My Patient’s in What Rhythm?
Non-AMI Causes of ECG Changes

Presented By:
Barbara Furry, RN-BC, MS, CCRN, FAHA
Director The Center of Excellence in Education
Director of HERO

Follow me on Twitter!
CEE Med Updates@BarbaraFurryRN
Like me on Facebook!
Clinical Disorders

1 Medication
   1.1 Digoxin
   1.2 Antiarrhythmics
   1.3 Beta blockers
   1.4 Nortriptyline Intoxication
   1.5 Amitriptyline Intoxication
2 Pericarditis
3 Myocarditis
4 Pulmonary Embolism
5 Chronic Pulmonary Disease Pattern
6 Pacemaker
7 Tamponade
8 Ventricular Aneurysm
9 Dilated Cardiomyopathy
10 Hypertrophic Obstructive Cardiomyopathy
11 Electrolyte Disturbances
12 Hypothermia
13 ECG Changes after Neurologic Events
14 Cardiac Contusion
15 Lown Ganong Levine Syndrome
16 Ebstein
17 Left and right bundle branch block
18 Cocaine Intoxication
19 Sarcoidosis
20 Early Repolarization
ST Segment

- Represents phase 2 of the cardiac cell’s action potential
- Measured from the end of the QRS complex (J point) to the beginning of the T wave
- Normally isoelectric
- < 1mm in standard leads
- < 1mm in precordial leads
ST Segment Depression Morphologies

Normal | Upsloping | Horizontal | Downsloping
The T Wave Normal Pattern:
Represents the ventricular repolarization phase of the action potential

- Rounded & asymmetrical
- Usually ascends more slowly than it descends
- Height should not exceed 5mm in the standard leads or 10mm in the precordial leads

- I, II, V3-V6 are positive
- AVR negative
- III, V1, V2, AVL & AVF are variable
Normal Variations in ECG

- May have slight left axis due to rotation of heart
- May have high voltage QRS – simulating LVH
- Mild slurring of QRS but duration $\leq 0.10$
- J point depression, early repolarization
- T inversions in V2, V3 and V4 – Juvenile T ↓
- Similarly in women also T ↓
- Low voltages in obese women and men
Digoxin

- Oddly shaped ST-depression with 'scooped out' appearance of the ST segment
- Flat, negative or biphasic T wave
- Short QT interval
- Increased u-wave amplitude
- Prolonged PR-interval
- Sinus bradycardia
Antiarrhythmics

- **Anti-arrhythmics:** These may lead to several ECG-changes:
  - Broad and irregular P-wave
  - Broad QRS complex
  - Prolonged QT interval (brady-, tachycardia, AV-block, ventricular tachycardia)
  - Prominent U-wave
  - In case of intoxication, the above mentioned characteristics are more prominent
Beta Blockers

- Beta blocker intoxication can result in:
  - Bradycardia
  - Hypotension
  - QRS widening
Atenolol Intoxication

E CG P EDIA.ORG

 Courtesy of C. Rebel, RN, Hilversum, The Netherlands
Nortriptyline Intoxication
Nortriptyline Intoxication
Myocarditis and Pericarditis
Pericarditis
Myocarditis

Acute myocarditis causes nonspecific ST segment changes.

These can be accompanied by supraventricular and ventricular rhythm disturbances and T-wave abnormalities.
Acute Pulmonary Embolism
Pop Quiz!
Is this ECG demonstrating acute myocardial ischemia?

A. Yes
B. No

79% Yes
21% No
Pulmonary Embolism

- Sinus tachycardia
- Stress on the right ventricle:
  - right atrial dilatation
  - Axis is to the right
  - Right bundle branch block
- "S1Q3T3"
- Deep S in I
- Q and negative T in III
- T wave inversion anterior
Chronic Pulmonary Disease Pattern

- The ECG shows low voltage QRS complexes in leads I, II, and III and a right axis deviation.
- This is caused by the increased pressure on the right chamber. This leads to right ventricular hypertrophy.
Paced Rhythm
Tamponade

- Sinus tachycardia
- Low-voltage QRS complexes
- Alternation of the QRS complexes, usually in a 2:1 ratio
- PR segment depression (this can also be observed in an atrial infarction)
Cardiac Tamponade
Ventricular Aneurysm

- The ECG pattern suggests an acute MI
- Classical signs of MI may occur: Q waves, ST segment elevations (>1mm, >4 weeks present) and T wave inversions are present
- To exclude an acute MI, comparison with old ECG's is compulsory
Dilated Cardiomyopathy

- Often, a LBBB or broadened QRS-complex can be seen
- Additionally, nonspecific ST segment changes are present with signs of left atrial enlargement
Dilated Cardiomyopathy
Hypertrophic Obstructive Cardiomyopathy

- HOCM is a hereditary illness
- EKG will have signs of left ventricular hypertrophy and left atrial enlargement
ID: 005115760  23-JAN-2002  10:31:00

Normal Sinus Rhythm
Minimal Voltage Criteria for LVH, May Be Normal Variant
Inferior T Wave Abnormality

Med: Unknown

Referred by:  Confirmed By: DAVID SCHNELL

25mm/s  10mm/mV  100Hz  005C  12SL 206  CID: 8
Hypertrophic cardiomyopathy (HOCM)
Pop Quiz #2
This ECG is demonstrating:

A. Acute myocardial infarction
B. Ventricular fibrillation
C. Ventricular tachycardia
D. Hyperkalemia

D. Hyperkalemia
Hypokalemia
Hypercalcemia
Hypercalcemia

- Mild: broad based tall peaking T waves
- Severe: short ST segment
Hypocalcemia
Hypocalcemia

- Reduced PR interval
- T wave flattening and inversion
- Prolongation of the QT-interval
- Prominent U-wave
Hypothermia

- Sinus bradycardia
- Prolonged QTc-interval
- ST segment elevation (inferior and left precordial leads)
- Osborn-waves (slow deflections at the end of the QRS-complex)
Figure 30.25. Intracerebral hemorrhage. Note bradycardia, large inverted precordial T and U waves.
SAH ECG Changes
SAH ECG Changes

- Striking ECG changes of non cardiac origin
- Incredible deep and symmetric T inversions
- Seen in young adults with massive subarachnoid hemorrhage
- Presumably due to autonomic dysfunction
ECG Changes After Neurologic Events

- Q waves
- ST segment elevations
- ST segment depressions
- T wave changes. Large negative T waves over the precordial leads are observed frequently
- Prolonged QT-interval
- Prominent u-waves
SAH ECG Abnormalities

- Are frequently seen after subarachnoid hemorrhage (SAH) (if measured serially, almost every SAH patients has at least one abnormal ECG but also in subdural hematoma ischemic stroke, brain tumors, Guillain Barre, epilepsy and migraine.
- The ECG changes are generally reversible and have limited prognostic value.
- However, the ECG changes can be accompanied with myocardial damage and echocardiographic changes.
- The cause of the ECG changes is not yet clear. The most common hypothesis is that of a neurotransmitter "catecholamine storm" caused by sympathetic stimulation.
SAH

© The Author [2011]. Published by Oxford University Press on behalf of the British Journal of Anaesthesia. All rights reserved. For Permissions, please emil: journals.permissions@oup.com
Cardiac Contusion

- Nonspecific changes
- Pericarditis-like ST elevation
- Prolonged QT interval
- Myocardial damage
- New Q waves
- ST-T segment elevation or depression
- Conduction delay
- Right bundle branch block
- Fascicular block

- AV delay (1st, 2nd, and 3rd degree AV block)
- Arrhythmias
- Sinus tachycardia
- Atrial and ventricular extrasystoles
- Atrial fibrillation
- Ventricular tachycardia
- Ventricular fibrillation
- Sinus bradycardia
- Atrial tachycardia
ST-elevation in lead V3 and T-wave inversions in leads V3 through V5 represent ECG changes detected in the acute phase.
Lown Ganong Levine Syndrome

- The Lown Ganong Levine Syndrome is a pre-excitation syndrome in which the atria are connected to the lower part of the AV node or bundle of His
- Short PR interval < 120 ms
- Normal QRS complex
- No delta wave
Lown Ganong Levine Syndrome

- Short PR interval < 11
- Normal QRS complex
- No delta wave
Ebstein

- Right atrial enlargement or tall and broad 'Himalayan' P waves,
- First degree atrioventricular block
- Atypical right bundle branch block
- T wave inversion in V1-V4
Left Bundle Branch Block
Right Bundle Branch Block
Cocaine Intoxication

 Courtesy of M. Meuwissen, MD, PhD
Sarcoidosis

- In patients with proven pulmonary sarcoidosis, ECG changes can be used as a marker of cardiac involvement.
- Presence of a Bundle Branch Block increases the likelihood of cardiac involvement.
Abnormal Q wave in leads II, III, aVF and ST elevation in V5 and V6
Sneaky ST’s Causes of Elevation Other Than AMI

Early Repolarization

- Young, healthy black men often manifest ST segment elevation up to 4mm, particularly in the precordial leads
- May also be found in the trained athlete
Early Repolarization

The ST-T (J) Junction point is elevated
Segment initial portion is concave
This does not signify ischemia!