EKG — *Subtle Emergencies*

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**Disclosures:**

- I work for Virginia Garcia Memorial Health Center
- And I am a medical editor for *Jones & Bartlett Publishing*.

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11 clinics: 45,000+ patients from all over the World

*Providing Culturally Competent Care to Our Community*

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55 Languages spoken at VG-Beaverton: English, Spanish, Arabic, Somali, Mai Mai, Russian, Cantonese, Mandarin, Vietnamese, Korean, Swahili, Kirundi, Farsi, Aramaic, Pashtu, Urdu, ASL, and more!
Goals for today’s session:

• Quick review / EKG leads
• Subendocardial MI
• Myocardial Ischemia
• Right Ventricle MI
• Mobitz
• Brugada Syndrome
• Others!

ECG Pearls

• Lead II is the easiest lead to read / most intuitive
• But Lead V1 is the single best EKG lead.
• Lead V3 is best for QT interval measurement
• “A Q in III is free.” (isolated Q in L III)
• If you know where the + electrode is, you can read any ECG
• Finding the “P” is ~80% of reading an ECG!

Ready?
First, a quick review:

- EKG lead placement
- Coronary artery anatomy
- And a few not-so-subtle emergencies

Conduction System

SA Node — AV Node — His Bundle — BBs — Purkinje Fibers

Intervals

PR Interval: 120 – 200 msec (3 – 5 boxes)
QRS width: 60 – 120 msec (1½ – 3 boxes)
QT/QTc interval: 400 msec (10 boxes)
Acute Anterior MI (STEMI)

Elevated ST segments

V1–V4: Anterior Leads

V1–V4: Leads that look at the anterior wall of the left ventricle

45% of MIs

(ST segment elevation ≥ 1 mm, with or without Q waves in two or more contiguous Leads: V1–V4. Poor R wave progression* and inverted T waves may also be present. Reciprocal ST depression may be present in II, III, AVF.)

The anterior descending branch of the left coronary artery is occluded. May cause: Left anterior hemiblock; Right bundle branch block; BBB; 2° AV block; Mobitz II, 3° AV block; EWR, CHF, pump failure.

*Note: LHV also can cause poor R wave progression & Q waves in V1-V2. Rule it out first.
Acute Inferior MI

Also not-subtle: Acute Inferior MI (STEMI)

ST elevation

II, III, aVF: Inferior Leads

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<th>I</th>
<th>AVR</th>
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<td>III</td>
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<td>aVF</td>
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II, III, aVF: Leads that look at the inferior wall of the left ventricle

If you know where the “+” electrode is, you can read any EKG

II, III, aVF: Leads that look at the inferior wall of the left ventricle
**Acute Inferior MI**

(ST segment elevation ≥1 mm in two or more contiguous Leads: II, III, AVF. Q waves and inverted T waves may also be present. Reciprocal ST depression may be present in Leads: I, AVL, V2 – V4.)

The right (or left) coronary artery is occluded. May cause: left posterior hemiblock; left axis deviation, LBBB, sinus bradycardia. 1° AV block, 2° AV block Mobitz I (Wenckebach), 3° AV block LUR.

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**RCA before and after stenting**

Before stenting  
After stenting

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**And an obvious:**

Acute Lateral MI (STEMI)  
(with an Acute Inferior MI too)
I, aVL, V5, V6: Lateral Leads

I, aVL, V5, V6: Leads that look at the lateral wall of the left ventricle

Lateral Leads

Lateral Leads

15% of MIs

Acute Lateral MI

(ST segment elevation ≥ 1mm in Leads: I, AVL, V5, V6, Q waves and inverted T waves may also be present)

Reciprocal ST depression (ST elevation in AVR)

The circumflex branch of the left coronary artery is occluded. May cause: LV dysfunction, AV nodal block.

Note: Lateral MI may be a component of a multiple site infarction, including anterior, inferior and/or posterior MI.
Now for the Subtle Emergencies

Subtle Emergencies

Subendocardial MI

- ST depression +
- T wave inversion

- Can be hard to distinguish from acute ischemia

- Needs emergency reperfusion (PCI)
Subendocardial MI (AKA: “NSTEMI” or “Non-Q Wave MI”) vs. STEMI
- small marginal coronary artery occlusion
- transmural infarct
- major epicardial coronary artery occlusion

The Spectrum of Acute Coronary Syndromes
- Healthy CAD Angina
  - Patent artery ~50% ~70%
  - No symptoms
- Unstable Angina
  - Pain at rest; relieved by NTG
- NSTEMI
  - Pain on exertion
- STEMI
  - Constant pain
- Shock / Death
- ~90% 100% 100%

Subtle Emergencies
Myocardial Ischemia
- T wave inversion
- ± ST depression
- Can be hard to distinguish from NSTEMI / subendocardial MI,
  (but the chest pain is usually relieved by NTG)
Subendocardial MI / NSTEMI
• ST depression
• T wave inversion
• Elevated troponin
• Elevated CK-MB
• Constant chest pain
• Needs STAT cath lab + PCI

Myocardial Ischemia
• AKA "preinfarction angina"
• T wave inversion
• ± ST depression
• Normal troponin
• Normal CK-MB
• Chest pain relieved by NTG
• Needs angiography

Tip: If chest pain does not improve with nitrates: STAT cath lab + PCI.

Anterolateral Ischemia

T wave inversion

T wave inversion

Subtle Emergencies

Right Ventricle MI
• Usually seen with Inferior MI
• Identified with special leads: V4R
• These patients are especially sensitive to nitrates, morphine, lasix
• Need emergency reperfusion (PCI)
Acute Inferior MI & Right Ventricle MI

Right chest leads

1/3 of Inferior MIs

(Acute Right Ventricle MI

(ST segment elevation in Leads: V_{4R}(MC_{4R}).
Q wave and inverted T wave may also be present)
Accompanies Inferior MI in 30% of cases.

Normal V_{R}(MC_{R})
Pathologic V_{R}(MC_{R})

RCA is occluded. May cause: AV block, A-Fib,
A-failure, right heart failure, JVD with clear lungs. Bp may drop if
preload is reduced (be cautious with Morphine,
NTG, Furosemide). Treat hypotension with IV fluids, pacing.

Tip: for acute inferior MI, always check right chest leads for RV MI.

Subtle Emergencies

Mobitz

• 2nd Degree AV block, Type II
• Usually degenerates to complete heart block
2nd Degree AV Block (Mobitz)
(BBB, PRI stays constant, then a dropped QRS)

Causes:
- infarction of the His bundle, or both bundle branches.
- Note: also called "2nd degree block, Mobitz II"

Mobitz = His Bundle infarction, or Bundle Branch Infarction

2nd\textsuperscript{a} AV Block, Mobitz

\textit{Stable}: prepare for transvenous pacemaker
\textit{Unstable}: begin transcutaneous pacing &/or dopamine or epinephrine infusion, because:
Mobitz can progress to this:

Third Degree Block
Treatment: CPR, pacing, epinephrine 1 mg

Mobitz can progress to this:

Sinus Rhythm ... Asystole — Yikes!
Treatment: CPR, Pacing, Epinephrine 1 mg IV

Different Kinds of Heart Blocks

• Sinus Arrest
• 1st Degree AV Block (PR > .20 sec)
  • 2nd Degree Block (some Ps don’t conduct)
    — Wenckebach (PRI lengthens, dropped QRS)
    — Mobitz (PR is constant, dropped QRS)
• 3rd Degree Block (complete A-V dissociation)
• Bundle Branch Block (wide QRS > 120 msec)
2nd Degree Block (Wenckebach)

[PRI lengthens, then a dropped QRS]

PR gets longer  dropped QRS

Causes:
- antiarrhythmic drugs such as digoxin, calcium blockers, beta blockers, etc. Reversible and often benign.
- AMI
  - Note: also called “2nd degree block, Mobitz I”

Wenckebach =

closest AV Node depression

2nd Degree AV Block (Mobitz)

• PRI stays constant, then a dropped QRS

PR is constant  dropped QRS

• or 2:1 conduction with BBB
Mobitz = His Bundle infarction, or Bundle Branch Infarction

Tip: for Mobitz, always prepare for transvenous pacemaker.

Subtle Emergencies
Brugada Syndrome

- Sodium channel defect
- RBBB on EKG, with ST elevation in V1 - V3
- Sudden unexplained death
- Typical patient is 30s – 40s
- Avoid TCAs, many SSRIs, most antiarrhythmics. www.brugadadrugs.org
- Treat all fevers with antipyretics
- Consider ICD • Quinidine
- Inherited/ Autosomal dominant: so screen all family members

Brugada Syndrome

Normal

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<td>V1</td>
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- RBBB with elevated ST segments
Polymorphic VT in patients with Brugada Syndrome

“R on T” (a PVC on the T wave) causes VT & sudden death

Brugada Syndrome

Tip: any time you see RBBB and elevated ST segments in V1, V2, V3 consider Brugada Syndrome.

Subtle Emergencies
3 y.o. child with muffled heart tones, shortness of breath, JVD, low O2 sat
Pericardial Effusion

- Low-voltage QRSs in all leads

Thanks to Brett Burbridge, PA-C!

Note: the computer’s Dx is way off

Emergency pericardiocentesis
Consider thoracotomy

Pericardial Tamponade

Review!
What Subtle Emergency?
75 y.o. female c/o chest pain.
Improves well with NTG.

Tip: If chest pain does not improve with nitrates: STAT cath lab + PCI.

Acute Anterolateral Ischemia
(Junctional Rhythm)

What Subtle Emergency?
65 y.o. male c/o chest pain; had syncope when given NTG by EMS.
Acute Right Ventricle MI (and Acute Inferior MI)

Tip: for acute inferior MI, always check right chest leads for RV MI.

What Subtle Emergency?
85 y.o. male c/o chest pain, syncope

Second Degree Block—Mobitz
(PR is constant, sudden dropped QRS)

Tip: for Mobitz, always prepare for transvenous pacemaker.
What Subtle Emergency?
35 y.o. male c/o episodes of rapid heart beat.
Father died @ 30 y.o.: sudden death.

Brugada Syndrome
RBBB pattern and elevated ST segments in V1, V2

Tip: any time you see RBBB and elevated ST segments in V1, V2, V3 consider Brugada Syndrome.

See you next time!

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