Basic ECG Interpretation

for Nurses

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Outline

• Definition of the ECG
• Types of pathology can we identify and study from ECGs
• Review of the conduction system
• ECG waveforms and intervals
• Determining heart rate
• ECG-common rhythm abnormalities
What is an ECG?

**An Electrocardiogram** (ECG or EKG) is:

A graphical representation of the electrical activity of the heart.
What types of pathology can we identify and study from ECGs?

- Arrhythmias
- Myocardial ischemia and infarction
- Pericarditis
- Chambers hypertrophy
- Electrolyte disturbances (i.e. hyperkalemia, hypokalemia)
- Drug toxicity (i.e. digoxin and drugs which prolong the QT interval)
Basic conduction mechanisms

- Sinoatrial node (SA node)- primary pacemaker of the heart
- Atrioventricular node (AV node)
- His Bundle
- Bundle branches
- Purkinje fibers
1. SA node discharge: no deflection
2. Right and left atrial activation: P wave
3. Activation of AV node and bundle of His: No deflection
4A. Septal activation: Onset of QRS complex, initial septal Q wave
4B. Left ventricular free wall activation: Inscription of QRS complex
5. Full ventricular activation: No deflection
6. Ventricular repolarization: His Purkinje T wave
7. Late ventricular repolarization: His Purkinje U wave
ECG Waveforms & Intervals
ECG Paper

• Vertically:
  each large square = 0.5 mv.

• Horizontally
  each large square = 0.2 sec.
Determining Heart Rate
Quiz Question:

What is the width of the normal QRS complex in little squares?
Fundamentals of Rhythm Interpretation

- P wave morphology
- PR interval
- QRS Morphology
- Rate & Rhythm
- Conduction (P-QRS Relation)
Normal - Sinus Rhythm
**Sinus arrest**

Please note trace and grid have been reduced in size.

<table>
<thead>
<tr>
<th>Heart rate</th>
<th>Rhythm</th>
<th>P wave</th>
<th>PR interval (in seconds)</th>
<th>QRS (in seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>Irregular</td>
<td>Before each QRS, identical. New rhythm begins after a pause. The P to P interval is disturbed.</td>
<td>.12 to .20</td>
<td>&lt;.12</td>
</tr>
</tbody>
</table>
ARRHYTHMIAS OF ATRIA

- Atrial ectopic beats
- Paroxysmal atrial tachycardia
- Atrial flutter
- Sinus node
- Atrial fibrillation
ATRIAL ECTOPIC BEAT
# ATRIAL FIBRILLATION

## COMMON ARRHYTHMIAS

Fibrillatory waves

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### Atrial Flutter

<table>
<thead>
<tr>
<th>Heart Rate</th>
<th>Rhythm</th>
<th>P Wave</th>
<th>PR interval (in seconds)</th>
<th>QRS (in seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: 220-430 bpm</td>
<td>Regular or variable</td>
<td>Sawtoothed appearance</td>
<td>N/A</td>
<td>&lt;.12</td>
</tr>
<tr>
<td>V: &lt;300 bpm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

![ECG Image]
Supraventricular Tachycardia (SVT)

Figure 3. Regular SVT at a Rate of Just Under 200 Beats/Minute

Atrial activity is not readily apparent. Calculation of the rate in this example makes it unlikely that the rhythm is either sinus tachycardia or atrial flutter. (See text.) PSVT is therefore the most probable diagnosis. Reproduced from Grauer K. A Practical Guide to ECG Interpretation. St. Louis, Mosby-Lifeline; 1993.
### Junctional Rhythm

<table>
<thead>
<tr>
<th>Heart Rate</th>
<th>Rhythm</th>
<th>P Wave</th>
<th>PR interval (in seconds)</th>
<th>QRS (in seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-60 bpm</td>
<td>Regular</td>
<td>Inverted, absent or after QRS</td>
<td>&lt;.12</td>
<td>&lt;.12</td>
</tr>
</tbody>
</table>

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VENTRICULAR ARRHYTHMIAS

- Multifocal ventricular ectopic beats
- Irritable foci in ventricular fibrillation
- Ventricular ectopic beat (unifocal) or ventricular tachycardia
Premature Ventricular Contractions (PVC’s)

R on T: occur on the peak of the T wave of the preceding beat
Coupled PVC's: occur in pairs
Triplet PVC's: occur in groups of three
Bigeminal PVC's: every other beat is a PVC.
Unifocal PVC's: identical shapes
Note: A single PVC is labeled isolated
Multifocal PVCs: more than one shape
VENTRICULAR TACHYCARDIA
Polymorphic Ventricular Tachycardia
(Torsades de pointes)
<table>
<thead>
<tr>
<th>Heart Rate</th>
<th>Rhythm</th>
<th>P Wave</th>
<th>PR interval (in seconds)</th>
<th>QRS (in seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300-600</td>
<td>Extremely irregular</td>
<td>Absent</td>
<td>N/A</td>
<td>Fibrillatory baseline</td>
</tr>
</tbody>
</table>
Ventricular fibrillation

Coarse VF

Fine VF

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First-degree AV block

<table>
<thead>
<tr>
<th>P wave</th>
<th>PR interval (in seconds)</th>
<th>QRS (in seconds)</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before each QRS, identical</td>
<td>&gt;.20</td>
<td>&lt;.12</td>
<td>Regular rhythm</td>
</tr>
</tbody>
</table>
### Second-degree AV block • Mobitz I (Wenckebach)

<table>
<thead>
<tr>
<th>P wave</th>
<th>PR interval (in seconds)</th>
<th>QRS (in seconds)</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduction</td>
<td>Increasingly prolonged</td>
<td>&lt;.12</td>
<td>QRS dropped in a repeating pattern</td>
</tr>
<tr>
<td>intermittent</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Second-degree AV block - Mobitz II

### Characteristics

<table>
<thead>
<tr>
<th>P wave</th>
<th>PR interval (in seconds)</th>
<th>QRS (in seconds)</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduction intermittent</td>
<td>Interval is constant for conducted beats</td>
<td>$\geq 0.11$ Usually a BBB pattern</td>
<td>Fixed ratio of conduction $(P:QRS)$</td>
</tr>
</tbody>
</table>
# Third-degree (complete) AV block

<table>
<thead>
<tr>
<th>P wave</th>
<th>PR interval (in seconds)</th>
<th>QRS (in seconds)</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal but not related to QRS</td>
<td>None</td>
<td>N/A</td>
<td>No relationship between P and QRS</td>
</tr>
</tbody>
</table>
Thank You