



MED439
KING SAUD UNIVERSITY



Cardiac Science

“Arrhythmia”

Revised & Approved
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Objectives

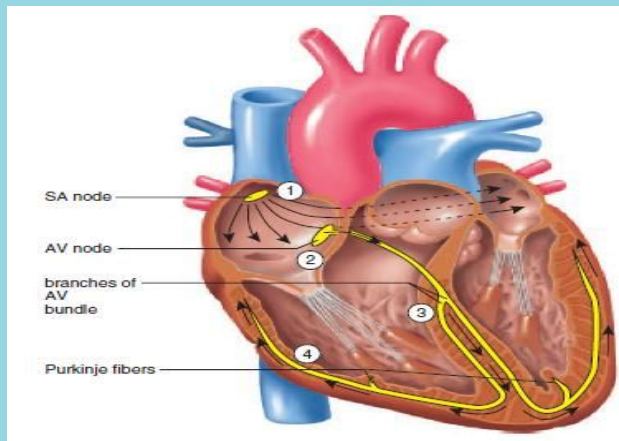
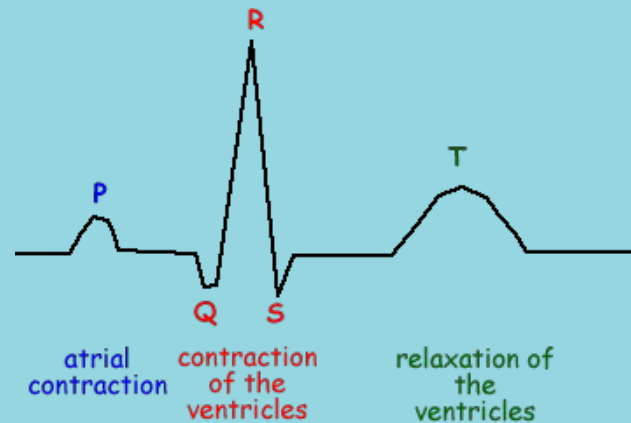
we HIGHLY recommend that you wash your hands and study the ECG lecture from our amazing physiology team

- ❑ 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

- ♥ Important
- ♥ Main Text
- ♥ Only in male slides
- ♥ Only in female slides
- ♥ Extra information
- ♥ Notes

❖ The conducting system & wave forms

| | |
|----------------------------------|--|
| SA node | <ul style="list-style-type: none">● the pacemaker of the heart● paces at 60 to 100 bpm* <small>beats per minute</small> |
| internodal & interatrial pathway | <ul style="list-style-type: none">● anterior internodal tract● middle internodal tract (wenckebach tract)● posterior internodal tract (thorel tract) |
| AV node | <ul style="list-style-type: none">● a potential pacemaker <small>work in case of failure of the SA node</small> paces at a rate of 45 to 60 bpm |
| AV bundle of his | - |
| Rt & Lt bundle | - |
| purkinje fibers | <ul style="list-style-type: none">● potential pacemaker <small>in case of sa and av node failure</small> paces at rate of 15 to 45 bpm |



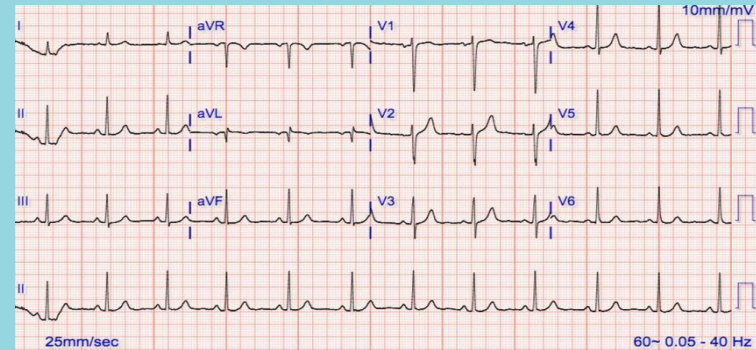


How to Measure the ECG?*

chest and limb leads

Males Slides only

| limb leads | | chest leads | |
|---------------------|----------------|---------------|---------------|
| Lead I → Lateral | aVR | V1 → Septal | V4 → Anterior |
| Lead II → Inferior | aVL → Lateral | V2 → Septal | V5 → Lateral |
| Lead III → Inferior | aVF → inferior | V3 → Anterior | V6 → Lateral |



Interpretation How to read an ECG? btw ECG and EKG

are the same but different spelling

▷ **systematic approach to read EKGs and use it every time**, first we need to check the patient name and the time ecg was taken then we check :

- the heart rate by the rule of 300
- rhythm explained in the next slide
- axis

After that we start looking for abnormalities:

- hypertrophy
- Ischemia

Determine the heart rate:

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

- HR of 60-100 is normal
- HR >100 → tachycardia
- HR <60 → bradycardia

| Number of boxes | Rate |
|-----------------|------|
| 2 | 150 |
| 3 | 100 |
| 4 | 75 |



Normal Sinus Rhythm vs. Sinus Arrhythmias

01

characteristics of Normal Sinus Rhythm:

- Regular
- **Originating from SA node**
- **Single 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



02

What is sinus Arrhythmias? A problem with the heart rate or rhythm

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

03

Causes/Mechanisms of Cardiac Arrhythmias

- Abnormal rhythmicity of the pacemaker **all the cardiac cells have the potential to produce an impulse.**
- Shift of the pacemaker from the sinus node to another place in the heart

basically one of the cells will go crazy and takeover the function of SA node

- Blocks at different points during the spread of the impulse through the heart
- **Abnormal pathways of impulse transmission through the heart**
- **Spontaneous generation of spurious impulses in almost any part of the heart**
- **Triger & Reentry**

04

Classification of Cardiac Arrhythmias

- Rate above or below normal. (Tachy vs. Brady)
- Regular or irregular rhythm. **irregularity further classified into 1- irregularly irregular. 2- irregularly regular**
- Narrow or broad QRS complex
- Relation to P wave
- **Supraventricular 99% of conditions**
- **ventricular lethal and dangerous**

Common Types Of Arrhythmia

Females Slides only

(438 team) slightly edited

| origin | SA node | Atria | AV node | Ventricles |
|--------------------|---|--|--|--|
| 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 a very tragic condition they mostly die during sleep or exercise and we only get to see the living not the dead.... cuz it happens suddenly also it runs in the family therefore we have to scan the family to prevent it from happening again• Torsades de pointes• Ventricular Fibrillation |
| 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 |



Differential Diagnosis of Tachycardia

Females Slides only

| Tachycardia | Narrow QRS Complex | Wide QRS 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 | Atrial Flutter with variable conduction Atrial Fibrillation - Multifocal Atrial Tachycardia | Atrial Fibrillation with aberrancy Atrial Fibrillation with WPW - Ventricular Tachycardia |

Tachycardia:

increase the heart rate (> 100bpm).

Causes:

- increased body temperature
- Sympathetic stimulation
- Drugs e.g. digitalis
- Inspiration



Abnormal Sinus Rhythm



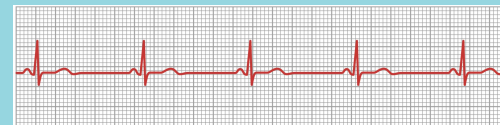
both tachy & brady
cardia are symptoms
not a pathology so we
should look for the
underlying cause

Bradycardia:

Slow the heart rate (< 60bpm)

Causes:

- Parasympathetic stimulation
- Expiration



Abnormal Cardiac Rhythms

that Result From Impulse Conduction Block **Block=Bradycardia**

Sinoatrial Block

- Blockade of the S-A node impulse before entering atrial muscle □
Cessation of P wave (No P wave)
- **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



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 (**Transient denervation to the node**)
- **Types of the A-V Block:**
 - 1st° Block
 - 2nd° Block
 - 3rd° Block
- **The Atrium is no longer communicating with the ventricle**

Abnormal Cardiac Rhythms. Cont,

Types of the A-V Block:

1st° Block

- Prolong P-R interval (0.2 seconds) *without drop beat*
- Benign, Asymptomatic
- Some drugs and old age contributes to this blockade degree



2nd° Block

- P-R interval lasts more than 0.25 second
- Only few impulses pass to the ventricles
- atria beat faster than ventricles
- “dropped beat” of the ventricles.
NO QRS-T wave
- Higher dose of drugs(β and Ca Blockers and Digoxin), Old age and Ischemia (MI) contributes to this blockade degree



Mobitz | and Mobitz || (MALES SLIDES ONLY)

•Mobitz | :

Progressive PR prolongation
+ drop beat.



•Mobitz || :

Constant PR prolongation
+ drop beat.



3rd° Block (Complete)

- Complete dissociation of P wave and QRS waves
- 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, etc...





Premature Contractions*

Females Slides only

Overview

- Premature contractions, extrasystoles, or ectopic beat result from ectopic foci that generate abnormal cardiac impulses (pulse deficit) it includes both **Bradycardia** and **Tachycardia**
- **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
 - **Benign**, it can be due to **coffee**, and **anxious** emotional situations (e.g. exams). Drugs are only given if it interferes with daily life and affect it negatively. مثل الالتماس

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 (PVCs)


- Prolong QRS complex because the impulses are carried out with myocardial fibers with slower conduction rate than Purkinje fibers. it will be wide
- 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.

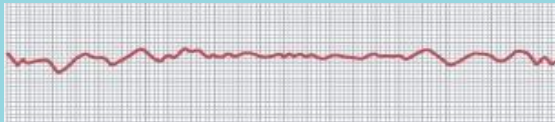




Fibrillations:

Ventricular Fibrillation

- The most serious of all arrhythmias chances of survival are 5%
- **Causes:**
 - sudden electrical shock
 - ischemia
 - Tachycardia
 - Irregular rhythm
 - Broad (wide) QRS complex , almost absent
 - No P wave
- **Due to:**
 - impulses stimulate one part of the ventricles, then another, then itself. Many part contracts at the same time while other parts relax (Circus movement)
- **Treatment:**
 - DC shock and resuscitation , CODE BLUE 



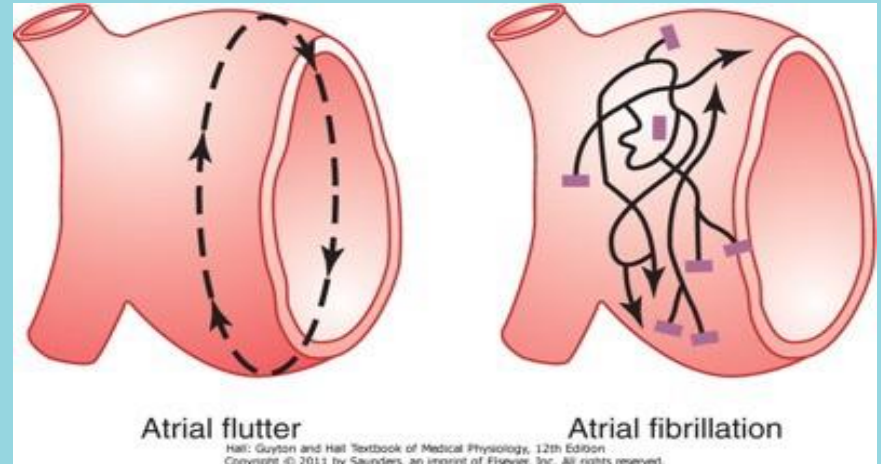
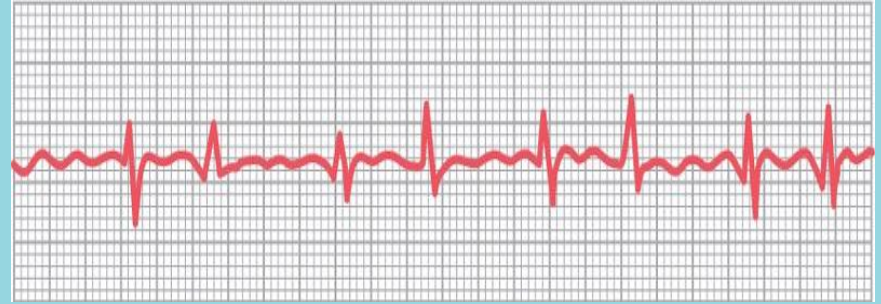
Atrial Fibrillation

- Same mechanism as ventricular fibrillation. It can occur only in atria without affecting the ventricles (SA Node dysfunction)
- It occurs more frequently in patients with enlarged heart
- The atria do not pump if they are fibrillating
- The efficiency of ventricular filling is decreased 20 to 30% (if this % is lost then it will lead to Heart failure)
- No P wave, or high frequency of low voltage P wave (Completely irregular, fast, and each Cardiac Cycle is different because each ectopic foci is working on its own)
- **Treatment:** DC shock , A person can live for years with atrial fibrillation



◆ Atrial Flutter

- □ A single large wave travels around and around in the atria □
- The atria contracts at high rate (250 beats/min) □
- 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
- More P waves, the electrical current is circulating around



❖ 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*

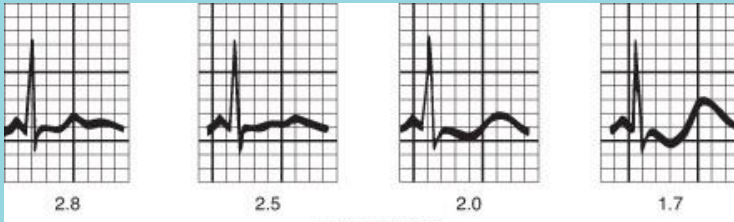
Males Slides only

- Inverted T wave
- ST segment depression

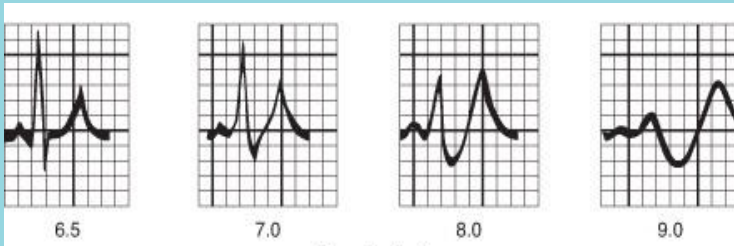


❖ Potassium and the ECG

- Hypokalemia: flat T wave

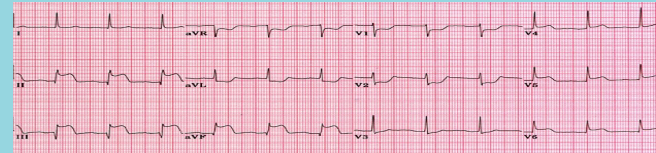


- Hyperkalemia: Tall peaked T wave

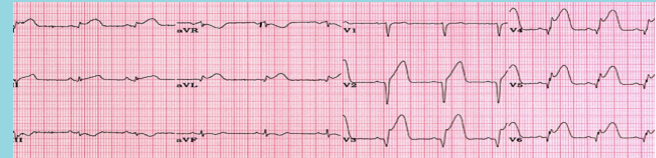


❖ Myocardial Infarction*

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



- Antero-Lateral MI



★ QUIZ:

1) Sinus tachycardia does not show which of the following ECG characteristics?

- A) upright consistent P wave
- B) Regular rhythm
- C) heart rate less than or equal 100
- D) none

2) 65 years old man went to the hospital for routine check up and had an ECG tracing, what's the most likely diagnoses :



- A) tachycardia
- B) bradycardia
- C) normal rhythm
- D) I dont know

3) 35year old male arrives in the emergency department complaining of dizziness, shortness of breath and chest pain. He was given a chewable aspirin, and a blood sample was drawn. His ECG Lead II is shown below. What is his approximate heart rate?



- A) 100
- B) 90
- C) 60
- D) 50

4) 50-year-old man has a blood pressure of 140/85. He reports that he is not feeling well, his ECG has no P waves, he has a heart rate of 46 beats/min, and the QRS complexes occur regularly. What is his likely condition? (From Med438)

- A) First-degree heart block
- B) Second-degree heart block
- C) Third-degree heart block
- D) Sinoatrial heart block

5) which one is the most serious arrhythmia ?
(From Med438)

- A) Ventricular fibrillation
- B) Atrial flutter
- C) Sinus Tachycardia
- D) Atrial Fibrillation

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

- A) 250
- B) 150
- C) 40
- D) 100

Answer: 1.C 2.C 3.D 4.D 5.A 6.A

Good Luck!

Done by:

Shayma Alghanoum & Faisal Alotaibi



Special Thanks to:

Samar Al Mohammedi

Sarah Alobaid

Shaden Alobaid



Check these amazing notes
from Shaden Alobaid
for further understanding

