Physiology Team 431

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Cardiovascular System Block
Cardiac Arrhythmias
(Physiology)

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NOTES WERE ADDED AFTER EACH SLIDE !!

(MALE NOTE) IN GREEN COLOR

Lecture Objectives

- 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

The ECG and the rhythm disturbances

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

Notes about the previous slide :

When the DR starts to read the ECG, he/she should look at these points..

- Heart Rate : Whether it's increased or decreased. (Normal at resting : 6o beats per min.)

- Rhythm :

- Regular:-

- **R-R intervals should repeat with the same distance.**
- **The width of the QRS complex should be within the normal range. (the QRS complex shouldn't be narrowed or broaden)**
- **A single p wave precedes every QRS complex.**
- **The T wave should be normal and present.**

Then, the DR. can determine whether the ECG was normal or abnormal.

Questions can be asked: Is the R-R (or P-P) interval in the normal sinus rhythm constant, increasing, decreasing ,changeable ..??

*** Normal sinus rhythm in the heart !!**

Causes of Cardiac Arrhythmias

- Rate above or below normal
- Regular or irregular rhythm
- Narrow or broad QRS complex
- Relation to P waves

Notes about the previous slide :

- ARRHYTMIAS are abnormal rhythms in the heart !

Below are the causes of arrhythmias:

Abnormal heart rates ⇧ or ⇩

Irregular Rhythms.

QRS complex isn't normal.

Relations to p wave (If it's not present like in some diseases, or a prolonged P-R interval..)

*** The Dr. mentioned that the previous slide is just to show the points of the lecture !!**

Abnormal Sinus Rhythm

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

Notes about the previous slide :

An increase in the heart rate (Tachycardia) can cause an arrhythmia ..

- Normal heart rate: 60-80 beats per min.
- Heart Rate In Tachycardia : 80 <

*Here the heart rate increases but with a normal rhythm, it happens physiologically in any childe or any adult, it's caused by doing an effort or when there is a sympathetic stimulation; ex: you have an exam or a presentation to do, fever, inspiration and drugs also can cause tachycardia..

*ECG will show that the R-R intervals are close to each other, because of the increased heart rate, but every thing else is normal.

* Tachycardia isn't considered a disease but if the patient is having a tachycardia at rest .. this could be considered a sign of a disease like hyperthyroidism.

Abnormal Sinus Rhythm

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

Notes about the previous slide :

- Bradycardia is an abnormal sinus rhythm like tachycardia, everything will be normal except the heart rate.

* R-R intervals will be prolonged because of the slow heart rate.

Questions can be asked: During bradycardia R-R interval is

- **Prolonged**
- **Decreased**
- **QRS complex is prolonged …**

- **Questions can be asked: An ECG of a patient showed a prolongerd R-R interval with a normal rhythm what most likely to be the cause ??**

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

Notes about the previous slide :

- When an A-V block occurs impulses can't reach the A-V node from the S-A node.

- Causes:

1- Ischemia of the aria in-between the nodes (we know that the heart is supplied by the coronaries .. when they are blocked because of a certain reason the blood supply to the heart will be decreased, so the aria between the SA node and the AV node will be effected for that cells of that aria will not function well and impulses can't be conducted).

2- scar formation(fibrous tissue) because of a previous disease or an injury.

3- inflammation in the aria.

4- strong vagal stimulation (The Parasympathetic system mainly supplies the SA node, if there was a strong stimulation; this will lead to a complete blockage of the impulse).

Types of the A-V Block

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

Notes about the previous slide :

- A-V block occurs alot even in healthy individuals.

- The degree of the A-V block depends on the severity of it.

Types of the A-V Block

- **First degree block**
  - **Prolong P-R interval (0.2 seconds)**

Notes about the previous slide :

- The time needed for the contraction to pass from the atria to the ventricle is represented as the P-R interval.
- Since there is an A-V blockage .. the impulses will take a longer time to reach the A-V node.
- In this case [A first degree block]: you will find the P-R interval longer than normal, (normal is 0.16 sec.) but everything else in the ECG is normal including the rhythm.

- **Questions can be asked: A 40 year old man was presented in the ER with a palpitation, In Examination everything was normal except a prolonged P-R interval (or she can mention it was 0.2 sec.) what is the most likely diagnosis??**

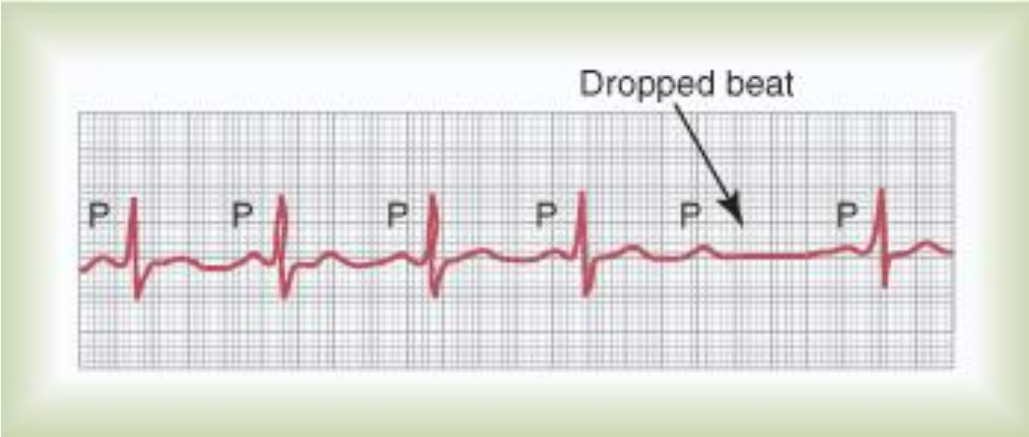
Types of the A-V block

Second Degree Block

- P-R interval > 0.25 second
- Only few impulses pass to the ventricles

  → atria beat faster than ventricles

  →"dropped beat" of the ventricles



Notes about the previous slide :

- P-R interval is prolonged (more than in the first degree block). > 0.25 sec. [A second degree block]

Impulses will take longer time to pass from atria to ventricles .. After a period the impulses won't pass because of this abnormal situation (This what we call a dropped beat).

Atria will beat faster than ventricles (Atria beating is normal) , while ventricles will beat slower because impulses will take much longer time to reach them and because of the dropped beats.

Types of the A-V block

Third degree block (complete)

- Complete dissociation of P wave and QRS waves

→The ventricle escape from the influence of S-A node

- *Stokes-Adams Syndrome*: AV block comes and goes

Notes about the previous slide :

[A third degree block] when the impulses can't pass from the SA node to the AV node completely.

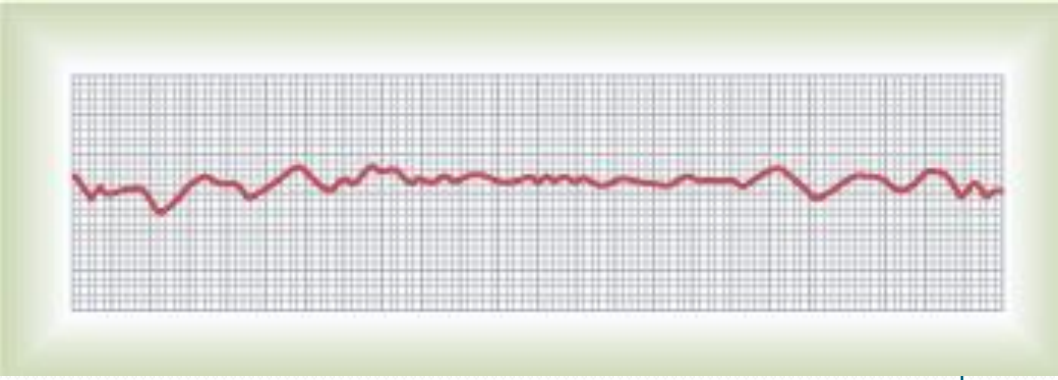
There is a complete dissociation of P waves and QRS waves. (each one works separately).

This case is an example of an ectopic peace maker, impulses will develop in other parts in the heart with a new rate (complete dissociation).

On and off AV block of the heart is a feature of Strokes-Adams syndrome.

Ventricular Fibrillation

- The most serious of all arhythmias
- 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*



Notes about the previous slide :

Ventricular Fibrillation is a serious arrhythmia (ER case) should be treated on spot . (it's considered lethal)

- Cause :

Abnormal ventricle (mycoytes "cells" of the ventricle will begin stimulation and then start to stimulate each other, they go in a circus movement).

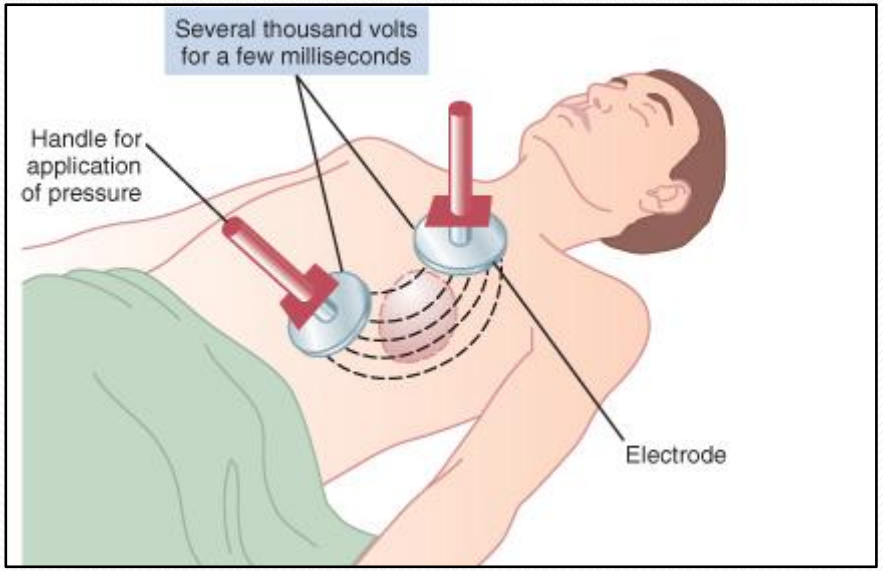
- Complications (features in the ECG): increased heart rate (tachycardia), very broad QRS complex, No P wave "complete dissociation"

Patients are treated with a DC shock (it will stop the circus movement).

Questions can be asked: About the treatment of the ventricular fibrillation ???

Ventricular Fibrillation

- *Treatment : DC shock*



Atrial Fibrillation

- 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

Notes about the previous slide :

Atrial Fibrillation isn't considered an emergency !!

Cause : same as what happens in the ventricle but instead it will occur in the atria.

It occurs more frequently in patients with *enlarged heart "Dilated cardiomyopathy " (imp. point)*.

The disease will effect both the atria and ventricles. (ventricle function is decreased).

You can live with an atrial fibrillation.

Atrial Flutter

- A single large wave travels around and around in the atria
- The atria contracts at high rate (250 time per minute)

Notes about the previous slide :

- Atrial Flutter (contraction of atria at a very high rate) exceeding 250 per min.

Ischemia and the ECG

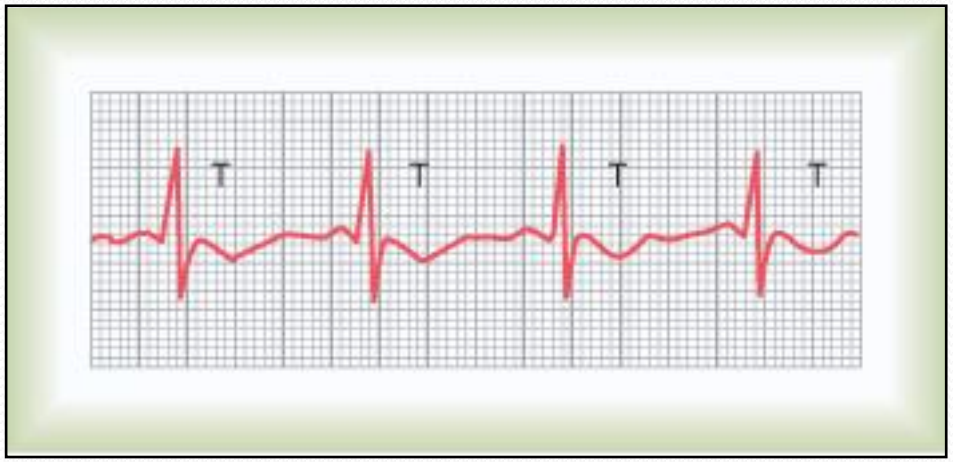
- One of the common uses of the ECG is in acute assessment of chest pain
- Cause: restriction of blood flow to the myocardium, either:
  - Reversible: angina pectoris
  - Irreversible: myocardial infarction
- ***Ischemia → injury → infarction***

Notes about the previous slide :

- Ischemia is the most important one.
- Ischemia : Low O_2 supply (low perfusion) to the myocardium. (blockage of coronaries it could be reversible or permanent).
- Ischemia is associated with a very serious chest pain.
- Chest pain is one of the most common causes to use ECG.
- Ischemia is one of the common diseases in KSA and in all around the world.
- Ischemia is one of the most common causes of death in KSA.

Reversible ischemia

- *Inverted T wave*
- *ST segment depression*



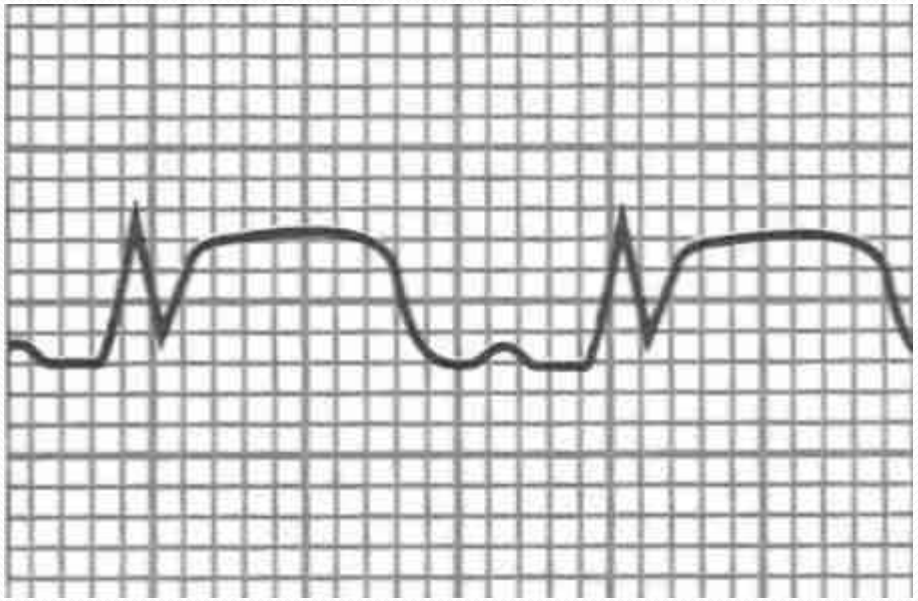
Notes about the previous slide :

The ECG in a case of angina (imp.):

- Inverted T wave (it becomes upside-down).
- ST segment depression [QRST is usually on the isoelectric line “zero”, but here it becomes less (on lines below zero)].

Myocardial Infarction

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



Notes about the previous slide :

The ECG in a case of a myocardial infarction :

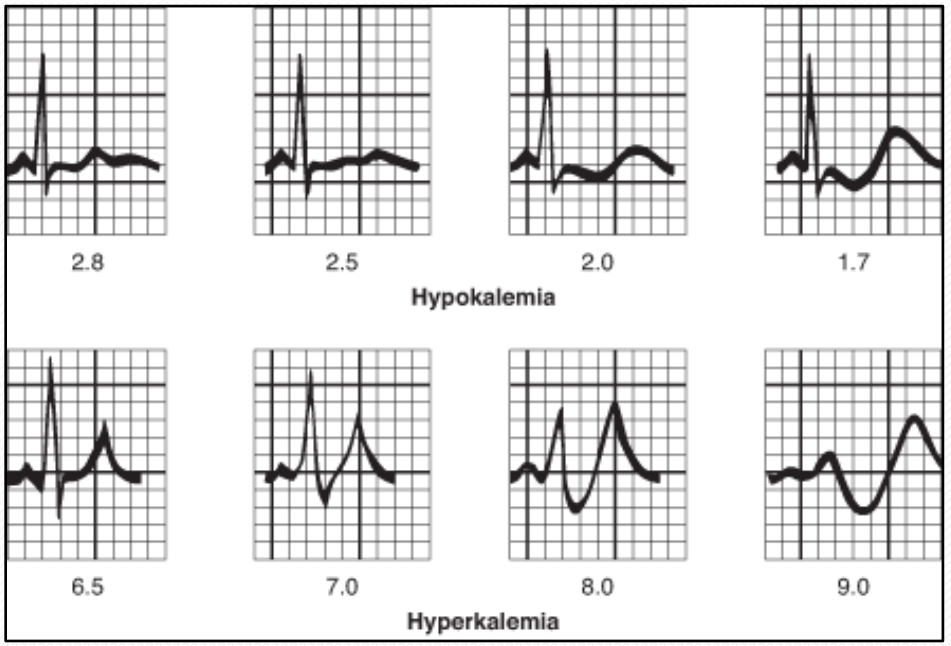
- ST segment elevation (becomes pointed upwards “lines above zero”).

- Deep Q wave.

*You can see one of the features or both of them.

Potassium and the ECG

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

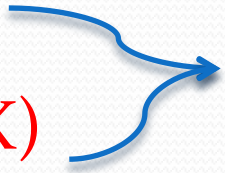


Notes about the previous slide :

Ionic changes in our bodies will effect the ECG; like a change in the potassium will effect our hearts.

-Hypokalemia (low k)

- Hyperkalemia (high K)



Both treated on spot !!

MALE NOTES

Arrhythmia : absence of rhythm
Arrhythmia : is change in rate or change in rhythm

each heart beat comes equal interval origin from S.A node

rhythm: relation between heart beat, which are equal in distance

heart rate : 70 – 90 \ min

heart rate = pulse rate arise from S.A node

sinus rhythm : heart beat start from S.A node

Sinus arrhythmia : is regular and absence of rhythm and heart rate is less than 70

Arrhrythmia always abnormal except sinus arrhythmia

causes of arrhythmia :
1- change of heart rate
2- conductive blocked
3- re-entry mechanism → impulse re-enter again and again

sinus tachycardia above 100 beat \min
sinus bradycardia below 60 beat\min

arrhythmia : relation between heart rate and respiration seen in young people because ANS, we you inspire heart rate increase , and when expire heart rate decrease

1 heart beat = 1 depolarization from S.A node

Two sources of heart beat :
1- S.A node .
2- atrial extrasystol .

If there is ventrical extrasystol in ventricle you will see big QRS complex and unable to identify P wave

If hundreds foci generate impulse at the same time, it cause fibrillation, and the atrium will not work fully, this is called atrial fibrillation. In ECG you see fibrillary wave (F wave), and P wave is removed

Atrial flutter : there is no QRS complex after first P wave, and QRS complex may be seen after second or third P wave

Questions:

- A 40 years old patient presented to the emergency department with palpitation. On examination everything was normal except P-R interval was prolonged (or may be they will give figure showing prolonged P-R interval) ..
- What is the most likely diagnosis?
- A) Tachycardia .
- B) Bradycardia .
- C) 1st degree block.
- D) 2nd degree block.

- Which one of these diseases shows inverted T wave?
- A) Atrial flutter.
- B) Myocardial infarction.
- C) Angina pectoris.
- D) 3rd degree block.