Electrocardiography Review and the Normal EKG Response to Exercise

Quick Quiz

• Which valves are the a-v valves?
• Closure of the a-v valves is associated with which heart sound?
• Which are the semilunar valves?
• Closure of the semilunar valves is associated with which heart sound?

Cardiac Anatomy

Electrical Pathways in the Heart

Quick Quiz

• What abnormal cardiac rhythm is caused by an accessory conducting pathway between the atria and ventricles that causes premature contraction of part of the ventricles? (Bundle of Kent)
• Hint, this causes a “slurring” of the QRS complex (a delta wave).
Quick Quiz

• How long is a normal PR interval?
• How long should the QRS interval be?
• What arrhythmia is characterized by a prolonged PR interval?

Frontal Leads?

Horizontal Plane Leads?

Anterior leads: V3, V4
Lateral leads: I, aVL, V5, V6
Inferior leads: II, III, aVF
Septal leads: V1, V2
Steps for Analyzing an EKG strip

Rhythm, rate, P waves, PR interval, QRS interval, QT interval, ST, T/U waves, interpretation

Table for Small Box Method to measure HR

<table>
<thead>
<tr>
<th>Small Block</th>
<th>Heart Rate per Minute</th>
<th>Number of Small Blocks</th>
<th>Number of Seconds</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>60</td>
<td>1</td>
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</tr>
<tr>
<td>2</td>
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</tr>
<tr>
<td>3</td>
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<tr>
<td>5</td>
<td>300</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>360</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

See back cover of Huff

Quick Quiz

- For the rhythm to be called “irregular”, the distance between R waves would vary by more than how many small blocks?
- How many large blocks do you count to mark 6 seconds?
- Once you count the R waves for 6 seconds, what do you do next to estimate the HR?

QT interval is dependent on HR and gender (below)

<table>
<thead>
<tr>
<th>Heart Rate</th>
<th>QT interval (ms)</th>
<th>QT interval (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
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<td>.30</td>
</tr>
<tr>
<td>250</td>
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<tr>
<td>150</td>
<td>.35</td>
<td>.50</td>
</tr>
</tbody>
</table>

Quick Quiz

- Why is it dangerous when the Q-T interval is prolonged?
- Congenital Long QT syndrome (pg 224)
  - family history of sudden death
  - unexplained syncope
  - prolongation of QT interval during exercise
Normal PR changes with exercise
1. Shortened PR interval
2. Taller P waves
3. A Ta wave may occur with exercise and cause downward displacement of the PQ junction. This may look like ST depression. (measure from the PQ junction, not the isoelectric line). Common in young boys and athletic men.

Abnormal Changes in P Waves
• An increased duration of the P wave (> 5 small boxes, 20 msec) is a sign of ischemia (64% specificity)
• Loss of ventricular compliance causes blood to back up in the atria. Increased distending pressure reduces blood flow in atria wall and slows depolarization
• Thus P wave is prolonged.

Normal QRS Changes with Exercise
• R-wave amplitude increases at the start of exercise
• QRS duration, reduces slightly due to cats increasing conduction velocity.
• QRS amplitude decreases near peak workload or just after exercise (R & S)
  • Brody effect.
  • Occurs when CO is falling rapidly after exercise.

Normal ST segment changes during exercise
A normal response is a transient decrease in J point, followed by rapidly upsloping ST segment that returns to baseline within 0.04 to 0.06 s. J point depression is a normal finding.
Intermittent ST depression

- ST segment depression varying with respiration
  - related to different rates of ventricular filling
  - with inspiration increased filling causes transient ischemia in persons with a stiff ventricle
- Occurs in unconditioned subjects, near maximal stress levels
  - where cardiac compliance is reduced due to high cats and increased venous return with deep breathing

QT Interval

- Normally, QT interval decreases with increasing HR during exercise
- Prolonged QT indicates disorganized repolarization, a sign of cardiac disease
- Prolonged QT is a concern for the R on T phenomena and fibrillation

T wave changes with exercise

- T waves normally increase in height during and after exercise
  - associated with increased filling
- Often occurs in healthy young boys after exercise when HR drops rapidly leaving a very large SV.
- Also may be related to elevated K during and after exercise

T wave and ST changes with hyperventilation

- Hyperventilation before exercise testing?
- Changes in T waves may occur with hyperventilation
  - mediated by sympathetic nervous system
  - not indicative of ischemia
  - sometimes indicative of mitral valve prolapse
- If abolished by beta-blockers--proves it was related to ANS

U Waves?

- Caused by delayed ventricular repolarization
- Usually upright if T wave is upright
- Appears during low HR, disappears HR > 90
- U wave inversion occurs with ischemia (20%), but most due to LVH
- Associated with large diastolic volume, hypokalemia, digitalis, calcium.

Practice EKGs

From: Huff: ECG Workout

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