Management of the Hospitalized Patient
October 15, 2010

ECG Refresher and Update 2010

Return to Basics
- Determine rate and rhythm
- Determine intervals and axes
- Define morphology of P-QRS-T-U
- Compare with normal values
- Integrate with clinical presentation into meaningful conclusion

ECG – Rate and Rhythm
- Normal rate for adults – 60 to 100 bpm
- Speed Reading – Normal, Slow, Fast
- Normal rhythm for adults – Sinus with less than 10% variability of beat to beat
- Remember hiding premature atrial or ectopic beats can affect rhythm regularity
- Review p wave morphologies to determine if the rhythm is truly sinus

Normal Intervals & Axes
- PR – 0.12 to 0.20 sec
- QRS - ≤ 0.10; 0.11 to 0.12 incomplete IVCD; abnormal > 0.12 sec
- QTc ≤ 0.44 sec (QTc = QT/√RR)
- P axis: 0 - 60º
- QRS axis: -30 to 90º
- T axis – generally follows the QRS axis except in the precordial leads where T waves should be upright from V2-6
Speed Reading Intervals & Axes

- PR < one large box
- QRS < 3 small boxes
- QT < 50% of RR interval (not reliable in AFib)

Axes:
- P upright in I & II
- QRS positive in Leads I & II = normal
- LAD – QRS isoelectric or negative in II
- RAD – QRS isoelectric or negative in I
- T waves
- Same direction as major QRS vector in limb leads
- Upright in V2-6

Orderly Sequencing of Frontal Leads – “Cabrera Format”

55 yo man awaken by chest pain

Question #1
Which is the correct answer?

1. This ECG excludes an Acute MI
2. This ECG can be seen in STEMI
3. This ECG is a “Right-Sided ECG”
4. This ECG represents Arm Lead Reversal
Electrically silent MI’s

- Right Ventricular MI – Right sided ECG
- High Lateral MI – V7, V8, V9
- Small Apical MI

78 yo man with intracerebral hemorrhage
Einthoven's Triangle - ECG

RA – RL Cable Reversal
- Far Field Signal in II
- No structural abnormality can explain this finding
- The Technician’s Test

55 yo man admitted for abdominal pain

Sinus Arrhythmia
Sinus Rhythm Variations

- Normal Sinus Rhythm HR 60 – 100 bpm
- Sinus Bradycardia HR < 60 bpm
- Sinus Tachycardia HR > 100 bpm
- Sinus Arrhythmia >10% change from longest to shortest P – P interval
- Irregular sinus rhythm (Sinus arrhythmia of the elderly)

43 yo obese man admitted with chest pain.

LVH LBBB PCard ↑ K+ AMI RB+AMI Brugada
STEMI - ACS

- If the patient’s history and clinical presentation is consistent with ACS – IT DOESN’T MATTER WHAT THE ECG LOOKS LIKE!
- THE WORRISOME CLINICAL PRESENTATION OF CONCERN IS “THIS PATIENT LOOKS LIKE 😄😊 (%)!!”

ST Elevation – Common Causes

- Acute myocardial injury pattern
- Acute pericarditis
- Early Repolarization / Normal Variant
  - ± 0.1mV in any lead
  - Up to 0.3mV in young men in early precordial leads
- Myocardial aneurysm
Acute Pericarditis

RBBB

45 yo woman with nausea and vomiting

Which of the following is **not** true about RBBB?

A. RBBB occurs in up to 29% of AMI
B. The most common cause in children is post open heart surgery for Tetralogy of Fallot repair
C. Post MI patients with persistent RBBB are at the same risk for cardiac mortality
D. Transient RBBB is a complication of right heart catheterization

Differential Dx of Tall R wave in V1

- Definition – R/S ratio > 1 in V1 or V2
- RBBB
- RVH
- True Posterior MI
- WPW
- Brugada’s Abnormality
65 yo Asian man who presents with recurrent syncope. Echo was normal.

**Brugada Syndrome**

- Brugada Abnormality is defined as RBBB with ST elevation and occurrence of sudden cardiac death or syncope due to polymorphous VT (1990)
- Hereditary bundle branch defect
- Autosomal dominant trait with variable expression
- Diagnosis by EPS with procainamide stimulation
- TX: AICD

**Brugada Pattern**

Patterns of ST segment elevation in brugada syndrome

36 yo woman presenting to the ED with acute dyspnea.
79 yo man admitted with CVA

Diffuse (”Global”) T Wave Inversion

- Myocardial Ischemia (Evolving MI is focal)
- CNS event
- Apical HCM
- Pericarditis
- Myocarditis
- Takatsubo’s Cardiomyopathy
- Cardiac metastases
- Carotid endarterectomy
- Cocaine abuse
- Pheochromocytoma
- Acute illness in women

84 yo woman with pneumonia

Which of the following answers about LBBB is not true?

A. LBBB can be caused by toxic, inflammatory changes, hyperkalemia, or digitalis toxicity
B. In most patients with LBBB, septal wall motion abnormalities can exist without coronary artery disease
C. In patients presenting to the ED with chest pain and a LBBB, the management is observe with frequent ECGs, treat pain and await enzymes
D. The QRS duration is at least 0.12 seconds
A 32 yo woman from Viet Nam presents with dyspnea on exertion. What is the diagnosis?

The most likely diagnosis is:

A. Primary Pulmonary Hypertension
B. Atrial Septal Defect
C. Ventricular Septal Defect
D. Mitral Stenosis
E. Aortic Stenosis

**Biatrial Abnormality**

- A large diphasic P in V, with the positive component > 1.5 mm and the terminal negative component reaching 1mm in amplitude, > 0.04 sec in duration or both
- Tall peaked P wave (>1.5mm) in the right precordial lead and a wide notched P wave in the limb leads or lateral leads (V,6)
- Increase in both the amplitude (>2.5mm) and duration(>0.12 sec) of the P wave in the limb leads
56 yo man presents with flu

This ECG represents:

1. Acute Myocardial Infarction with alternating bundles
2. Sinus rhythm with PVC’s
3. Ashman’s Phenomenon
4. He’s got more going on than a flu
5. A cardiac emergency requiring pacemaker implantation

70 yo woman admitted for weakness

24 yo woman with FHx of SCD presents with syncope
78 yo man with hx of HF presents with nausea

What is the most appropriate next test?

1. Serial Troponins
2. Serial CK with iso’s
3. Digoxin level
4. Serum potassium level
5. I don’t know

AFib with AV Dissociation

AFib or AFib/Aflutter or Aflutter?
What is the rhythm? What is the treatment?

1. 2nd AVB Mobitz 1
2. AVNRT

What is the rhythm? What is the treatment?
Supraventricular Tachycardias: Which statement is true?

1. If hemodynamically stable, acute management includes Adenosine by slow IV push
2. The majority of SVT is AVNRT
3. AVRT does not involve accessory bypass tracts
4. If the patient after adenosine converts from a narrow complex tachycardia to a wide complex tachycardia, the patient has most likely degenerated to ventricular tachycardia

**Slow-fast form of AVNRT**

- Representation of dual pathway physiology involving the AV node and peri-nodal atrial tissue in the common form of AVNRT. Left panel: A normal sinus beat (A1) is conducted through the fast pathway (F) to the fast common pathway (C). In the AV node and into the bundle of His. The conduction through the slow pathway (S) runs into the refractory period of the impulse through the fast pathway and is extinguished. Middle panel: A critically timed atrial premature beat (A2) finds the fast pathway refractory but is able to conduct through the slow pathway which has a shorter refractory period. If excitability in the fast pathway has recovered by the time the impulse reaches the A2, there may be retrograde activation of the fast pathway. Right panel: The retrograde impulse throws off an extra to the atrium (A4), and, if the slow pathway has recovered its excitability, the impulse reenters the slow pathway and produces ventricular depolarization V3. If the mechanism persists, a repetitive circuit is established that creates a sustained reentrant tachycardia. The sequence of antegrade (C3) and retrograde (CF) conduction is called the slow-fast form of AVNRT.

**Generation of ECG in common form of AVNRT**

- Ladder diagram of the common (slow-fast) form of AVNRT showing transmission of the impulse in atrial, AV node, and ventricular tissue and the resultant electrocardiogram. The first two cycles show the normal sinus beat (A1) conducting through the fast pathway (F) to the ventricle (V1) with the impulse blocked in the slow pathway. The premature atrial beat (A2) is of critical maturity; it finds the fast pathway refractory, but it is able to conduct through the slow pathway resulting in an inverted P wave (P), a long PR interval, and a ventricular depolarization V2. It is also able to reenter and conduct retrogradely up the now recovered fast pathway, resulting in an inverted P wave that is buried in the T wave. This impulse gives rise to an atrial extrasystole (A*) and also reenters the now recovered slow pathway, which eventuates in ventricular depolarization V*. The cycle repeats and the circle movement tachycardia is sustained.

**Figure 6. Response of narrow complex tachycardia to adenosine.** AV indicates atrial beat. AVN, atrioventricular nodal. AVRT, atrioventricular re-entrant tachycardia. AVNRT, atrioventricular nodal re-entrant tachycardia. IV adenosine, QRS, ventricular activation on echocardiogram.
A 34-year-old woman with idiopathic cardiomyopathy became dizzy.

Wide QRS-complex tachycardia (QRS > 120 ms)

- Regular or irregular?
  - Regular
    - In sinus rhythm or that during BrS
      - VT or SVT
        - No previous MI or structural heart disease? If yes, VT is likely
          - 1:1 AV relationship?
            - Yes or unknown
            - Yes or unknown
              - No
              - QRS morphology in precordial leads
                - R or S in V1
                - Onset of R to nadir > 100 ms
                - qR or qS in V6
                - RBBB pattern
                  - VT
                    - qR, Rs or Rr' in V1
                    - Frontal plane axis range from +90 degrees to –90 degrees
                    - RBBB pattern
                      - VT
                        - R in V1 > 30 ms
                        - R to nadir of S in V1 > 60 ms
                        - qR or qS in V6

Wide QRS-complex tachycardia II

- Regular or irregular?
  - Regular
    - In sinus rhythm or that during BrS
      - VT or SVT
        - No previous MI or structural heart disease? If yes, VT is likely
          - 1:1 AV relationship?
            - Yes or unknown

Atrial Tachycardia

- Atrial Flutter

- VT

- Next slide
A fib with WPW

82 yo man presents with chronic fatigue. Why is he on your service?

The correct diagnosis is:

1. Acute anterior myocardial infarction
2. Congestive Heart Failure
3. Sick Sinus Syndrome
4. Complete Heart Block with an artifact
5. Wandering Atrial Pacemaker
75 yo AA male presents with prolonged CP

Prognostic Value of Lead aVR in Patients with a First Non-ST segment Elevation Acute Myocardial Infarction

Odds ratio for death in groups 2 and 3 – 4.2 and 6.6


First Degree AV Block

- Generally benign
- Bad prognostic sign in:
  - Bifascicular Block
  - RBBB + LAFB
  - RBBB + LPFB
  - LBBB
  - Infectious endocarditis
Q: Had this patient suffered a myocardial infarction?

1. No!
2. Yes. Inferior
3. Yes. Posterior
4. Yes. Septal
5. Yes. Localization not possible due to RBBB

75 yo man presents with palpitations