Abnormal ECG in common cardiac disorders

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Abnormal ECG in common cardiac disorders

- Cardiovascular disease
- Systemic disease
Putting the A&P with the EKG
ECG leads

**Einthoven’s Triangle**

**Lead I**
extends from the right to the left arm

**Lead II**
extends from the right arm to the left foot

**Lead III**
extends from the left arm to the left foot
Anatomy of a 12-Lead EKG (cont.)

View of Inferior Heart Wall

- Leads II, III, aVF
  - Looks at inferior heart wall
  - Looks from the left leg up
Anatomy of a 12-Lead EKG (cont.)

View of Lateral Heart Wall

- **Leads I and aVL**
  - Looks at lateral heart wall
  - Looks from the left arm toward heart

*Sometimes known as High Lateral*
Anatomy of a 12-Lead EKG (cont.)

View of Lateral Heart Wall

- **Leads V5 & V6**
  - Looks at lateral heart wall
  - Looks from the left lateral chest toward heart

*Sometimes referred to as Low Lateral or Apical view*
Anatomy of a 12-Lead EKG (cont.)

View of Entire Lateral Heart Wall

- Leads I, aVL, V5, V6

  - Looks at the lateral wall of the heart from two different perspectives
Anatomy of a 12-Lead EKG (cont.)

View of Anterior Heart Wall

• Leads V3, V4
  – Looks at anterior heart wall
  – Looks from the left anterior chest
Anatomy of a 12-Lead EKG (cont.)

View of Septal Heart Wall

- **Leads V1, V2**
  - Looks at septal heart wall
  - Looks along sternal borders
Anatomy of a 12-Lead EKG (cont.)

<table>
<thead>
<tr>
<th>I Lateral</th>
<th>aVR</th>
<th>V1 Septal</th>
<th>V4 Anterior</th>
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<tbody>
<tr>
<td>II Inferior</td>
<td>aVL Lateral</td>
<td>V2 Septal</td>
<td>V5 Lateral</td>
</tr>
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<td>III Inferior</td>
<td>aVF Inferior</td>
<td>V3 Anterior</td>
<td>V6 Lateral</td>
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</table>
Normal 12 leads ECG
Clinical presentation of cardiac disorders

- Chest pain
- Dyspnea
- Syncope/palpitation
Case

- A 65 year old man
- Chest tightness 3 hours
- Chest pain started from retrosternal and radiated to jaw and left arm
- Underlying: DM, HT, smoking
- BP 140/90mmHg, HR 80, RR 18
- Normal heart and lung exam
- What could be the cause of chest pain?
Heart Attack: Acute coronary syndrome

ECG performed within 10 minutes
Which ECG needs emergency management?
Atherosclerotic coronary artery disease
Ischemic Discomfort

Acute Coronary Syndrome

Presentation

Working Dx

ECG

Cardiac Biomarker

Final Dx

No ST Elevation

ST Elevation

Non-ST ACS

UA

Unstable Angina

UA

ST Elevation

NSTEMI

Myocardial Infarction

NQMI

Qw MI


Acute Coronary Syndromes

- ST-elevation MI
- Non-ST elevation ACS
Well Perfused Myocardium

- Septum
- Lateral Wall of LV
- Epicardial Coronary Artery
- Left Ventricular Cavity
- Interior Wall of LV
- Positive Electrode
Normal ECG
Ischemia

Septum

Left Ventricular Cavity

Epicardial Coronary Artery

Lateral Wall of LV

Positive Electrode

Interior Wall of LV
ST depression
Injury

- Thrombus
- Ischemia
ST elevation
Many infarcts do not develop Q waves. Infarcted Area Electrically Silent.
Q Waves
Effect of Myocardial ischemia and infarction on ECG

Myocardial ischemia causes ST segment depression with or without T wave inversion as result of altered repolarization.

Myocardial injury causes ST segment elevation with or without loss of R wave.

Myocardial infarction causes deep Q waves as result of absence of depolarization current from dead tissue and receding currents from opposite side of heart.
ST elevation ACS

hours

Loss of R wave

minutes

Q

hours

Loss of R wave

ST elevation ACS
Inferior wall ischemia
Lateral wall ischemia
Acute extensive anterior wall MI
Old anterior wall MI
Localization of Myocardial Infarcts

Anterior infarct

Occlusion of proximal left anterior descending coronary artery

Significant Q waves and T wave inversions in leads I, V₂, V₃ and V₄
Acute inferoposterior wall MI
Recent inferior wall MI
Localization of Myocardial Infarcts (continued)

Diaphragmatic or Inferior infarct

Occlusion of right coronary artery

Significant Q waves and T wave inversions in leads II, III and aVF. With lateral damage, changes also may be seen in leads V5 and V6.
Which ECG needs emergency management?

- Normal
- NSTE-ACS: lateral wall ischemia
- STE ACS: inferior wall
- Acute pericarditis
Acute pericarditis

29 y/o with chest pain:
Diffuse ST elevation
PR segment depression
Acute pericarditis

- Young patients
- Chest pain (substernal, left anterior, epigastrium)
- Sharp pain, radiate to trapezius ridge
- Relieved by sitting forward and worsen by lying down
- Pericardial rub
Clinical presentation of cardiac disorders

• Chest pain

• Dyspnea

• Syncope/presyncope
Case

- A 40 year old man
- Progressive dyspnea on exertion for 2 years
- Sleep on 2 pillows for 3 months (orthopnea)
- Occasionally wake up during the night with shortness of breath and cough (paroxysmal nocturnal dyspnea)
- Hx heavy smoking for 20 years
Case

- BP 90/60mmHg, HR98bpm, RR 24
- Engorged neck vein
- Diffuse apex, nonsustained apical heaving, soft S1, loud P2, pan-systolic murmur grade II at apex radiate to axillar
- Fine crepitation both lower lung field
- Liver 2 cm below RCM
- Pitting edema 1+
What is the most likely cause of dyspnea?

Heart failure

What is the underlying cause of heart failure?
Echocardiogram

Globally hypokinesia, LVEF 20%

Enlargement of one or both of the ventricles and systolic dysfunction: DCM
Algorithm for Rx of HFrEF (DCM)

1. Symptomatic Heart Failure + Reduced Ejection Fraction

   - Diuretic + ACEI (or ARB)
     Titrated to clinical stability

   - β-Blocker

   - Persisting signs and symptoms?
     - Yes
     - ADD aldosterone antagonist OR ARB
     - Persisting symptoms?
       - Yes
         - QRS > 120 ms?
           - Yes
             - Consider: CRT-P or CRT-D
           - No
             - Consider: digoxin, hydralazine/nitrate, LVAD, transplantation

       - No
         - LVEF < 35%?
           - Yes
             - Consider ICD
           - No
             - No further treatment indicated
Left ventricular dyssynchrony

Prolonged PR interval plus LBBB - QRS interval = 0.22 sec
• Optimize AV synchrony
• Restore ventricular coordination

Cardiac Resynchronization Therapy
Cardiac Resynchronization Therapy (CRT) Device Implantation
Cardiac resynchronization therapy in HFrEF
Case

- A 60 year old man
- Progressive dyspnea on exertion for 2 years
- Sleep on 2 pillows for 3 months (orthopnea)
- Occasionally wake up during the night with shortness of breath and cough (paroxysmal nocturnal dyspnea)
- Hx heavy smoking for 40 years
Case

- BP 90/60mmHg, HR98bpm, RR 24
- Engorged neck vein
- Liver 2 cm below RCM
- Pitting edema 1+
ECG: Low voltage

- Obese
- Pericardial effusion
- Infiltrative myocardial disease

qrs <10mm in precordial leads
qrs < 5 mm in limb leads
Pericardial effusion
Massive pericardial effusion: electrical alternans
Pericardial effusion: pericardiocentesis
Clinical presentation of cardiac disorders

• Chest pain
• Dyspnea
• Syncope/palpitation
Case

- A 21 year old woman
- Presyncope on moderate level of exertion for 2 years
- Syncope on minimal exertion for 6 months
- Dyspnea on minimal exertion for 3 months
Case

- BP 107/58, P 78, R 18
- A young lady with good consciousness
- Normal carotid pulse volume with peak and dome contour
- Heart: PMI 6th MCL, double apical impulse, normal S1 and S2, S4, SEM grade III/VI at LPSB
ECG: LVH
Prominent R in V2, pseudo Q wave in lateral leads

LVH
Septal hypertrophy
Asymmetrical septal hypertrophy
HOCM
Myotomy-myomectomy
Alcohol septal ablation
Case

- A 21 year old man
- Palpitation on exertion for 3 years
- Presyncope on moderate level of exertion for 2 years
- Syncope on minimal exertion for 6 months
Palpitation and syncope in a young man
Exercise induced VT

Regular wide QRS complex tachycardia
Palpitation and syncope in a young man

Epsilon wave

[ECG images showing the epsilon wave]
ARVC
Morphologic Changes

• Increased Fatty or fibrofatty RV infiltrate
• EM demonstrates Desmosomal Abnormalities
  – plakoglobin, desmoplakin, and plakophilin-2
• Genetics
  – Sporadic
  – Autosomal Dominant 100% penetrance
  – Autosomal Recessive (Naxos Disease)
ARVC: ECG

- **ECG abnormalities:** 90% of patients.
- **QRS >110 ms in lead V1,** a terminal deflection within or at the end of the QRS complex (epsilon wave) in leads V1–V3 (30%), and inversion of Tw in the right precordial leads (50%–70%).
- **Complete RBBB:** approximately 15%.
- **Incomplete RBBB:** 18%. 

![ECG Graph](image-url)
Case

- A 17 year old man
- Syncope during school football match
- Hx of sudden cardiac death in family
- Normal physical exam
Syncope in a young man: Long QT syndrome
Medication induced long qt

Medications

**Antiarhythmic drugs, class I, III**
- Amiodarone
- Disopyramide
- Dofetilide
- Ibutilide
- Procainamide
- Quinidine
- Sotalol

**Antibiotics**
- Fluoroquinolones (eg, levofloxacin, gatifloxacin)
- Macrolides (eg, clarithromycin, erythromycin)
- Pentamidine

**Antipsychotics**
- Chlorpromazine
- Haloperidol
- Risperidone
- Thioridazine
- Tricyclic antidepressants
Syncope in a young man: short QT syndrome

Congenital SHORT QT syndrome (<320ms) --- VT, syncope, SCD
Palpitation/syncope:
Wolf-Parkinson-White (WPW) syndrome

Short PR interval, delta wave
Case

- A 37 year old man
- Agonal breathing during sleeping
- Normal physical exam
Syncope or survived sudden cardiac arrest
Brugada syndrome

Na ion channelopathy that predisposes to v-tach/fib

Coved or Saddle types
Brugada syndrome

- A 37 year old man
- His wife observed agonal breathing during sleeping
- Normal physical exam
Abnormal ECG in common cardiac disorders

- Cardiovascular disease
- Systemic disease
Case

• A 70 year old woman
• Drowsiness for 2 days
• Hx Chronic renal failure
• Refuse to undergoing dialysis
• Hx DM/HT
• BP 160/50mmHg, HR 56
Hyperkalemia: K 8.4 mEq/L
Hyperkalemia

- Tall peaked T wave
- Loss of P wave
- Widened QRS with tall T wave
Ventricular tachycardia:

Hypokalemia induced VT
Hypokalemia

- Prolong QT interval
- U wave
Calcium and ECG change
Case

• A 20 year old woman
• Severe depression
• Was brought to the hospital because of unconsciousness
Tricyclic antidepressant overdose

Wide qrs complex, RAD: sodium channel blockade

Sodium channel blockade: TCA, Cocaine, anticholinergic, dilantin
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• Cardiovascular disease

• Systemic disease
Thank you for your attention