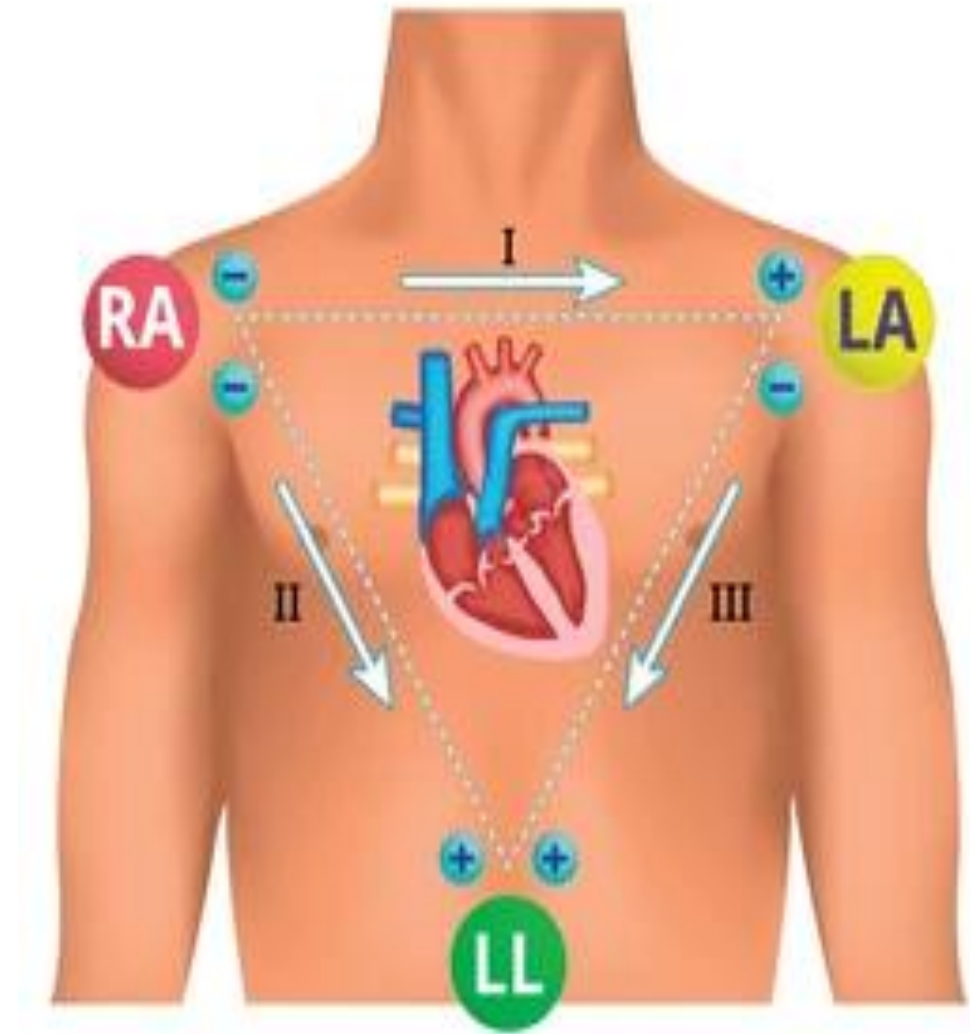
PROTOTYPE – Applying the Concept



- Einthoven's law states that at any given moment in an electrocardiogram (ECG), the electrical potential of Lead II is equal to the sum of Lead I and Lead III.
- The law shows that the three standard limb leads are not independent and that the information from any two leads can be used to calculate the third, a concept crucial to understanding the [Einthoven triangle](#).

→ According to **Einthoven's Law**:

$$\text{Lead II} = \text{Lead I} + \text{Lead III}$$



Standard Limb Leads and Augmented Leads

Lead	Type	Positive Electrode	Negative Reference	Cardiac View
I	Bipolar	LA	RA	Lateral
II	Bipolar	LL	RA	Inferior
III	Bipolar	LL	LA	Inferior
aVR	Unipolar	RA	LA + LL	Right upper heart
aVL	Unipolar	LA	RA + LL	Lateral
aVF	Unipolar	LL	RA + LA	Inferior

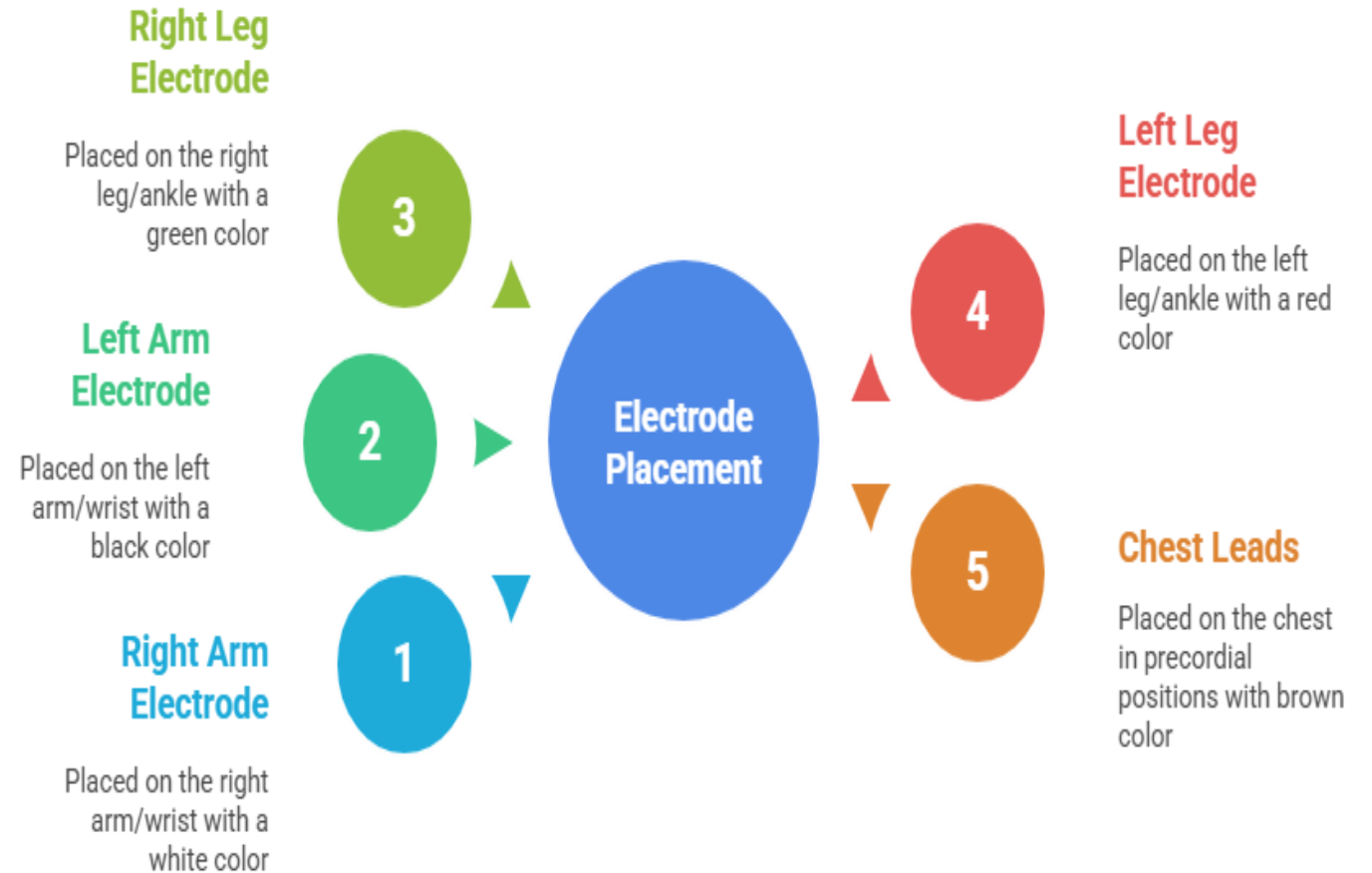
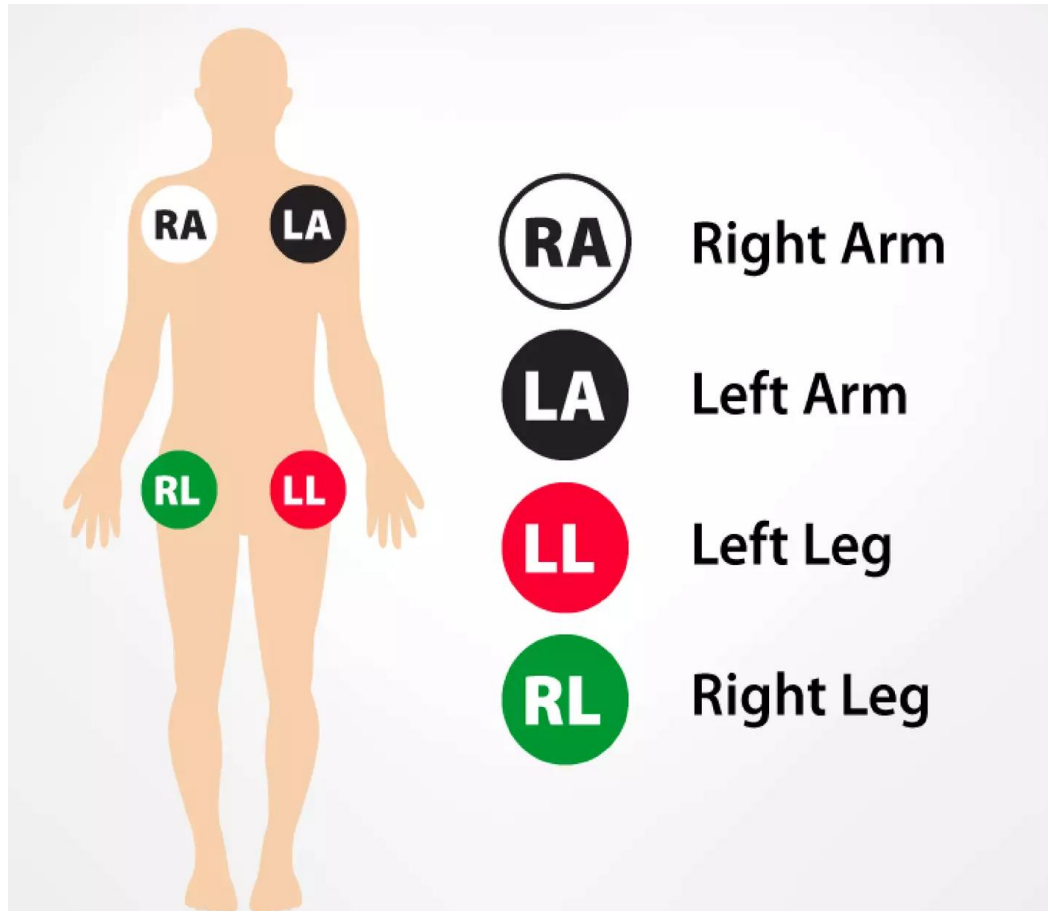
Precordial (Chest) Lead Placement



ECG Lead Positions



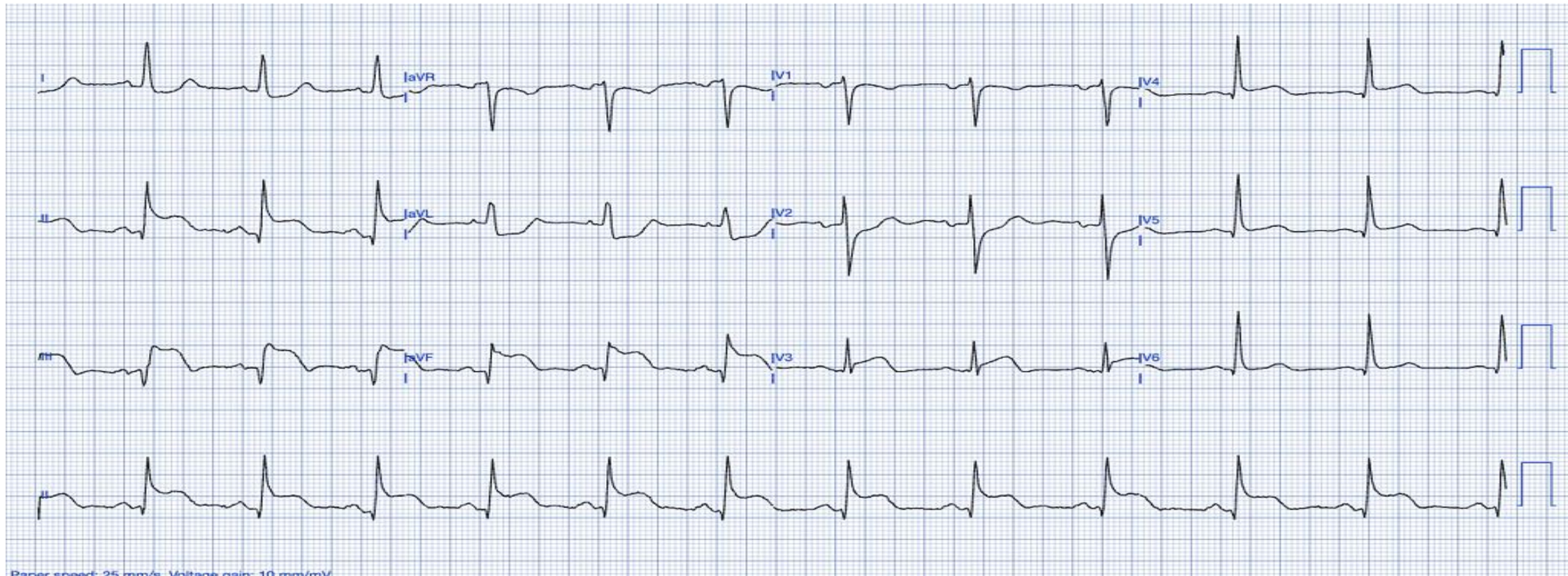
Understanding the colour code & limb lead Electrode placement



TEST – Application and Verification

In-Case ECG Findings are

- ST elevation in Leads II, III, aVF → Inferior MI.
- Normal precordial leads → Isolated inferior involvement.



Summary Table: Design Thinking Reflection

Stage	Focus	Example Application
Empathize	Understand patient & ECG need	Chest pain, need accurate ECG
Define	Identify learning problem	Lead placement and color confusion
Ideate	Concept mapping	Einthoven's Triangle, Lead system
Prototype	Apply theory to case	ECG placement & tracing
Test	Evaluate outcome	Correct inferior MI identification

References

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- Chou TC, Knilans TK. *Electrocardiography in Clinical Practice*, 7th Edition, Elsevier, 2019.
- Guyton & Hall. *Textbook of Medical Physiology*, 15th Edition, Elsevier, 2021.
- Marieb & Hoehn. *Human Anatomy & Physiology*, 12th Edition, Pearson, 2021.
- American Heart Association (AHA). *ECG Electrode Placement Standards*, 2020.