ALQUSOUR ACADEMY
اكاديمية القصور

Q.A.J.U.S.T

PHYSIOLOGY LAB

لطلبة العلوم الطبية والصيدلة وطب الأسنان

Subject:

Final Exam: Lab Material

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المقر الرئيسي

سبت - الخميس: 11:00 ظهراً - 12:00 ليلاً

جمعـــــة: 2:00 ظهراً - 12:00 ليلاً

مقر ش. الجامعة

السبت - الخميس: 12:30 ظهراً - 9:30 ليلاً

الجمعـــــة: عطلة

حذير: محاضراتنا (الملخصات) متوفرة لدى:

أكاديمية القصور بفروعها.

0795 33 99 34 / 0785 70 60 08 - لتوفير والتسجيل:ايد

Heart Sounds

* Two heart sounds normally heard by a stethoscope, during each cardiac cycle.

* First heart sound (S1):
- Caused by the mitral and tricuspid valves closure (AV-valves)
- Occur at the beginning of systole
- The mitral valve closes before the tricuspid valve, although it's not usually possible to appreciate the dual nature of the sound

* Second heart sound (S2):
- Caused by the closure of the aortic and then pulmonary valve (semilunar valves)
- Because the delay is greater than in the first heart sound, this sound (S2) usually can be heard, as dual sound
- The splitting between the two sounds, of two valves (aortic & pulmonary)

* **The four main areas usually used to listen to the heart sounds**:
1- Mitral Valve: at the position of the apex beat
2- Tricuspid Valve: over the xiphoid process
3- Aortic Valve: in the 2nd right intercostals space
4- Pulmonary Valve: at the 2nd left intercostals space

Arterial Pulse

* Arterial pulse: is pressure wave distending the arterial wall, starting from the aorta toward peripherally
* Arterial pulse: reflects the number of heartbeats per minute
* Arterial pulse is measured at different parts of the body
* **Most common parts**, which used to measure arterial pulse, are:
1- Radial artery in the wrist
2- Brachial artery in the elbow
3- Common carotid artery in the neck

* Other parts, Axillary, Subclavian, Femoral, Popliteal, Dorsalis pedis and Posterior tibial

* Arterial pulse use to study the following characteristics:
1- Heart rate: number of beats/ min
2- Rhythm: Regularity of intervals
3- Condition of the Artery (soft or hard)
4- Character of the pulse wave

* **Note**: **Radial pulse** is usually used to assess for rate, rhythm, character and volume

* **Practically**:
- Assess the following, using the right radial pulse
1- Rate:
- To measure the pulse at wrist, place the index and middle finger over the underside of the opposite wrist, below the base of the thumb
- Then, press firmly with flat fingers, until you feel the pulse
- To determine heart rate, one feels the beats at a pulse point like, the inside of the wrist for 30 seconds, and multiplies this number by 2.

- Abnormal rates could be:
1- Bradycardia: rate below normal (<60)
2- Tachycardia: rate above normal (>100)

2- Rhythm:
- Can be classified into two categories:
1- Regular
2- Irregular

3- Character:
- The character of the pulse may be one of the following:
1- Weak
2- Strong

Blood Pressure

* **Blood pressure**: is measured in peripheral artery of arm or leg, usually in brachial artery
- An occluding pressure is applied to the surface of the limb through a "**pneumatic cuff**"

- Pneumatic cuff consist of:
1- Cuff: a rubber bag, usually the adult size 13 by 23 cm
2- Inflator: rubber bulb with two valves that let the air move in one direction
3- Pressure Indicator: Hg manometer

* **Systolic Pressure:** is the maximum pressure in an artery during ventricular contraction
- It's could be measured by two methods:
1- Palpatory Method (that measure systolic pressure only)
2- Auscultatory Method (measure both systolic and diastolic)

* **Diastolic Pressure**: is the lowest pressure in an artery during ventricular relaxation
- It could be measured by two methods:
  1- Auscultatory Method
  2- Observation of maximum oscillation (measure diastolic pressure only)

* **How is blood pressure measured**?

1- A sphygmomanometer (Blood Pressure cuff), to measure systolic Pressure by "**palpatory method**":

a- It is important that the subject is relaxed and rested for at least 5-10 minutes before having his blood pressure taken

b- Deflate the cuff and place it around the upper arm, so it's fits not too tightly

c- If you are right handed, you should hold the bulb/ pump in your left hand to inflate the cuff, hold it in the palm so yours fingers can easily reach the valve at the top to open/ close the outlet valve

d- Observe palpate radial artery and inflate the cuff until radial pulsation no longer perceptible and take the manometer reading

e- Pressure is the reduced slowly until pulsation again appear, manometer reading is taken as "systolic pressure"

2- A sphygmomanometer and stethoscope, to measure both systolic & Diastolic pressure by **Auscultatory method**:

Note: The first three steps (a, b, c) in previous method mentioned also here in this Method

d- Put the head of the stethoscope, just under the edge of the cuff, a little above the crease of the person's elbow, hold it the firmly with your right hand

e- Put the ear pieces of the stethoscope in your ears

f- Inflate the cuff with brisk squeezes of the bulb, and watch the pressure manometer

Note: For most adult people, you shouldn't need to go over (180 mmHg)

g- At 180 mmHg, slightly open the valve on the air pump, but don't let the air out too suddenly and not too slowly

h- Now, pay attention to what you hear, the first time you hear the sound, note what the reading on the pressure manometer, this will be "systolic pressure"

i- The sounds should continue and become louder in intensity. **Note**, the pressure reading when you hear the sound for last time, this will be "diastolic pressure"

j- After that, open the air valve completely to release any remaining pressure

Note:

- The sound from the systolic until is disappeared into five phases known as "Korotkov Sounds"
  1- Sudden appearance of sharp sound (systolic)
  2- Slightly muffled around 20 mm
  3- Sound of increase intensity and shortness
  4- Less intense
  5- The sound disappeared

3- Observation of maximum oscillation (measure diastolic pressure only):

- As pressure is let down from systolic level, oscillation in manometer Gradually increase to maximum and then decline
- Pressure in cuff at maximum oscillation said to coincide with "diastolic pressure"

ECG "Electrocardiography"

*** The Heart:**

- Function of heart: is to pump blood through out the body to deliver "O_2" and nutrient demands of the body's tissue, as well as to remove "CO_2"

- Heart Size: the heart is approximately the size of clenched fist

- Heart Position: - The heart is positioned in the mediastinum, near the midline
  - 2/3 of the heart is on the left side of the chest
  - The base of the heart faces up and to the right
  - The apex faces down, out, and to the left
  - The apex actually comes into contact with the chest wall at the 5^{th} intercostals space in the mid-clavicular line

- **Note:** The position of the heart in the chest will vary slightly with:
  1- Age 2- Weight 3- Physical condition

- The Heart Structure: - Four chambers: right atrium, right ventricle, left atrium, left ventricle
  - The wall thickness directly affects the pressure in each of the chamber of the heart
  - The wall of the left ventricle is quiet a bit thicker than the right ventricle

* Heart conduction system:
- The conduction system of the heart is a network of specialized cardiac cells
- It's designed for starting each heart contraction and for rapid and coordinated spread of excitation
- The components of conducting system:
  1- Sinoatrial node (SA node or pacemaker)
  2- Atrioventricular node (AV node)
  3- Atrioventricular bundle (AV bundle or Bundle of Hiss)
  4- Right and left branches
  5- Purkinje fiber

* What is Electrocardiogram: (ECG, EKG)
- Electrocardiogram: is a common, painless that records the electric currents produced by the heart from the body surface, and converts it into lines called "waveform", that can been seen on amonitor or printed out on paper
- The waveforms created by the ECG, can be divided into time segments to measure the rate of movement of the heart's electrical impulses
- Electrodes are harmless devices with wires that lead to a recording machine
- The Electrocardiograph: is the machine used for recording the ECG

* Principles of Electrocardiography:
- It is electrical impulses that drive the heart
- Just before contraction, a wave of depolarization is spreading along the muscle fibers of the heart, and this generates an electrical current which

has both magnitude and direction
- Because, the body cells and fluids contain electrolytes, the body can be considered to be conductor
- The electrical activity of the heart can be picked up from the surface of the heart by means of electrodes placed on skin
- However, the voltage is quiet small, and has to be amplified sufficiently. And this happen by using metallic electrodes attached to wires are placed on the skin using electrolyte paste
- Lead is a pair of electrodes placed on the body in designated anatomical locations
- Each lead has a positive and negative pole.

- <u>The standard ECG has 12 lead:</u>
  1- Bipolar (3) leads: where they record the potential difference between two points, "the positive and negative pole"
  2- Unipolar leads (9): where they record the electrical potential at a particular point by means of a single exploring electrode

- In the routine ECG examination, the recording are made from two planes:
  1- The Frontal plane
  2- The Transverse plane

A. Frontal plane leads, are:
  1- Standard bipolar limb leads, they are:
  - Lead I: left arm (+), right arm (-)
  - Lead II: right arm (-), left leg (-)
  - Lead III: left arm (-), left leg (+)

  2- Augmented Unipolar leads; same 3 electrodes used in standard limbs leads:
  - a VR: Augmented voltage of right arm
  - a VL: Augmented voltage of left arm
  - a VF: Augmented voltage of left foot

B. Transverse or horizontal plane leads:
  - There are six Unipolar leads, and they provide information on how the instantaneous cardiac vectors are directed anteriorly and posteriorly

- These are termed: precordial lead or chest leads. (V_1-V_6)
- The standard chest lead position is:
  1- V_1: Fourth intercostals space, right sternal edge
  2- V_2: Fourth intercostals space, left sternal edge
  3- V_4: "Place the fourth electrode before the third", Fifth intercostals space in the midclavicular line
  4-V_3: Bang it half way between the second and fourth electrode
  5- V_5: Lies on the fifth rib in the anterior Axillary line
  6- V_6: On an imaginary horizontal line with V_5 in the mid Axillary Line

* Characteristics of ECG:

- The ECG is composed of:
  1- P wave: is the wave of atrial depolarization
     - It has the following characteristic, in normal physiology:
       a- Smooth and rounded
       b- Not more than 3 mm tall
       c- Upright in leads I, II, a VF
  2- QRS complex: - is the wave of ventricular depolarization, atrial repolarization
     - Q wave is first downward stroke
     - R wave is the first positive stroke
     - S wave is a negative stroke that follows a positive upstroke
     - The QRS should be at least 5 mm and not more than 20 mm tall
     - Normal QRS duration is (0.06 to 0.10) second

3- T wave: - is the wave of ventricular repolarization
- should be smooth and rounded
- The period from the beginning of T wave, to nearly the end is called the "Relative refractory period"
- At this time, the ventricles are vulnerable

4- PR segment: - represent AV nodal delay
- It's measured from the end of P wave to the beginning of QRS complex

5- ST segment: - This segment at the end of QRS complex to the Beginning of T wave

- Indicate the period of time between the ends of ventricular depolarization and the beginning of Ventricular repolarization "Plateu phase"
- It's "ISOELECTRIC" or on the "base line"
- Deviation of it from baseline indicate "Coronary artery disease"

6- TP interval: - It's at the end of T wave, to the beginning of P wave
- Represent the heart when it's relax, and passive filling

7- PR interval: - It's measured from the beginning of P wave, to the beginning of QRS complex
- Represent the time it takes the electrical impulse to travel from the SA node to the ventricles
- By the end of PR interval, the atria are beginning to repolarize and the ventricles are beginning to depolarize or become electrically stimulated
- The normal duration of it is (0.12 to 0.20) seconds

8- QT interval: - It's at the beginning of QRS complex, to the end of T wave
- It represents ventricular depolarization + ventricular repolarization
- The normal duration of it is (0.40 to 0.43) seconds

* **Note:** ECG intervals depends on the Heart Rate

* <u>ECG paper: - What does it mean?</u>
- Look in figure (9) in the manual, show the design and the calculation of ECG paper (very important)
- Notes on the figure:
  1- 1 mm intervals (vertical and horizontal)
  2- Every 5 mm, the line is accentuated (bold)
  3- Speed of the record is 25 mm/sec
  4- 5 mm distance = 0.2 second = 200 msec
  5- 1 mm distance = 0.04 sec = 40 msec
  6- 1 sec = 5 bold lines = 25 mm
  7- 1.0 mV = 10 mm of vertical deflection on the grid

* <u>ECG Interpretation:</u>

1- Heart Rate: - Normal HR is 70 beat/min

- If HR < 60 beat/min is called (bradycardia)
- If HR > 100 beats/min is called (Tachycardia)
- How to calculate HR using ECG paper:
  1- Each small horizontal square is 0.04 second, and each large horizontal square is 0.2 second
  2- P-P, R-R is one cycle
  3- HR = 1500 / number of small squares
  Ex. if the distance between R-R is 18 mm, the HR is 1500/18 =83.3

2- Rhythm evaluation:
- It's the most difficult part of ECG interpretation
- To asses the rhythm, one must identify the P waves and QRS complexes and determine the relationship between them
- In the normal cardiac rhythm there is a constant distance between similar waves (R-R, P-P)
- Arrhythmias: are abnormal (inconsistent) cardiac rhythms

3- Duration time for waves & Intervals

* **Note:** - For a resting ECG, the person must remain still and quiet
- The test takes about 5-10 minutes

* The causes of ECG artifacts are:
1- Poor skin contacts
2- Gel drying up, due to exposure to air for long time
3- Damaged cables
4- Skeletal muscle contraction

Pulmonary Function Tests

* **Note:** Our breathing activities are so automatic, that mean we are not conscious of the changes in lung Volumes that occur from time to time
* Lung Volumes and Capacities:

- Lung Volumes: are integral units. (Four Lung Volumes)
- Lung Capacities: consist of 2 or more volumes. (Three Lung Capacities)

- Lung Volumes:

1- Tidal Volume (TV): The volume of air in and out, moved during normal quiet breathing (about 0.5 L)

2- Inspiratory Reserve Volume (IRV): The volume of air that can be forcefully inspired following a normal quiet inspiration. (about 2.5- 3.5 L)

3- Expiratory Reserve Volume (ERV): The volume of air that can be forcefully expired after a normal or resting expiration (about 1.0 L)

4- Residual Volume (RV): The volume of air remaining in the lungs after a forceful expiration (about 1.0- 1.2 L)

- Lung Capacities:

1- Vital Capacity (VC): - The summation of Tidal Volume, Inspiratory reserve volume and expiratory reserve volume
- Represent the air that can in or out through the lungs

2- Inspiratory Capacity (IC): The amount of air that the lung will hold after normal expiration (i.e. Inspiratory Reserve Volume + Tidal Volume)

3- Total Lung Capacity (TLC): The total amount of air in the Lungs following a maximal inspiration "The Summation of All Volumes"

* Spirometer: - Device used to measure some lungs volumes and capacities
- It's function quiet simply

- The basic idea is that there is an Oxygen source and a carbon dioxide sink that allows the subject to inhale and exhale solely with the apparatus (Providing a closed breathing system)
- The result of this process: diagram called "Spirogram"
- Spirogram used to calculate the different static lung volumes and capacities
- Spirometry: can only measure changes in Volumes
- We cannot measure (RV) directly by Spirometer, because we cannot expire all gases from our lungs

- The main volume fraction of the lung (static lung volumes) that can be measurable:
  1- Tidal Volume
  2- Inspiratory Reserve Volume
  3- Expiratory Reserve Volume

- There are additional parameters, which can be determined only by estimating them. "Measurable or calculated static lung volumes":
  1- Inspiratory capacity
  2- Vital capacity

* Pulmonary Function Tests (PFTs):
- PFTs: Wide variety of tests those are essential in the evaluation of the entire respiratory system
- These tests are useful in:
  1- The assessment and diagnosis of pulmonary disease, ex. diagnosing obstructive pulmonary disease (OPD) "ex. asthma, emphysema" Versus Restrictive lung disease "ex. pneumonia, pulmonary fibrosis"

  2- Allow the determination of lung volumes and airflow rates, which provide information in the evaluation of various lung diseases "Include determination of static and dynamic lung volumes"
  3- Aid in determining the necessary course of treatment

* The reference standard values for pulmonary functions are the: Function of age, body build, gender and emotional state

* Dynamic Lung Volumes: They are lungs volumes that depend upon the rate at which air flows out the lungs

- Dynamic Lung Volumes are:
  1- FVC "Forward Vital Capacity": Volume achieved by quickest possible exhalation after maximal inhalation
  2- SVC "Slow Vital Capacity": Lung Volume measured from a complete expiration following a deep inspiration
  3- MMV "Maximum Voluntary Ventilation": Maximum volume of air which can be moved on expiration while breathing as deeply and as rapidly as possible
  4- MV "Minute Ventilation": Volume of expired air in liters per minute measured over a minimum of one minute

* FEV1: forceful expiratory volume first second

* Spirometer "Schiller Spirovit SP-1"

-This Spirometer is compact unit with a liquid crystal display and high quality thermal printer
- Measurements are mode with light weight and hygienic open pneumotaco sensor
- With this instrument you can do the following:
  1- Spirogram
  2- FVC "Forced Vital Capacity"
  3- SVC "Slow vital capacity"
  4- MVV "Maximum Voluntary Ventilation"
  5- MV "Minute Ventilation"