EKG 101

Jesse Felts
PGY2, not a cardiologist.
Objectives

- Approach to reading an EKG
- Myocardial Ischemia
- Blocks
- Tachyarrhythmia and Bradyarrhythmia
- Other Miscellaneous EKGs
Before you interpret an EKG

- One of the most important parts of EKG interpretation is comparing the current EKG with any previous EKGs available.

- Minor changes in between EKGs can have huge implications (in the right clinical context).

- Reading an EKG can be intimidating but the key is forming a system that works for you.

- Take a DEEP Breath! (It’s an “EasyG,” Dr. Ortiz)
Approach to Reading an EKG

- Step 1: Rate
- Step 2: Rhythm
- Step 3: Axis
- Step 4: Intervals
- Step 5: P wave
- Step 6: QRS Complex
- Step 7: ST segment-T wave
- Step 8: Overall interpretation
What is the Rate?
Rate

- **Quick Estimate**
  - “300, 150, 100, 75, 60, 50”

- **Alternative Methods**
  - Count the 6 second strip and multiply by 10
  - Count the number of beats on the EKG and multiply by 6

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Heart rate = 7 x 10 = 70/min
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Is it Sinus?
Rhythm

- P wave before every QRS?
- Every P waves followed by QRS?
- Regular Vs Irregular?
What is the Axis?
## Axis

<table>
<thead>
<tr>
<th>QRS deflection</th>
<th>Axis</th>
</tr>
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<tbody>
<tr>
<td>Lead 1</td>
<td>aVF</td>
</tr>
<tr>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>
Blocks

- AV blocks
  - First degree block
    - PR interval fixed and > 0.2 sec
  - Second degree block, Mobitz type 1
    - PR gradually lengthened, then drop QRS
  - Second degree block, Mobitz type 2
    - PR fixed, but drop QRS randomly
  - Type 3 block
    - PR and QRS dissociated
Intervals

- PR
  - Normal PR interval is 0.20 sec (less than 1 large box)
- QRS
  - Normal QRS <0.12sec (Less than 3 small Boxes)
- QT interval
  - 450 ms in men and 460 ms in women
  - Based on sex and The HR
  - With normal HR, usually less than Half of the RR interval
- QTc
  - Corrects for the HR
  - $\text{QTc} = \frac{\text{QTm}}{\sqrt{\text{RR}}}$
17 year old female found by her room mate unconscious
Causes of QT prolongation

- Drugs (Na channel blockers), Antipsychotics
- Hypocalcemia
- Hypomagnesemia
- Hypokalemia
- Hypothermia
- AMI
- Congenital
- Increased ICP
P Wave

- Upright In Lead II → Sinus rhythm
- The P wave can also help with atrial enlargement
  - L Atrial Enlargement
    - Lead II: Bifid P wave with total P wave duration of >110ms
    - Lead V1: Biphasic P wave with terminal negative portion > 1mm deep
  - R Atrial Enlargement
    - Lead II: Peaked P waves >2.5mm
    - Lead I: Peaked P wave >1.5mm
QRS Complex

- Dr. Mohan’s 4 things to look for in a QRS complex
  - Amplitude (Helps with LVH)
  - Duration (Bundle Branch)
  - Q waves (Old MIs)
  - R wave progression
Amplitude

- Add the larger S wave of V1 or V2 in mm, to the larger R wave of V5 or V6.
- Sum is > 35mm = LVH
Duration

- Normal Duration <0.12 sec
- If prolonged, have to think about RBBB or LBBB
  - **LBBB**
    - Dominant S wave in V1 and Broad monophasic R wave in lateral leads (I, aVL, V5-V6)
  
  ![ECG of LBBB](image)

  - **RBBB**
    - RSR’ pattern in V1-3 (‘M-shaped’ QRS complex) and Wide, slurred S wave in the lateral leads (I, aVL, V5-V6)

  ![ECG of RBBB](image)
R wave Progression

- Usual Transition between V3-V4
- Early Progression
  - 3 major causes: RBBB, RVH and Posterior MI
R Wave progression

- Late R wave Progression
- 3 Major causes: LVH, LBBB and Anterior MI
Coronary Artery Anatomy

Anterior View

- Left Main Coronary Artery
- Left Anterior Descending Artery
- Left Anterior Interventricular Artery
- Right Coronary Artery
- Infundibular Artery
- Conal Artery
- Conus Artery
- Diagonal Artery
- Left Circumflex Artery
- Left Main Coronary Artery
- Left Obtuse Artery

Posterior View

- Left Main Coronary Artery
- Left Circumflex Artery
- Left Obtuse Artery
- Right Coronary Artery
- Right Marginal Artery
- Inferior Interventricular Artery
- Posterior Interventricular Artery
STEMI

- ≥2 mm of ST segment elevation in 2 contiguous precordial leads in men (1.5 mm for women)
- ≥1 mm in other leads (2 contiguous)
- 2 Other Categories considered to be STEMI even though there might not be true ST elevations: New LBBB and Posterior MI

<table>
<thead>
<tr>
<th>SITE</th>
<th>FACING</th>
<th>RECIPROCAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>INFERIOR</td>
<td>II, III, aVF</td>
<td>I, aVL</td>
</tr>
<tr>
<td>HIGH LATERAL</td>
<td>I, aVL</td>
<td>II, III, aVF</td>
</tr>
<tr>
<td>ANTERIOR</td>
<td>V1, V2, V3, V4</td>
<td>NONE</td>
</tr>
<tr>
<td>POSTERIOR</td>
<td>NONE</td>
<td>V1, V2, V3, V4</td>
</tr>
</tbody>
</table>
ST Depression

- ST depression can be either upsloping, downsloping, or horizontal (see diagram below).

- Horizontal or downsloping ST depression ≥ 0.5 mm at the J-point in ≥ 2 contiguous leads indicates myocardial ischemia.
- ST depression ≥ 1 mm is more specific and conveys a worse prognosis.
- ST depression ≥ 2 mm in ≥ 3 leads is associated with a high probability of NSTEMI and predicts significant mortality (35% mortality at 30 days).
- Upsloping ST depression is non-specific for myocardial ischemia.
Wellens T Waves
T wave Inversion

- At least 1 mm deep
- Present in ≥ 2 continuous leads that have dominant R waves (R/S ratio > 1)
- Dynamic — not present on old ECG or changing over time
- Wellens’ syndrome is a pattern of inverted or biphasic T waves in V2-4 (in patients presenting with ischemic chest pain) that is highly specific for critical Stenosis of the left anterior descending artery.
Tachycardia

- Narrow Complex Vs. Wide Complex
- Regular Vs. Irregular
- Regular Narrow Complex Tachycardia: Sinus Tachycardia, Atrial Tachycardia, A flutter, SVT, AVNRT
- Irregular Narrow Complex Tachycardia: A Fib, A flutter with Variable Block, MAT etc
- Regular Wide complex Tachycardia: VT, V-Flutter, Tachycardia with aberrancy, Hyperkalemia
- Irregular Wide Complex Tachycardia: Torsades, V-Fib Etc.
Bradycardia

- Narrow Vs Wide Complex
- Regular Vs. Irregular
- Regular narrow complex bradycardia: Sinus, Junctional, Complete AV block (junctional escape), A-flutter with high degree block.
- Irregular narrow complex bradycardia: Sinus, A-fib with slow ventricular response, A-flutter with variable block, Type I and Type II second degree block.
- Regular wide complex bradycardia: Idioventricular rhythm, Complete AV block (ventricular escape), Regular bradycardias with aberrancy or bundle branch block.
- Irregular wide complex bradycardia: Type 1 and type 2 second degree blocks, Irregular bradycardias with bundle branch block.
Hyperkalemia

- > 5.5 mEq/L is associated with repolarization abnormalities
- Peaked T waves
Progression of Hyperkalemia

- > 6.5 mEq/L is associated with progressive paralysis of the atria
- P wave widens and flattens, PR segment lengthens, P waves eventually disappear
Hyperkalemia Continued

- > 7.0 mEq/L is associated with conduction abnormalities and bradycardia.
- Prolonged QRS interval with bizarre QRS morphology, High-grade AV block with slow junctional and ventricular escape rhythm, Any kind of conduction block (bundle branch blocks, fascicular blocks), Sinus bradycardia or slow AF, Development of a sine wave appearance (a pre-terminal rhythm)
Hyperkalemia Continued

- > 9.0 mEq/L causes cardiac arrest.
  - Asystole
  - Ventricular fibrillation
  - PEA with bizarre, wide complex rhythm
ECG 7. 51-year-old female with shortness of breath:

Codes:
07 Sinus rhythm
37 Right axis deviation (> +100 msec)
41 Right ventricular hypertrophy
43 RBBB, complete
67 ST and/or T wave abnormalities secondary to hypertrophy
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