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ECG in the field
Learning Objectives

- Establish Consistent Approach to Interpreting ECGs
- Review Essential Cases for Paramedics and first responders
- Provide Additional Resources for Future Learning
ECG Interpretation

What is your approach to reading an ECG?

• Rate
• Rhythm
• Axis
• Hypertrophy
• Intervals
• QRS complex
• ST segment – T wave
Rate

Square Counting: 300-150-100-75-60-50-42A

Count QRS in 10 second rhythm strip x 6
ECG Interpretation

What is your approach to reading an ECG?

- Rate
- Rhythm
Rhythm

• Are P waves present?
• Are the P waves and QRS complexes regular?
• Is the PR interval constant?

>3 morphologies → not sinus (multifocal)
Rhythm

- No P waves?
  - Atrial Fibrillation

- Junctional rhythm

- Reentry with p waves buried/very close to QRS
ECG Interpretation

What is your approach to reading an ECG?

- Rate
- Rhythm
- Axis
Axis

Leads I, II and aVF.

- **Normal:** I +, II +, aVF +

- **LAD:** I +, II +-, aVF –
  - LVH, LBBB, LAFB, Inferior MI, ASD, COPD, Hyperkalemia

- **RAD:** I -, II+-, aVF +-  
  - RVH, LPFB, Lateral MI, PE, Dextrocardia, ASD
ECG Interpretation

What is your approach to reading an ECG?

- Rate
- Rhythm
- Axis
- Hypertrophy
Ventricular Hypertrophy

RVH: V1 R/S ratio $>1$

LVH: R in avl + S in V3 $\geq 28$ or $20$ mm
Atrial abnormalities

Shape, height and width

- Notched (M-shaped) P-wave in II, > 2.5 small boxes → P-mitrale seen in left atrial enlargement

- Tall (>2.5 small boxes) in II → P-pulmonale seen in right atrial enlargement
ECG Interpretation

What is your approach to reading an ECG?

- Rate
- Rhythm
- Axis
- Hypertrophy
- Intervals
Intervals

What is a normal PR interval?
- 0.12 to 0.20 s (3 - 5 small squares).
  - Short PR – watch out for accessory pathways
  - Long PR – AV block bundle of his disease

What is a normal QRS?
- < 0.12 s duration (3 small squares).
  - Long QRS - look for bundle branch block, ventricular pre-excitation, ventricular pacing or ventricular tachycardia

What is a normal QT?
- < 0.40 / 0.44 s (10 - 11 small squares)
  - Long QT is associated with torsades to pointes.
  - Short QT < 0.35 s (congenital) is associated with increased risk of SCD
PR Interval

- 1 degree AV block
- Wenckebach
- Mobitz II
- Complete heart block
ECG Interpretation

What is your approach to reading an ECG?

- Rate
- Rhythm
- Axis
- Hypertrophy
- Intervals
- QRS complex
QRS-Bundle Branch Block

Monophasic R wave in lead I

Prominent rS pattern in V1

Late intrinsicoid deflection, no Q waves, and monomorphic R wave in V6
QRS complex

Poor R Wave Progression: Suggests LVH or loss of anterior forces (old anterior MI)

Pathologic Q wave: > 1.5 small box suggestive of ol infarct in the corresponding region
ECG Interpretation

What is your approach to reading an ECG?

• Rate
• Rhythm
• Axis
• Hypertrophy
• Intervals
• P wave
• QRS complex
• ST segment – T wave
ST-T
Regions of ECG
ST segment & T wave

- PR Segment Baseline
- ST Segment
- ST Elevation
- ST Depression

- Hyperkalemia
- Repolarization Variant
- Ischemia
- Strain
- Prolonged QT interval
Case #1

70 year old male with history of diabetes mellitus and hypertension occasionally feels lightheaded. He recently fainted while standing.
Case #1 ECG

- Rate: HR: 45 bpm. Bradycardia
- Rhythm: Regular.
- Axis: Normal
- Hypertrophy: LVH
- Intervals: Prolonged PR interval 240 ms – 1st degree AV block.
- QRS complex: Good R wave progress. No pathologic Q waves.
- ST segment – T wave: Normal.

Answer: Sinus bradycardia with 1st degree heart block causing symptomatic syncope.
Case #2

88 year old female presents with AMS, lightheadedness and shortness of breath.

BP 72/40 mmhg
Case #2 ECG

- Rate: Count QRS complexes and multiply by 6. HR 120. Tachycardia.
- Rhythm: Any P-waves present? None, so A fib.
- Axis: Normal
- Hypertrophy: LVH
- Intervals: Normal
- QRS complex: Normal.
- ST segment – T wave: Normal.

**Answer:** Atrial fibrillation with rapid ventricular response. Symptoms are often vague. Palpitations are not always felt.
Case #3

78 year old female with history of HTN, DM, HL, CAD, had syncope and complains of palpitations and lightheadedness.
Case #3 ECG

Rate: HR 150. Tachycardia.
Rhythm: Any P-waves present? Not a supraventricular rhythm.
Axis: Equivocal.
Hypertrophy: Unable to determine.
Intervals: QRS > 120 ms (wide complex)
QRS complex: Unable to determine R wave progression or Q waves.
ST segment – T wave: Unable to determine.

Answer: Monomorphic V Tach. Interns should recognize this immediately as a life threatening emergency. Begin ACLS
Case #4

67 year old male with history of diabetes, hypertension, COPD presents with sudden onset chest pain.
Case #4 ECG

Answer: Wellen’s Syndrome
Deep T wave inversions in V1-V3 + CP → Proximal LAD/LM lesion
Case #4 ECG
Case #5

38 year old female with history of DM, HTN, CKD presents with 2 days of nausea and abdominal pain.
Case #5 ECG

- Rate: HR 120
- Rhythm: Regular.
- Axis: Indeterminate
- Hypertrophy: ?
- Intervals: ? PR longer
- P waves: no ?
- QRS complex: wide.

- Answer: Hyperkalemia. Serum K+ 7.7.
- Teaching point: As hyperkalemia progresses, PR interval increases, QRS widens, P waves disappear. An ominous sign is the appearance of a sine wave pattern.
- Next step? Calcium gluconate (stabilizes cell membrane), Insulin and D50 (drives K+ into cells), and kayexalate (removes potassium) and possibly albuterol inhaled or lasix.
Case #6

60 year-old man with history of HTN, HL, CAD presents with nausea, shortness of breath and chest pain.
Case #6 ECG

- Rate: HR 55
- Rhythm: Regular.
- Axis: Normal
- Hypertrophy: LVH
- Intervals: Normal
- QRS complex: Good R wave progression.
- ST segment – T wave: ST elevations in the inferior (II, III, aVF) and apical/lateral (V5-V6) leads. ST depressions consistent with reciprocal changes are seen in leads aVL and V1-V2.

- Answer: Inferior STEMI
- Next steps? Give ASA. Order 15 lead ECG to check for right ventricular MI. Call cardiology to activate the cath lab.
- Which vessel is most likely occluded? Right coronary artery.
Logical Approach to Managing Arrhythmias

- **Look at the Patient**
  - Do I need to rush or not?
    - Usually not!

- **Is it narrow QRS?**
  - Has to be using the AV node
  - Adenosine is always safe
  - Cardizem is safe if SBP > 100

- **Is it wide QRS?**
  - Patient stable – quick medical Hx, get them to hospital (adenosine or amiodarone)
  - Patient unstable - defibrillate
Arrhythmias - simpler than you think

- **Narrow QRS tachycardia**
  - Atrial fibrillation
  - Atrial flutter
  - AVNRT
    - atrioventricular nodal re-entrant tachycardia
  - AVRT
    - Bypass tract mediated
    - Down AV node, up bypass tract
  - Atrial tachycardia

- **Wide QRS Tachycardia**
  - VT (95% of time)
  - SVT with LBBB or RBBB
  - Bypass tract mediated tachycardia (WPW)
    - Using the bypass tract in the antegrade direction
    - Extremely rare
Case #7

- 28 year old male with no history and syncope
Case #7 ECG

Cardizem bolus given

Patient Shocked
If Afib occurs with WPW, any AV nodal blockade may result in 1:1 conduction of AF → ventricle resulting in VF.

Treatment of choice: procainamide or DC cardioversion.
AVRT

- Short PR
- Slurred initial component of QRS (delta waves)
- History Younger patients first or second event
- **Orthodromic tachycardia**
  - Down the AV node, up the bypass tract
  - Narrow complex
    - More common 90%

- **Antidromic tachycardia**
  - Down the bypass tract, up the AV node
  - Wide complex (pre-excited)
    - Less common 10%
AVNRT

- Short RP tachycardia
- Look for Pseudo r’ in V1-V2
- History (Older patients recurrent events)
AVNRT Reentry

Panel A: Most impulses conduct down both pathways.

Panel B: Unidirectional block, due to longer refractoriness in one pathway.

Panel C: Potential to have reentry back up the previously refractory pathway.

Panel D: Reentry then can persist.

Path a: Slow conduction, short refractory period
Path b: Rapid conduction, long refractory period
Wide Complex Tachycardias

- If unstable shock
- If stable and suspect SVT with aberrancy – adenosine ok
- If stable and suspect VT or unsure - amiodarone
Additional Resources

Websites:
- http://en.ecgpedia.org/
- http://ecg.utah.edu
- http://ecg.bidmc.harvard.edu/maven/

Apps:
- ECG Guide by QxMD (iPad and iPhone)
- ECG Interpret (iPhone)

Books:
- Dale Dubin: Rapid interpretation of ECGs
- James O’Keefe: The complete Guide to ECG
Summary

- Always keep a consistent approach.
- Do not rely upon machine reads.
- Practice makes perfect.