ECG Workshop

A Review of Commonly
(and not-so-commonly...) encountered ECG Tracings for Family Physicians

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Financial Disclosures

• I am conflicted about many things, but they have nothing to do with money or this presentation
Workshop: 90 minutes

- ECG Intro [5 mins]
- Clinical Cases (30)

- Use Web-enabled Smartphone
- Use an Audience Response Card (36)
Audience Participation: Use your smartphone

- Use your smartphone’s internet browser
  - www.rwpoll.com
  - Session ID: uconn
    - Then press [join]
  - Next screen:
    - Don’t bother entering a First Name, Last Name, or User Data
  - just press the [continue] button
  - Should say “Welcome to Session UCONN”
ECG Algorithm

• Clinical Context
• Validity
• Rate
• Rhythm
• Axis
• 4 l’s
  – Intervals
  – I(e)nlargements
  – Ischemia / Injury / Infarction
  – Interpretation
• Action
Relationship of Current Flow (Depolarization and Repolarization Vectors) to Lead Axis and Consequent Electrocardiographic Deflection

- Axis of ECG lead +
  - Vector of current flow

If current flows in same direction as axis of lead, ECG stylus is deflected strongly upward from baseline in that lead.

If current flows obliquely to axis of lead, stylus is deflected less strongly upward, its height varying with angle that vector of current makes with axis.

- Axis of ECG lead +
  - Vector

If current flow is perpendicular, either toward or away from axis of lead, there is no deflection, either up or down, of stylus.

- Axis of ECG lead +
  - Vector

If current flow is in opposite direction to axis of lead, stylus is deflected strongly downward.

If current flows obliquely in opposite direction to axis of lead, strongly downward, its depth varying with angle that vector of current makes with axis of lead.

- Axis of ECG lead +
  - Vector

If there is no current flow, there is no deflection of stylus.
PR Segment is the isoelectric baseline.
Valid ECG?

1. Are I and aVR mirror images of one another?
2. Is R wave progression normal across V1-V6?
Let’s Begin!

*Audience Participation*
Use your web-enabled Smartphone
OR
Use an Audience Responsecard
[Simply click on correct numerical answer]
This ECG was taken from an otherwise healthy 13 yo female. The ECG is suggestive of:

1. Normal Sinus Rhythm
2. Sinus Bradycardia
3. Sinus Arrhythmia
4. First Degree Heart Block
5. None of the above
21 yo female with a history of a seizure disorder, not currently on medication. ECG is most consistent with which of the following?

1. Wolff-Parkinson White (WPW) pre-excitation syndrome
2. Long QT syndrome
3. Hypokalemia
4. Tricyclic antidepressant overdose
5. Hypothyroidism
QT Interval

• Normal rate: QT is less than half the RR interval

• If prolonged, think:
  – Drugs: Type Ia antiarrythmics, TCAs, phenothiazenes
  – Lytes: Hypo-kalemia,-magnesemia,-calcemia
  – CNS: CVA, Subdural, CNS depression

• If QT exceeds 450ms, it is likely prolonged...
This 66 yo has a longstanding history of hypertension. What is the most likely ECG diagnosis?

1. Left Bundle Branch Block
2. Right Bundle Branch Block
3. Intraventricular Conduction Defect
4. Lateral Myocardial Ischemia
5. Right Axis Deviation
**Right Bundle Branch Block**

- SA node
- AV node
- Common bundle of His
- Late abnormal electrical vector bypasses block
- Right bundle branch
- Block
- Left main bundle branch
- Left anterior fascicle
- Left posterior fascicle

**Diagram Notes:**
- Total QRS complex prolonged (≥0.12 second).
- Terminal broad S wave in lead I.
- RSR' complex in lead V1.

**Left Bundle Branch Block**

- Block of left main bundle branch
- or block of left anterior and posterior fascicles
- Right bundle branch
- Electrical vector directed toward left ventricle as is normal, but delayed and prolonged

**Diagram Notes:**
- Wide QRS complex (≥0.12 second), with ST depressions and inverted T waves, particularly in leads I, aVL, V5, and V6.
This ECG is from a 30 yo male with a five year history of hypertension, well controlled on diuretics. ECG shows:

1. Left Axis Deviation
2. Early Repolarization Abnormality
3. LBBB
4. Nonspecific ST T Wave Changes
5. Anterior Myocardial Injury pattern
Admission ECG for 49 yo male, with muscle weakness and constipation, no meds. ECG is most consistent with which of the following:

1. Hypokalemia
2. Hyperkalemia
3. Hypocalcemia
4. Hypercalcemia
5. Hypothyroidism
60 yo female with a history of lupus anticoagulant syndrome who presents with chest pain. ECG is most consistent with:

1. Acute IMI
2. Anterior ischemia with reciprocal change in inferior leads
3. Sinus arrhythmia
4. Acute IMI with Second degree heart block (Wenckeback)
5. Brugata syndrome
Atrioventricular Conduction Variations

A. Fixed normal PR interval
   Sinus rhythm (see Plate 10 A)

B. Fixed but short PR interval
   1. Junctional or coronary sinus rhythm (see Plate 11 K)
   2. Wolff-Parkinson-White syndrome (see Plate 12 B, D)

C. P wave related to each QRS complex, but variable PR interval
   1. Wandering atrial pacemaker (see Plate 10 F)
   2. Multifocal atrial tachycardia (see Plate 11 G)

D. Fixed but prolonged PR interval
   First-degree AV block
   Partial block
   P wave precedes each QRS complex but PR interval, although uniform, is >0.2 second (>5 small boxes)

E. Progressive lengthening of PR interval with intermittent dropped beats
   Second-degree AV block: Mobitz I (Wenckebach)
   Good, rapid conduction across crest of AV node; normal PR interval
   Conduction less good; PR longer
   Conduction still less good; PR still longer
   Conduction fails; QRS dropped
   AV node recovers; PR normal again

F. Sudden dropped QRS without prior PR lengthening
   Second-degree AV block: Mobitz II (non-Wenckebach)
   AV block at level of bundle of His, or at bilateral bundle branches or trifascicular
   PR intervals do not lengthen
   Sudden dropped QRS without prior PR changes
This is an ECG from a 58 yo male with which of the following ECG diagnoses?

1. Brugada Pattern
2. Left Bundle Branch Block
3. Right Bundle Branch Block with acute Anteroseptal MI
4. Hyperkalemia
5. Right Ventricular Hypertrophy
QRS Interval

• Normal: .10 sec
• Abnormal: .10 - .12 sec
• LBBB, RBBB, IVCD
  – Where are the ‘late’ forces of the QRS pointing
    • i.e. if toward left ventricle, LBBB
    • i.e. if toward right ventricle (anterior V1-V4 leads) then RBBB
    • if undistinguishable, IVCD
• N.B. Abnormal depolarization results in abnormal repolarization
Right Bundle Branch Block

- SA node
- AV node
- Common bundle of His
- Right bundle branch
- Block
- Left main bundle branch
- Left anterior fascicle
- Left posterior fascicle

Late abnormal electrical vector bypasses block

Total QRS complex prolonged (≥0.12 second). Terminal broad S wave in lead I. RSR' complex in lead V1.

Left Bundle Branch Block

- Block of left main bundle branch
- Block of left anterior and posterior fascicles
- Electrical vector directed toward left ventricle as is normal, but delayed and prolonged

Wide QRS complex (≥0.12 second), with ST depressions and inverted T waves, particularly in leads I, aVL, V5 and V6.
This is an ECG from a 77yo female best suggests which of the following medical conditions?

1. Renal Failure
2. COPD
3. Hypertension
4. Hyperkalemia
5. Right Ventricular Hypertrophy
This 87 yo female has hptn, CVA, and CHF. An appropriate ECG interpretation would conclude:

1. Inferior Myocardial Infarction, Indeterminate Age
2. Atrial Fibrillation
3. Left Axis Deviation
4. Left Ventricular Hypertrophy
5. Digoxin Toxicity
LVH:
35 in patient age greater than 35?
Strain pattern?
LAA?
LAD?
This ECG from a young female patient shows which of the following:

1. Early Repolarization Phenomenon
2. Right Ventricular Hypertropy
3. LBBB
4. Nonspecific ST T Wave Changes
5. Pericarditis
Axis

**Right Axis Deviation**: Right axis deviation is when the electrical axis is ≥ +105°, e.g., chronic obstructive lung disease and pulmonary hypertension.

**Left Axis Deviation**: Left axis deviation is when the electrical axis is ≥ −30° (more negative), e.g., hypertension or aortic stenosis with major left ventricular predominance.

**Normal Axis**: Normal electrical axis is between −90° to +90°.

**Leftward Axis**: Perpendiculars (blue) are drawn at plotted points on respective vectorial reference lines. Line (red) drawn from central point through intersection of perpendiculars gives electrical axis (in this case about +53°, which is within normal range).
RVH:
Tall R (greater than S) in V1?
RAA?
RAD?
This 32 yo female has returned to her cocaine habit with a weekend of binging. What does it show?

0% 1. Anterior myocardial infarction in evolution
0% 2. Tombstone T waves
0% 3. Anterolateral myocardial infarction
0% 4. STEMI
0% 5. All of the above
Triad:

Ischemia, Injury, Infarction

- **Ischemia**
  - ST depression and T wave inversion
- **Injury**
  - ST elevation, peaking T waves
- **Infarction**
  - Q wave formation
67 yo male following v-fib arrest. What is the correct ECG interpretation in this patient?

0%  1. RBBB
0%  2. AMI
0%  3. Poor R wave progression
0%  4. Ventricular Aneurysm
0%  5. All of the above
Effects of Myocardial Ischemia, Injury, and Infarction on ECG

Myocardial ischemia causes ST segment depression with or without T wave inversion as result of altered repolarization.

Myocardial injury causes ST segment elevation with or without loss of R wave.

Myocardial infarction causes deep Q waves as result of absence of depolarization current from dead tissue and receding currents from opposite side of heart.
Tall R waves in V1 and V2 in a 48 yo male. What does it likely indicate?

1. Normal
2. Posterior MI
3. Right Ventricular Hypertrophy
4. Nonspecific ST T Wave Changes
5. Hypertrophic Cardiomyopathy
39 yo male with acute dyspnea, and a “muscle strain” in his left leg. ECG is suggestive of:

1. RBBB
2. Right Axis Deviation
3. Pulmonary Embolism
4. Juvenile T Wave Inversion
5. None of the above
This 65 yo male presented with fatigue and weakness. ECG is strongly suggestive of:

1. Hyperthyroidism
2. Hypothyroidism
3. Hyperkalemia
4. Hyperkalemia with LVH
5. None of the above
Can you predict what might happen to this patient (on halol and erythromycin) in the near future?

1. Third Degree Heart Block 0%
2. Sinus Arrhythmia 0%
3. Torsades de Pointes 0%
4. Renal Failure 0%
5. None of the above 0%
What is a possible underlying cause of this patient’s abnormal ECG findings?

<table>
<thead>
<tr>
<th>Option</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Atrial Fibrillation / Atrial Flutter</td>
<td>0%</td>
</tr>
<tr>
<td>2. Hyponatremia</td>
<td>0%</td>
</tr>
<tr>
<td>3. Torsades de Pointes</td>
<td>0%</td>
</tr>
<tr>
<td>4. Parkinson Disease</td>
<td>0%</td>
</tr>
<tr>
<td>5. None of the above</td>
<td>0%</td>
</tr>
</tbody>
</table>
What is the underlying heart rhythm?

1. Atrial Fibrillation
2. Atrial Flutter
3. PSVT
4. AVNRT
5. Atrial Tachycardia
71 yo female who has been ordered a consult. To which service is the consult likely requested?

1. Cardiology
2. Pulmonary
3. Renal
4. Endocrinology
5. Hematology/Oncology
RAA:
Peaked P Waves
II, III, aVR
50 yo male with acute chest pain. ECG is consistent with what underlying condition?

1. AMI
2. Acute Pericarditis
3. Ventricular Aneurysm
4. Nonspecific ST T Wave Changes
5. Pulmonary Embolism
Pericarditis:

Diffuse ST elevations

Horizontal morphology

Four phases, till resolution (normal ECG)
18 yo male with what abnormal finding on preoperative ECG?

1. IVCD
2. RBBB
3. LBBB
4. Nonspecific ST T Wave Changes
5. Wolff-Parkinson White (WPW) Syndrome
25 yo Laotian male with atypical chest pain. ECG most consistent with:

1. Early Repolarization Phenomenon
2. Brugada Syndrome
3. RBBB
4. Nonspecific ST T Wave Changes
5. Pericarditis
This is an ECG from a 77yo female best indicates which of the following conditions:

1. Ventricular Bigeminy
2. Unifocal PVCs
3. Hypertension
4. Pacemaker Syndrome
5. Impending Ventricular Fibrillation
34 yo female with HIV and no cardiac murmur. Most likely cause of right axis deviation?

0%  1. WPW Syndrome
0%  2. Limb lead reversal
0%  3. Pulmonary Hypertension
0%  4. Posterior MI
0%  5. Left Posterior Fasicular Block
RAA: Peaked P Waves
II, III, aVF

LAA: Biphasic P wave
Lead V1
84 yo female with high degree heart block, necessitating single lead ventricular pacemaker. Now complaining of dizziness.

1. AV Sequential pacing
2. Superimposed atrial flutter
3. Likely “Pacemaker Syndrome”
4. Hyperkalemia
5. Right Bundle Branch Block
What is the nature of this rhythm disturbance?

1. AV sequential pacing
2. Ventricular pacing
3. Sinus Arrhythmia
4. Wandering Atrial Pacemaker
5. Atrial Pacing
30 yo male admitted in a coma. Most likely diagnosis?

0% 1. Hypokalemia
0% 2. Systemic Hypothermia
0% 3. Hypercalcemia
0% 4. Nonspecific ST T Wave Changes
0% 5. Pericarditis
This is an ECG from a 18 yo asthmatic female with which of the following ECG diagnoses?

1. Brugada Pattern
2. Anterior myocardial ischemia
3. Juvenile T Wave Inversion
4. Anterior myocardial injury
5. Left Ventricular Hypertrophy
Thank You

• Turning Technologies
  – www.turningtechnologies.com
  – Free use of internet enabled polling system for the CT Academy of Family Physicians Annual Meeting

• Scheidt, Steven: Clinical Electrocardiography


• Aneesh Tolat, MD