Advanced ECG Interpretation

for Nurses

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Outline

- ECG leads
- Ischemic Changes
- The ECG in ST Elevation MI
- Bundle Branch Blocks and Chambers Enlargement
ECG leads
### Arrangement of Leads on the ECG

<table>
<thead>
<tr>
<th>Lead</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Lateral</td>
</tr>
<tr>
<td>aVR</td>
<td>None</td>
</tr>
<tr>
<td>V₁</td>
<td>Septal</td>
</tr>
<tr>
<td>V₄</td>
<td>Anterior</td>
</tr>
<tr>
<td>II</td>
<td>Inferior</td>
</tr>
<tr>
<td>aVL</td>
<td>Lateral</td>
</tr>
<tr>
<td>V₂</td>
<td>Septal</td>
</tr>
<tr>
<td>V₅</td>
<td>Lateral</td>
</tr>
<tr>
<td>III</td>
<td>Inferior</td>
</tr>
<tr>
<td>aVF</td>
<td>Inferior</td>
</tr>
<tr>
<td>V₃</td>
<td>Anterior</td>
</tr>
<tr>
<td>V₆</td>
<td>Lateral</td>
</tr>
</tbody>
</table>

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Normal 12 leads ECG
ECG Abnormalities

Associated with ischemia
Ischaemic Changes

• S-T segment elevation
• S-T segment depression
• Hyper-acute T-waves
• T-wave inversion
• Pathological Q-waves
• Left bundle branch block
ST Segment

• The ST segment represents period between ventricular depolarization and repolarisation.
• The ventricles are unable to receive any further stimulation
• The ST segment normally lies on the isoelectric line.
ST Segment Elevation

The ST segment lies above the isoelectric line:

- Represents myocardial injury
  - It is the **hallmark** of Myocardial Infarction
  - The injured myocardium is slow to repolarise and remains more positively charged than the surrounding areas
  - Other causes to be ruled out include pericarditis and ventricular aneurysm
Myocardial Infarction

- A medical emergency!!!
- ST segment curves upwards in the leads looking at the threatened myocardium.
- Presents within a few hours of the infarct.
- Reciprocal ST depression may be present.
ST Segment Depression

- **Downsloping ST**
- **Upsloping ST**
- **Horizontal ST**

The J point occurs at the end of the QRS complex. The ST segment begins at the J point and extends to a user defined interval.
Horizontal *ST Depression*

**Myocardial Ischemia:**

- **Stable & Unstable Angina**
- **Non ST elevation MI** - usually quite deep, can be associated with deep T wave inversion.
ST Segment Depression

*Downsloping ST segment depression*:
- Can be caused by Digoxin.

*Upward sloping ST segment depression*:
- Normal during exercise.
T waves

- Hyperacute T waves occur with ST segment elevation in acute MI
- T wave inversion occurs during ischemia and shortly after MI
Hyperacute T waves

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T wave inversion in an evolving MI
Q Waves

**Non Pathological Q waves**
Q waves of less than 2mm are normal

**Pathological Q waves**
Q waves of more than 2mm indicate full thickness myocardial damage from an infarct
Late sign of MI (evolved)
Pathological Q waves
Q Waves of Inferior MI
Q Waves of ????
The ECG in ST Elevation MI
The evolution of infarct changes

<table>
<thead>
<tr>
<th>Old ECG</th>
<th>At onset</th>
<th>Within hours</th>
<th>Hours to days</th>
<th>Days to weeks</th>
<th>Weeks onwards</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change</td>
<td>ST elevation</td>
<td>Q wave</td>
<td>R shortened</td>
<td>ST resolves</td>
<td>T reverts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T inversion</td>
<td></td>
<td>Q persists</td>
</tr>
</tbody>
</table>
Bundle Branch Blocks and Chamber Enlargement

Some EKGs in this presentation have been borrowed from:
The Alan E. Lindsay ECG Learning Center ; http://medstat.med.utah.edu/kw/ecg/
2006
Left Bundle Branch Block

- QRS duration $\geq 120\text{ms}$
- Broad R wave in I and V$_6$
- Prominent QS wave in V$_1$
Right Bundle Branch Block

- QRS duration ≥ 110ms
- rSR’ pattern or notched R wave in $V_1$
- Wide S wave in I and $V_6$
Left Atrial Enlargement

Criteria

P wave duration in II ≥ 120ms

or

Negative component of biphasic P wave in V₁ ≥ 1

“small box” in area
Right Atrial Enlargement

Criteria

P wave height in II ≥ 2.4mm

or

Positive component of biphasic P wave in V₁ ≥ 1 “small box” in area
Left Ventricular Hypertrophy

Many sets of criteria for diagnosing LVH have been proposed:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>The sum of the S wave in V₁ and the R wave in either V₅ or V₆ &gt; 35 mm</td>
<td>43%</td>
<td>95%</td>
</tr>
<tr>
<td>Sum of the largest precordial R wave and the largest precordial S wave &gt; 45 mm</td>
<td>45%</td>
<td>93%</td>
</tr>
</tbody>
</table>
Left Ventricular Hypertrophy
Right Ventricular Hypertrophy

Although there is no widely accepted criteria for detecting the presence of RVH, any combination of the following EKG features is suggestive of its presence:

- Right axis deviation
- Right atrial enlargement
- Downsloping ST depressions in $V_1$-$V_3$ (a.k.a. RV strain pattern)
- Tall R wave in $V_1$
Right Ventricular Hypertrophy
QUESTIONS
Thank You