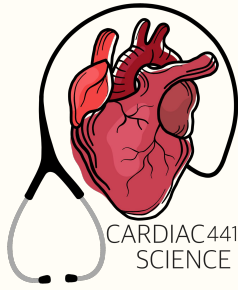
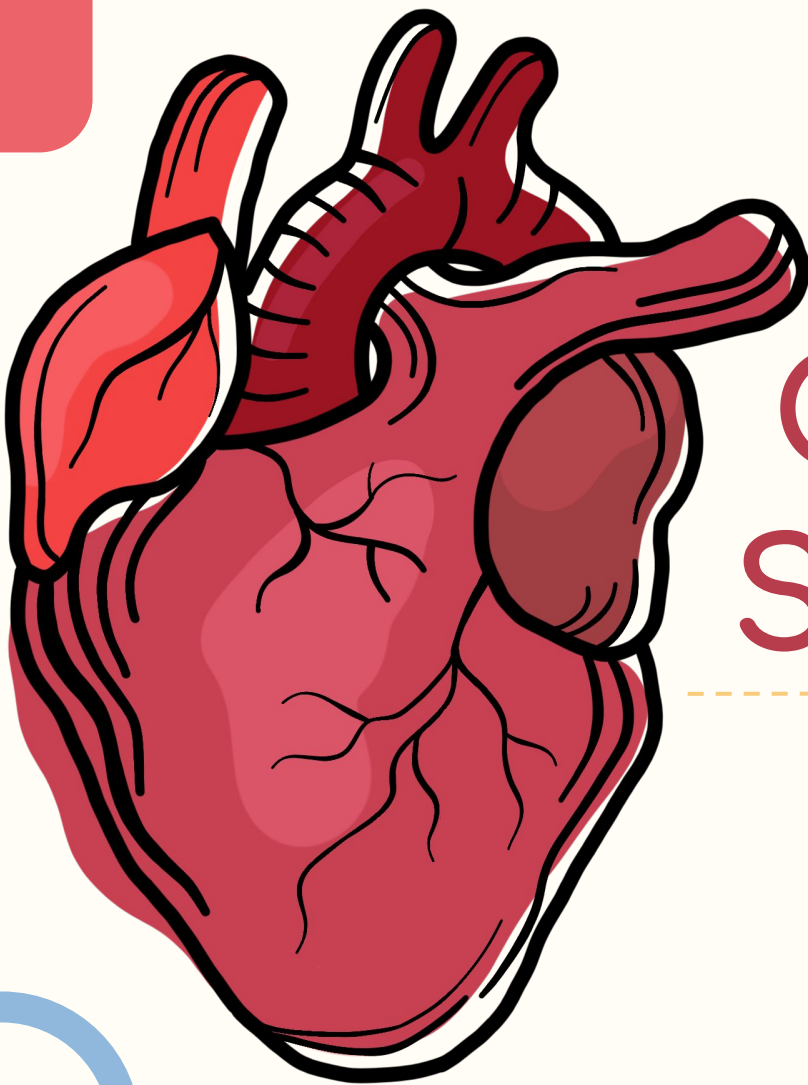




MED441
KING SAUD UNIVERSITY



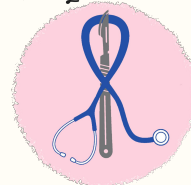
CARDIAC441
SCIENCE






Cardiac Sciences

Arrhythmias

Revised & Reviewed
by
Abdulaziz & Bahammam
Faye Wael Sendi



-  Main text
-  Important
-  Boys slides
-  Girls slides
-  Notes
-  Extra

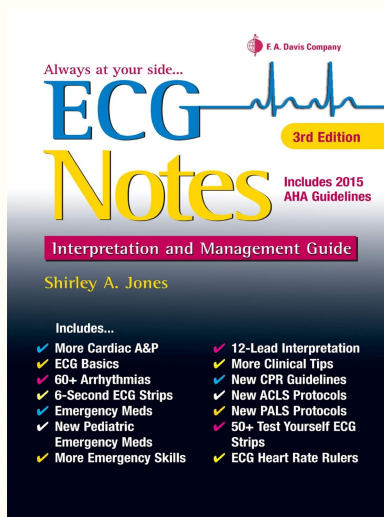
Editing File

We highly recommend to watch this video below before start studying & we suggest these 2 books if you want more details

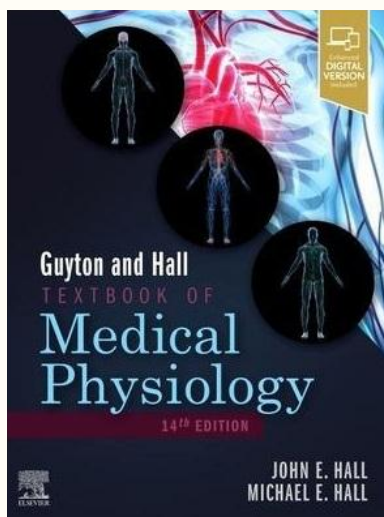
~ Click on it ~



Cardiovascular | EKGs by Ninja Nerd Lectures



ECG Notes: Interpretation and Management Guide 3rd Edition by Shirley A. Jones



Guyton and Hall Textbook of Medical Physiology 14th Edition by John E. HALL & Michael E. HALL

Chapter 13
Pages 157-168



Objectives



Describe sinus arrhythmias



Describe the main pathophysiological causes of cardiac arrhythmias



Explain the mechanism of cardiac block

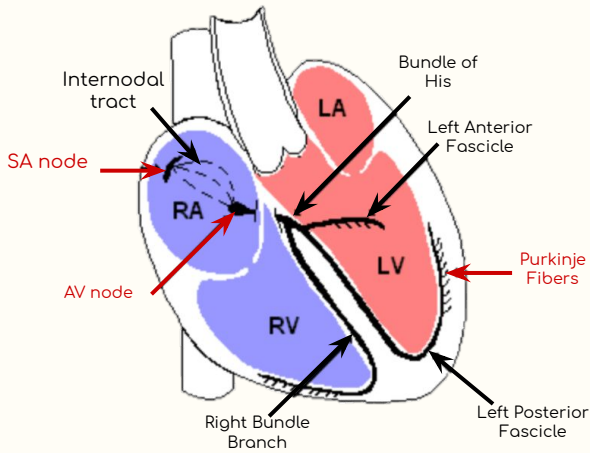
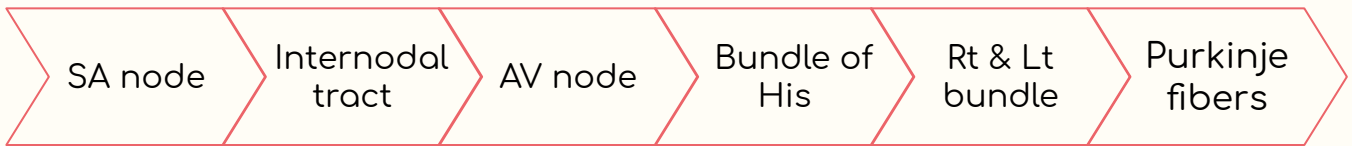


Enumerate the common arrhythmias and describe the basic ECG changes

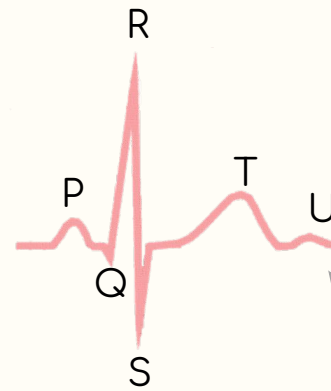


Explain the origin of an ectopic foci

The Normal Conduction System



Waveforms



- U wave is most often seen at slow heart rates and hypokalemia.
- Prominent U waves can be seen in hypokalemia (discussed in slide 14)

Interpretation

- Develop a systematic approach to read EKGs and use it every time

- Rate
- Rhythm
- Axis
- Hypertrophy
- Ischemia

Heart rate

Rule of 300/ Divide 300 by the number of boxes between each QRS = rate

- Normal HR = 60-100 bpm
- Tachycardia = > 100 bpm
- Bradycardia = < 60 bpm



ECG/EKG Interpretation:
Assessment of the morphology (appearance) of the waves and intervals on the ECG curve

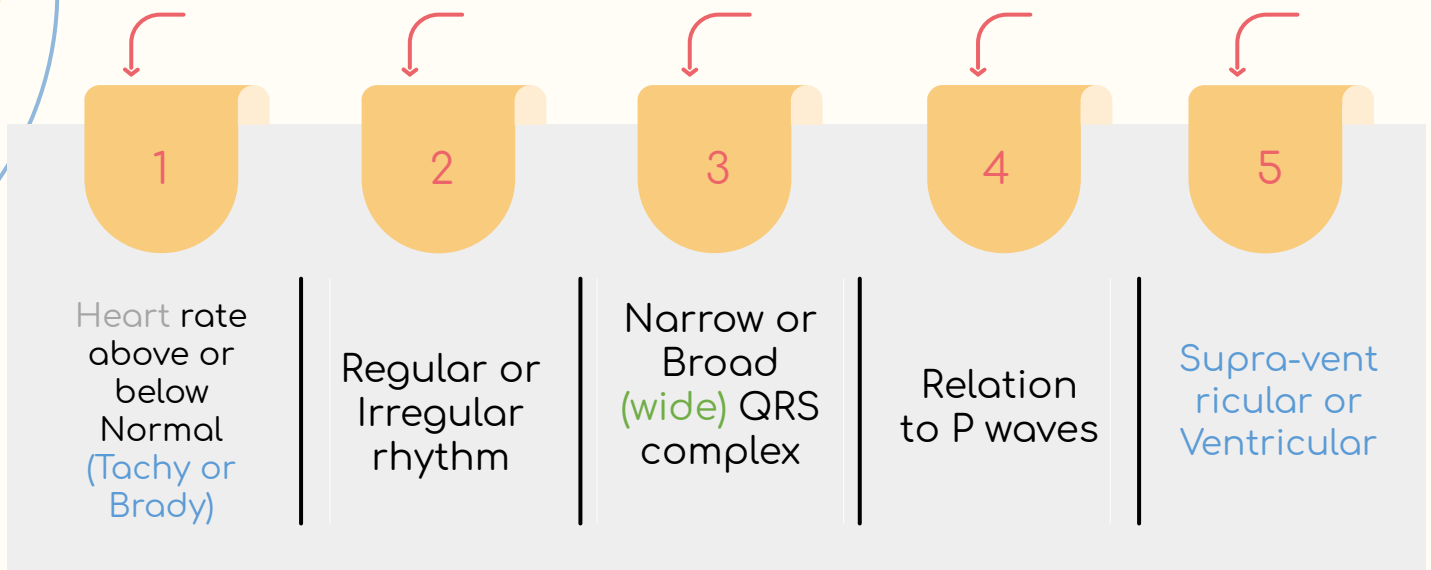
بإختصار يعني نشوف معدل النبض سريع أو بطيء ، نشوف هل فيه P wave أو لا ، هل المسافات متساوية أو فيها اختلاف ، وهكذا لحد ما نقدر نشخص المرض



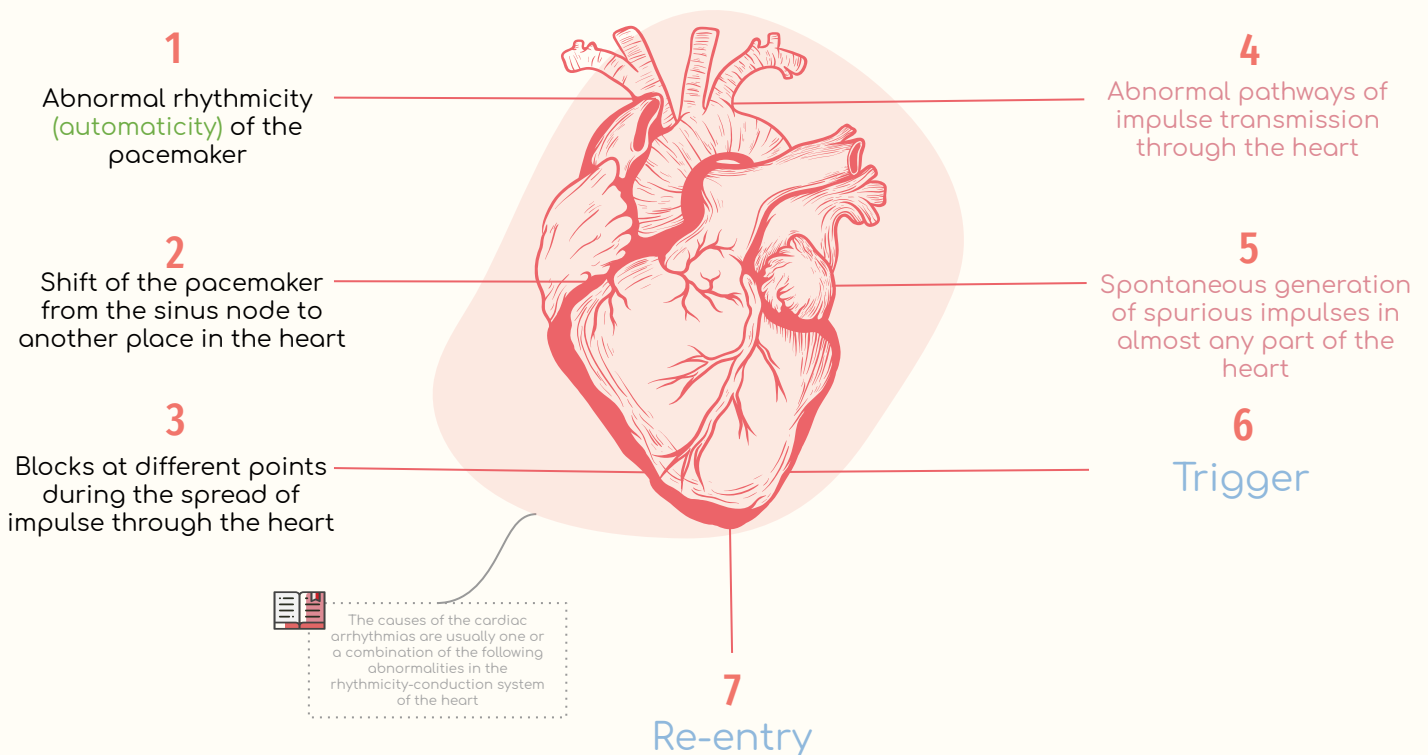
Counting large boxes for heart rate. The rate is 60 bpm.

| Number of big boxes | Rate |
|---------------------|------|
| 1 | 300 |
| 2 | 150 |
| 3 | 100 |
| 4 | 75 |
| 5 | 60 |

Classification of Cardiac Arrhythmias

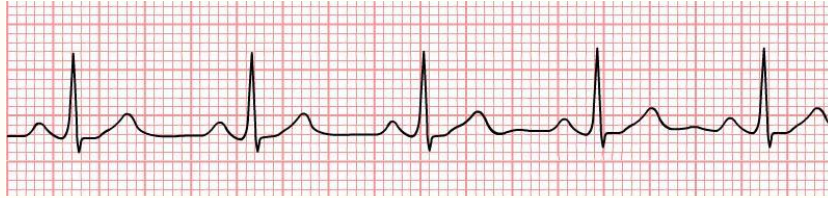


Causes of Cardiac Arrhythmias



Normal Sinus Rhythm

- Regular
- Originating from SA node
- Single upright P-wave precedes every QRS complex
- P wave in same direction as QRS
- P-R interval is constant and within normal range
- P-P interval is constant



Abnormal Sinus Rhythm

Bradycardia

- Slow heart rate < 60 bpm
- Causes:
 - Parasympathetic stimulation
 - Athlete people
 - Sleep
 - SA node problems
 - Expiration



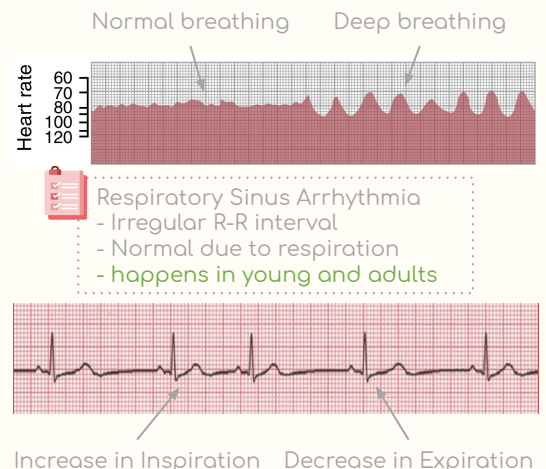
Tachycardia

- Fast heart rate > 100 bpm
- Causes:
 - Increased body temperature
 - Sympathetic stimulation
 - Drugs: digitalis, $\beta 1$ agonists
 - Bleeding to compensate blood loss
 - Inspiration



Sinus Arrhythmia

- Result from spillover of signals from the medullary respiratory center into the adjacent vasomotor center during inspiration and expiratory cycles of respiration
- The spillover signals cause alternate increase and decrease in the number of impulses transmitted through the sympathetic and vagus nerves to the heart



Common Types of Arrhythmias

| Origin | SA node | Atria | AV node | Ventricles |
|--------------------|--|--|---|---|
| Bradycardia | <ul style="list-style-type: none"> • Sinus Bradycardia • Sick Sinus Syndrome | - | <ul style="list-style-type: none"> • Conduction Blocks (1st, 2nd, 3rd) • Junctional escape rhythm | <ul style="list-style-type: none"> • Ventricular escape rhythm |
| Tachycardia | <ul style="list-style-type: none"> • Sinus tachycardia | <ul style="list-style-type: none"> • Atrial Premature Beats • Atrial Flutter • Atrial Fibrillation • Paroxysmal SVT • Multifocal Atrial Tachycardia | - | <ul style="list-style-type: none"> • Ventricular premature Beats • Ventricular Tachycardia • Torsades de pointes • Ventricular Fibrillation |

Differential Diagnosis of Tachycardia

| Tachycardia | Narrow Complex | Wide Complex |
|------------------|---|--|
| Regular | <ul style="list-style-type: none"> • Sinus tachycardia • Supraventricular tachycardia • Atrial flutter | <ul style="list-style-type: none"> • Sinus tachycardia with aberrancy • Supraventricular tachycardia with aberrancy • Ventricular Tachycardia |
| Irregular | <ul style="list-style-type: none"> • Atrial Fibrillation • Atrial Flutter with variable conduction • Multifocal Atrial Tachycardia | <ul style="list-style-type: none"> • Atrial Fibrillation with aberrancy • Atrial Fibrillation with WPW • Ventricular Tachycardia |

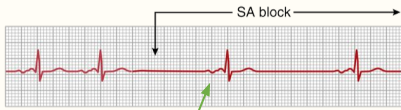


Abnormal Cardiac Rhythms

that Result From Impulse Conduction Block

Blockade of the S-A node impulse before entering atrial muscle
-Cessation of P wave-

S-A BLOCK



- The AV node will be the pacemaker after SA block and these impulses are from AV node

- 1-Ischemia of the affected node
- 2-Compression of the affected node by scar or fibrosis
- 3-Inflammation of the affected node
- 4-Strong vagal stimulation



Extra causes for A-V BLOCK from Guyton:

- 5- Degeneration of the A-V conduction system, which is sometimes seen in older patients.
- 6- Medications such as digitalis or beta-adrenergic antagonists, can in some cases impair A-V conduction.

When impulse from the S-A node is blocked

A-V BLOCK

Constant PR prolongation without drop beat

1st° Block



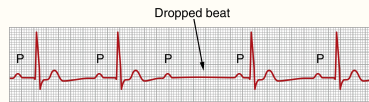
- Note that, it will be:
- Prolong P-R interval more than (0.2 seconds)
 - Benign, Asymptomatic
 - Caused by Some drugs and old age
 - No need for pacemaker



P-R interval lasts more than 0.25 seconds

2nd° Block

- Note that, there will be:
- Only few impulses pass to the ventricles
 - Atria beat faster than ventricles
 - "dropped beat" of the ventricles. means (NO QRS & T waves)
 - Higher dose of drugs (β and Ca Blockers and Digoxin), Old age and Ischemia (MI)



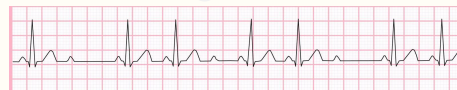
Types

Mobitz I

- Progressive PR prolongation
- Drop beat

Mobitz II

- Constant PR prolongation
- Drop beat



Complete dissociation of P wave and QRS waves

3rd° Block (complete)



- Note that, there will be:
- Ventricle escape from the influence of S-A node
 - Atrial rate is 100 beats/min
 - Ventricular rate is 40 beats/min
 - Stokes-Adams Syndrome: AV block comes and goes
 - the patient needs a pacemaker
 - Symptoms: syncope, dizziness.



- The Purkinje Fibers will be the pacemaker after AV block

Also called (Wenckebach) and it's Normal, happens during sleep, no need for treatment



Premature Contractions

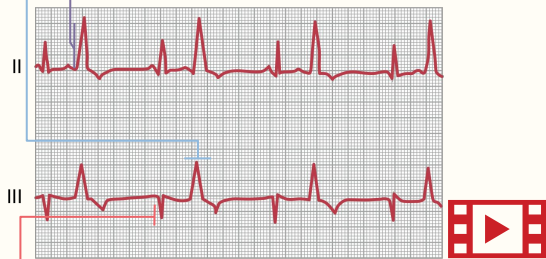
Premature Ventricular Contractions (PVCs)

What?

Premature Atrial Contractions

Prolong QRS complex because the impulses are carried out with myocardial fibers with slower conduction rate than Purkinje fibers

Increase QRS complexes voltage because QRS wave from one ventricle can not neutralize the one from the other ventricle



After PVCs, the T wave has an electrical potential of opposite polarity of that of the QRS because of the slow conduction in the myocardial fibers, the fibers that depolarizes first will repolarize first

- Causes: drugs, caffeine, smoking, lack of sleep, emotional irritations

Premature contractions, extrasystoles, or ectopic beat result from ectopic foci that generate abnormal cardiac impulses (pulse deficit)

What causes it ?

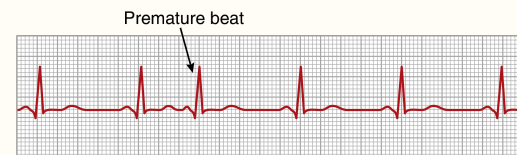
- 1-Ischemia
- 2-Irritation of cardiac muscle by calcified foci
- 3-Drugs like caffeine

Ectopic foci can also cause premature contractions

originate in:

- 1- The atria
- 2- A-V junction
- 3- The ventricles

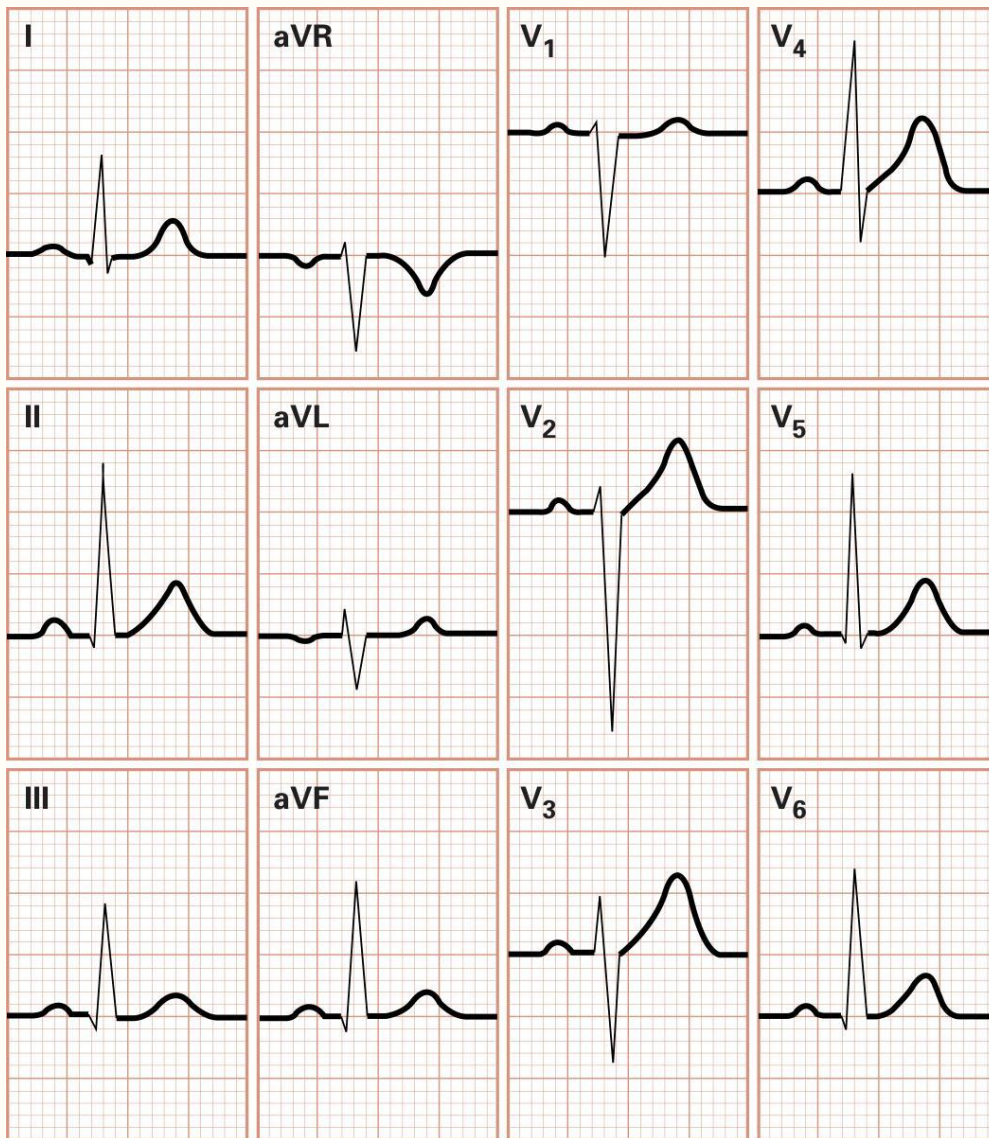
- **Short P-R interval** depending on how far the ectopic foci from the AV node
- Pulse deficit if there is no time for the ventricles to fill with blood
- The time between the premature contraction and the succeeding (التالية) beat is increased (Compensatory pause)



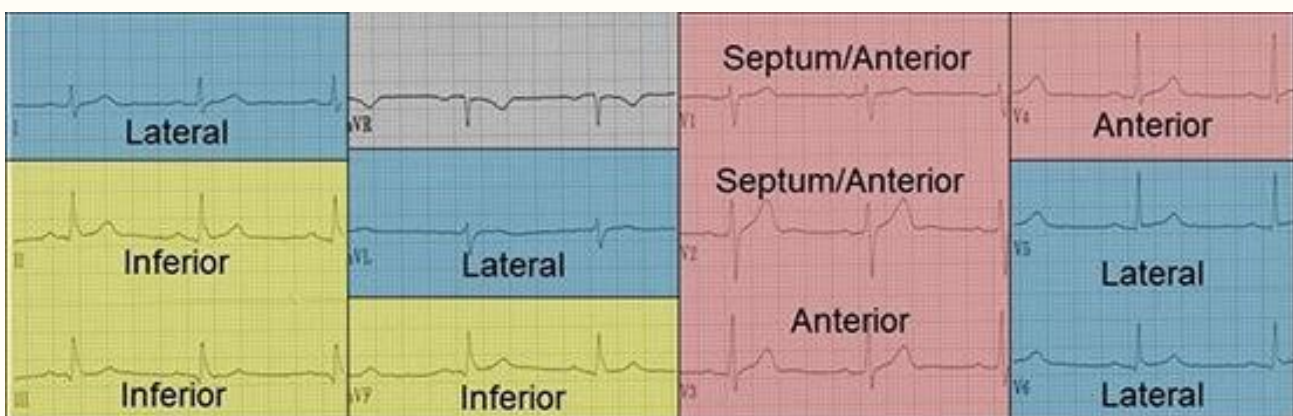
(1)-Normally,septum and endocardial areas of the ventricular muscle depolarize first and repolarize the last because,the septum and other endocardial areas have a longer period of contraction than do most of the external surfaces. BUT,in PVCs the role change completely and the fibers that depolarizes first will repolarizes first due to the slow conduction of myocardial fibers in the ventricles! That's why the QRS complex voltage will increase (taller),and the polarity of T wave will be opposite to the QRS complex.



The Normal 12-Lead ECG



Location of MI by ECG Leads



● Inferior: RCA

Right Coronary Artery

● Anterior: LAD

Left Anterior Descending Artery

● Lateral: LCX

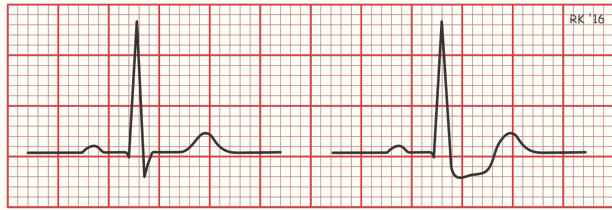
Left Circumflex Artery

Ischemia and the ECG

- One of the common uses of the ECG is in acute assessment of chest pain
- Cause : restriction of blood flow to the myocardium, either:
 - Reversible: angina pectoris
 - Irreversible: myocardial infarction
- Ischemia ➡ Injury ➡ Infarction



Inverted T wave

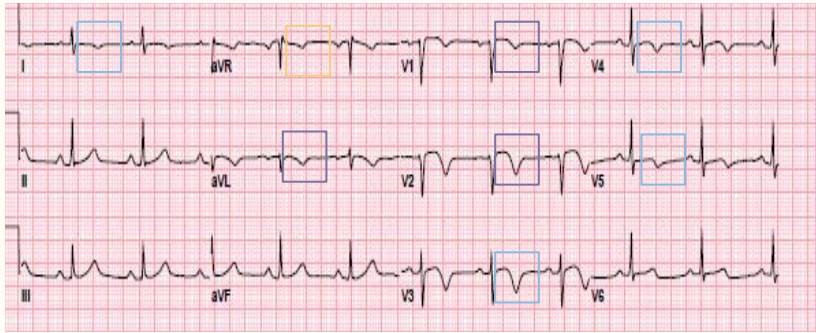


Normal

ST Depression

Reversible Ischemia

- Inverted T wave
- ST segment depression



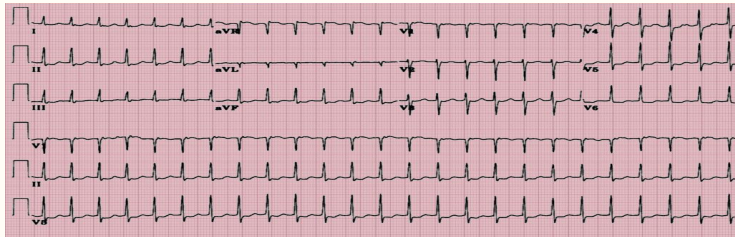
- Inverted T wave in leads I, II, V3-V6 is Abnormal

- Inverted T wave in **aVR** is Normal, when it's upright it will be Abnormal

- Inverted T wave is variable in leads III, **aVL**, **aVF**, V1, V2

AVRT–Narrow complex

- Tachycardia
- Regular rhythm
- SVT



Ventricular Tachycardia

- Regular rhythm
- Wide QRS complex
- No P wave
- Caused by: Ischemia, Electrolytes abnormalities

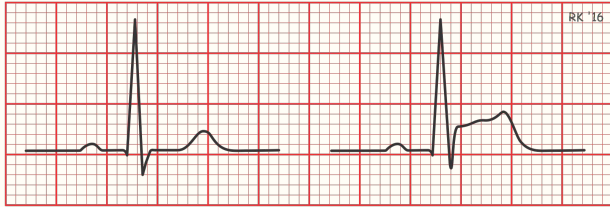


Myocardial Infarction

- Complete loss of blood supply to the myocardium resulting in necrosis or death of tissue
 - ST segment elevation
 - Deep Q wave



STEMI : ST-Elevation Myocardial Infarction

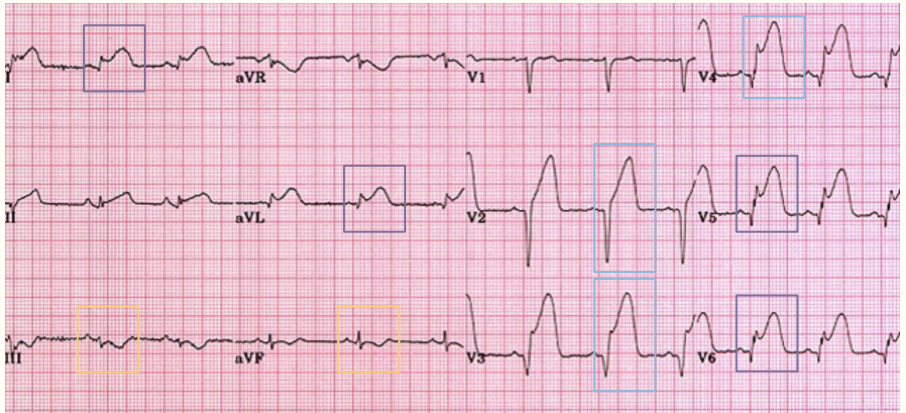


Normal

ST elevation

Antero-Lateral MI

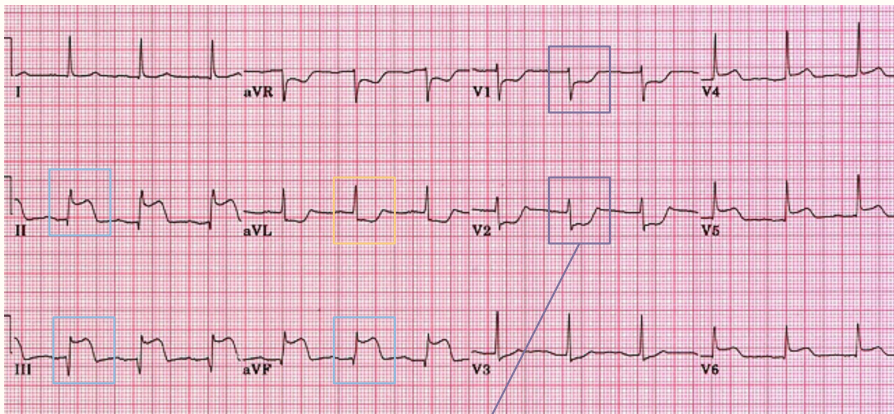
- Anterior
- Lateral
- Reciprocal Changes



- ST elevation in leads **V2-V6, I, aVL**
- Reciprocal ST depression in leads **III, aVF**

- Occlusion of the Left Anterior Descending Artery (LAD)

- Inferior
- Posterior
- Reciprocal Changes



Infero-Posterior MI

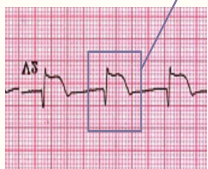
- ST elevation in leads **II, III, aVF**
- Reciprocal ST depression in **aVL**



- Occlusion of the Right Coronary Artery (RCA)

STEMI in Lead III

Inverted Lead V2



Diagnosis may require a 15-lead ECG because a standard 12-lead does not look directly at the Posterior wall.



aVL is the only lead truly reciprocal to the inferior wall, It is thus a sensitive marker for inferior infarction

Ventricular Fibrillation

- The most serious of all arrhythmias
- Cause : impulses stimulate one part of the ventricles, then another, then itself, many parts contract at the same time while other parts relax (circus movement) ➔ Tachycardia, Irregular rhythm, Broad QRS complex, No P wave
- Causes : sudden electrical shock, ischemia
- Treatment: DC shock

| Interpretation | |
|----------------|-----------------|
| Rate | Chaotic & Rapid |
| Rhythm | Irregular |
| P wave | N/A |
| PR interval | N/A |
| QRS complex | Broad |



Note the chaotic & irregular rhythm with no identifiable waves



Atrial Fibrillation

- Cause/same mechanism as ventricular fibrillation, it can occur only in atria without affecting the ventricles
- It occurs more frequently in patients with enlarged heart
- The atria do not pump if they are fibrillating
- The efficiency of ventricles pumping/filling is decreased 20-30%
- No P wave, or high frequency of low voltage P wave
- Treatment : DC shock
- A person can live for years with atrial fibrillation

| Interpretation | |
|----------------|--------------------|
| Rate | > 350 bpm |
| Rhythm | Irregular |
| P wave | Chaotic appearance |
| PR interval | N/A |
| QRS complex | Narrow |



Note the 'fibrillatory waves' or 'f' waves



Atrial Flutter

- A single large wave travels around and around in the atria
- The atria contracts at high rate (250 bpm)
- Because one area of the atria is contracted and another one is relaxed, the amount of blood pumped by the atria is slight
- The refractory period of the AV node causes 2-3 beats of atria for one single ventricular beat ; 2:1 or 2:3 rhythm

| Interpretation | |
|----------------|----------------------|
| Rate | 250-350 bpm |
| Rhythm | Regular |
| P wave | Saw-tooth appearance |
| PR interval | N/A |
| QRS complex | Narrow |



Note the 'Flutter' or 'F' waves they look like a 'saw tooth'



Hypokalemia

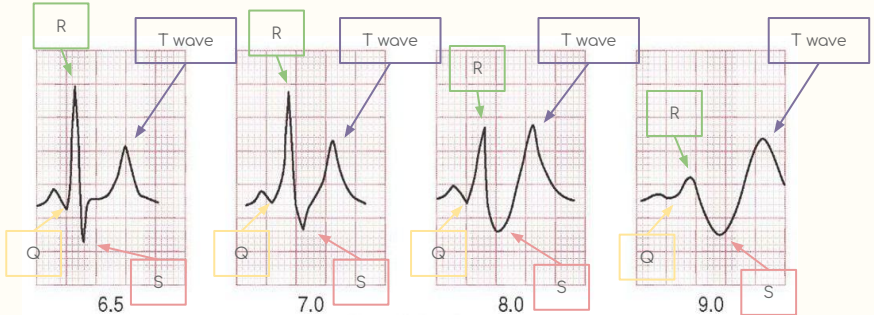
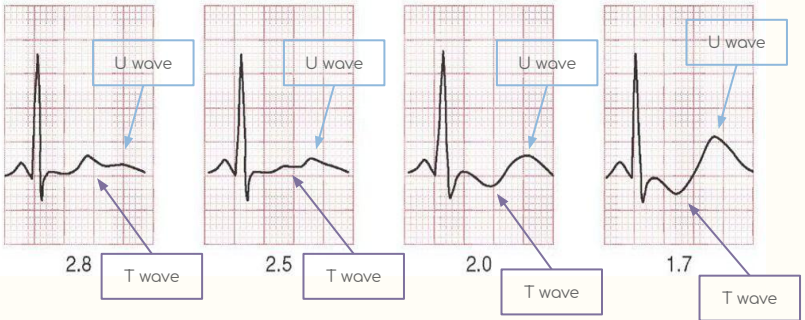
Flat T wave

Hyperkalemia

Tall peaked T wave



The source of the U wave is unknown but it may be caused by the late repolarization of the Purkinje fibers



Summary

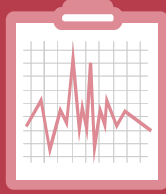


Click [HERE](#)

Or

Scan the code for the amazing summary that include the important rhythms in this lecture





QUIZ

Q1/ This rhythm called ?



- A/ Normal sinus rhythm
- B/ Sinus tachycardia
- C/ Sinus bradycardia
- D/ First degree AV block

Q2/ Which one of the following conditions will cause a sinus bradycardia ?

- A/ Sympathetic NS
- B/ Parasympathetic NS
- C/ Fever
- D/ Bleeding

Q3/ After SA node got blocked or damaged which node will be the pacemaker ?

- A/ Purkinje Fibers
- B/ Bundle of His
- C/ AV node
- D/ Internodal tract

Q4/ Which AV block have a progressive PR prolongation with drop beat ?

- A/ First degree AV block
- B/ Mobitz I
- C/ Mobitz II
- D/ Complete heart block

Q5/ Patient has sawtooth waves in ECG test, which one is most likely he has ?

- A/ Atrial flutter
- B/ Atrial fibrillation
- C/ Ventricular flutter
- D/ Ventricular fibrillation

Q6/ This ECG shows ?

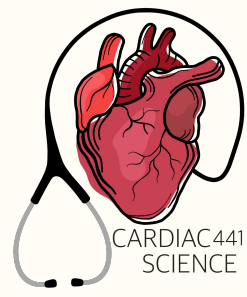


- A/ Atrial flutter
- B/ Atrial fibrillation
- C/ Ventricular flutter
- D/ Ventricular fibrillation

Time to see by yourself



| | |
|--|-----------------------|
| 1nd° Block | |
| 2nd° Block | I II |
| 3nd° Block | |
| Ventricular Fibrillation | |
| Atrial Fibrillation | |
| Atrial Flutter | |
| Premature Ventricular Contraction | |
| Premature Atrial Contraction | |



DONE BY

ABDUALRAHMAN ALROQI



MARAM ALDEEJ
WAREEF ALMOUSA

LOGO
DESIGNED BY

