Physiology Team 431

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Practical 1

ECG

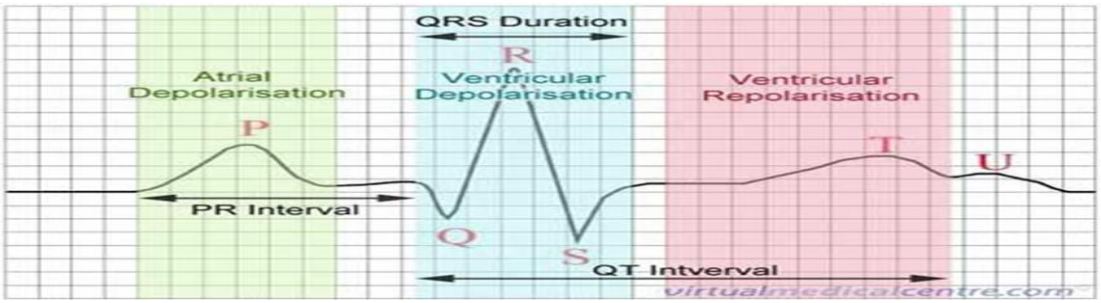
Objectives

- Normal range for intervals on ECG
- Types of AV- block
- What happens if there is a changes on the ECG e.g. (ST segment elevation or depression, T wave …etc.)
- Heart rate calculation

1. Normal range for intervals on ECG

Components of the normal ECG recordings:

Wave	Caused by	Duration
P Wave	Atrial depolarization (before the atrial contraction)	-
QRS Complex	Ventricular depolarization (before the ventricular contraction)	0.08 –0.1 sec
T Wave	Ventricular repolarization (before relaxation of ventricles)	-
U Wave	Repolarization of hyperploid papillary muscle . (Seen in slower HR, hypokalemia)	

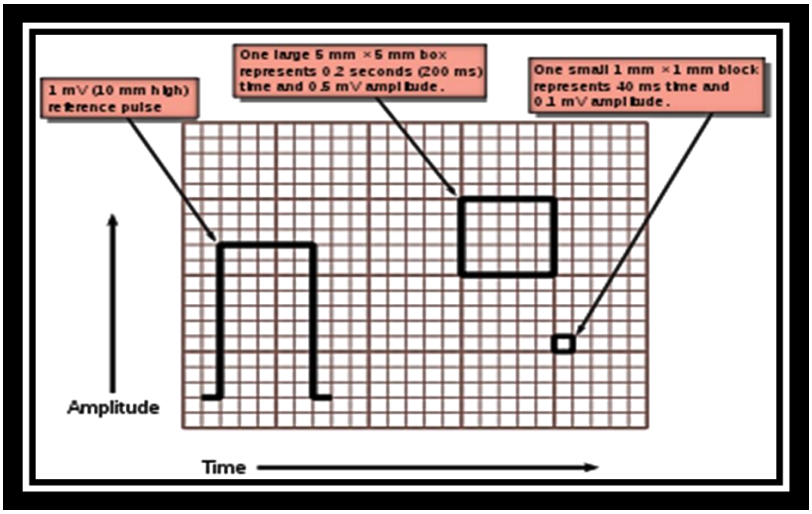


Calibrations of ECG:

Speed of ECG machine is 25 mm / sec

Based on that :

- **One small square = 0.04s**
- **5 small seq= 1 big seq = 0.2 Sec**
- **5 large seq = 1 Sec**
- **0.04 sec = 1mm**
- **1 sec = 25mm**
- **1mV=10mm**



ECG intervals:

1. **PR interval: Measured from the beginning of the P wave to the beginning of the QRS complex.**
   - **Duration: 0.12-0.20 sec**

   How is the duration measured? By counting the little squares from beginning of the P wave to the beginning of the QRS complex and multiply by 0.04

****Long PR interval (>0.20s) means impulse is delayed through atria or AV node as in: 1st degree HB, Hypothyroidism or Digitalis toxicity**

Short PR interval (<0.12): ectopic pacemaker.

2. **QT Interval (age, gender, HR) :**

- **From beginning of Q wave to the end of T wave .**
- **The duration of it is 0.36 – 0.44 sec**
- **PROLONGED in hypocalcemia .**

3. **ST interval :**

- **from the end of QRS complex to the end of the T wave.**
- **The duration of it is 0.28 – 0.36 sec**
  - **ST Segment: End of QRS until beginning of T wave. It is Isoelectric. (Important clinically)**

2. Types of AV- block:

- May occur at the AV node, Bundle of His or Purkinjie fibers.
- PR interval duration is used to determine the type of HB
- QRS width is used to assess the level of location of the block

3 types of AV block: 1st degree, 2nd degree and 3rd degree.

Type of AV block	Caused by	Findings in ECG	Notes
1st Degree	Impulses from SA node to the ventricles are delayed. At AV node	Prolonged PR interval (more than 0.20sec) proceeding every QRS	Maybe normal in athletes. Hyperkalemia, inferior wall MI, rheumatic heart disease, digitalis etc.

4. Changes in ECG intervals:

Interval	Abnormality
ST Segment	▪ Elevation: Myocardial injury, pericarditis and ventricular aneurysm. ▪ Depression: Myocardial ischemia or Hypokalemia and digitalis.
T Wave	▪ If opposite to QRS and (inveted) –ve: MI. ▪ Tall and peaked: hyperkalemia.
U Wave	▪ If taller than 1.5mm: electrolyte imbalance (hypokalemia, hypomagnesemia, and hypercalcemia), medications (digitalis, etc.), hyperthyroidism, and NS disease. ▪ If U wave is -ve: heart disease such as ischemic heart disease.

5. Heart Rate Calculation.

Regular Rhythm:

HR =

$$\frac{1500}{\text{R-R interval (\#small sq.)}}$$

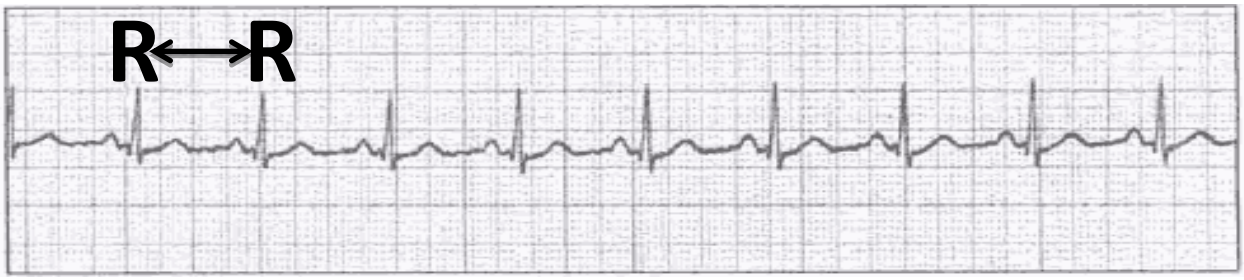
Or HR =

$$\frac{300}{\text{R-R interval (big sq.)}}$$

Irregular Rhythm:

1. Count the number of QRS complexes in 30 big squares = no. of QRS in 6 seconds.
2. Then Multiply by 10.

dr. said:
" not important"



Normal = 60-100 bpm (beats per minute).

Bradycardia = Less than 60 bpm.

Tachycardia = More than 100 bpm.

Sinus Arrhythmia: occurs when SA node discharges irregularly. If associated with respiration changes, it is called respiratory sinus arrhythmia. Inspiration causes increase in HR, shortening of R-R. This is Opposite during expiration.

Axis: Average direction of electrical current in the heart

- Lead II is the same normal direction of heart electrical activity

- Normal Axis range = (-30 to +110)
- Left Axis deviation (-30 to -90)
- Right Axis deviation (+110 to 180)

Thumbs method:

- When lead I upward & lead III upward= Normal
- When lead I upward & lead III downward= Left Axis deviation (husband & wife left each other)
- When lead I downward & lead III upward= Right Axis deviation (husband & wife are kissing each other which is Right thing to do)
- When lead I & lead III are both downward= extreme right axis deviation

Heart sounds

	S1	S2	S3	S4
Cause	Sudden closure of A-V valves	Sudden closure of semilunar valves	Vibration of ventricular muscles because of rush of blood flow, during rapid ventricular filling	Vibration produced by forced contraction of atrium (Attributed to ventricular filling)
Cycle timing	Marks beginning of vent. Systole (Isovolumetric contraction)	Marks beginning of vent. diastole (vent.pressure falls below atrial pressure)	Max. vent. filling phase of diastole	Atrial systole (Just before 1st heart sound)
Best heard	Mitral & tricuspid	Aortic & pulmonary	--	--
Physiologic Splitting		The aortic valve will shut and the pulmonary valve will be SHORTLY delayed during deep inspiration ➔ split of sound> may be confused for S3. LUB TaDUB	--	--
ECG	After QRS complex	After 'T' wave	--	--
Characteristics	Prolonged Dull High frequency	Short Sharp High frequency	--	--

Locations:

1. Pulmonary area: 2nd intercostal space, just left to the sternum

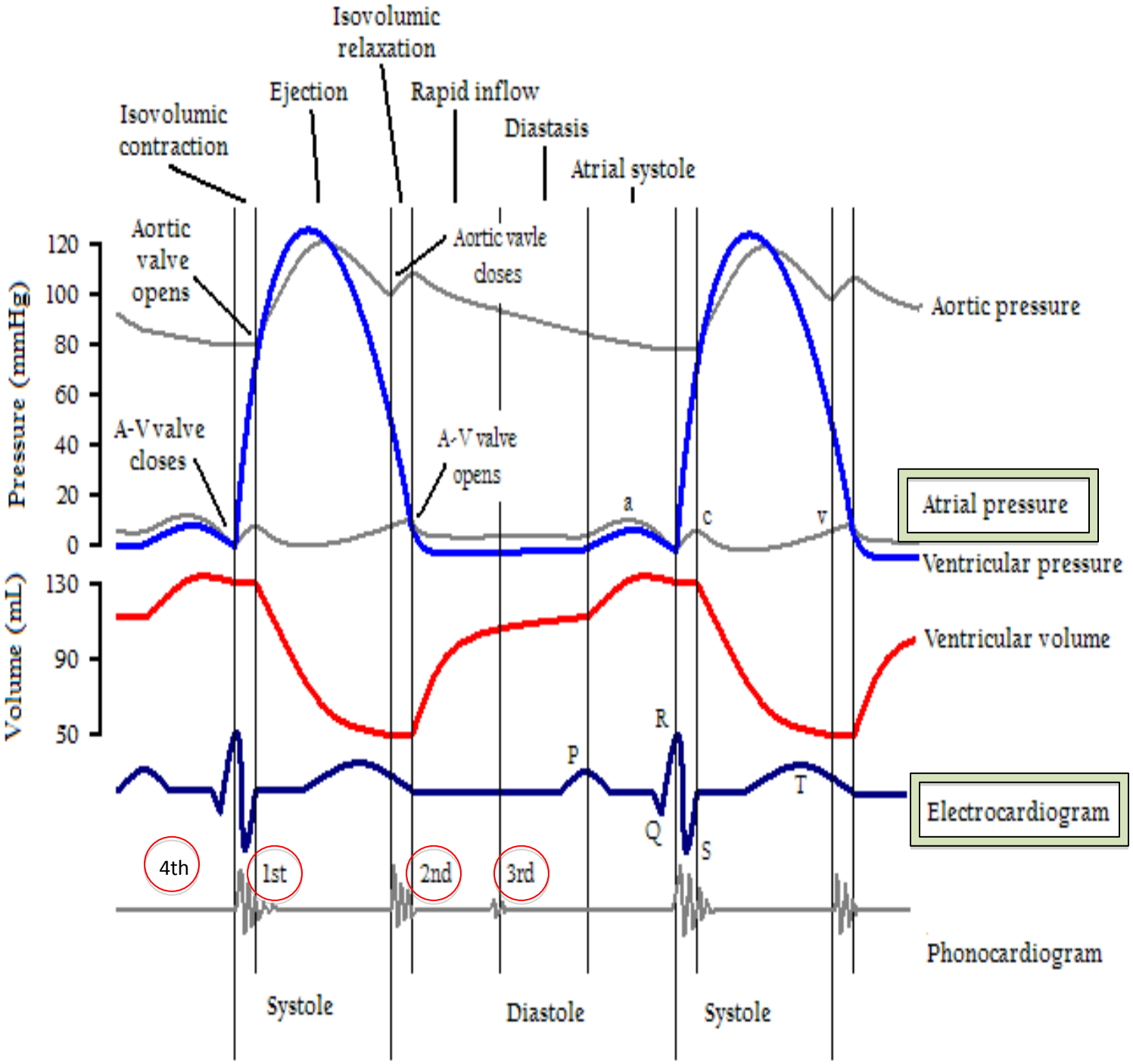
2. Aortic area: 2nd intercostal space, just right to the sternum

3. Mitral area: (apex beat) left 5th intercostal space low medial to mid clavicular line.

4. Tricuspid area: at the lower part of sternum towards the right side.

**First heart SOUND best heard AT: Mitral area or Tricuspid area

**Second heart SOUND best heard AT: Aortic and pulmonary areas


Isovolumic relaxation
Ejection
Rapid inflow
Isovolumic contraction
Diastasis
Atrial systole
Aortic valve opens
Aortic vavle closes
Aortic pressure
A-V valve closes
A-V valve opens
a
c
v
Atrial pressure
Ventricular pressure
Ventricular volume
Pressure (mmHg)
120
100
80
60
40
20
0
Volume (mL)
130
90
50
R
P
T
Q
S
Electrocardiogram
4th
1st
2nd
3rd
Phonocardiogram
Systole
Diastole
Systole

You can feel the arterial pulse but you cannot feel the venous pulse

Arteries pulsation is outward (from inside to outside)

Venous pulsation is inward (from outside to inside)

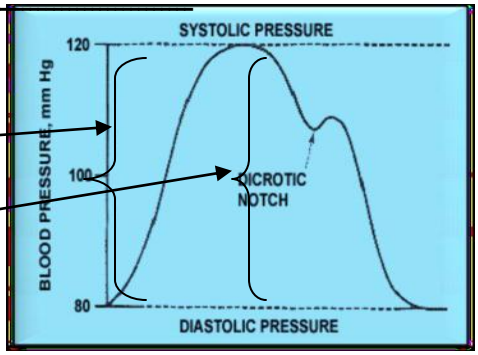
Arteries are higher pressure than veins.

Veins have very low pressure, thus as soon as you touch the vein, it collapses.

We measure the pulse of internal jugular vein; because it has no valve, which means if there is any change in it, there will be the same change in the right atrium.

Carotid Arterial pulse; related to Aortic pressure.

1- Ascending limb (Anacrotic); from 80mmgh to 120mmgh
2- Descending limb (Dicrotic)



- Because of Aortic and Carotid elastic recoil, the pressure will not reach to 0, only to 80mmgh.

- Ascending anacrotic limb= rapid ejection phase of ventricular systole
- Cause of dictoric notch= closure of Aortic valve
- After dicrotic notch= ventricular diastole
- From the peak to incisura= reduced ejection phase
- Dicrotic limb= reduced ejection phase+ ventricular diastole

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Jugular Venous Pulse:

A,C,V waves= +

X,Y= - (descent waves)

A=right atrial contraction

- Atrial systole happens in the last part of ventricular diastole

C= Due to bulging of tricuspid valve into right atrium

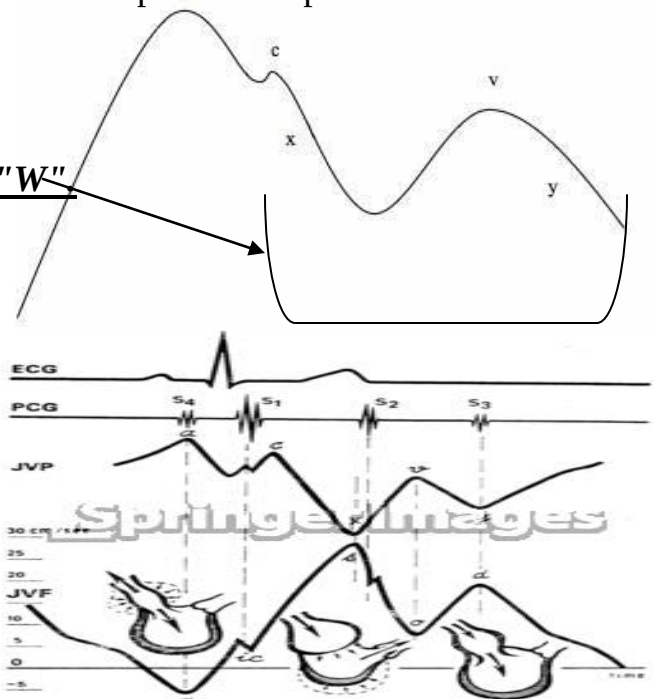
X= downward displacement of tricuspid valve by contraction of papillary muscle which pull the valve leading to larger space in atrium leading to decrease pressure in atrium

V= increase in right atrial pressure, when atrium continue to be filled from venous return against the closure tricuspid valve .

Y wave= due to fall of right atrial pressure when the tricuspid valve open

For identification the waves , look for the litter "W"

- First descent of the "W" is "X" wave .
- Second descend of the "W" is "Y" wave .
- Between "X" and "Y" waves there is "V" wave
- Before "X" wave there is "C" wave
- Before "C" wave there is "A"



What is Blood Pressure?

is the force exerted by blood against a vessel wall due to the pumping action of the heart.

Normal range : (**100-140/ 60-90** mmHg)

Systolic Pressure: is the force exerted by blood against a vessel wall during heart contraction (systole).

Normal range : (**100-140** mmHg)

Diastolic Pressure: is the force exerted by blood against a vessel wall during heart relaxation (diastole).

Normal range : (**60- 90** mmHg)

Pulse Pressure :

Is the difference between diastolic and systolic pressure .

= Systlic Pressure – Diastolic Pressure

= 120 - 80 = 40 mmHg

— is called Pulse pressure because it is the pressure needed to feel the pulse.

Mean Arterial blood pressure :

one-third of the pulse pressure added the diastolic Blood Pressure.

= diastolic pressure + 1/3 (Systolic-Diastolic)

Ex. = 80 + 1/3 (120-80) = 93 mmHg

Mean arterial pressure is also called **perfusion pressure**. It is important for Organ Perfusion.

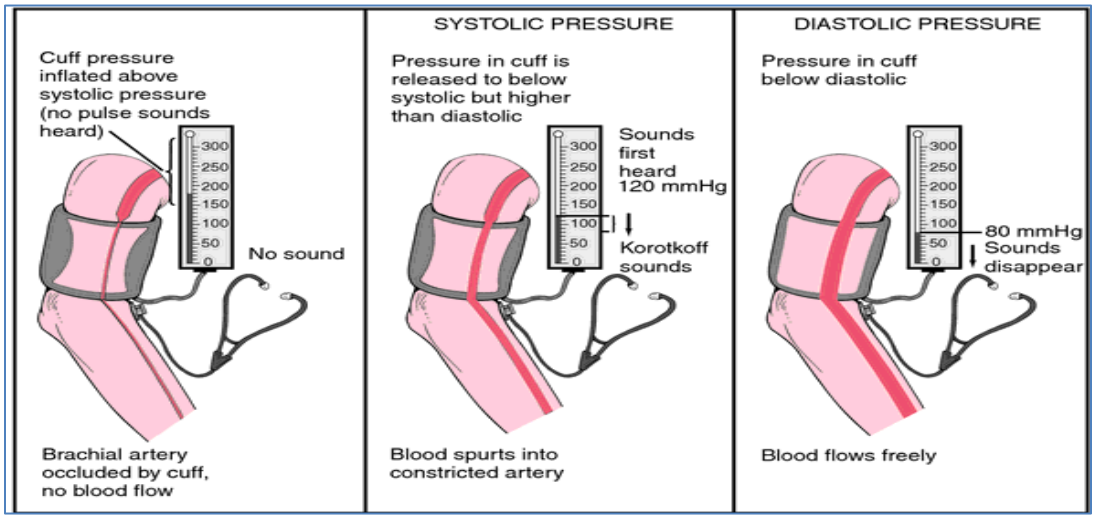
Normal Range (**70 – 110** mmHg)

— If Person has Low Perfusion Pressure (Lower than 60 mmHg) → he will suffer from Ischemia.

Methods of measurement :

1- **Palpatory method** (you can measure only systolic BP)

2- **Auscultory method** (Korotkoff sounds).



Precautions:

- The manometer should be at the level of the heart
- Cuff applied 4 cm above elbow.
- The subject should be physically relaxed .
- The cuff size should be appropriate for the patient arm size .

Systolic hypertension:

elevated systolic blood pressure.

If the systolic blood pressure is elevated (>140) with a normal (<90) diastolic blood pressure (DBP), it is called "isolated systolic hypertension"

Effects of exercise :

- Increase systolic Blood pressure

Because the cardiac output is increased .

- Systolic BP depends on CO .
- Diastolic BP depends on TPR .
- NO change in diastolic BP in mild to moderate exercise .
- Decrease in diastolic BP IN SEVER exercise(heavy exercise) .

CO ×ABP = TPR

HR× SV ×ABP = TPR