MED437
KING SAUD UNIVERSITY

ANATOMY
Team 437

Cardiac Arrhythmias

{وَمَنْ يَتَوَكَّلْ عَلَى اللَّهِ فَهُوَ حَسْبُهُ}

OBJECTIVES

by the end of this lecture you will be able to:

- Describe sinus arrhythmias
- Describe the main pathophysiological causes of cardiac arrhythmias
- Explain the mechanism of cardiac block
- Explain the origin of an ectopic foci
- Enumerate the common arrhythmias and describe the basic ECG changes

Depolarization and Repolarization

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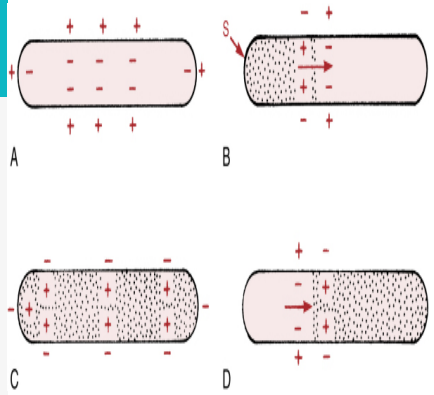
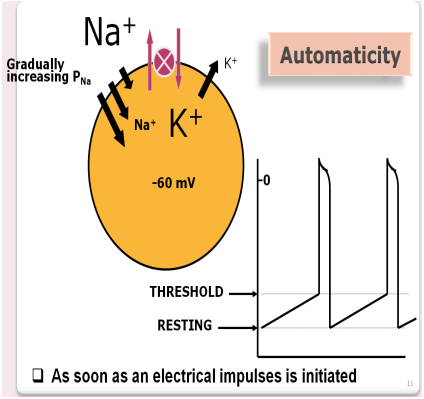
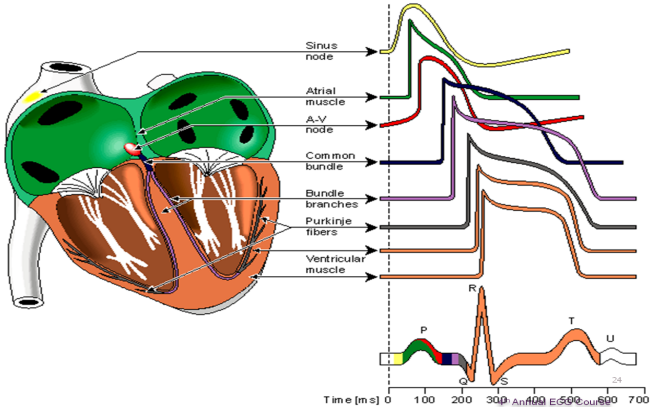
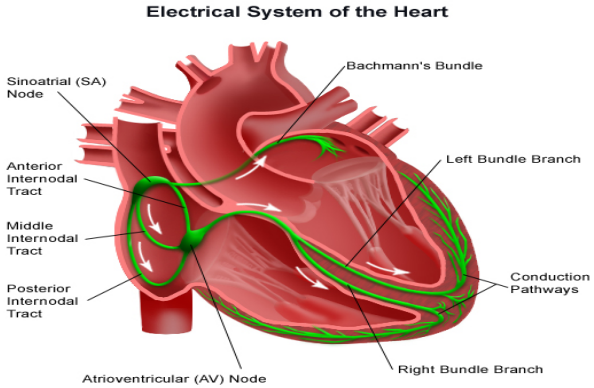
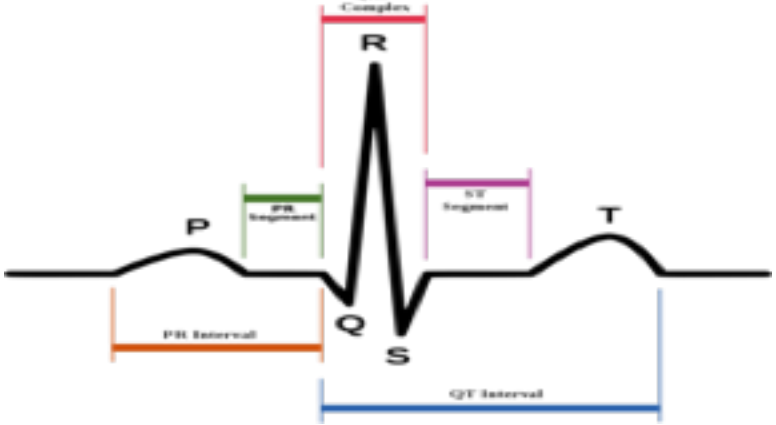






Electrical Conduction system (pathway)



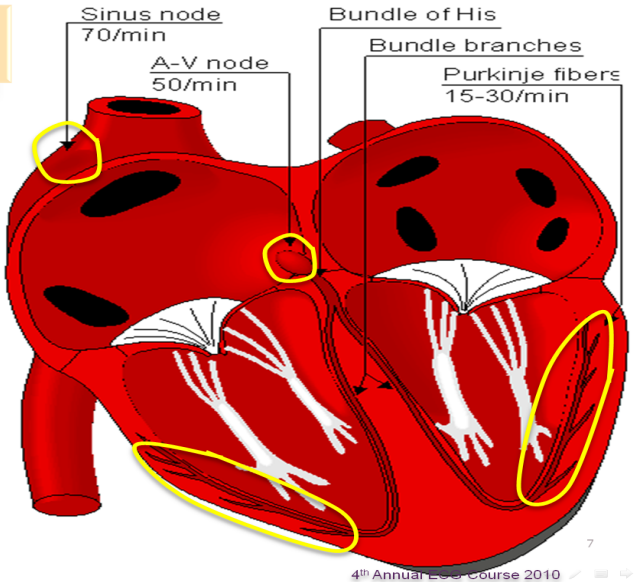


Conduction system

Intrinsic Firing Rates

Three potential areas capable of beginning cardiac conduction

- **SA node:**
  - Cardiac pacemaker
  - Paces at a rate of 60–100 bpm
  - Average of 70 bpm
- **AV node:**
  - 45-60 bpm
- **Purkinje:**
  - 15-45 bpm



Function of A.V node

- Conduction of impulses from upper chambers to the lower chambers
- Cause Coordination between upper & lower chambers "Decremental Conduction" "Delay of conduction"

ECG Leads

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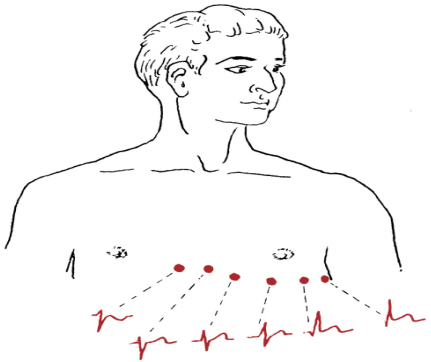
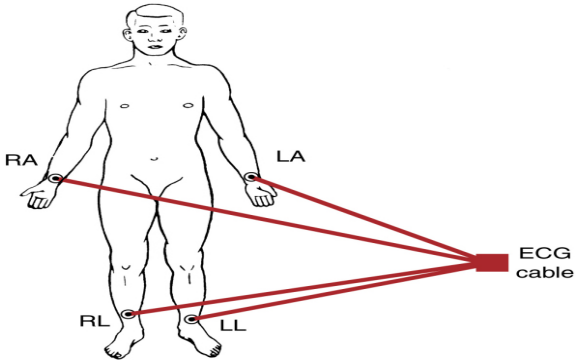
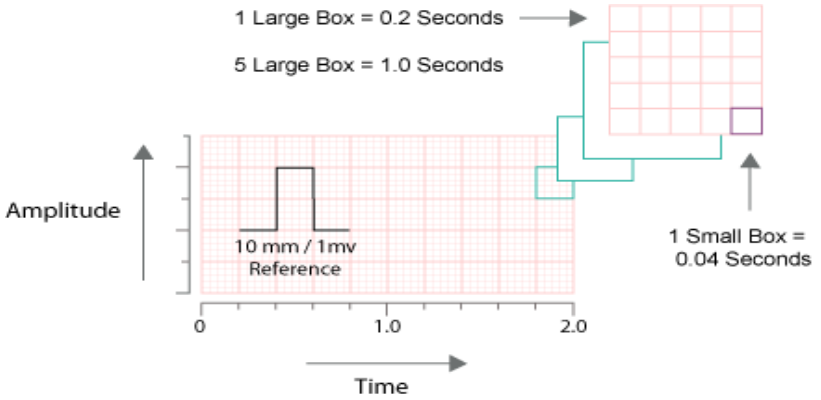
Chest leads

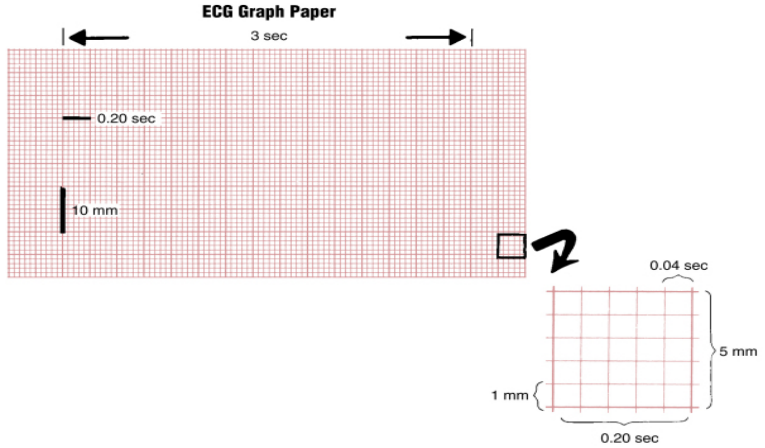


Limb leads



ECG Graph Paper





12 EKG Leads

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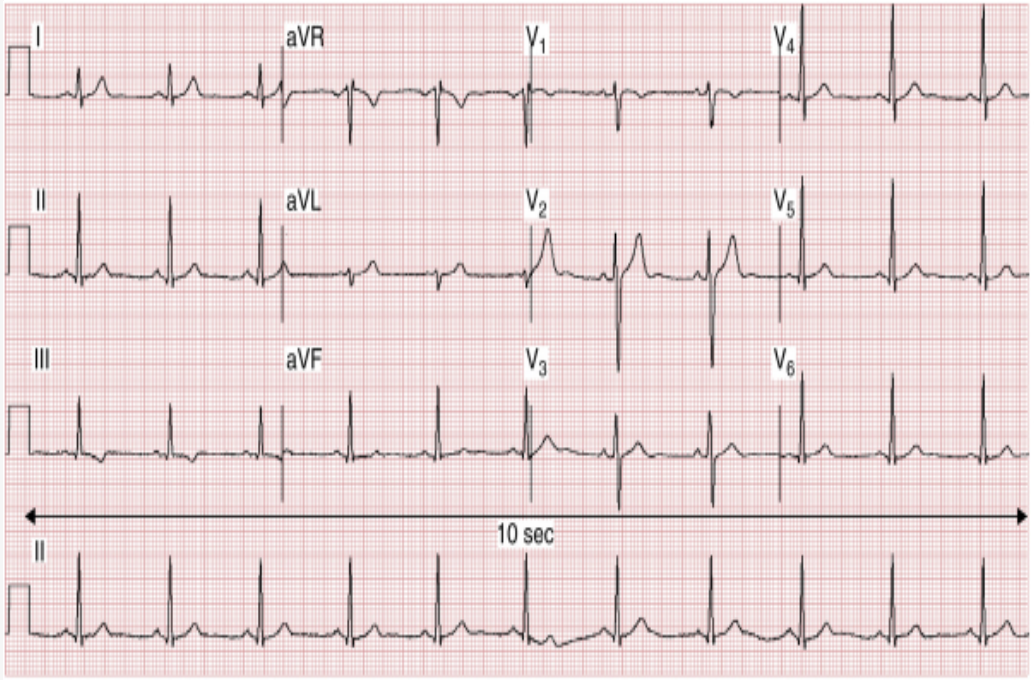
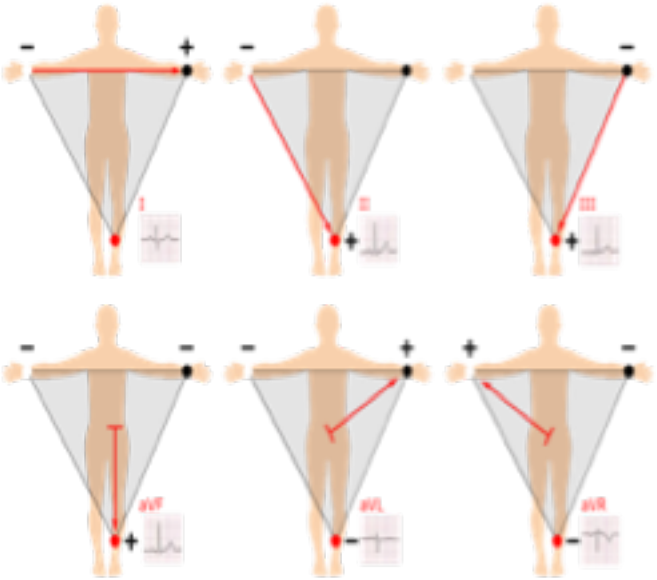
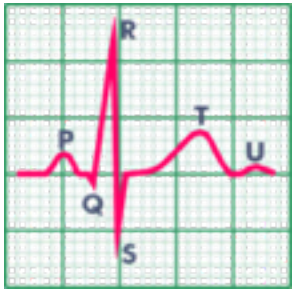




Interpretation

- Develop a systematic approach to reading EKGs and use it every time
- The system we will practice is:
  - Rate
  - Rhythm (including intervals and blocks)
  - Axis
  - Hypertrophy
  - Ischemia

Wave forms



Normal Sinus Rhythm

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

Some time there is ”U” wave which is usually found in young people.

Heart rate

- Rule of 300- Divide 300 by the number of boxes between each QRS = rate
- (300/6) = 50 bpm
- **Normal sinus rate:** (60-100).
- **Tachycardia:** >100.
- **Bradycardia:** <60.

Number of big boxes	Rate
1	300
2	150
3	100
4	75
5	60
6	50

Causes/Mechanisms of Cardiac Arrhythmias

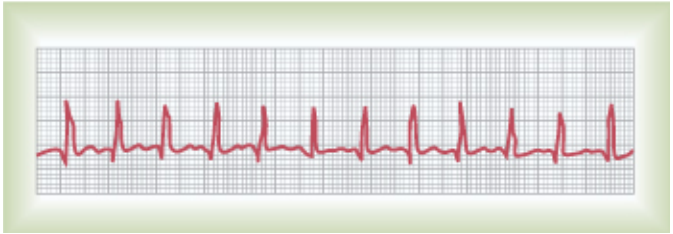
- Abnormal rhythmicity of the pacemaker (S.A Node hyperactivity)
- Shift of the pacemaker from the sinus node to another place in the heart (Ectopic pacemaker)
- Blocks at different points in the spread of impulse through the heart
- Triger (Electrolyte abnormalities/PVC → Relative refractory period)
- Reentry (Accessory fibers → create a circuit movement "e.g: WPW")
- Abnormal pathways of impulse transmission through the heart
- Spontaneous generation of spurious impulses in almost any part of the heart

Classification of Cardiac Arrhythmias

- Rate above or below normal (tachy vs. Brady)
- Regular or irregular rhythm
- Narrow or broad QRS complex
- Relation to P waves
- Supraventricular Vs. ventricular

Abnormal Sinus Rhythm

- Tachycardia: an increase in the heart rate
- Heart rate > 100 beats per minute
- Causes:
  - Increased body temperature
  - Sympathetic stimulation
  - Drugs: digitalis
  - Inspiration



Sinus rhythm

Sinus tachycardia

24 year-old pregnant woman with three days of frequent vomiting

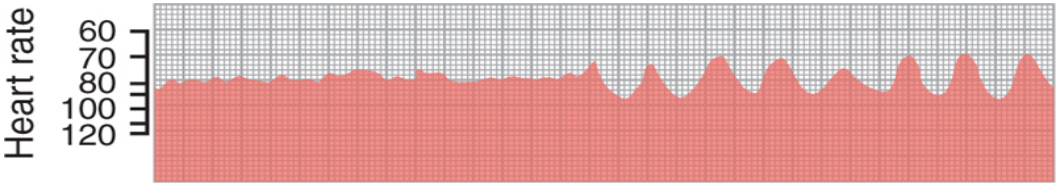
only in boy's slides

Abnormal Sinus Rhythm

- Bradycardia: Slow heart rate < 60 beats per minute
- Causes:
  - Parasympathetic stimulation
  - Expiration

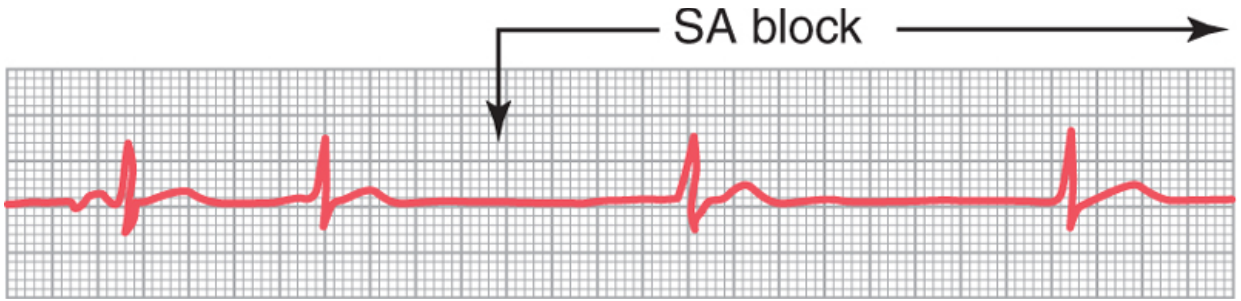
Sinus Arrhythmia

- 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



Abnormal Cardiac Rhythms that Result from Impulse Conduction Block

- Sinoatrial Block ,The impulse from the **S-A node is blocked** before it enters the atrial muscle.
- Cessation of P waves
- Causes:
  - **Ischemia** of the S-A node
  - Compression of the S-A node by **scar formation**
  - **Inflammation** of the S-A node
  - Strong vagal stimulation



AVRT-Narrow complex

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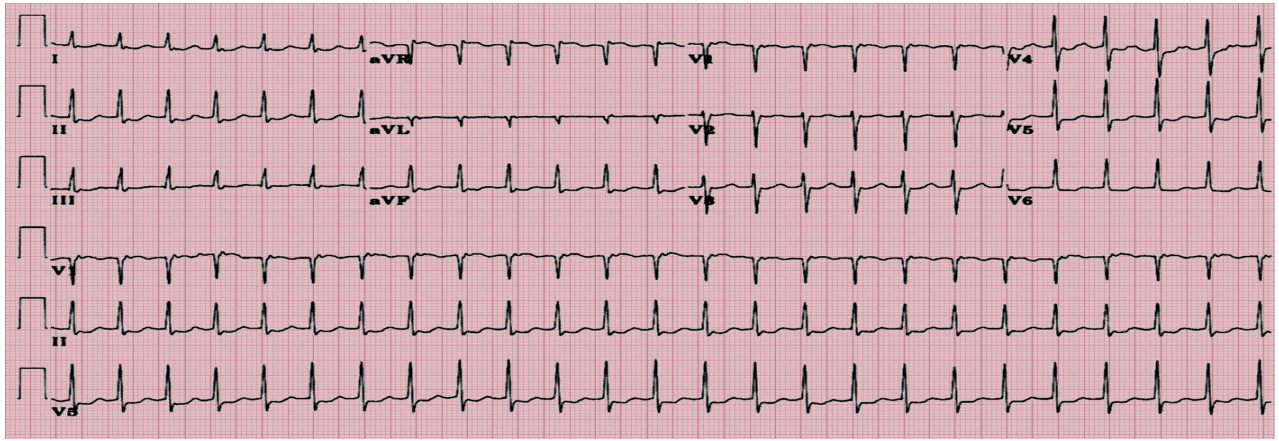
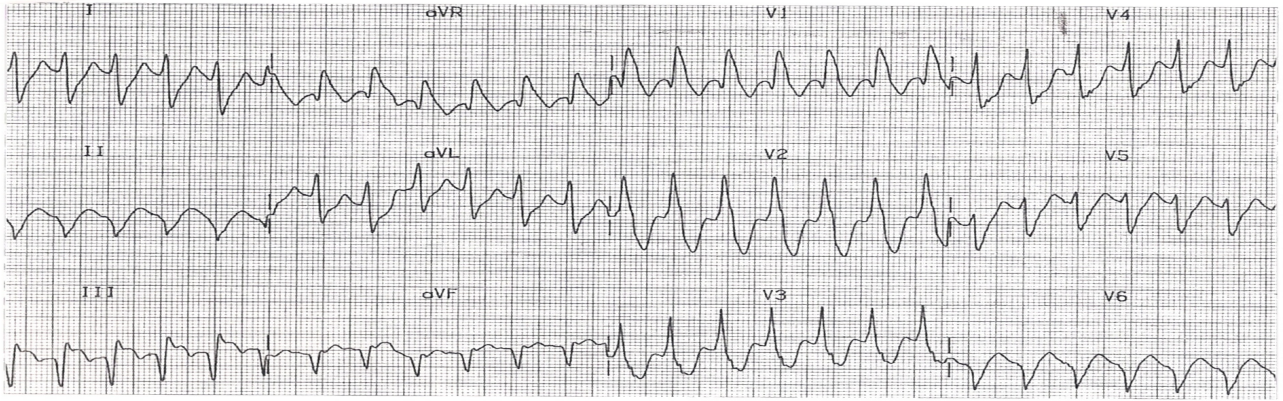


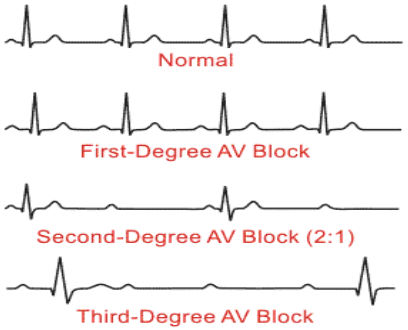


Abnormal Cardiac Rhythms that Result from Impulse Conduction Block

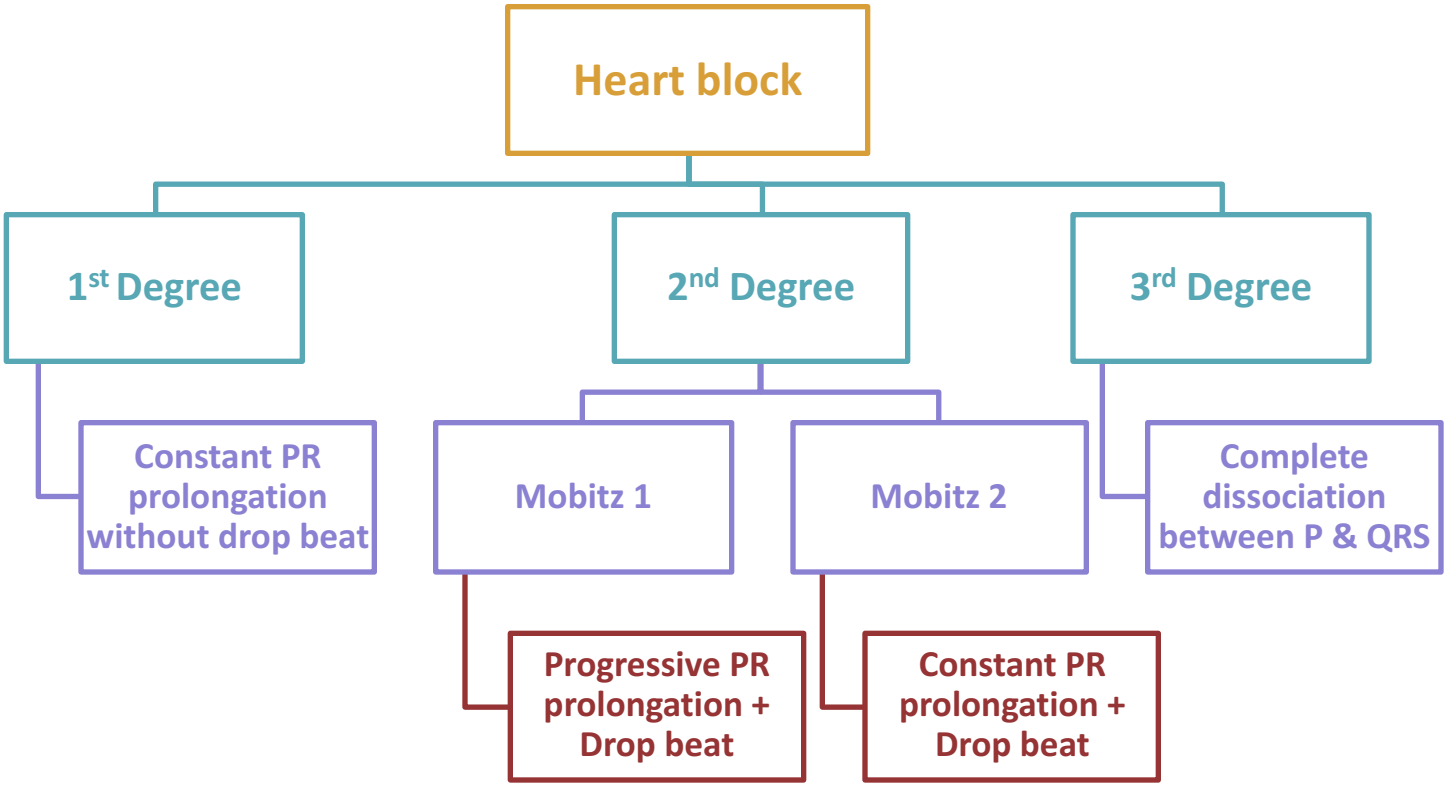
- A-V Block
  - When impulse from the S-A node is blocked
  - Causes:
    - Ischemia of the A-V node
    - Compression of the A-V node by scar formation
    - Inflammation of the A-V node
    - Strong vagal stimulation

Types of the A-V Block

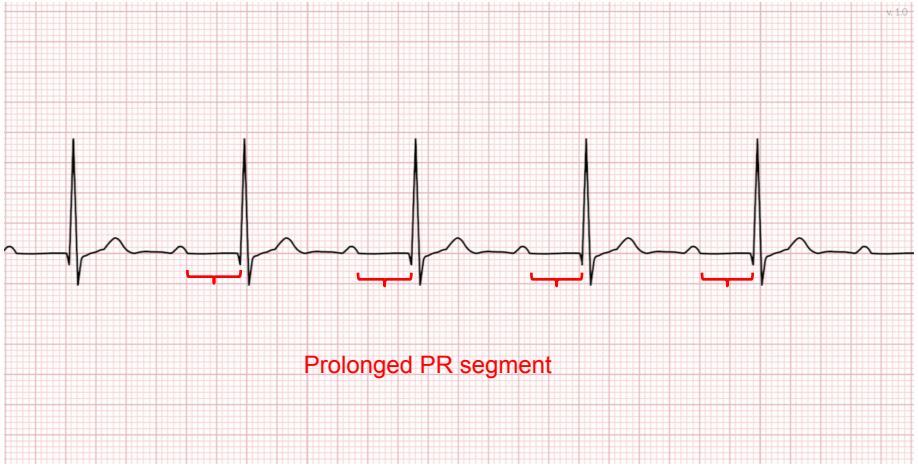
- First degree block
- Second degree block
- Third degree block



Heart Block


Heart block
1st Degree
2nd Degree
3rd Degree
Constant PR prolongation without drop beat
Mobitz 1
Mobitz 2
Complete dissociation between P & QRS
Progressive PR prolongation + Drop beat
Constant PR prolongation + Drop beat

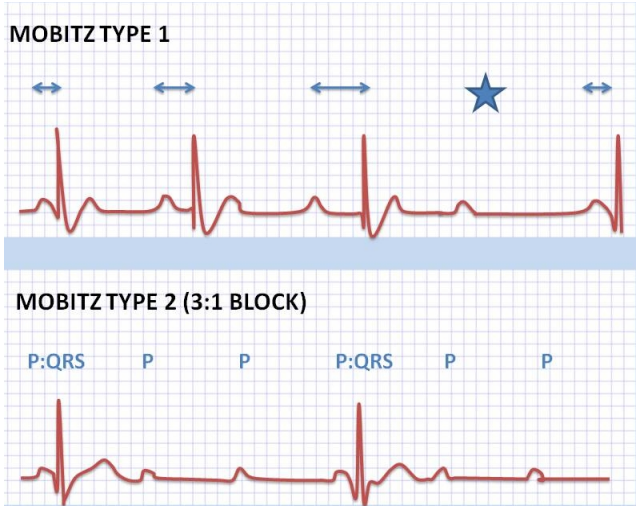
First Degree Heart Block



- Constant prolongation of P-R segment interval (more than 0.2 sec)

Second Degree Heart Block

- **P-R interval: > 0.25 second**
- Only few impulses pass to the ventricles → atria beat faster than ventricles → "dropped beat" of the ventricles
- Mobitz1 is a physiological respone "Normal"
- Also called "Decremental conduction or Wenchebach block"
- Mobitz 2 is pathologic
- Can be described as "Irregulary regular"

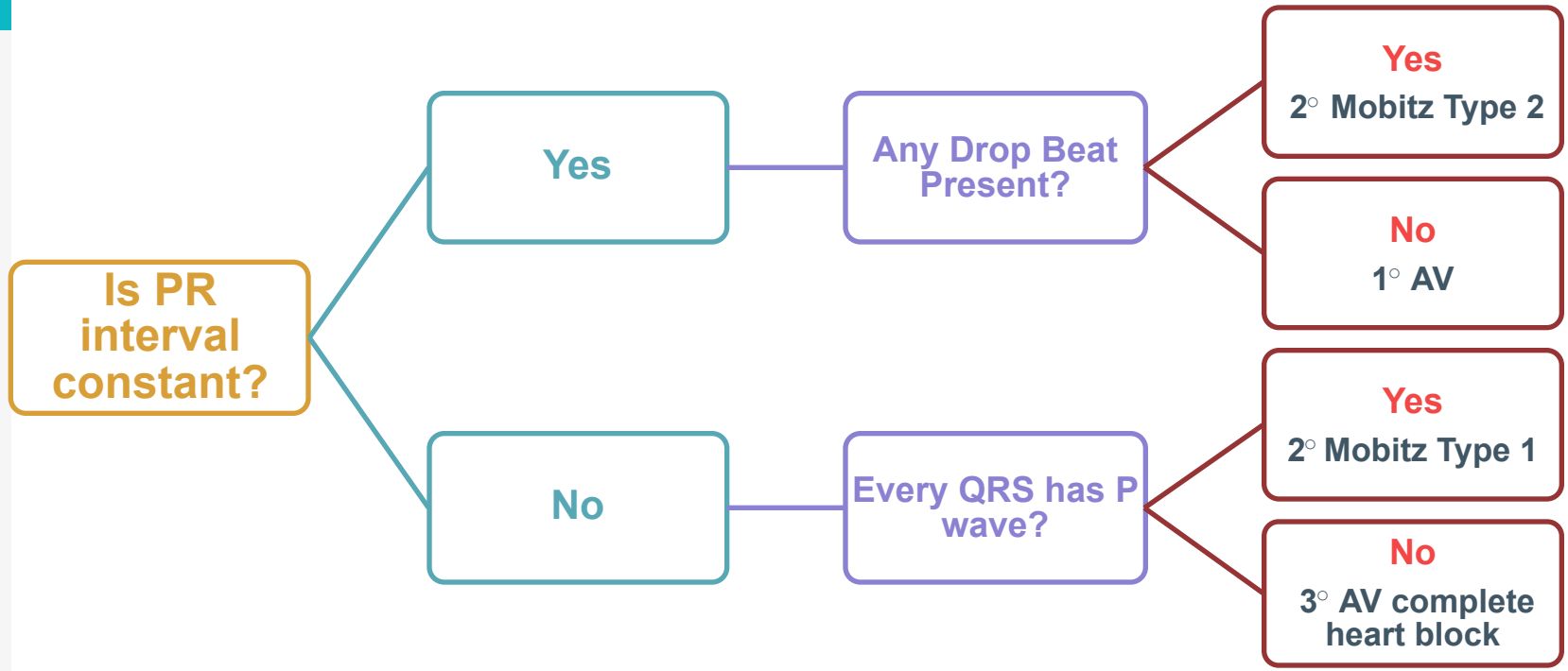


Third Degree Heart Block

- Complete dissociation of P wave and QRS waves → The 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

In Third degree heart block there is:

- Complete A.V dissociation
- Very slow HR “Bradycardia”
- Regular QRS complex


Is PR interval constant?
Yes
Any Drop Beat Present?
Yes
2° Mobitz Type 2
No
1° AV
No
Every QRS has P wave?
Yes
2° Mobitz Type 1
No
3° AV complete heart block

Premature contractions

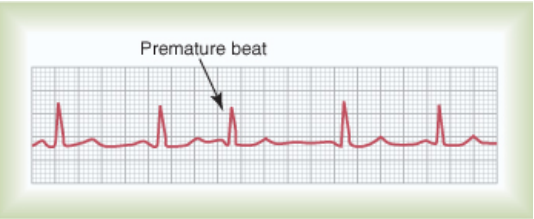
only in girl's slides

- Premature contractions, *extrasystoles, or* ectopic beat result from *ectopic foci* that generate abnormal cardiac impulses (pulse deficit)
- Causes :
  Ischemia
  Irritation of cardiac muscle by calcified foci
  Drugs like caffeine
- Ectopic foci can cause premature contractions that originate in:
  The atria
  A-V junction
  The ventricles

only in girl's slides

Premature Atrial contractions

- 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 beat is increased (*Compensatory pause*)



Premature Ventricular contractions

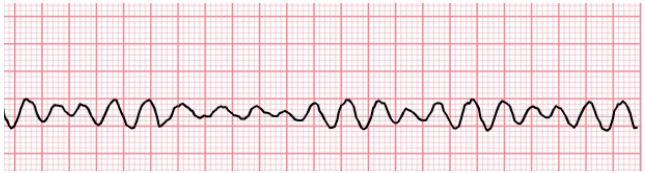
- Prolong QRS complex because the impulses are carried out with myocardial fibers with slower conduction rate than Purkinje fibers
- Increase QRS complexes voltage because QRS wave from one ventricle can not neutralize the one from the other ventricle
- After PVCs, the T wave has an electrical potential 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

Ventricular Fibrillation

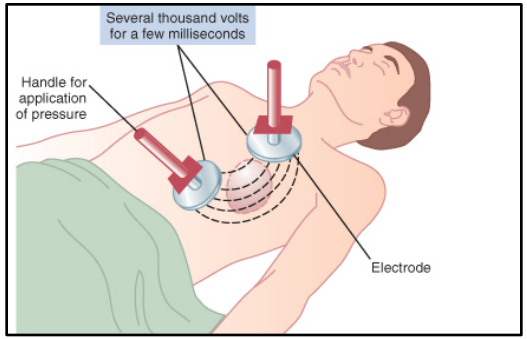
- The most serious of all arrhythmias **"Lethal"**
- **Cause:**

impulses stimulate one part of the ventricles, then another, then itself. Many part contracts at the same time while other parts relax (Circus movement)

- Tachycardia
- Irregular rhythm
- Broad QRS complex
- No P wave

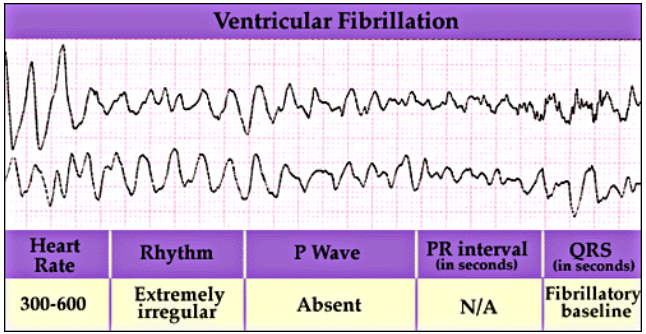


- Treatment:
  - DC shock



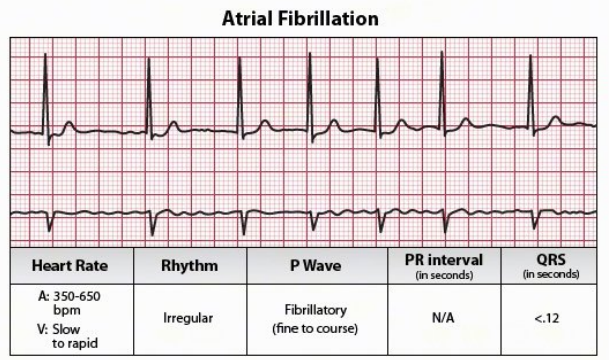
Causes:

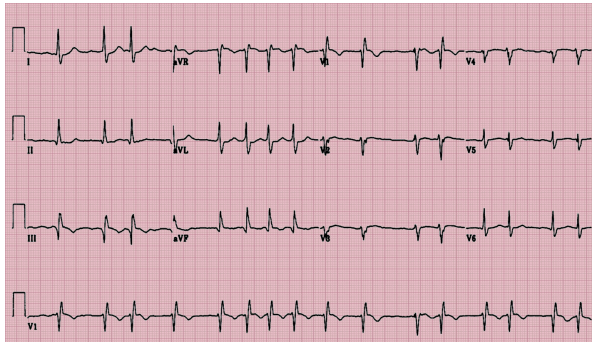
- Ischemia
- Congenital anomalies "e.g: **Channelopathy**"
- Drugs



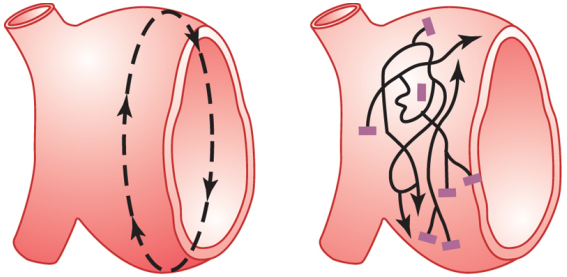
Atrial Fibrillation

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



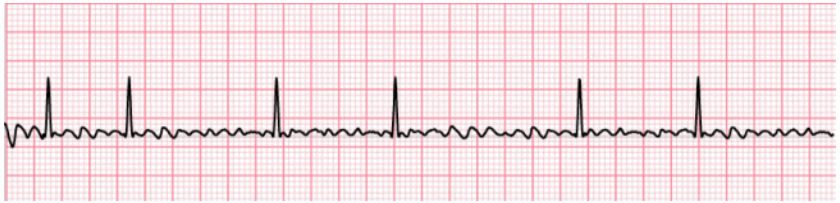


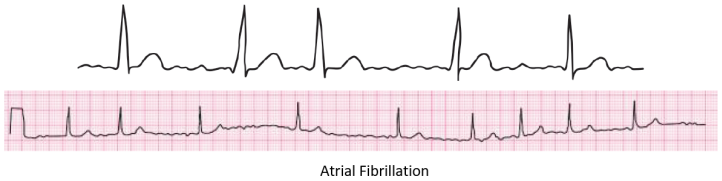
Atrial Flutter



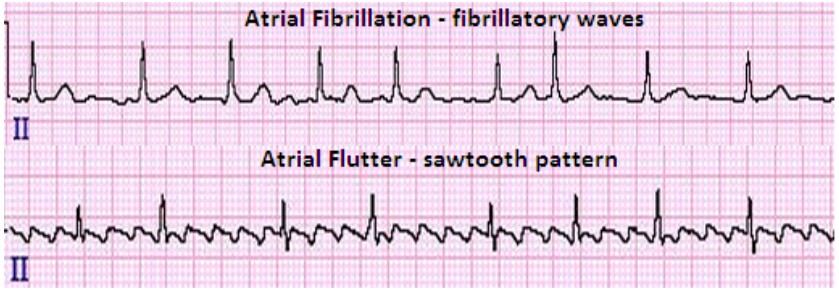
Atrial flutter | Atrial fibrillation

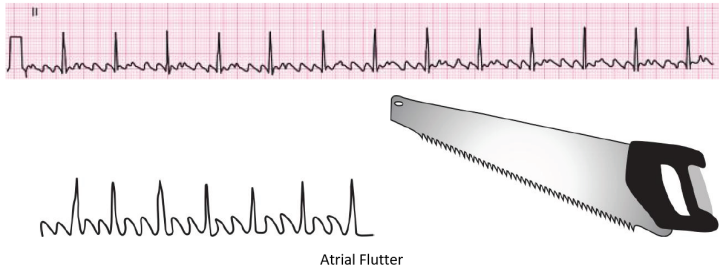
- A single large wave travels around and around in the atria
- The atria contracts at high rate (250 time per minute)
- Because one area of the atria is contracted and another one is relaxed, the amount of blood pumped by the atria is slight
- The refractory period of the AV node causes 2-3 beats of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





Atrial Fibrillation





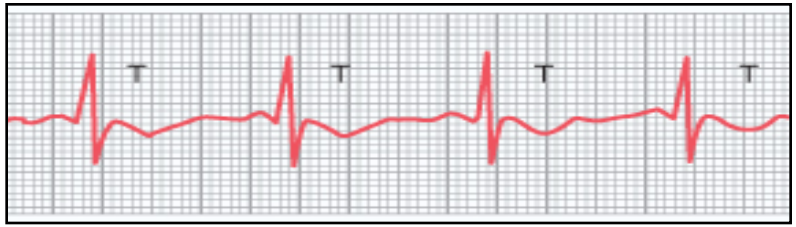
Atrial Flutter

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

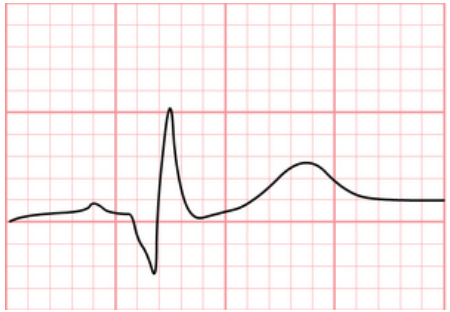
Reversible ischemia

- Inverted T wave
- ST segment depression

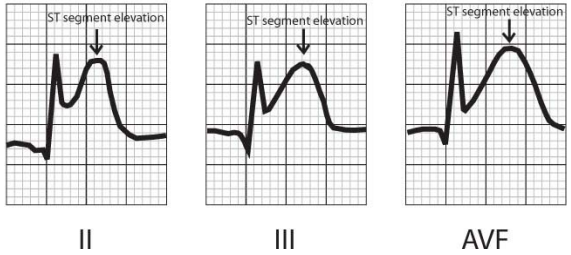


Myocardial Infarction

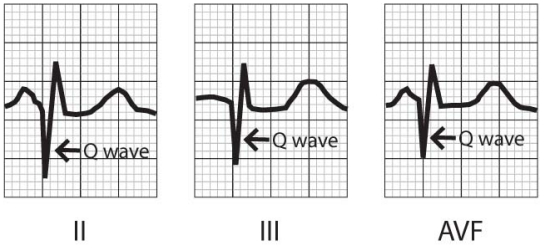
- Complete loss of blood supply to the myocardium resulting in necrosis or death of tissue
- ST segment elevation
- Deep Q wave

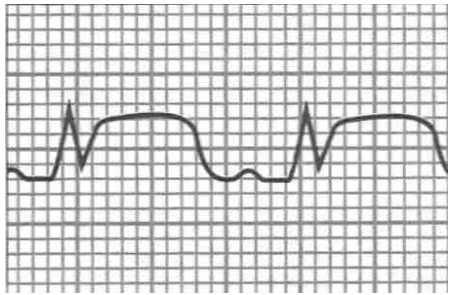


Acute Inferior Myocardial Infarction



Q waves after an Inferior MI





Infero-Posterior MI

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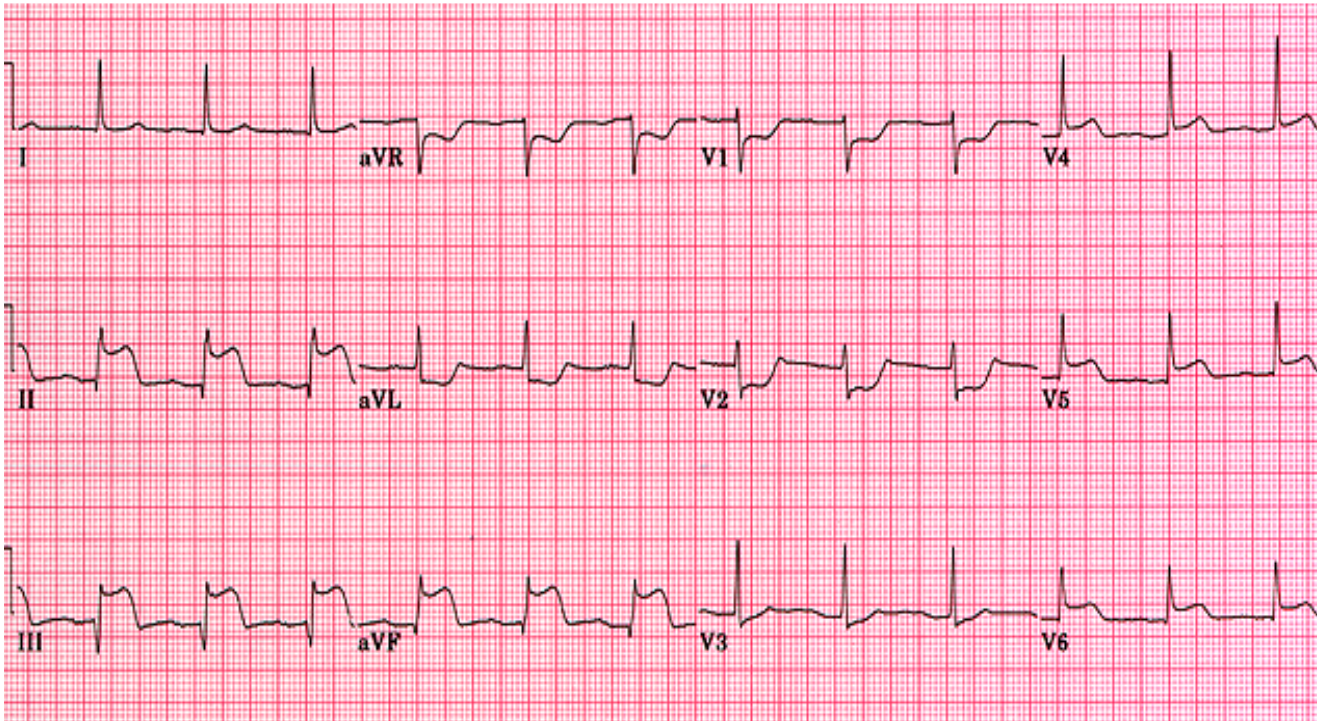

Antero-Lateral MI

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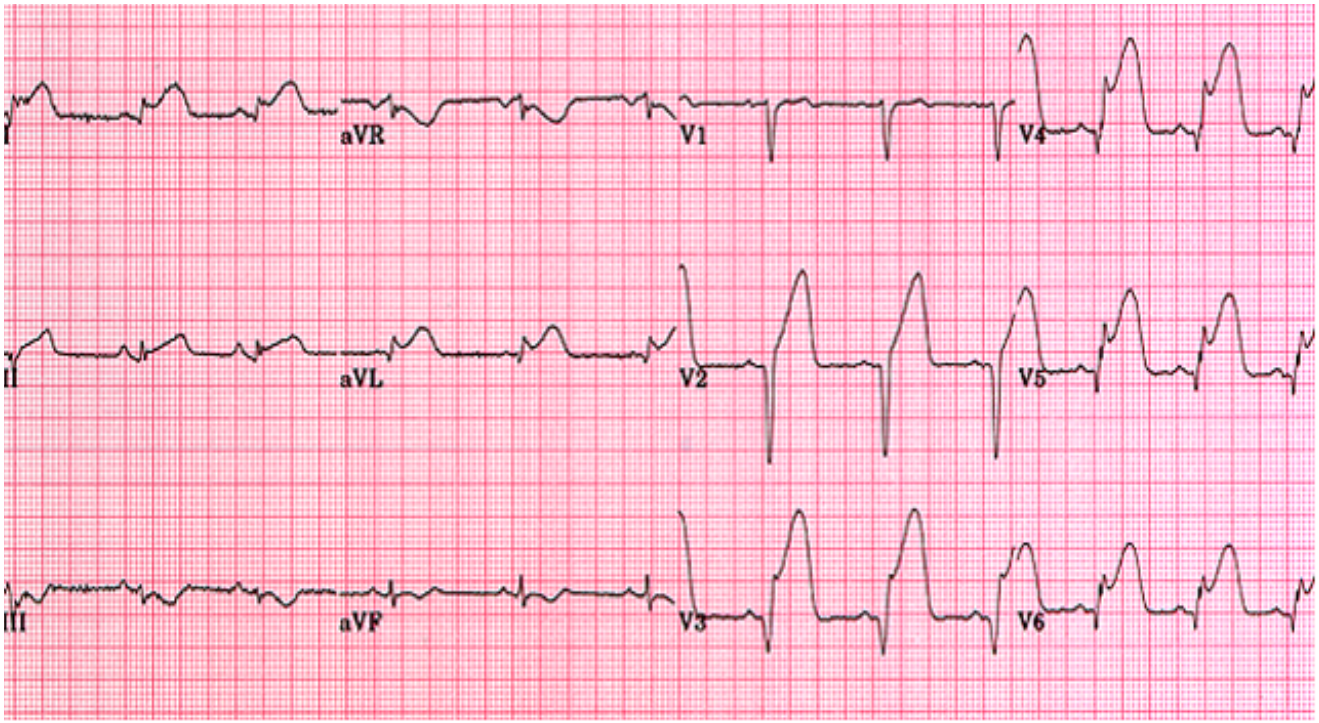

57 year-old man with chest pressure and diaphoresis

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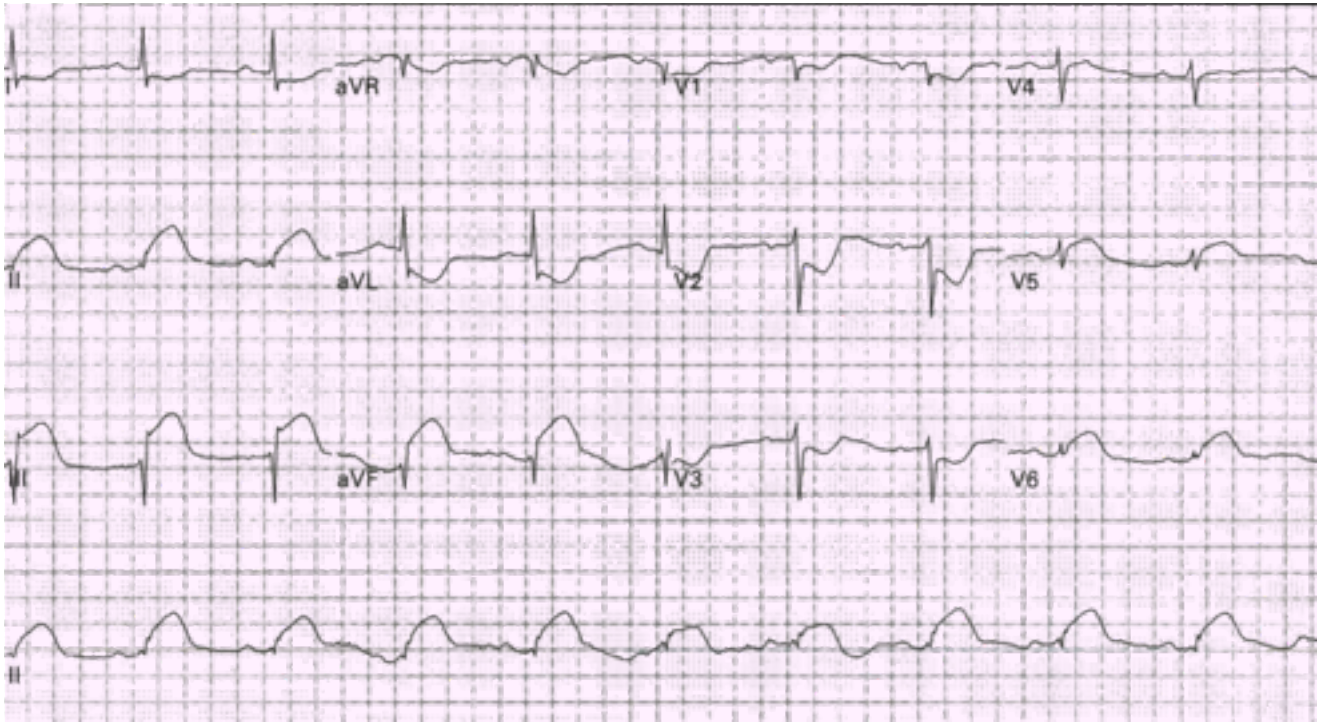
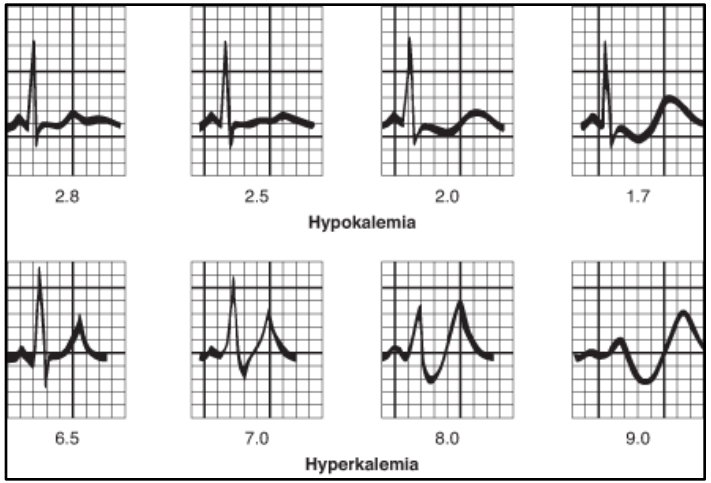
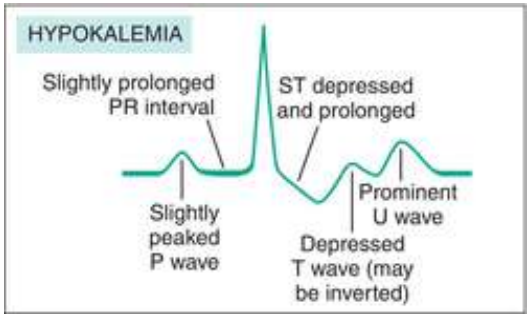


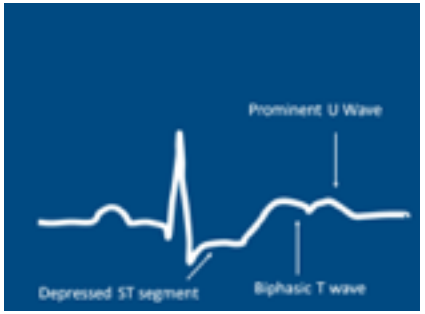
Potassium and the ECG

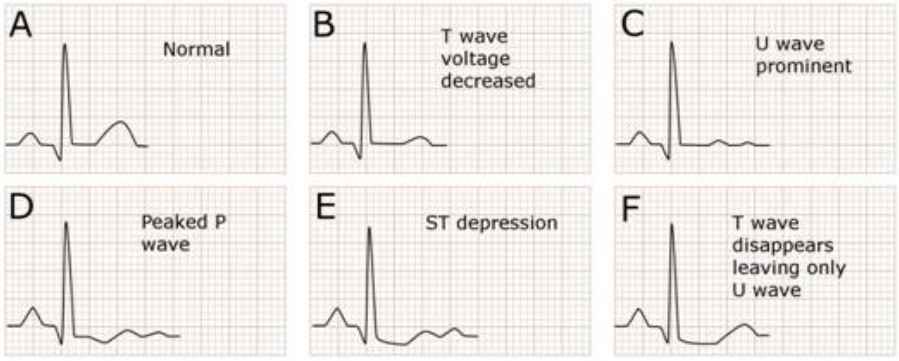
- **Hypokalemia:**
  - flat T wave
- **Hyperkalemia:**
  - Tall peaked T wave

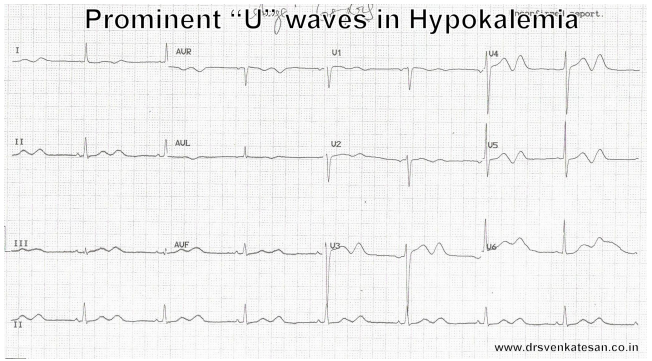


Hypokalaemia

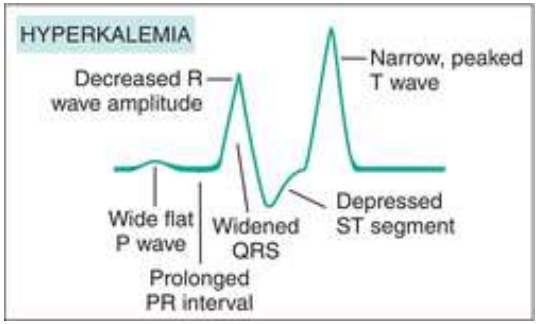


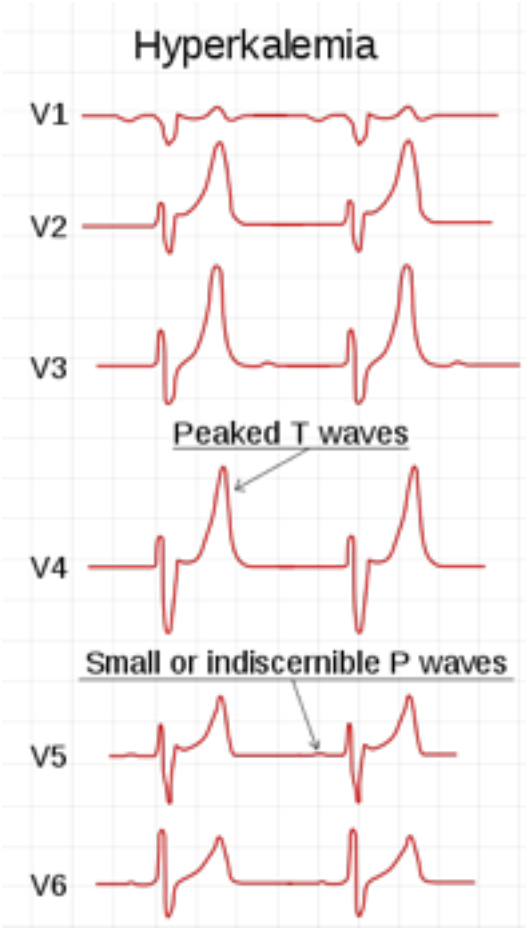




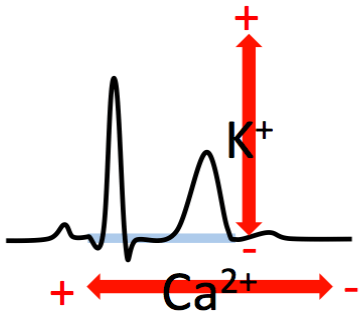


Hyperkalemia





Electrolyte effects on ECG



Quiz

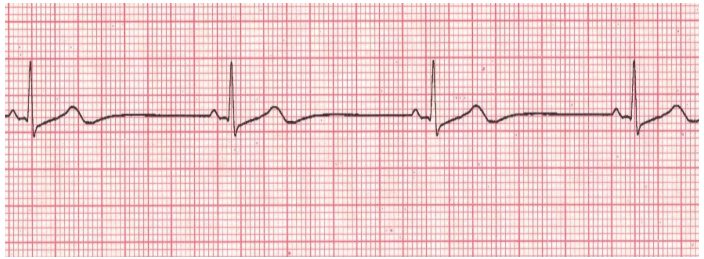
1) Identify The Tracing:

A. Premature Junctional Complex
B. Normal Sinus Rhythm
C. Pacemaker AV Sequential
D. Junctional Trigeminy
E. Pacemaker - Failure to Capture
F. Atrial Fibrillation

2) Identify The Tracing:

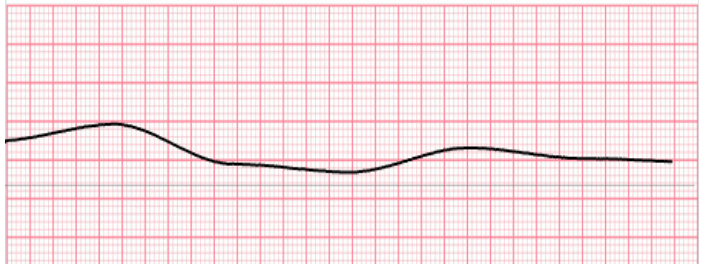
A. Pacemaker - Single Chamber - Atrial
B. ST Segment Elevation
C. Atrial Trigeminy
D. Sinus Tachycardia
E. Premature Ventricular Complex
F. Junctional Bigeminy

Ans:
1 - F
2 - B
3 - C



3) Identify The Tracing:

A. Sinus Arrhythmia
B. Sinus Tachycardia
C. Sinus Bradycardia
D. Premature Atrial Complex
E. Atrial Flutter



4) Identify The Tracing:

A. Premature Ventricular Complex
B. Bundle Branch Block
C. Normal Sinus Rhythm
D. Sinus Exit Block
E. Pacemaker - Single Chamber - Atrial
F. Asystole

5) Identify The Tracing:

A. Pacemaker - Single Chamber -Ventricular
B. Second Degree Heart Block Type II
C. Supraventricular Tachycardia
D. Premature Ventricular Complex
E. Ventricular Tachycardia Torsade de Pointes
F. Premature Atrial Complex

Ans:
4- F
5- B
6- C
7- A

6) What causes Sinus Bradycadia?

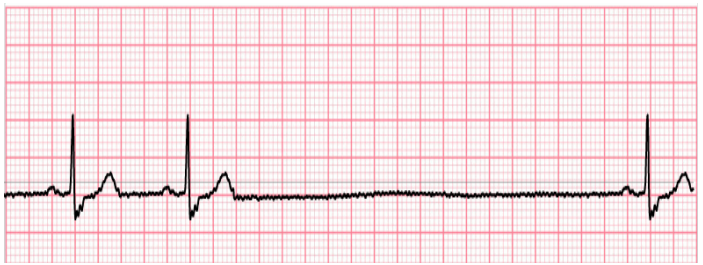
A. The blockage of electrical conduction through the antrioventricular node
B. Increase in sinoatrial node impulse rate
C. Dysfunction of the sinoatrial node
D. Both A & C are common causes
E. Both B & C are common causes

7) During atrial flutter, the atrial beats could fire as many as how many times per minute?

A. 230-350
B. 100-140
C. 100-250
D. More than 100 beats
E. less than 150 61-99

8) Identify The Tracing:

A. Ventricular Fibrillation
B. Premature Junctional Complex
C. Atrial Fibrillation
D. Second Degree Heart Block Type I
E. First Degree Heart Block
F. Ventricular Tachycardia Torsade de Pointes



9) Identify The Tracing:

A. Premature Junctional Complex
B. Pacemaker - Single Chamber - Atrial
C. Ventricular Tachycardia
D. Premature Ventricular Complex
E. Idioventricular Rhythm
F. Sinus Arrest

Ans: 8- C
9- F
10- D

10) identify the true statement(s) about Sinus tachycardia

A. It is usually a response to normal physiological situations, such as exercise and an increased sympathetic tone with increased catecholamine release—stress, fright, flight, anger.
B. P–R interval: Between 0.99–1.0 seconds and shortens with increasing heart rate
C. Beta blockers are a useful treatment option if the cause is sympathetic overactivity
D. Both A & C are true
E. It cannot be caused by an intake of stimulants such as caffeine

Thank you for checking our work

Done by:
Abdulelah Aldossari
Faisal Alsaif
Abdulaziz aldukhayel