Electrocardiograms

ECG Leads

- Leads are electrodes which measure the difference in electrical potential between either:
  1. Two different points on the body (_______________________)
  2. One point on the body and a reference point, located in the center of the heart (_______________________)
ECG Leads

- Standard 12-lead uses 12 different leads to provide 12 different angles of view.
- More complete picture obtained.
- The standard EKG has 12 leads: ___ Standard Limb Leads
  ___ Augmented Limb Leads
  ___ Precordial Leads
- 2 electrodes placed on arms.
- 2 electrodes placed on legs.
- 6 electrodes placed on chest.
- ECG machine can vary the orientation of 10 electrodes to create 12 leads.

Axis

- Axis = direction
  - axis of heart = direction of the electrical wave
  - axis of a lead = viewpoint from which it looks at the heart.
- When wave moves towards positive electrode, it creates a ________ deflection on the ECG.
- When wave moves away from positive electrode, it creates a ________ deflection.
- When wave moves perpendicular to a positive electrode, it creates an equiphasic (or isodiphasic) complex on the ECG - it will be positive as the depolarization wave approaches (A), and then become negative as it passes by (B).
Standard Limb Leads

- Leads I, II, and III
- Triangle

Standard Limb Leads

- Lead I
  - RA → LA
  - Lateral view
- Lead II
  - RA → LL
  - Inferior view
- Lead III
  - LA → LL
  - Inferior view

Augmented Limb Leads

- aVR, aVL, aVF
- Created by measuring the voltage at 1 limb lead at a time with all others made negative
Augmented Limb Leads

- Lead aVR
  - RA is positive
- Lead aVL
  - LA is positive
  - lateral view
- Lead aVF
  - LL is positive
  - inferior view

Limb Leads

- 6 limb leads view the heart in a vertical plane called a __________

- Any electrical activity directed up, down, left, right is recorded
  - envision a giant circle that surrounds patient & lies in same plane
  - circle marked off in 360°

Limb Leads

- Angle of orientation for each bipolar lead can be determined by drawing a line from its negative lead to its positive lead
  - Lead I → 0°
  - Lead II → +60°
  - Lead III → +120°
  - aVR → -150°
  - aVL → -90°
  - aVF → 90°
Chest Leads

- Also called precordial leads
- \( V_1, V_2, V_3, V_4, V_5, V_6 \)
- Unipolar leads
- These chest leads create a horizontal or transverse plane
- View electrical waves as they move outward from center of heart

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Chest Leads

- \( V_1, V_2 \) - septal view
- \( V_3, V_4 \) - anterior view
- \( V_5, V_6 \) - lie over left ventricle
- left lateral view
Chest Leads

Summary of Leads

<table>
<thead>
<tr>
<th>Limb Leads</th>
<th>Precordial Leads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bipolar</td>
<td></td>
</tr>
<tr>
<td>L, II, III</td>
<td>-</td>
</tr>
<tr>
<td>(standard limb leads)</td>
<td></td>
</tr>
<tr>
<td>Unipolar</td>
<td></td>
</tr>
<tr>
<td>aVR, aVL, aVF</td>
<td>V1-V6</td>
</tr>
<tr>
<td>(augmented limb leads)</td>
<td></td>
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</tbody>
</table>

Arrangement of Leads on the EKG

<table>
<thead>
<tr>
<th>I</th>
<th>aVR</th>
<th>V1</th>
<th>V6</th>
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</thead>
<tbody>
<tr>
<td>II</td>
<td>aVL</td>
<td>V2</td>
<td>V5</td>
</tr>
<tr>
<td>III</td>
<td>aVF</td>
<td>V3</td>
<td>V6</td>
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</tbody>
</table>
### Anatomic Groups (Septum)

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral</td>
<td>aVR</td>
<td>aVL</td>
<td>aVF</td>
</tr>
<tr>
<td>None</td>
<td>Lateral</td>
<td>Inferior</td>
<td>Inferior</td>
</tr>
<tr>
<td>V1</td>
<td>V2</td>
<td>V3</td>
<td>V4</td>
</tr>
</tbody>
</table>

- V1: Septal
- V2: Septal
- V3: Anterior
- V4: Anterior
- V5: Lateral
- V6: Lateral

### Anatomic Groups (Anterior Wall)

<table>
<thead>
<tr>
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<th>III</th>
</tr>
</thead>
<tbody>
<tr>
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<td>V4</td>
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</tbody>
</table>

- V1: Septal
- V2: Septal
- V3: Anterior
- V4: Anterior
- V5: Lateral
- V6: Lateral

### Anatomic Groups (Lateral Wall)

<table>
<thead>
<tr>
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<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral</td>
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</table>

- V1: Septal
- V2: Septal
- V3: Anterior
- V4: Anterior
- V5: Lateral
- V6: Lateral
### Anatomic Groups

**(Inferior Wall)**

<table>
<thead>
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<tr>
<td>aVR</td>
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<td>aVL</td>
<td>aVF</td>
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<tr>
<td>V1</td>
<td>Septal</td>
<td>V2</td>
<td>V3</td>
</tr>
<tr>
<td>V4</td>
<td>Anterior</td>
<td>V5</td>
<td>V6</td>
</tr>
<tr>
<td>V5</td>
<td>Lateral</td>
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</tbody>
</table>

### Anatomic Groups

**-(Summary)**

<table>
<thead>
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<tr>
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<td>Lateral</td>
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</table>

### Normal 12-Lead EKG
Determining Axis

- Normal = down and to left (-30° to +90°)
  - -30° to -90° is referred to as a left axis deviation (LAD)
  - +90° to +180° is referred to as a right axis deviation (RAD)

- Most common causes of deviation
  - Left Axis Deviation (LAD)
    - inferior myocardial infarction
    - left ventricular hypertrophy
  - Right Axis Deviation (RAD)
    - right ventricular hypertrophy
    - anterolateral myocardial infarction
Determining Axis

- 2 methods to determine:
  - the Quadrant approach
  - the Equiphasic approach

Deviation Summary

<table>
<thead>
<tr>
<th></th>
<th>Lead I</th>
<th>Lead aVF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal deviation</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Left axis deviation</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Right axis deviation</td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>
Left Axis Deviation

Right Axis Deviation

Axis Quiz #1
Reversed Arm Electrodes

- If all components in Lead I are negative → arm electrodes are reversed