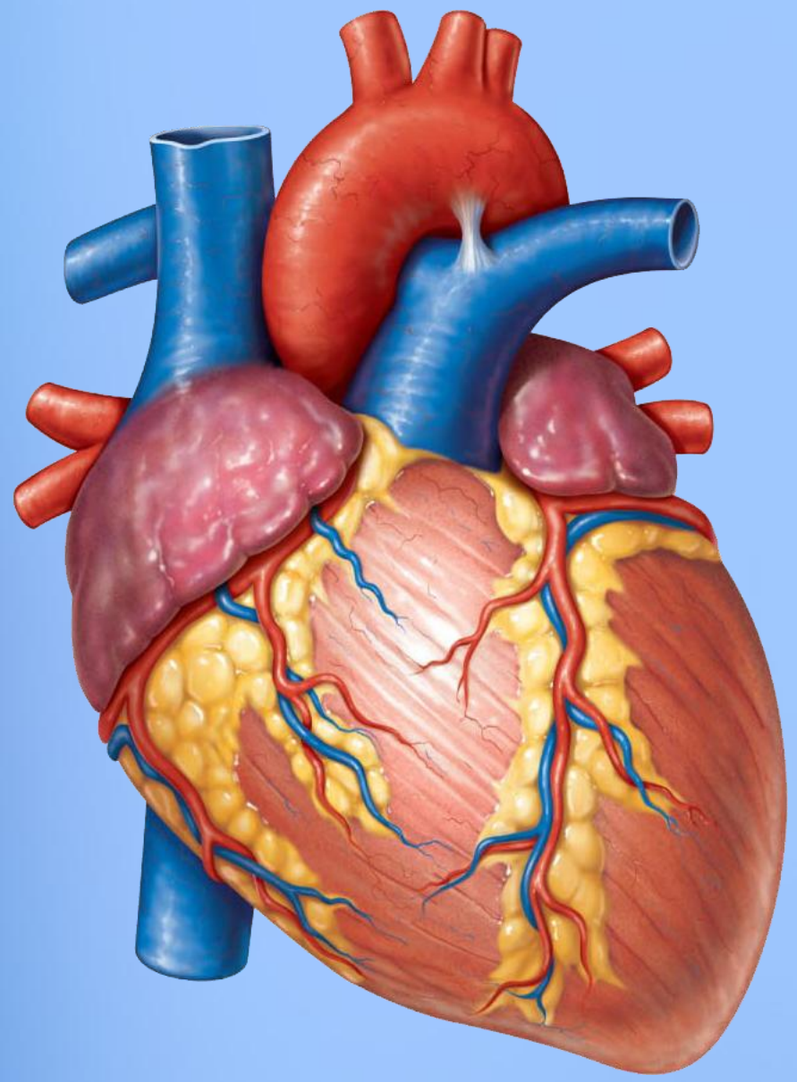
PHYSIOLOGY PRACTICAL REVISION



Cardiovascular Block

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1

HEART SOUNDS

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1-Stethoscope:

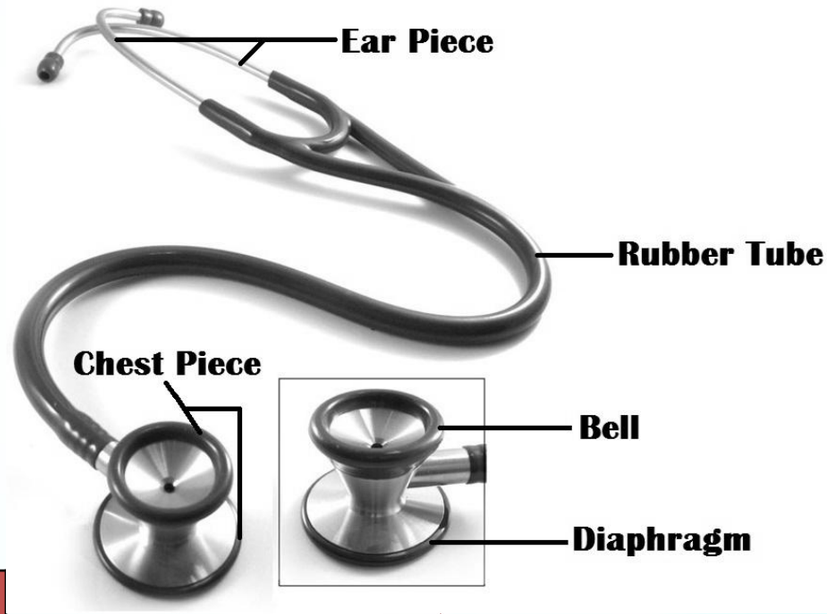
Stethoscope composed of :

1- Ear piece

2- Rubber tubing.

3- Chest piece (consists of diaphragm & bell).

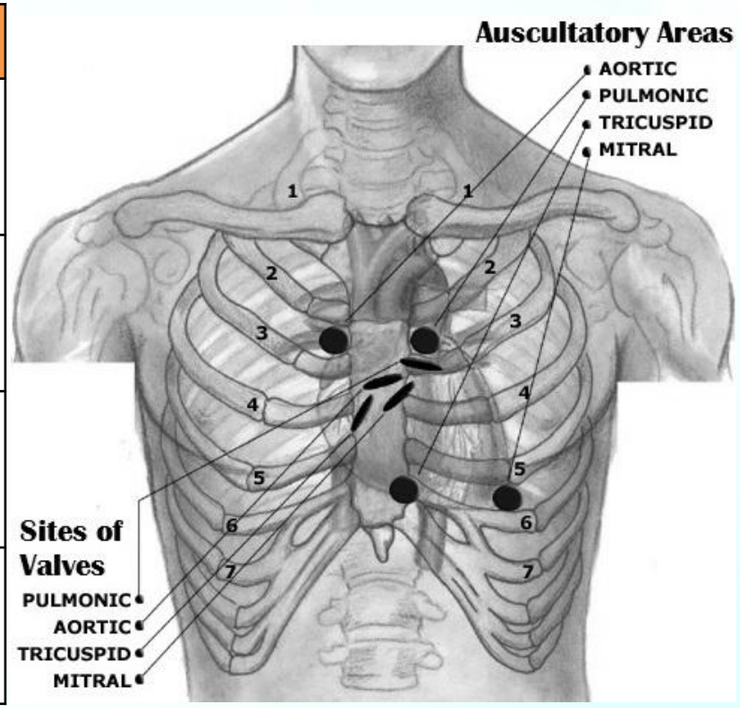
	BELL	DIAPHRAGM
Used for	murmurs	1st , 2nd heart sounds



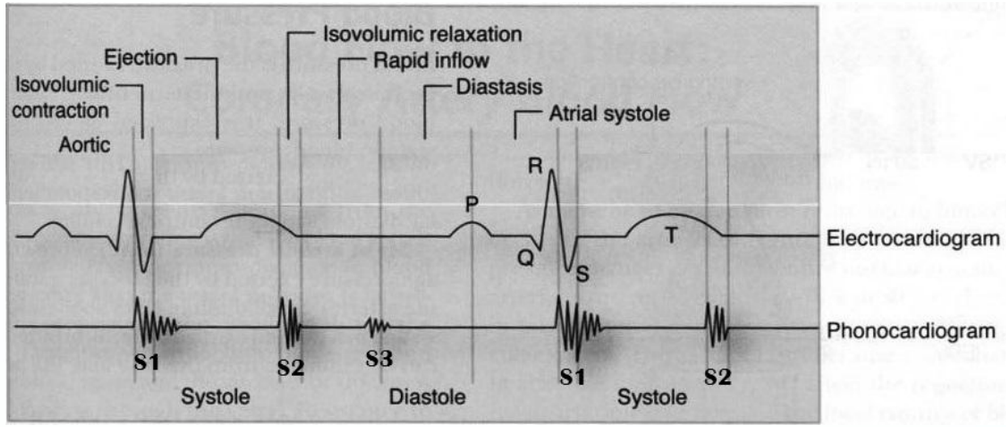
(memorize parts in the picture)

2-Ausculation:

AREA	SITE
The mitral area	left 5thintercostal space medial to the mid-clavicular line. **(Site of apex beat)** **Apex beat: outer most and lower most palpations**
The tricuspid area	the left of the lower border of the sternum.
The pulmonary area	left 2nd intercostal space at the sternal border.
The aortic area	right 2nd intercostal space at the sternal border.



3-HEART SOUNDS USING PHONOCARDIOGRAPHY:



Sound	Features
First heart sound "S1"	• It is always normal. It sounds as "lub". • It is caused by <u>the closure of AV valves</u>. **"the beginning of systole"** • It is best heard when auscultated at **mitral and tricuspid areas.** • It occurs **just after QRS complex** if we relate it to ECG.
Second heart sound "S2"	• It is always normal. It sounds as "dub". • It is caused by <u>the closure of semi-lunar valves.</u> **"the beginning of diastole"** • It is best heard when auscultated at **aortic and pulmonary areas.** • It occurs **just after T wave** if we relate it to ECG.
Third heart sound "S3"	It may be heard normally in **children, thin adults, and pregnant women or after exercise**.
Fourth heart sound "S4"	It may be heard normally in **older people**

4-PHYSIOLOGICAL SPLITTING OF THE SECOND HEART SOUND

<u>Second heart sound</u> splitting is a **normal** physiological that may occur **during deep inspiration.**

2

THE ELECTROCARDIOGRAPHY (ECG)

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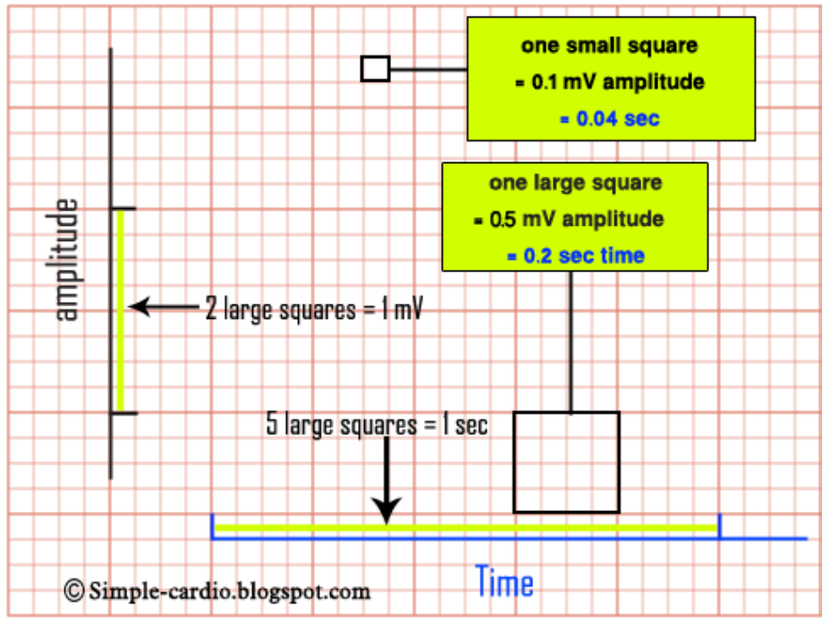
1-ECG Paper :

	Horizontal line
Represent	**Time (Seconds)**
One Square (1 mm)	**0.04 sec**



2-ECG Leads:

Definition: a pair of electrodes joined together to record the potential difference between the two electrodes.

How many leads? 12 standard leads to record ECG.

What is the different between bipolar and unipolar? A bipolar lead records the potential difference between two active electrodes and a unipolar lead records the potential of one active electrode

Type of Lead	Limb Leads	Precordial or Chest Leads
Bipolar	I, II, III (standard limb leads)	-
Unipolar	aVR, aVL, aVF (augmented limb leads)	V_1-V_6

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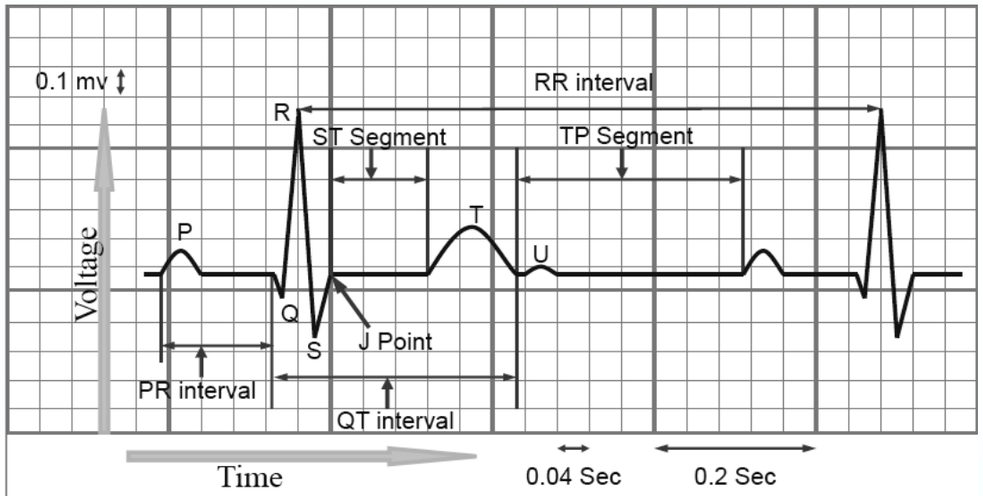
3-WAVES & INTERVALS OF ECG AND THEIR CALCULATIONS:



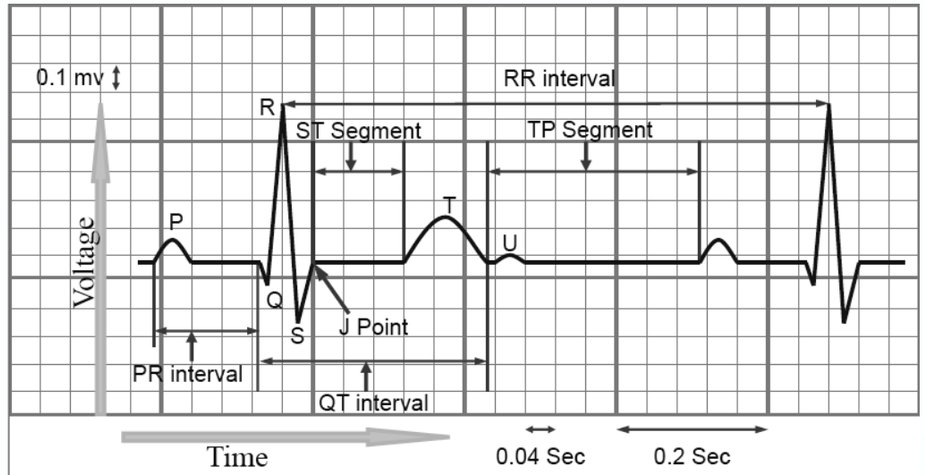
- PR interval 0.12 – 0.20 sec
- QRS duration 0.08 – 0.10 sec

- QT interval 0.4 – 0.43 sec
- RR interval 0.6 – 1.0 sec

Waves	
P wave	represents **atrial depolarization.**
QRS complex	represents **ventricular depolarization.**
T wave	represents **ventricular repolarization.**
U wave	is sometimes present due to **repolarization of hypertrophied papillary muscles.(physiological) and due to hypokalemia (pathological)**

Intervals			
Name of interval	**What the interval represent?**	**Normal range**	**Disease related to intervals**
PR interval	**from the "beginning of p-wave to the beginning of Q-wave" (R-wave in case if Q-wave is absent).**	**0.12 – 0.21 seconds**	**Prolonged PR interval more than 0.2 may be sign of first degree heart block.**
QRS duration	**from the beginning of Q-wave to the end of S-wave**	**0.08 – 0.1 seconds**	
QT interval	**from the beginning of Q-wave to the end of T-wave.**	**0.4 – 0.44 seconds**	**QT interval is short = hypercalcaemia. Prolong the QT interval = hypocalcaemia**
ST interval	**from the end of S-wave to the end of T-wave.**	**0.28 – 0.36 seconds**	

How can you calculate intervals from ECG papers ? (Explaining only)



•	PR interval	0.12 – 0.20 sec	
•	QRS duration	0.08 – 0.10 sec	

•	QT interval	0.4 – 0.43 sec	
•	RR interval	0.6 – 1.0 sec	

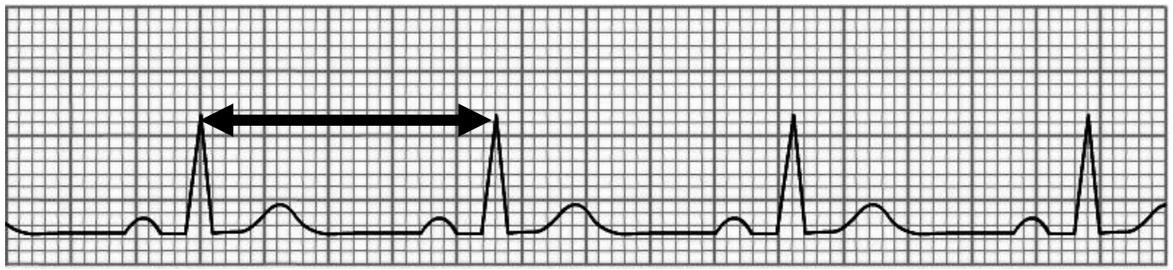
In order to calculate various intervals in an ECG recording, we have to always keep in mind that the small square in an ECG paper = **0.04 seconds** and then multiply it by the **number of small squares** in an interval to get its value.

- **PR interval**: In the above example, the number of small squares in the PR interval is approx. = 3, so the value of PR interval = 3 x 0.04 = 0.12 seconds.
- **QRS duration**: In the above example, the number of small squares in the QRS duration = 2, so the value of QRS duration = 2 x 0.04 = 0.08 seconds.
- **QT interval**: In the above example, the number of small squares in the QT interval = 8, so the value of QT interval = 8 x 0.04 = 0.32 seconds.
- **ST interval**: In the above example, the number of small squares in the ST interval = 6, so the value of ST interval = 6 x 0.04 = 0.24 seconds.

4- CALCULATION OF HEART RATE:

We can calculate the heart rate from the ECG by using the following formula:

$$Heart\ Rate = \frac{1500}{Number\ of\ small\ squares\ between\ R-R}$$



In the above ECG tracing, the arrow is indicating the R-R interval and if we count the number of small squares between R-R, they are 23. So if we fit this number in the above given formula for the heart rate calculation, the heart rate will be calculated as **1500/23 = 65 beats / minute.**
(don't forget the unit)

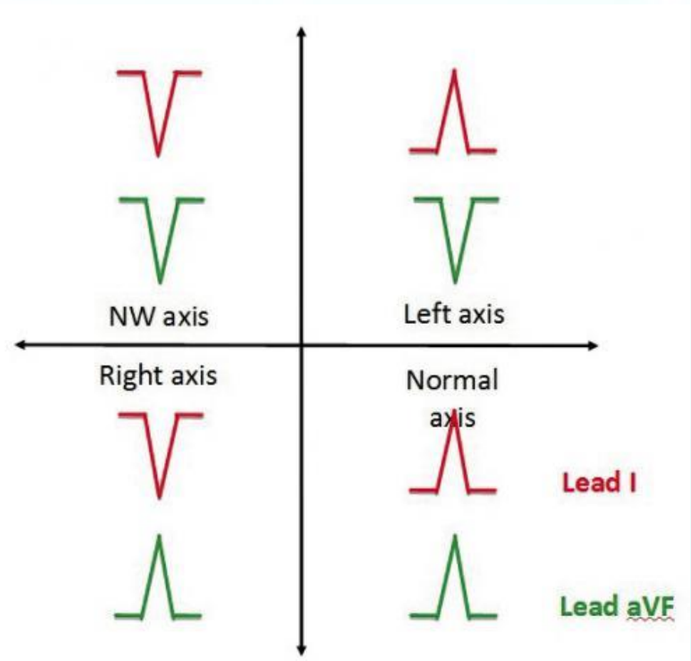
1- The normal range of heart rate is between **60 – 100 beats/minute.**
2- If the heart rate **exceeds from 100 beats/minute**, it is called ***Tachycardia*.**
3- If the heart rate goes **below 60 beats/minute**, it is termed ***Bradycardia*.**

5-DETERMINATION OF AXIS:

How we use it and why ? By applying rule of thumb on the direction of R-wave in the Leads I and III/aVF of the ECG in order to determine the electrical axis of the heart.

What does LAD and RAD mean? LAD = deviated to the left. – **RAD** = deviated to the right.

	R Wave	
Axis	**Lead I**	**Lead III or aVF**
Normal	**Positive "upward"**	**Positive "upward"**
LAD	**Positive "upward"**	**Negative "downward"**
RAD	**Negative "downward"**	**Positive "upward"**
Extreme RAD or Extreme LAD	**Negative "downward"**	**Negative "downward"**



3

JVP and CAP

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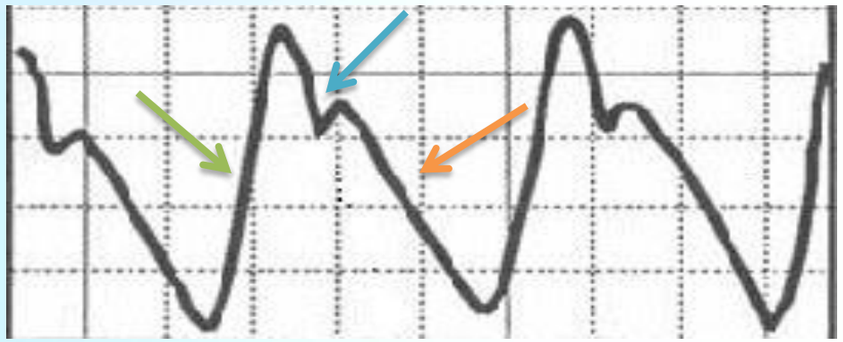
1-THE CAROTID ARTERIAL PULSE: (By Carotid artery)



When we record the carotid arterial pulse, we get a tracing, which has the following features:

Anacrotic limb (ANA means up)

- Increasing pressure in the carotid artery during **the maximum ejection phase** of ventricular systole
- In healthy individuals, the arterial pressure recorded at the beginning 80 mmHg and at the peak of the anacrotic limb is 120 mmHg

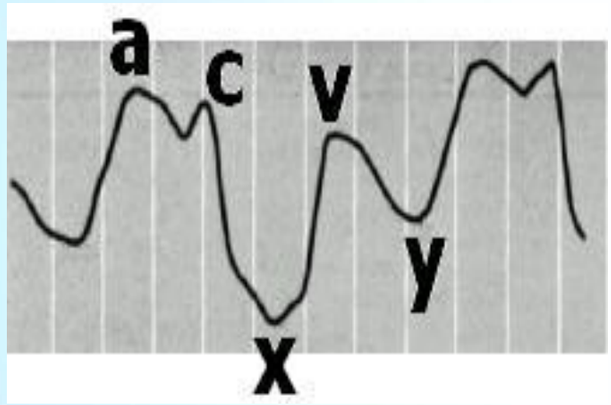
Dicrotic Notch (Dn) or Incisura

- Fall in the arterial pressure which interrupted by **the closure of the aortic** valve at the end of ventricular systole
- It marks the beginning of ventricular diastole, and we can easily find that it with:
  1- Second heart sound 2- after T-wave

Dicrotic limb

- Decreasing pressure in the carotid artery during **reduced ejection phase** of the ventricular diastole
- **but , The pressure does not fall all the way to 0 mmHg Why?** It stops falling further when it reaches 80 mmHg due to **the elastic recoil of the arterial wall**

2- THE JUGULAR VENOUS PULSE (By internal jugular vein)



Remember "W" to identify the waves:
- **First leg of "W" will be "x-descent".**
- **Second leg of "W" will be "y-descent".**
- **Between "x" and "y" will be "v" wave.**
- **Before "x-descent" will be "c" wave.**
- **Before "c" wave will be "a" wave.**

(They may ask you to label the site of waves in the picture)

"a" wave: increased right atrial pressure due to right atrial contraction

"c" wave: It is due to the increased right atrial pressure by the bulging of tricuspid valve into right atrium during isovolumetric contraction phase because of a continually increasing right ventricular pressure when all the valves are closed. OR another explanation is that it is just a Carotid Artifact

"x" wave: decreasing the right atrial pressure due to the downward displacement of the tricuspid valve by the contraction of papillary muscles during ventricular systole

"v" wave: increase in right atrial pressure due to filling of right atrium with the blood returning from great veins against the closed tricuspid valve

"y" wave: fall in right atrial pressure due to flows the blood out of the right atrium into the right ventricle as soon as the tricuspid valve opens

3- CLINICAL APPLICATION OF JVP

PROMINENT ‘a’ WAVE:
Pulmonary stenosis
Tricuspid stenosis

ABSENT ‘a’ WAVE:
Atrial fibrillation

LARGE ‘v’ WAVE:
tricuspid regurgitation

The information which I wrote in gray is not important just for your understanding

WHY DO WE PREFER INTERNAL JUGULAR VEIN TO RECORD JVP?

Pressure changes in the right atrium are transmitted directly to the internal jugular vein as there are no valves between this vein and the right atrium. The external jugular vein cannot be relied upon because this vessel :

- Has valves
- May be obstructed by the fascial and muscular layers through which it passes

WHAT IS AN ARTERIAL PULSE
When blood is forced into the aorta during ventricular systole, two things happen:

- Blood moved forward
- A pressure wave is set up which travels along the wall of arteries (faster than the flow of blood). The pressure wave expands the arterial walls as it travels. The expansion of the arterial wall is palpable as the pulse.

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4

MEASUREMENT OF ARTERIAL BLOOD PRESSURE

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First: METHODS FOR MEASURING ARTERIAL BLOOD PRESSURE

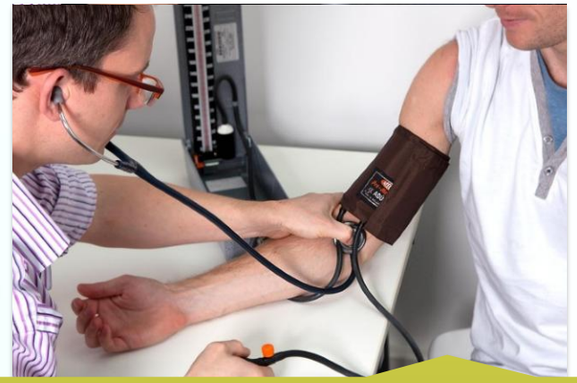
Method	A. PALPATORY METHOD	B. AUSCULTATORY METHOD
Measures	only gives an estimate of the systolic blood pressure.	both systolic and diastolic blood pressures.

SECOND : PRECAUTIONS FOR MEASURING ARTERIAL BLOOD PRESSURE

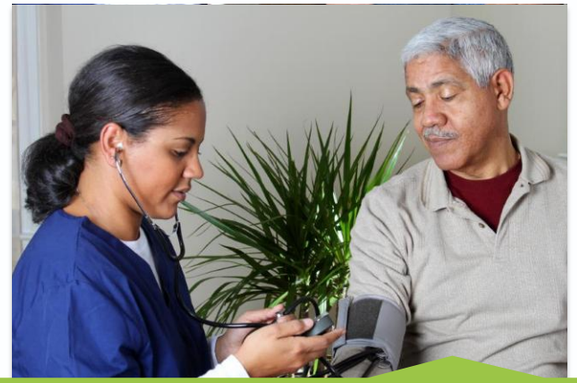
The cuff size should be appropriate for the age and built of the subject

The cuff should be applied over the upper arm in such a way that its lower end must be at least 1 inch (2.5 cm) above the cubital fossa.

rubber bag within the cuff is on the medial side→ so that it can occlude the brachial artery



The cuff should be at the same level as the heart.



subject must be physically and mentally relaxed and in a comfortable environment

Third: AN EXAMPLE OF BLOOD PRESSURE READING BEFORE & AFTER EXERCISE

CONDITION	BLOOD PRESSURE READING	Observation
BEFORE EXERCISE	120/80 mmHg	Normal adult BP
AFTER MILD TO MODERATE EXERCISE	140/80 mmHg	systolic blood pressure increases and the diastolic blood pressure remains more or less the same
AFTER HEAVY (SEVERE) EXERCISE	160/60 mmHg	the systolic pressure increases tremendously and the diastolic pressure drops.

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<table>
<tr><th>QUESTIONS AND PROBLEMS</th><th colspan="2">Answers and clarifications</th></tr>
<tr><td rowspan="2">What are the ranges of normal blood pressure?</td><td>Systolic BP</td><td>100 – 140 mmHg</td></tr>
<tr><td>Diastolic BP</td><td>60 – 90 mmHg</td></tr>
<tr><td>What is the pulse pressure?</td><td colspan="2">It is the difference between systolic and diastolic blood pressures.
PP = SP-DP</td></tr>
<tr><td>What is the mean arterial blood pressure? What is its significance?</td><td colspan="2"><u>Definition:</u> It is the average blood pressure within the arteries during a whole cardiac cycle
<u>Significance:</u> it is the force responsible for maintaining a continuous forward flow of the blood in the circulation during the whole cardiac cycle.
Dr.Najeeb
http://youtu.be/7nR3wEoncRs
Start from: 13:10 – 20:00</td></tr>
<tr><td rowspan="5">How can we calculate the mean arterial blood pressure?
Give an example.</td><td colspan="2">Because the diastole phase of a cardiac cycle is longer than its systole phase, → we cannot apply mathematical average to determine the mean arterial blood pressure; instead we can calculate the mean arterial blood pressure (M.A.B.P.) by applying the following formula:
M.A.B.P. =Diastolic Blood Pressure+1/3 Pulse pressure</td></tr>
<tr><td colspan="2"><u>Example</u>: a subject’s blood pressure is measured to be 120/90 mmHg,
we can calculate the mean arterial blood pressure in the following 3 steps :</td></tr>
<tr><td>1. Determine the pulse pressure</td><td>PP = SP-DP
120 – 90 = 30 mmHg</td></tr>
<tr><td>2. Divide the pulse pressure by 3</td><td>30/3 = 10 mmHg</td></tr>
<tr><td>3. Add the above answer to the diastolic blood pressure:</td><td>10 + 90 = 100 mmHg</td></tr>
<tr><td colspan="2">So 100 mmHg will be the mean arterial blood pressure in this example.</td></tr>
</table>

Questions that doctor mentioned during class (Very important)

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First Lecture : heart sounds

Q1: what is the conditions that present the 3rd sound normally?

- Children
- Thin people
- Athletes
- pregnancy

Q2: what is the conditions that present the 4th sound normally?

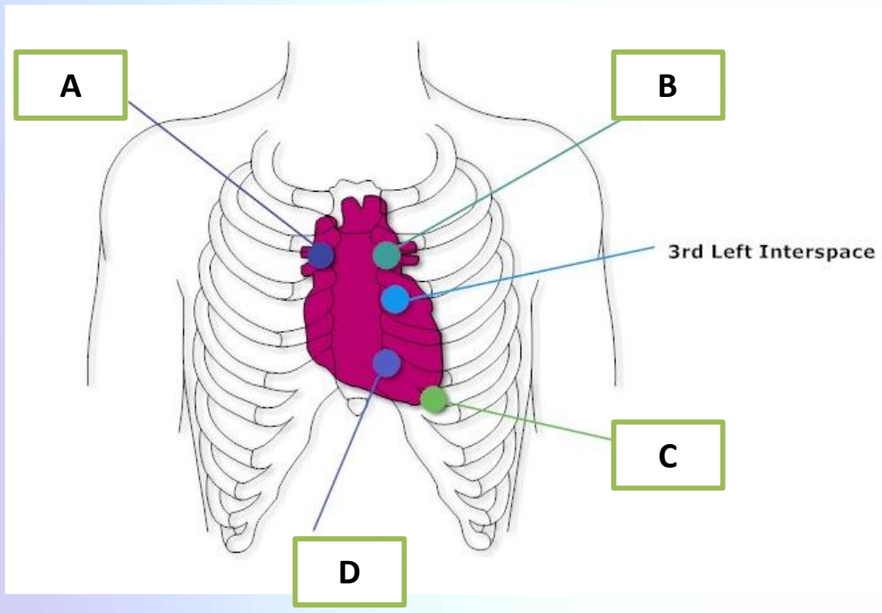
Old ages usually more than 60 years

Q3: How can you hear the heart sounds?

By stethoscope

Q4: What is the surface of the stethoscope you can hear the murmur?

Bell



Q5: Identify the labeled auscultators areas?

- A : Aortic
- B: Pulmonary
- C: Mitral
- D: Tricuspid

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Q6: what is the apex beat?

it is the lowermost and outermost cardiac palpation.

Q7: How the First heart sound is related to the ECG?

After QRS-complex

Q8: How the Second heart sound is related to the ECG?

After the T-wave

Q9: What is physiological heart sound can be auscultated in deep inspiration?

Second heart sound

Q10: what is the cause of the 1st heart sound?

Closure of the Atrioventricular valves

Q11: what is the cause of the 2nd heart sound?

Closure of semilunar valves

Second Lecture : ECG

Q1: what is the causes of P wave, QRS-complex, T wave? (Very important☺)

- P wave is due to **atrial depolarization**
- QRS-complex is due to **ventricular depolarization**
- T wave is due to **ventricular repolarization**
- U wave is sometimes present due to **repolarization of hypertrophied papillary muscles**.

YOU MUST KNOW HOW TO CALCULATE THE INTERVALS FROM ECG PAPER AND THEIR NORMAL VALUES

Q2: What will happen if PR interval is prolonged?

First degree heart block

Q3: What will happen if QT interval is prolonged or become short?

Prolonged = Hypocalcaemia

Short = Hypercalcaemia

Q4: What is the range of normal heart? and what is the abnormal?

- Normal is (60-100)
- > 100 is tachycardia
- < 60 is bradycardia

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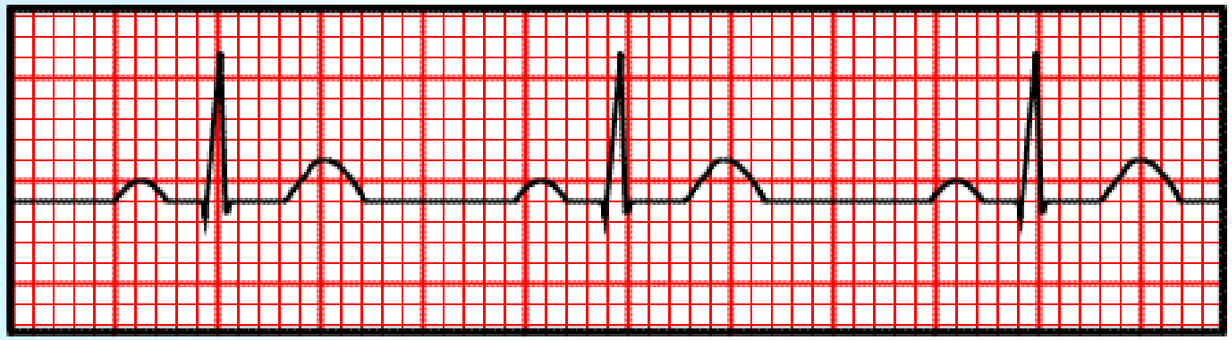
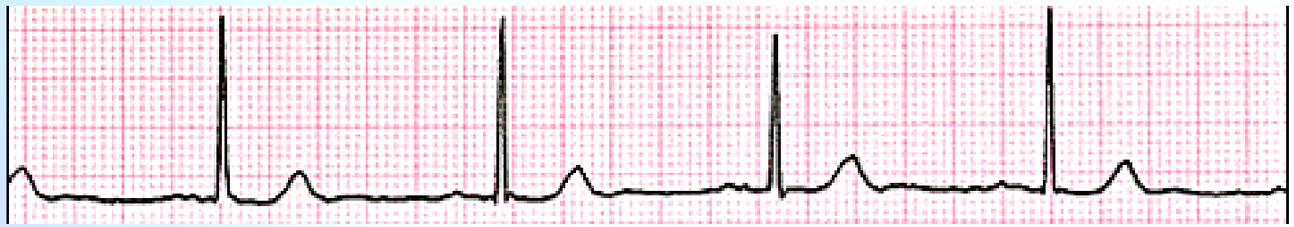
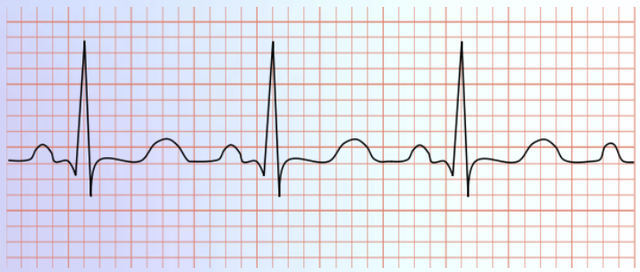
Q5: Calculate the heart rate for the following figures:



Heart Rate = $\frac{1500}{20}$ = 75 beats/minute.



Heart Rate = $\frac{1500}{\sim 28}$ = 54 beats/minute. (Bradycardia)



Heart Rate = $\frac{1500}{\sim 12}$ = 125 beats/minute. (Tachycardia)

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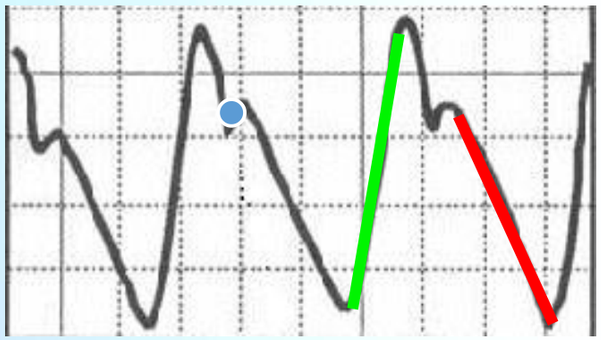
Third Lecture : CAP and JVP

Q1: from what artery can we take the arterial pulse?

- the carotid artery

Q2: from what vein can we take the venous pulse?

- Internal Jugular veins



Q3: In the figure: what is the colors refer?

- Blue: Dicrotic Notch is due to closure of the **aortic valves** and Causes 2nd heart sound (cannot be pulmonary valves)
- Green : Anacrotic limb is due increase of carotid blood pressure (at the beginning is 80 mmHg and the peak is 120 mmHg)
- RED : Dicrotic limb is due increase of carotid blood pressure

Q4: What is the phase of the cardiac cycle that make the anacrotic limb increase up to 120 mmHg?

- During maximum ejection phase

Q4: What is the phase of the cardiac cycle that make the dicrotic limb decrease to 80 mmHg?

- During Reduced ejection phase

Q6: why Dicrotic limb is falling into 80 mmHg only?

- Because is due to the elastic recoil of the arterial wall.

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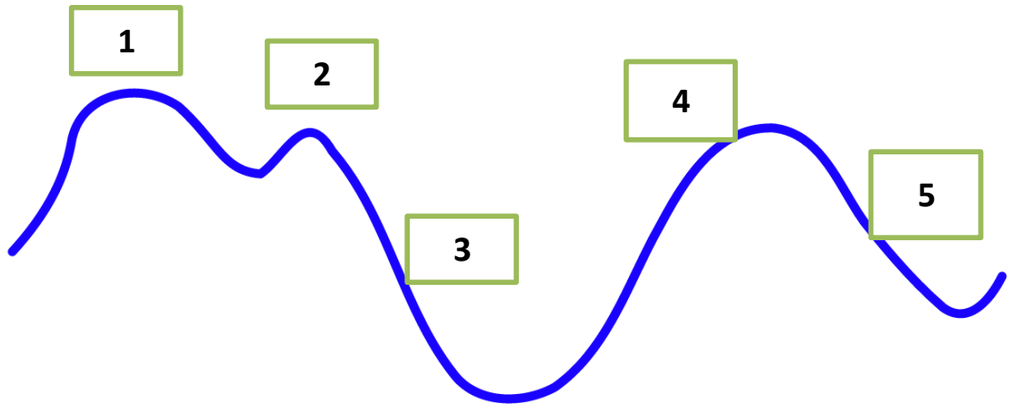

Q6: Identify the wave and these causes?

(1) ‘a’ wave: It is due to the right atrial contraction at the end of the ventricular diastole, which in turn will lead to increased right atrial pressure.

(2) ‘c’ wave: It is due to the increased right atrial pressure by the bulging of tricuspid valve into right atrium during isovolumetric contraction phase of ventricular systole because of a continually increasing right ventricular pressure in the early systole when all the valves are closed. OR another explanation is that it is just a Carotid Artifact.

(3) ‘x’ descent: It is due to the downward displacement of the tricuspid valve by the contraction of papillary muscles during ventricular systole, thus decreasing the right atrial pressure.

(4) ‘v’ wave: It is due to the increase in right atrial pressure, when right atrium continues to fill with the blood returning from great veins against the closed tricuspid valve.

(5) ‘y’ descent: It is due to the fall in right atrial pressure, when the blood flows out of the right atrium into the right ventricle as soon as the tricuspid valve opens.

Fourth Lecture : Blood pressure

Q1: what is the methods to measure the Blood Pressure?

- PALPATORY METHOD
- AUSCULTATORY METHOD

Q2: which method we use the stethoscope?

- AUSCULTATORY METHOD (we don't use it palpatory method)

Q3: which method we can measure the systolic and diastolic pressure?

- AUSCULTATORY METHOD, (we can measure only systolic in palpatory)

Q4: what is the name of device that used to measure the blood pressure?

- sphygmomanometer

Q5: if the patient has 130/70 mmHg, what is the mean blood pressure?

- Diastolic = 70 mmHg
- Pulse pressure = Systolic Pressure – Diastolic Pressure = 130 – 70 = 60 mmHg
- Mean Blood Pressure = Diastolic + 1/3 Pulse pressure = 70 + (1/3 × 60) = 70 + 20 = 90 mmHg

Q6: what is the effect of the exercise on blood pressure?

Effects of the exercise	Before the exercise	After the exercise
Person (1)	120 / 90 mmHg	160 / 60 mmHg
Person (2)	130/ 70 mmHg	150/ 70 mmHg

- Person (1) : it severe or heavy exercise because Systolic BP increases and Diastolic BP decreases
- Person (2) : it mild to moderate exercise because Systolic BP increases and Diastolic BP remain the same

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