ECG Refresher for the Boards

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I have no conflicts related to this presentation
Cardiac Conduction

ECG Basics

PR = 0.12 to 0.20 sec
QRS ≤ 0.12 sec
QTc (QT/√RR) = 0.35-0.43 sec

Heart Rate = 300/# of large boxes between R waves
ECG Basics

<table>
<thead>
<tr>
<th>Axis</th>
<th>Lead I</th>
<th>aVF</th>
<th>Lead II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal (0 to +100)</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Normal variant (0 to -30)</td>
<td>+</td>
<td>-</td>
<td>+</td>
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<tr>
<td>LAD (-30 to -90)</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RAD (&gt; +100)</td>
<td>-</td>
<td>+</td>
<td></td>
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<tr>
<td>R superior axis (-90 to +180)</td>
<td>-</td>
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ECG Basics
Atrial Enlargement

RAE

LAE

WENCKEBACH

- Progressive prolongation of PR interval and shortening of RR interval until P wave is blocked
- RR containing non-conducted P < 2 (PP) intervals.

MOBITZ II

- SR with intermittent non-conducted P waves
- PR interval in conducted beats is constant
- RR interval containing the non-conducted P wave = 2(PP)

COMPLETE HB

- Atrial and ventricular rhythms are independent of each other
- Ventricular rate is < atrial rate.

AV BLOCK
60 yo female with recent IPMI.

60 yo man who presents with presyncope
65 yo with lightheadedness.

75 yo male after recent surgery for aortic stenosis.
Cardiac Conduction

Bundle Branch Block

**RBBB**
- QRS duration ≥ 120 ms
- rSR’ pattern in V1
- ST segment depression and T wave inversion in V1 and V2.
- Normal QRS axis
- RBBB does not interfere with dx of hypertrophy or Q wave MI.

**LBBB**
- QRS duration ≥ 120 ms
- Broad monophasic R waves in I, V5, V6, which are usually notched or slurred
- rS or QS in right precordial leads
- ST-T changes in opposite direction as QRS deflection
- Interferes w/ dx of hypertrophy or MI.
40 yo man with newly diagnosed lung cancer who presents with acute SOB and pleuritic chest pain.

55 yo woman w/ h/o dilated cardiomyopathy
76 yo man with substernal chest pain with a prior LBBB on an old EKG

Hypertrophy

LVH
- Sokolow/Lyon criteria:
  - R in aVL > 11 mm or S in V1 + R in V5 or V6 > 35 mm
- Cornell criteria:
  - R in aVL + S in V3 >28 mm in men, and >20 mm in women
- LAD
- Low ant. forces (V1≥3)
- IVCD
- Repolarization abnormalities w/ ST depression/ T wave inversion in I, V5, and V6.
- LAE

RVH
- Dominant R wave:
  - R/S ratio in V1 > 1
  - R in V1≥7 mm
  - qR pattern in V1
  - rSR’ in V1 w/ R’ > 10 mm
- RAD
- ST depression and T wave inversion in right precordial leads
- RAE
- Other conditions may mimic eg. IPMI, WPW. etc
82 yo man with aortic stenosis

63 yo female with high blood pressure
25 yo with syncope and family h/o sudden death

50 yo, 80 pk-yr smoker admitted with cough and yellow sputum.
30 yo man with repaired Tetralogy of Fallot and heart failure.

Pre-operative ECG in an asymptomatic 45 yo. man
70 yo man w/ hypertension, now with exertional dyspnea, postural hypotension, and easy bruisability.
ST-T Changes with Chest Pain

**ISCHEMIA**
- Horizontal or downsloping ST segments ± T wave inversions
- T wave changes can be upright and peaked, symmetric and inverted, or biphasic ± ST depression.

**INJURY**
- Hyperacute T waves ↓
- ST elevation (convex) + reciprocal ST depression ↓
- Q waves ↓
- T wave inversion ↓
- ST segments return to baseline.

**PERICARDITIS**
- PR depression (except AVR) ↓
- ST elevation (concave) – reciprocal changes ↓
- ST segments return to baseline ↓
- T wave inversions

EKG Changes in Acute MI

A.  
B.  
C.  
D.
55 y.o. male who presents with 1 hour of 10/10 substernal chest pain, diaphoresis, and SOB.

60 y.o woman complaining of chest discomfort and lightheadedness. BP 80/64.
75 yo male with confusion and respiratory compromise.

40 yo female presents with flu-like symptoms and chest pain which is worse when she leans forward.
23 yo male presents for a routine physical.

**Electrolyte Abnormalities**

**HYPERKALEMIA**
- $K^+ = 5.5 - 6.5$ mEq/L
  - Tall, peaked T waves
- $K^+ = 6.5 - 7.5$ mEq/L
  - PR prolongation
  - Flattening and widening of P wave
  - QRS widening
- $K^+ > 7.5$ mEq/L
  - Disappearance of P waves
  - Sinusoidal pattern

**HYPOKALEMIA**
- Prominent U waves
- ST depression and flattened T waves usually seen with $K^+ < 2.7$ mEq/L
- Increased amplitude and duration of P wave
- ± Prolonged QT.
Baseline ECG in patient with CHF on lisinopril, aldactone, and potassium.

ECG in same patient in ED with nausea, fatigue and weakness. What is the abnormality and how would you treat it?
60 yo female with CHF, on furosemide and metolazone for CHF exacerbation.

**Electrolyte Abnormalities**

**HYPERCALCEMIA**
- QTc shortening (usually due to shortening of ST segment)

**HYPOCALCEMIA**
- Prolonged QTc (due to prolongation of the ST segment without change in the duration of the T wave)
44 yo w/ multiple myeloma. What is the abnormality?

28 yo w/ ovarian hyperstimulation syndrome and Chvostek’s sign. What is the abnormality?
Unidentified man found asleep on pavement with high serum alcohol level.

Drug Toxicities

- Digitalis
  - Increased automaticity with impaired AV conduction eg.
    - PAT w/ block
    - Afib w/ complete heart block
    - Complete HB w/ an accelerated junctional rhythm
    - SVT with alternating BBB

- Antiarrhythmics, antipsychotics, tricyclic antidepressants, antibiotics eg. Erythromycin, pentamidine, bactrim, others eg. cisapride
  - Usually cause QT prolongation
  - Prominent U waves
Atrial Tachycardia with Variable Block

50 yo man with CHF and increase in out-patient diuretic dose.

Paroxysmal Junctional Tachycardia due to Digoxin Toxicity
Patient admitted after suicide attempt. What is the ECG abnormality and how should we treat?

Summary

• This talk reviewed EKG findings related to:
  – Conduction abnormalities
  – Left and right ventricular hypertrophy
  – Ischemic changes
  – Electrolyte abnormalities
  – Drug toxicities
Board Question 1: 63 yo man comes to the ED with severe steady chest pain that began 14 hours ago. He has a history of HTN and hyperlipidemia and takes ASA, atenolol and simvastatin. He has a heart rate of 98 bpm and a BP of 150/90. His hematocrit is 30.

After aspirin, beta-blocker, nitroglycerin -- which of the following is the most appropriate next step in the management of this patient?

(A) Angioplasty (with or without stenting)
(B) Thrombolytic therapy
(C) Neither angioplasty or thrombolysis
(D) Await troponin prior to making decision
(E) Red blood cell transfusion

Answer: A
Board Question 2: This EKG was obtained in a 17 year old male high school athlete who presented with syncope.

Which of the following is the most appropriate next step in evaluating his condition?

(A) Two dimensional echocardiography to exclude structural heart disease.
(B) Electrophysiology testing
(C) Tilt-table testing
(D) Electrocardiography stress test

Answer: A
Board Question 3. 76 yo female with hypertension and hyperlipidemia who presents with abdominal pain and bloody diarrhea. BP is 90/60. Her admission EKG is as follows:

What should be the next step in her cardiac evaluation?

A) Pacemaker placement  
B) EP study  
C) Atropine  
D) Zoll pads at bedside  

Answer: D
Board Question 4: 35 yo female with breast cancer presents with shortness of breath. Exam reveals hypotension, elevated JVD, and distant heart sounds.

The next step in her treatment should be?

A) Intravenous diuretics  
B) Intravenous heparin  
C) Pericardiocentesis  
D) Intravenous dopamine

Answer: C
References

