Lecture 28 & 29

Editing file

MED438
KING SAUD UNIVERSITY

PRIMARY HEALTHCARE TEAMWORK

ECG Interpretation I & II

Objectives:

- ★ Calculate Heart rate
- ★ Determine the axis deviation
- ★ Determine type of the rhythm
- ★ Diagnose all degrees of heart block (1st, 2nd type 1, 2nd type 2, and third degree heart block)
- ★ Diagnose bundle branch block (Rt and Lt)
- ★ Diagnose main types of arrhythmia: Atrial fibrillation, Atrial flutter, Ventricular tachycardia, Ventricular Fibrillation, WPW, SVT, sinus tachycardia, prolong QT-interval, sinus arrhythmia and bradycardia.
- ★ Diagnose ischemic changes with determining heart anatomy involved.
- ★ Diagnose pericarditis and LVH.

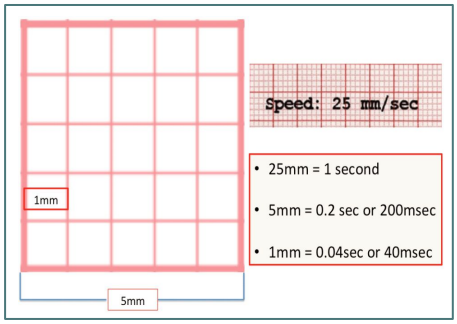
Color index:

Original text Important Doctor's notes Golden notes Extra

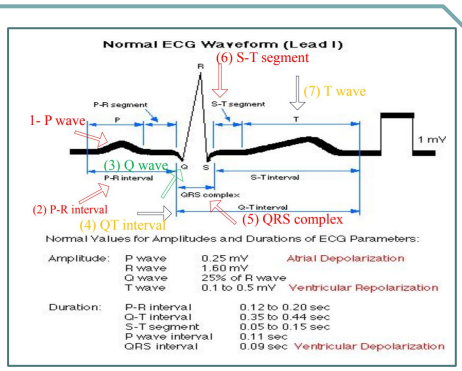
ECG Interpretation Approach

ECG Introduction

- **What is good about the ECG?**
  - Fast.
  - Cheap.
  - Non-invasive.
- Every **big square** contains **5 small squares.**
- Every small square is 1mm which **equals 0.04sec.**
  - So **ONE** big square equals **0.2sec.**



1. **P wave:** Atrial depolarization.
2. **PR interval:** Time of travel from SA node ⟶ AV node.
   - Normally it is **3-5 small squares.**
   - Prolonged in AV blocks.
3. Q wave.
4. QT interval.
5. QRS Complex.
6. ST segment.
7. T wave.



ECG Interpretation Approach

- This ECG interpretation approach to help to diagnose some common conditions. It is important to note that there are many other helpful approaches to interpret ECG and there are Many conditions not covered in this approach.
- The first thing you do is checking the patient's name. **Then look at the:**

1. **Rhythm[1]:**
   - Check the R-R intervals if it is constant or not, to decide whether it is regular or irregular.
   - There are many causes of **irregular rhythm**, but the **most important** and common are:
     A. **Atrial fibrillation** (Irregular rhythm + absent P wave)
     B. Atrial flutter (Sawtooth pattern).
     C. Second degree heart block Type 1 (mobitz l) (**Progressive** PR prolongation then sudden beat drop).
     D. Second degree heart block Type 2 (mobitz ll) (**Fixed** PR prolongation + sudden beat drop).
     E. Sinus arrhythmia:
        - Common in pediatrics.
        - They just have irregular rhythm, NO beat drop nor P wave absence.

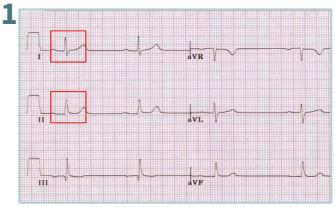
1. Distance between consecutive P waves and consecutive QRS complexes should be the same.
   - If the distance of the R-R intervals and P-P intervals is the same the rhythm is regular.
   - If the distance differs, the rhythm is irregular.

ECG Interpretation Approach

ECG Interpretation Approach Cont..

2. **Rate:**
   - **If regular rhythm:** Calculate big square between R-R
     - If > 5 big square (Bradycardia).
     - If < 3 big square (Tachycardia).
     - If between 3 and 5 big squares (Normal heart rate).
     - In standard ECG: Calculate the number of QRS complex in ECG and multiply by 6.
   - **The methods working for any ECG** (Eg. irregular rhythm)**:**
     - Calculate 30 large boxes, then count the number of QRS complex in these boxes.
       - Number of QRS complexes in 30 large boxes **X** 10 = HR
3. **Axis:** (Not Imp.)
   - Check **Lead I & II**:
     - If **both** are **positive** (pointing upward) = Normal axis[1]
     - If **lead I** is **Negative** & **lead II** is **Positive** = Right axis deviation[2]
       - They look at each other othe in ECG (اصحاب **اليمين** على سرر **متقابلين**)
     - If **lead I** is **Positive** & **lead II** is **Negative** = Left axis deviation[3]

1



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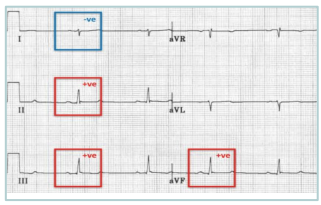

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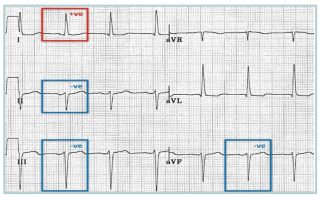


4. **P wave:**
   - Check for the P wave if it present or not.
   - What is the differential diagnosis of **ABSENT P Wave?**
     - **Atrial fibrillation:** Absent P Wave + Irregular rhythm.
     - **Supraventricular tachycardia (SVT):** Absent P Wave + Regular **Narrow QRS** complex tachycardia.
     - **Ventricular tachycardia (V tach):** Absent P Wave + Regular **WIDE QRS** complex tachycardia.
       - Any wide QRS complex tachycardia is considered VTuntil proven otherwise.
     - **Ventricular Fibrillation (V Fib):** An ECG finding of a rapid grossly irregular ventricular rhythm with marked variability in QRS cycle length, morphology, and amplitude.
5. **PR Interval:**
   - If the PR interval is **prolonged** {>0.2 sec (> 200 ms) (>5 small boxes)}, think about AV block (1st, 2nd, 3rd) & Hyperkalemia.
   - If the PR interval is **short** {<0.120 sec (120 ms) (< 3 small squares)}, think about **WPW** (if the duration is short always think of WPW regardless of the **delta wave**).
   - Remember 3rd degree heart block causing Variable P-R Interval length, So it will cause short and prolonged P-R interval.

AV Block & ST Segment

Heart Block (AV Block)

1. **First degree heart block: Regular rhythm**
   - The electrical impulses pass, but in a lower velocity.
     - **Finding: FIXED prolonged PR interval**
2. **Second degree heart block: Irregular rhythm**
   - **Type I (Mobitz I): Progressive prolongation** of P-R interval then **sudden QRS drop.**
   - **Type II (Mobitz II): Fixed** P-R interval (Prolonged or normal) + **Sudden QRS drop.**
3. **Third degree heart block (**Complete heart block**):**
   - **Regular rhythm** (because R-R is fixed).
   - When there is complete heart block, the AV node start to generate its own impulses (which are lower than SA node) so the patient will have **slow heart beats (lower side of normal).**
   - **P-P interval is fixed** (Because SA node can generate the P wave but not QRS complex due to the complete block).
   - **R-R interval is fixed** (AV node is generating the QRS complexes independently of the SA node)
   - **P-R Interval is variable** (Short, normal or prolonged).
   - **QRS complex might be wide (because it is from the AV node).**
     - **Wide QRS is usually dangerous DDX:**
       - 3rd degree block.
       - V Tach.
       - Hyperkalemia.
       - BBB.
       - WPW.

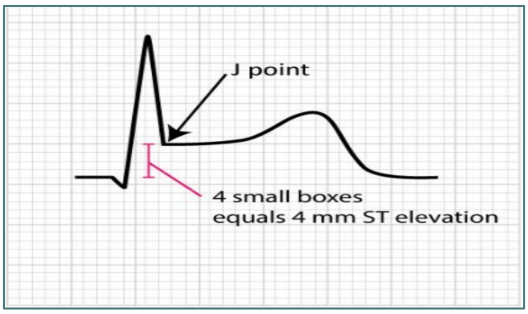
J point

J point

What's the j point?
- The connection between the S and T.

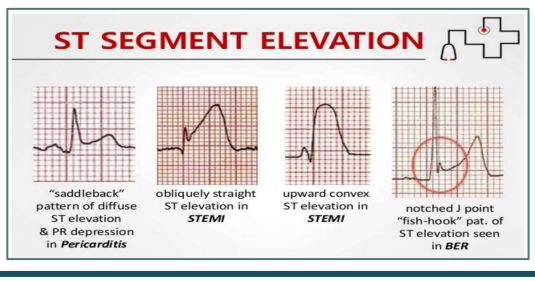
What's the isoelectric line?
- It's the segment between the T and P waves.

How can i know if the ST elevation is of clinical significance?
1. Compare the j point with the isoelectric line:
   - ≥ 1mm (one small square) is of clinical significance.
2. ST elevation in two or more consecutive leads in the same anatomy e.g. anterior, posterior, lateral.



ST Elevation

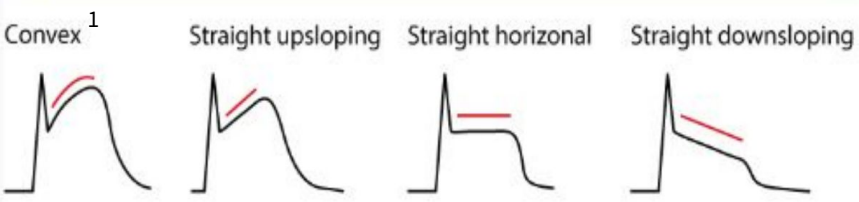
What are the Most Important causes of ST elevation in ECG?
- **MI**
- **Acute pericarditis**
- LBBB
- Benign early repolarization (very common in young)



ST Segment

ST Elevation Cont'

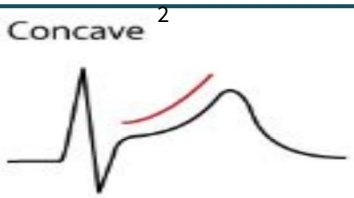
Characteristics of ST elevation caused by ischemia



ST-segment elevations caused by ischemia typically displays a convex or straight ST-segment. Such ST-segment elevations in presence of chest discomfort are strongly suggestive of transmural myocardial ischemia. Note that the straight downsloping variant is unusual.

What are the major ECG changes we can see in ischemia?

- ST elevation, ST depression, hyperacute T wave, T wave inversion, pathological Q wave.
- T wave changes can be due to ischemia but they are not specific.



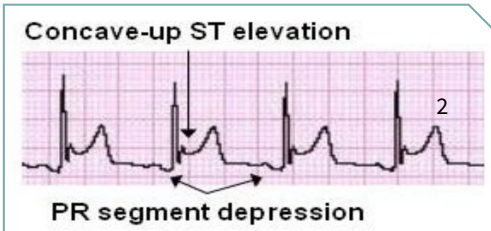
Non-ischemic ST-segment elevations are extremely common in all populations. They are characterized by a concave ST-segment and a greater distance between the J point and the T wave apex.

Typical non- ischemic ST-segment elevation

Acute Pericarditis

Acute Pericarditis

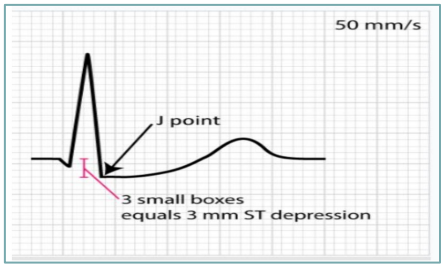
- **Usually diffuse ST elevation** and not in one anatomy.
- Can be associated with **PR depression (except in aVR it will be elevated)**
  - How to know if PR segment is depressed/elevated? compare it to isoelectric line (TP segment)
- No reciprocal changes
- The morphology of the ST segment



ST Depression

ST segment depression

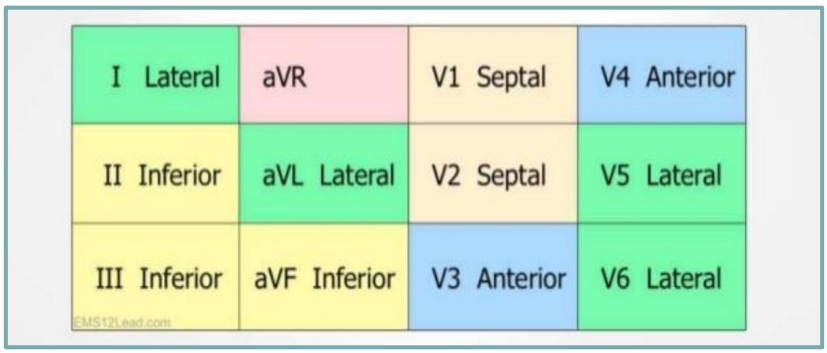
- **≥ 0.05** mV (or 0.5 mm) in leads **V2 and V3.**
- **≥ 0.1** mV in all other leads.
- What's the **first** differential diagnosis of ST depression?
  - reciprocal change from ST elevation.



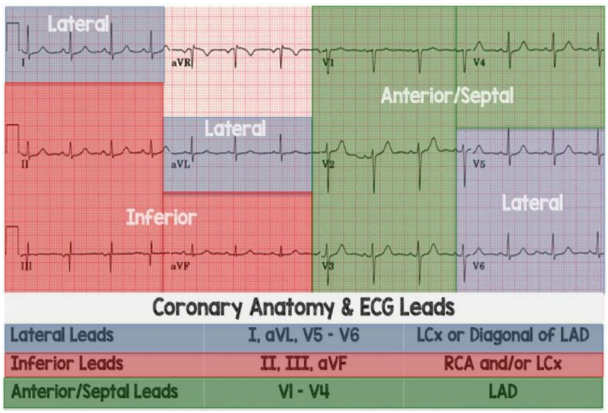
1. Convexity looks like a sad face (Sad= Bad), ischemic. ☹
2. Concavity looks like a happy face (Happy= Good), Non ischemic. ☺

Reciprocal Changes

Lead Perspectives



Lateral	Inferior	Anterior	Septal
I, aVL, V5, V6	II, III, aVF	V3, V4	V1, V2

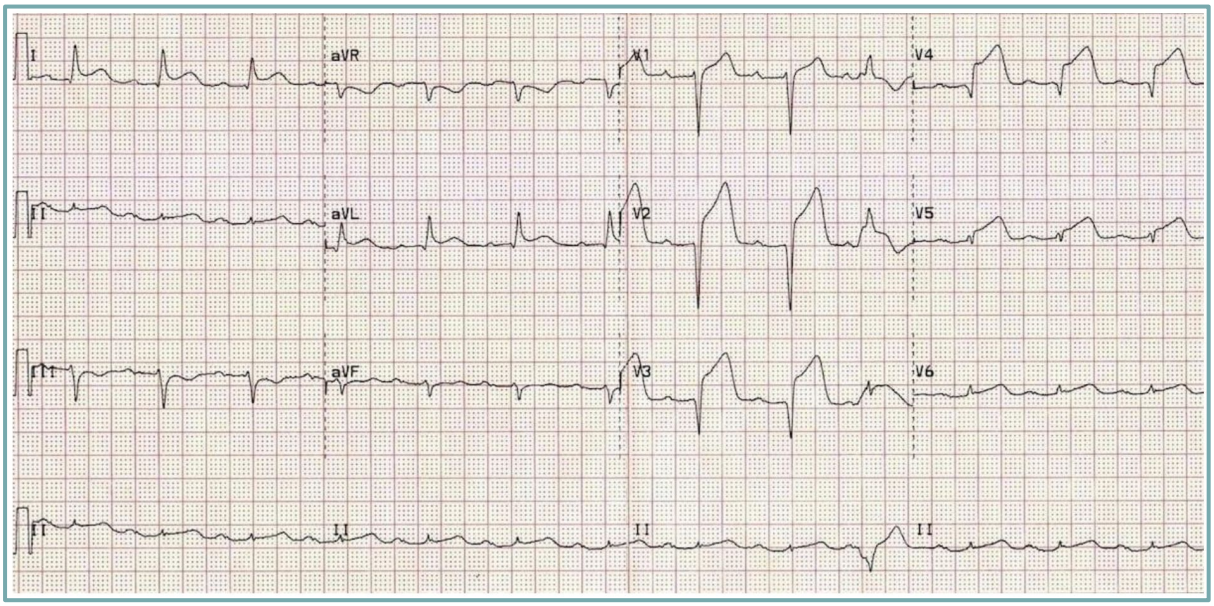


Reciprocal Changes

- **Reciprocal change is like a mirror, it happens due to ST elevation.**
- The inferior leads are mirrors to the lateral leads and vise versa.
- The anterior leads are mirrors to the posterior leads and vise versa
- **Each lead looks at the heart from a different view.**
  - **II, III, aVF looks at the heart inferiorly.**
  - **I, aVL, V5, V6 looks at the heart laterally.**
  - **V1, V2, V3, V4 looks at the heart anteriorly.**
- **Now let's say someone has MI. you'll have ST elevation on the leads looking at the affected part and ST depression on the opposite leads (think of it as if the ST elevation is dragging the electricity from the opposite leads and causing ST depression). So which lead is opposite to which?**
  - **lateral leads are opposite to inferior leads and vice versa.**
  - **Anterior leads are opposite to posterior leads and vice versa but you need 15-ECG leads to look at the heart posteriorly rather than the regular 12-ECG leads.**
- **Examples:**
  - If there is ST elevation in the lateral leads, **there might be** reciprocal changes (ST depression) in the inferior leads.
- **Can ST elevation be a reciprocal change to ST depression?**
  - No.
- **Please note:**
  - **Reciprocal changes doesn't always occur.**
  - **There are other causes for ST depression such as NSTEMI and LVH with repolarization abnormality.**
  -

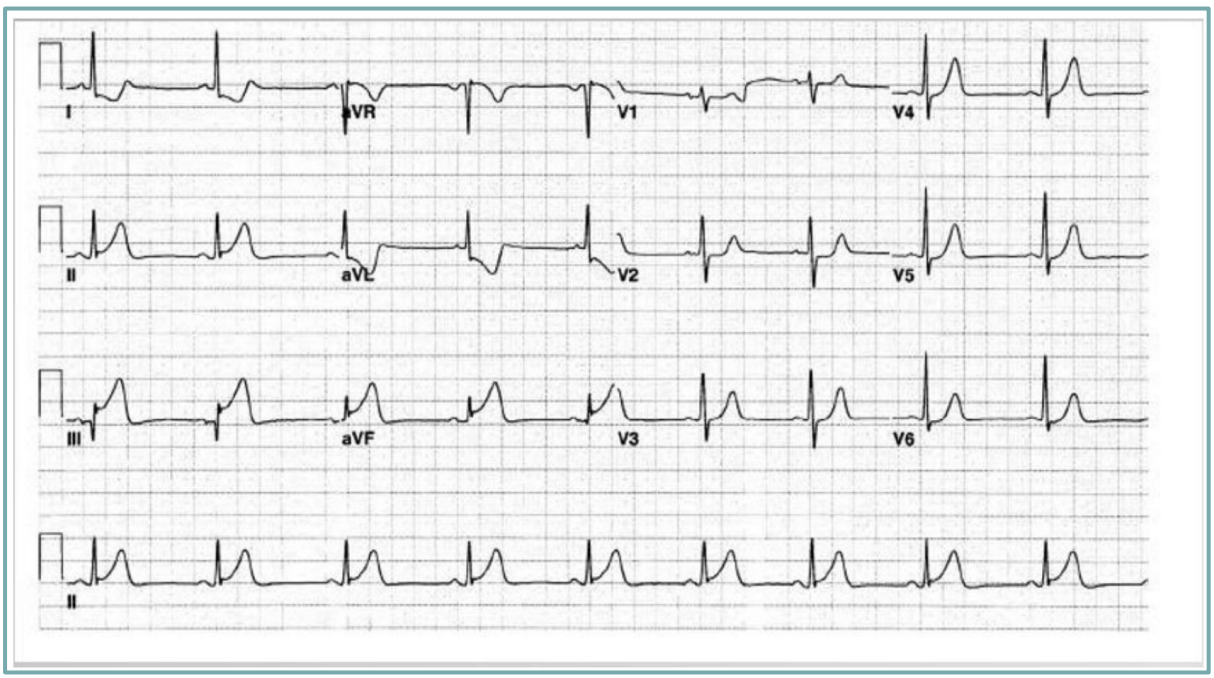
Interpret The Following ECG

Case Study 1:



- Regular rhythm and normal rate, P wave is present.
- Prolonged PR interval.
- **Elevated ST segment in lead 1, aVL, V1-V6.**
- **What is your diagnosis?**
  - Anteriorlatral STEMI caused by occlusion of left anterior descending artery

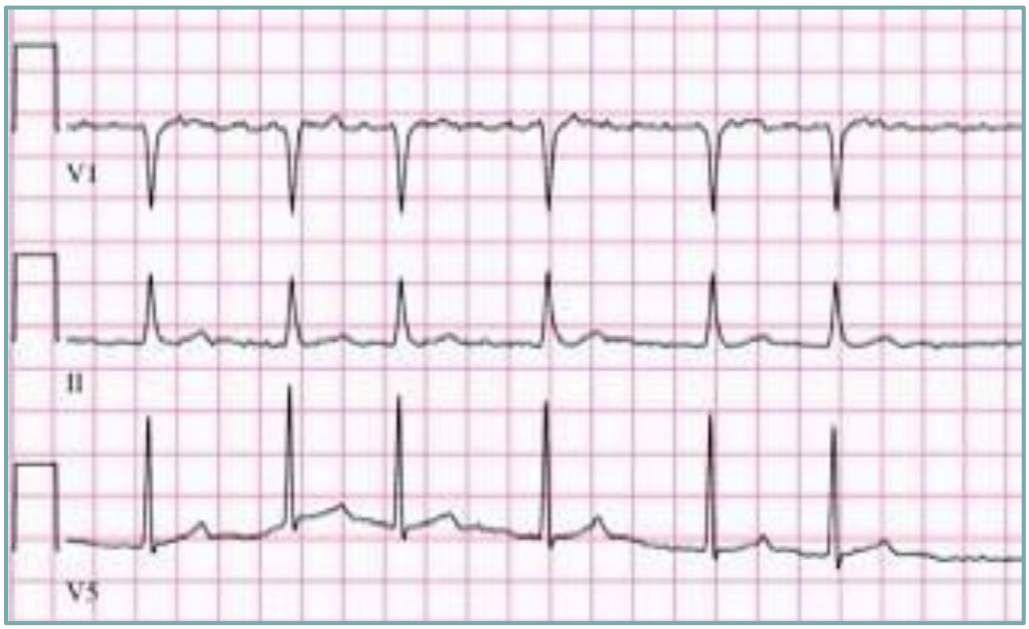
Case Study 2:



- **What is your diagnosis?**
  - Inferior STEMI with reciprocal changes in lateral leads.

Interpret The Following ECG

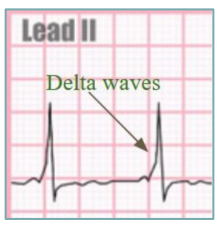
Case Study 3:



- Irregular rhythm + Absent P wave
- **What is your diagnosis?**
  - Atrial fibrillation

Case Study 4:

- Regular rhythm
- Normal HR
- P wave is present
- Short PR Interval (normal: 120ms)
- Delta wave
- **What is your diagnosis?**
  - Wolff Parkinson white (WPW) syndrome



Interpret The Following ECG

Case Study 5:

- Irregular rhythm
- Fixed PR interval followed by QRS complex drop
- **What is your diagnosis?**
  - Second degree heart block Type 2 (mobitz ll)
  - It is more dangerous than type 1 because of the risk of transforming into 3rd degree

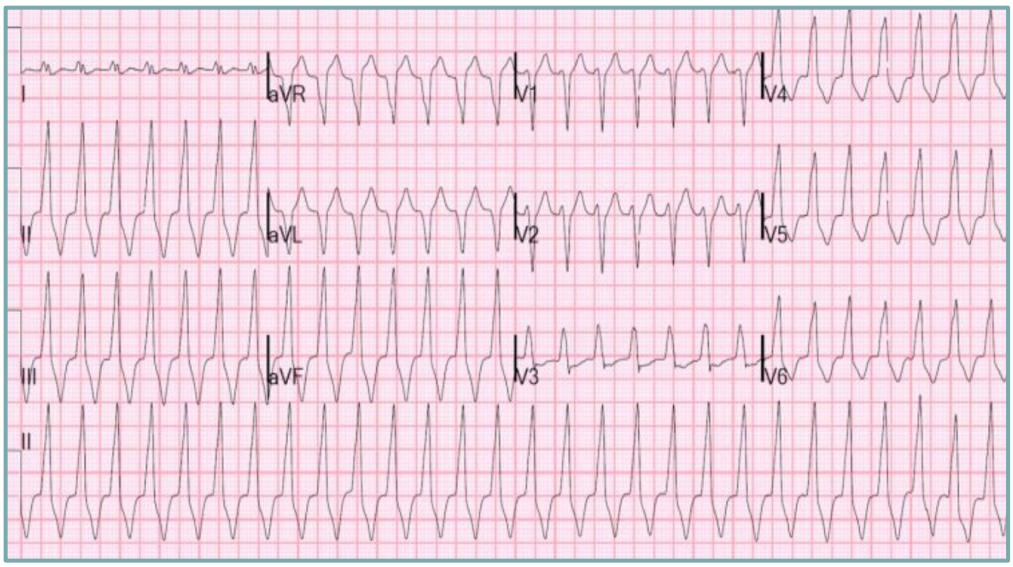
You can remember 2nd degree AV block by P-P sign: No QRS complex between the two P waves

Case Study 6:

- Regular rhythm
- Normal HR
- P wave is present
- Fixed Prolonged PR Interval (normal: 120ms)
- No QRS complex drop
- **What is your diagnosis?**
  - 1st degree heart block

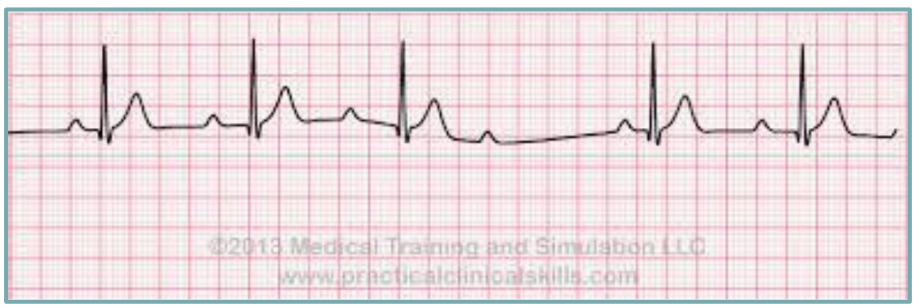
Interpret The Following ECG

Case Study 7:



- Regular rhythm
- Tachycardia
- Absent P wave
- Wide QRS complex
- **What is your diagnosis?**
  - Wide complex tachycardia, most likely ventricular tachycardia.

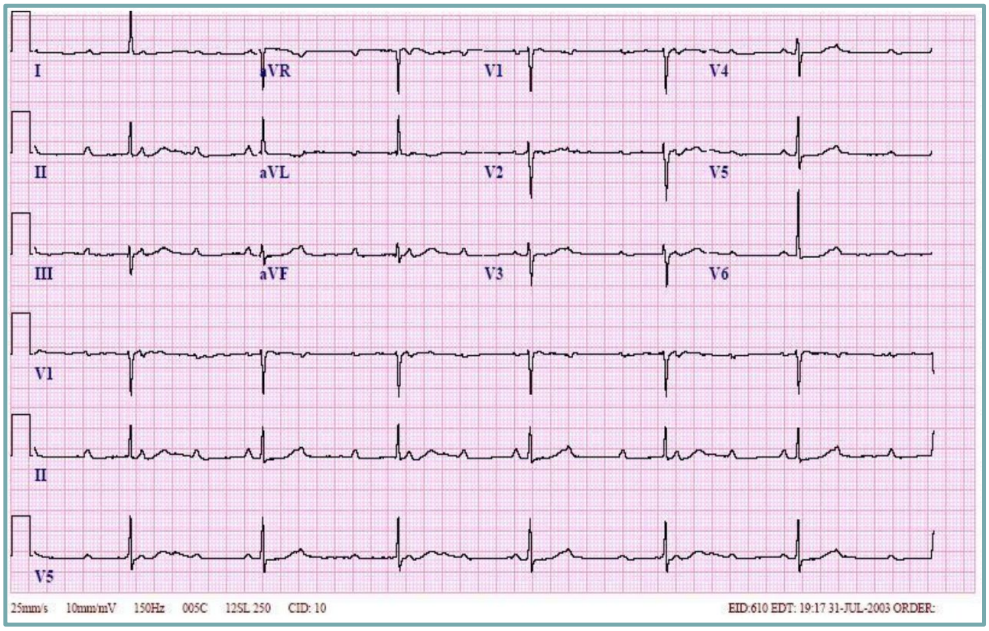
Case Study 8:



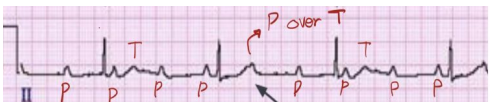
- Irregular rhythm
- Progressive prolongation of PR interval
- QRS complex drop
- **What is your diagnosis?**
  - 2nd degree heart block type 1 (Mobitz I)

Interpret The Following ECG

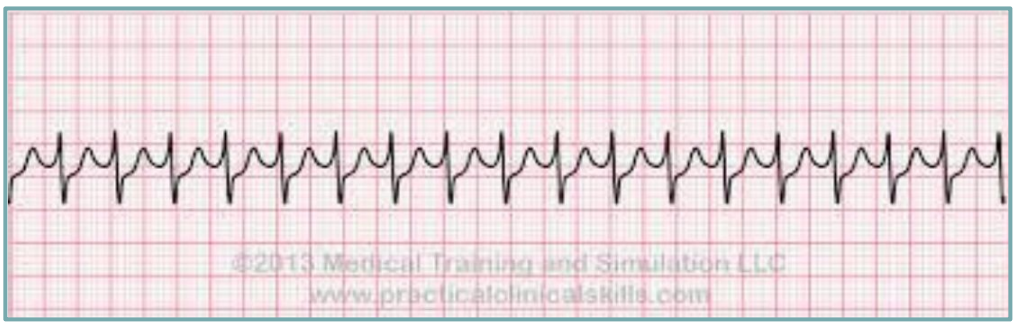
Case Study 9:



- Regular rhythm (regular R-R interval)
- Bradycardia
- P wave is present
- Regular P-P interval
- Variable PR Interval
- The QRS complex with a regular R-to-R interval.
- The PR interval will Be variable.
- **What is your diagnosis?**
  - 3rd degree heart block.
  - There is complete dissociation between P waves and QRS complex



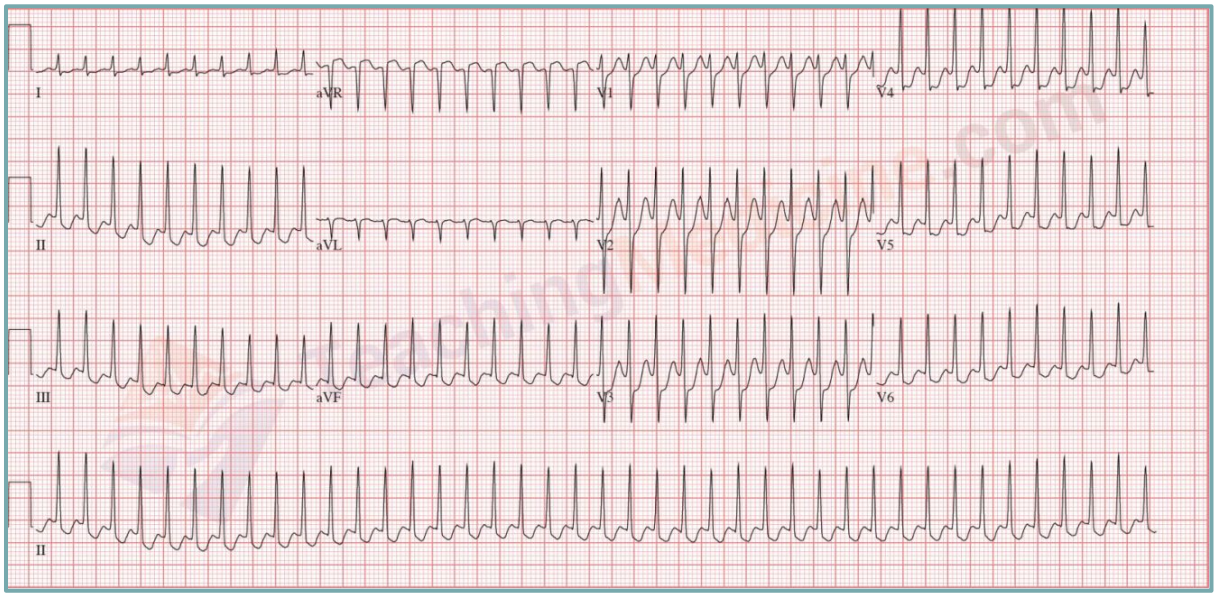
Case Study 10:



- Regular rhythm
- Tachycardia
- Absent P wave
- Narrow QRS complex
- ST segment depression
- **What is your diagnosis?**
  - Supraventricular tachycardia

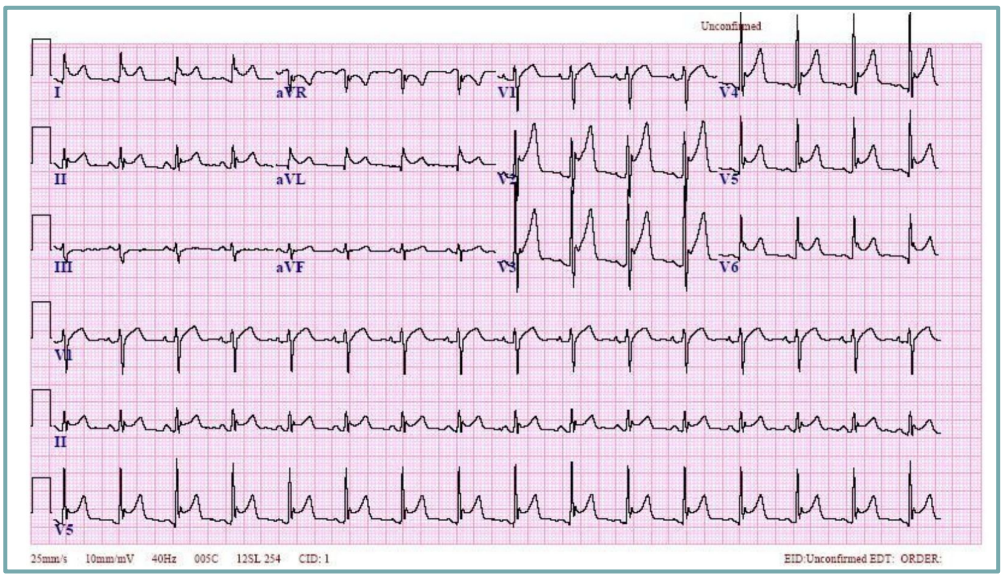
Interpret The Following ECG

Case Study 11:



- Regular rhythm
- Tachycardia
- Absent P wave
- ST segment depression
- **What is your diagnosis?**
  - Supraventricular tachycardia

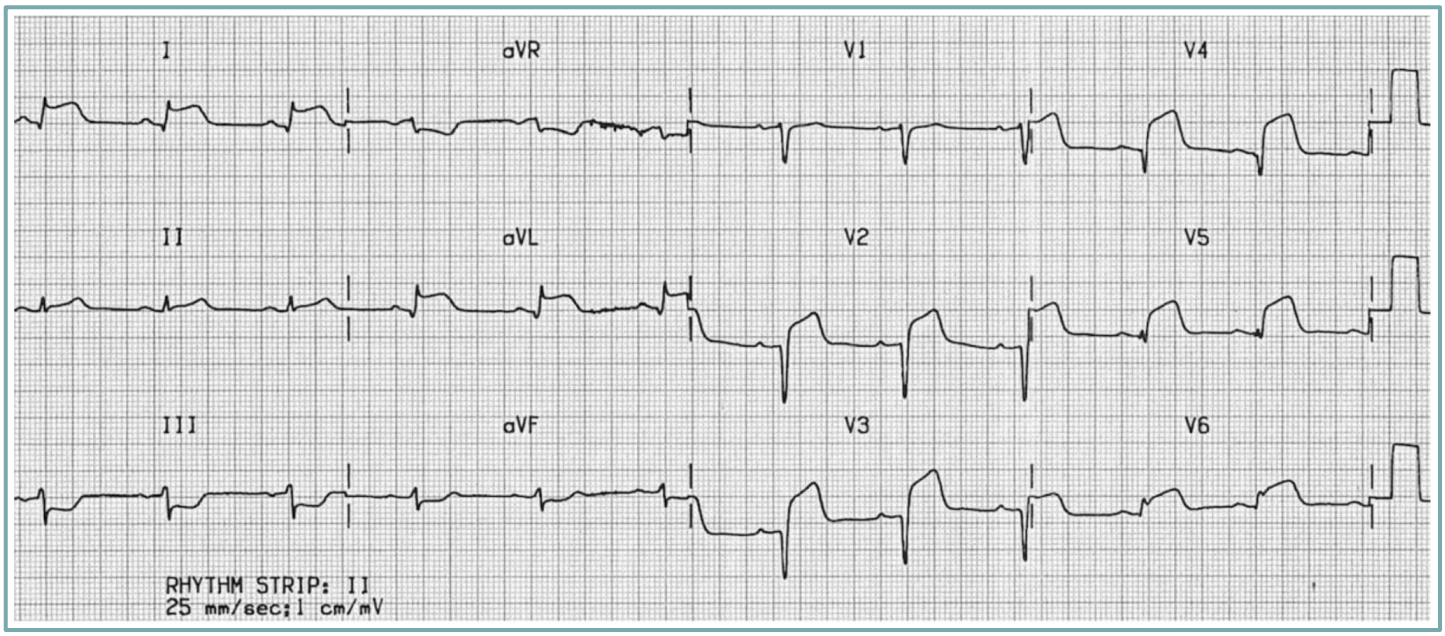
Case Study 12:



- Diffuse ST elevation (smile morphology) in more than one anatomy.
- PR segment depression in all leads except aVR which shows PR segment elevation and ST segment depression.
- J notch is present.
- **What is your diagnosis?**
  - Acute pericarditis

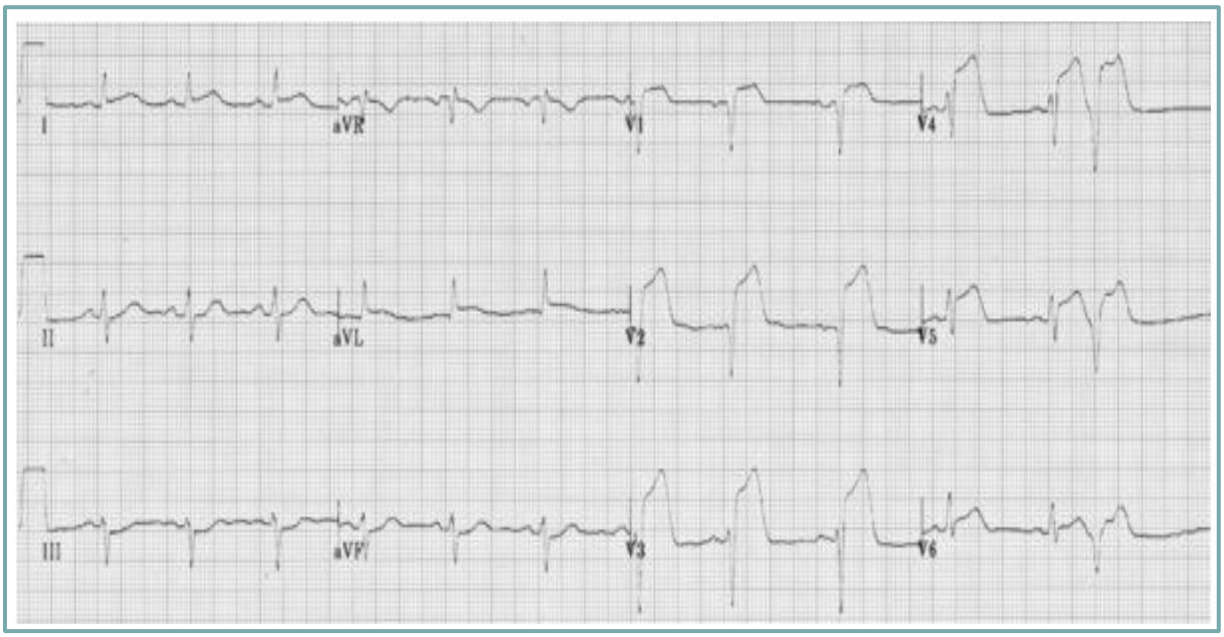
Interpret The Following ECG

Case Study 13:



- **What is your diagnosis?**
  - AnteroLateral STEMI

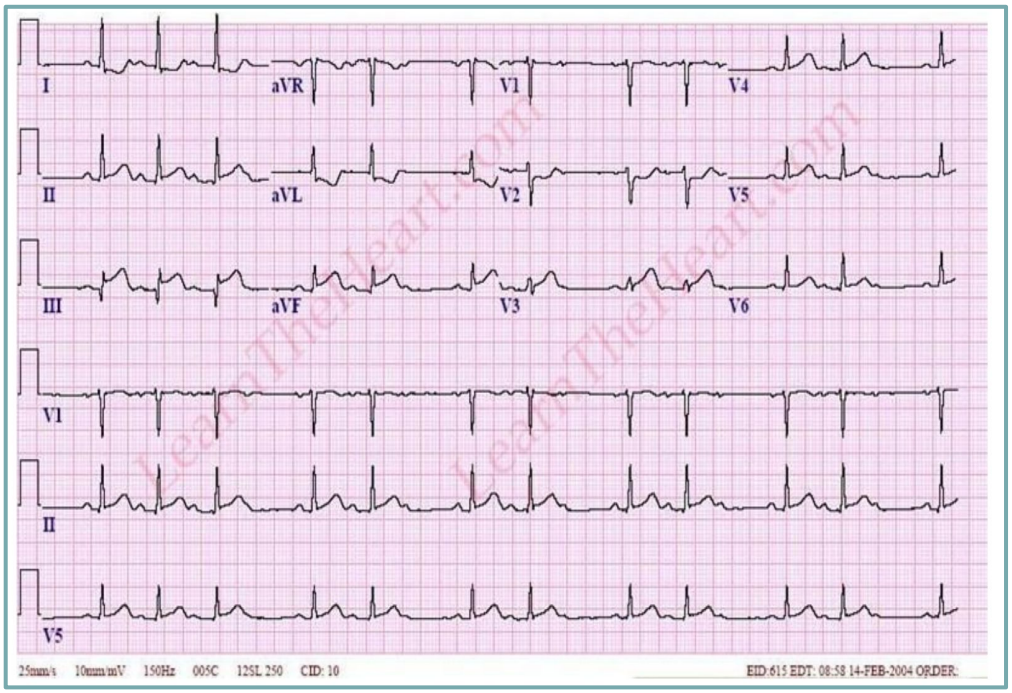
Case Study 14:



- **What is your diagnosis?**
  - Anterolateral STEMI

Interpret The Following ECG

Case Study 15:



- **Irregular rhythm, pumped T wave, dropped QRS complex, progressively prolonged PR interval.**
- ST elevation in V3 (ignore it because it's only one lead that is elevated).
- ST depression in V2.
- **Depressed ST in Lead 1 and aVL**
- **ST elevation in inferior leads**
- **What is your diagnosis?**
  - Acute inferior STEMI with reciprocal changes in lateral leads
  - And 2nd degree heart block type 1

THANKS!!

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Send us your feedback:
We are all ears!