Physio1

I-The respiratory passages:

(A) Air conducting zone:

•Nose → larynx → trachea → 2 main bronchi → bronchioles → terminal bronchioles [first **16** divisions].

•**No gas exchange** occurs due to thick wall. It has an important protective functions. It contains circular **cartilaginous rings** to prevent its collapse and contains longitudinal elastic fibers to allow lengthening and shortness of bronchi with lung expansion and collapse.

(C) Muscles of expiration:

1) Normal expiration: occurs **passively** due to relaxation of inspiratory muscle and elastic recoil of this muscle. So, there are not specific muscle for normal expiration.

2) Forced expiration:
A- Internal intercostal muscles:
- Oblique muscle – directed downwards and posteriorly.
- They are innervated by the intercostal nerves.
- When contract → downwards inwards of ribs and decrease chest volume and increase its pressure leading to expiration.

B- Abdominal muscles: Innervated by T1 – T12.
-When they contract → ↑ intra-abdominal pressure → elevate diaphragm and expiration occurs.
-In strong forced expiration with closed glottis as during labour or defecation, all body muscles contract even mastication muscle.

N.B: Respiratory cycle is composed of active inspiration and passive longer expiration followed by expiratory pause in a rate of 12-16 cycles/min.

N.B: The expiratory pause is caused by:
1- Reflex stoppage of the activity of the inspiratory centers.
2- The time required for re-accumulation of Co2 after its wash by expiration to stimulate new inspiration.

Respiratory pressures

A- Intrapulmonary (intra-alveolar) pressure):

•**Definition:** It is the pressure inside the alveoli during respiratory cycle.

•**Value:** - during normal inspiration = -1mmHg sub-atmospheric.
- during normal expiration = +1mmHg above atmosphere.
- during expiratory pause = zero (atmospheric).
- at end of forced inspiration = - 30 mmHg.
- at end of forced expiration = + 40 mmHg.
-during forced inspiration with closed glottis= - 80 mmHg.
-during forced expiration with closed glottis =+ 100 mmHg.

N.B.: Zero pressure in human body means **atmospheric pressure**.

•**Functions of IPP:**
1)It causes continuous expansion of the lungs.
2)It helps venous and lymph return.
3)It is a measure of lung elasticity as decrease elasticity in emphysema causes decrease the recoil and decrease the negativity of IPP.
N.B.: IPP becomes positive in:
1)Forced expiration as during talking or crying which causes bulging of neck veins due to decrease venous return.
2)Valsalva's manouver (severe straining as in labour).
3)Tension pneumothorax.
4)Abnormal fluid in pleural sac as blood (haemo-thorax), pus (pyo-thorax), bile (chylothorax) or serous (hydro-thorax) which occur in malignancy or other

Physio2

Starling forces affecting pulmonary cap.

1. The pulmonary capillary pressure is **low**, about **7 mm Hg**, in comparison with a considerably higher functional capillary pressure in the peripheral tissues of about 17 mm Hg.

2. The interstitial fluid pressure in the lung is slightly **more negative** than that in the peripheral subcutaneous tissue. (This has been measured by measuring the absorption pressure of fluid from the alveoli, giving a value of **about –8 mm Hg**.)

3. The pulmonary capillaries are relatively leaky to protein molecules, so that the **colloid osmotic pressure of the pulmonary interstitial fluid** is about **14 mm Hg**, in comparison with less than half this value in the peripheral tissues.

4. Plasma colloid osmotic pressure = 28 mm Hg.

-The alveolar walls are extremely **thin**, and the alveolar epithelium is so weak that it can be ruptured by any **positive pressure** in the interstitial spaces greater than alveolar air pressure (greater than 0 mm Hg), which allows dumping of fluid from the interstitial spaces into the alveoli.

	mm Hg
Forces tending to cause movement of fluid outward from the capillaries and into the pulmonary interstitium:	
Capillary pressure	7
Interstitial fluid colloid osmotic pressure	14
Negative interstitial fluid pressure	8
TOTAL OUTWARD FORCE	29
Forces tending to cause absorption of fluid into the capillaries:	
Plasma colloid osmotic pressure	28
TOTAL INWARD FORCE	28

Thus, the normal **outward** forces are slightly greater than the **inward** forces, providing a mean filtration pressure at the pulmonary capillary membrane; this can be calculated as follows:

	mm Hg
Total outward force	+29
Total inward force	−28
MEAN FILTRATION PRESSURE	+1

This filtration pressure causes a slight continual flow of fluid from the pulmonary capillaries into the interstitial spaces, and except for a small amount that evaporates in the alveoli, this fluid is pumped back to the circulation through the pulmonary lymphatic system.

-Safety Factor in Chronic Conditions:

When the pulmonary capillary pressure remains elevated **chronically** (for at least **2 weeks**), the lungs become even **more resistant** to pulmonary edema because the **lymph vessels expand greatly**, increasing their capability of carrying fluid away from the interstitial spaces perhaps as much as **10-fold**.

Rapidity of Death in Acute Pulmonary Edema

When the pulmonary capillary pressure rises even slightly above the safety factor level, lethal pulmonary edema can occur within hours, or even within **20 to 30 minutes** if the capillary pressure rises **25 to 30 mm Hg** above the safety factor level.

Thus, in **acute left-sided heart failure**, in which the pulmonary capillary pressure occasionally does rise to **50 mm Hg**, death frequently ensues in less than **30 minutes** from acute pulmonary edema.

Physio3

***(c) The curve is sigmoid or "S" shaped*:** because Hb contains 4 ferrous atoms and each one is saturated at certain O_2 tension & saturation of each one facilitates of the following one and so on .As there are 2 states of Hb: (1) Tense or "T" state when Hb gives O_2, the "β" chains moves a part with decrease O_2 binding. (2) Relaxed or "R" state when Hb take O_2 the β chains move closer and favors more O_2 binding.

- ***Bohr Effect:*** *it is the decrease in O_2 affinity to hemoglobin when pH of the blood falls . It can attributed to the fact that reduced HB binds H^+ more actively than does oxyhemoglobin which causes unloading of O2 more easily.*

i.e at lung level (↓ Co_2 & H^+) →↑ Hb affinity to O_2, and at tissue level (↑ Co_2 & H) →↓ Hb O_2 affinity to give it to tissue.

O_2-Hb curve *isn't between O_2 tension and O_2 content as this content is variable from person to other according to amount of hemoglobin. However, the percentage saturation isn't varied from one to another.*

Shift to right	Shift to left
Meanings: It means that at any O_2 tension the Hb is less saturated with O_2 and give O_2 to tissue (↓ affinity or unloading)	It means that at any O_2 tension the Hb is more saturated with O_2 so give less O_2 to tissue (↑ affinity or loading)
Causes: (1) decrease O_2 (2) increase Co_2 (Bohr's effect) (3) increase H^+ (acidosis or ↓pH) (4) increase temperature (fever) (5) increase 2,3 DPG . (6) Pregnancy (7) Exercise (8) Anemia.	(1) increase O_2 (2) decrease Co_2 (3) decrease H^+ (alkalosis) (4) decrease temperature (5) decrease 2,3 DPG (6) Fetal Hemoglobin (7) CO poisoning. (8) Polycythemia.
Significance: This increase O_2 supply to active muscle during exercise.	This increases O_2 loading on Hb at the lung .

P50 of Hemoglobin & factors influencing

The P50 is the **oxygen tension** at which **hemoglobin** is **50% saturated**. **The normal P50 is 26.7 mm Hg**.

Shifting the curve to the left or right has little effect on the SO2 in the normal range where the curve is fairly horizontal; a much greater effect is seen for values on the steeper part of the curve.

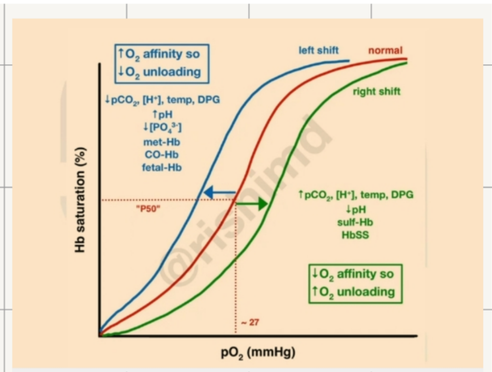
Shifting of the Oxy-hemoglobin dissociation curve:

A rightward shift increases P50 and lowers hemoglobin's affinity for oxygen, thus displacing oxygen from hemoglobin and releasing it to the tissues.

A leftward shift decreases P50 and increases hemoglobin's affinity for oxygen, thus reducing its availability to the tissues.

to Rt ⇒ ↑ P50
to Lt ⇒ ↓ P50

N.B: Met-hemoglobinemia causes a **left-ward shift** in the curve.



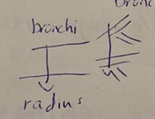
Physio4, 5,6

Q1: dynamic harmonious antagonism

Q2: physiological factors
1. Pa. at birth
2. Valsalva maneuver
3. elasticity of the lung and chest wall
4. surfactant factors

patho
1. stab wound (positive ve valve or ve without valve / zero valve)
2. emphysema (Less negative)

Q3:



asthma
1. less radius
2. brachi
3. worsen during expiration

Q4: inspiration — Right heart murmurs
expiration — Left heart murmurs

1

Q5:

exp	insp
- passive	- active
- short duration on the chest wall	- Longer
- Longer on trachea above the clavicle	

asthma: reversible emphysema: irreversible

Q6: RV
forensic
- still birth
- homocide

physiological
- blood gas exchange

Q7: ↓FEV1 / ↓FVC ratio 93% high restrictive.

↓↓↓ FEV1 / ↓ FVC ratio Low obestructive.

Q8: breath breath out CO_2 ⟶ pH

Q9: ~~above~~ upper the lungs — the lung — deep in the lung
velocity ⟶ diffusion ⟶ hard diffusion
16 : terminal bronchiol
or bronchoilits

2

Q10: Normal value
(hypoxia) 5–15 A-a gradient

due: A-a very high. in the lung (fibrosis) interinsic Restrictie lung disease

due: A-a normal
- hypoventilation
- highly ~~attended~~ altitude
- detect Hgb
- given 100% of oxygen good Therapy.

Q11: increase the tidal volume according to equation

FiO_2
pressure
flow rate (breathing rate)
volume rate (tidal volume).

Q12: Yes.
pulmonary circulation. $P_A - P_V$
bronchopulmonary circulation: (collateral circulation) (dual circulation)

3

Brachial artery
aorta ⟶ brachial artery ⟶ Pranchyma → brachial vein →
① Pulmonary vein (LV) ② hemi-azygus / azygus vein → R.A

Q13: Resistance
high atitude → ~~hypoxia~~ ↓Pb → ↓ FiO_2
Thypoxia (Less Oxygen)
Vasoconstriction in the Lung → ↓ radius →
↑ Resistence (pulmonary-shunt) oxygen goes to the ventilated side
normally other systemic organ.
Vasodilation

Sea level. Pb → ↑radius → ↓Resistence

4

Physio10

high o2 in apex than base
high blood flow in base than apex
v/q higher in apex than base
ventalation higher in base than apex
perfution in base higher than apex
this lead gas exchange in lung higher in base

N.B.: *in lung apex the ventilation & perfusion decreases but the decrease in* ***perfusion*** *is* ***more****, So, ventilation/perfusion ratio is more than normal but at base this ratio is less than normal .*

-**In respiratory physiology**, the ventilation/perfusion ratio (V/Q ratio) is a ratio used to assess the efficiency and adequacy of the matching of two variables :

V – ventilation – the air that reaches the alveoli

Q– perfusion – the blood that reaches the alveoli via the capillaries

The **V/Q ratio** can therefore be defined as the ratio of the amount of air reaching the alveoli per minute to the amount of blood reaching the alveoli / minute—a ratio of volumetric flow rates. These two variables, V & Q, constitute the main determinants of the blood oxygen (O2) and carbon dioxide (CO2) concentration.

The V/Q ratio can be measured with a **ventilation/perfusion scan**.

A V/Q mismatch can cause a type 1 respiratory failure.

The actual values in the lung vary depending on the position within the lung. If taken as a whole, the typical value is approximately **0.8**.

Because the **lung** is centered **vertically** around the **heart**, part of the lung is **superior** to the heart, and part is **inferior**. This has a major impact on the V/Q ratio:

Apex of lung – **higher** , Base of lung – **lower**

In a subject standing in **orthostatic** position (**upright**) the **apex** of the lung shows **higher** V/Q ratio **3.6**, while at the **base** of the lung the ratio is **lower** but nearer to the optimal value for reaching adequate blood oxygen concentrations. While both ventilation and perfusion increase going from the apex to the base, **perfusion increases to a greater degree than ventilation**, lowering the V/Q ratio at the base of the lungs **0.6**. The principal factor involved in the creation of this V/Q gradient between the apex and the base of the lung is **gravity** (this is why V/Q ratios change in positions other than the orthostatic position.

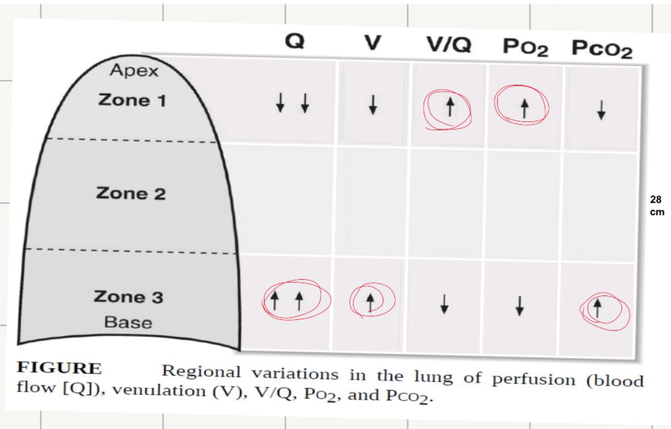


FIGURE Regional variations in the lung of perfusion (blood flow [Q]), venulation (V), V/Q, P_{O_2}, and P_{CO_2}.

-In normal healthy lung during **standing**, there are zone II (Apex) and zone III (at base) and during **recumbent position** all lung are of zone III.

So, in cases of hypertension with more blood flow to the lung during lying down lead to severe **dyspnea**.

-**Zone I** presents abnormally if the person breaths air under **positive pressure** in which intra-alveolar pressure reaches 10 mmHg also occur in **hypovolemic shock**.

-During **muscular exercise** the pulmonary blood flow increases in all parts of the lung via opening of new capillaries especially the **apex** which has already closed capillaries during rest. Whole lung becomes **Zone III.**

As a result of the regional differences in V/Q ratio, there are corresponding differences in the efficiency of gas exchange and in the resulting pulmonary capillary PO2 and PCO2.

Regional differences for PO2 are greater than those for PCO2.

a. At the apex (higher V/Q), PO2 is highest and PCO2 is lowest because gas exchange is more efficient.

b. At the base (lower V/Q), PO2 is lowest and PCO2 is highest because gas exchange is less efficient.

77) To Increase the thoracic cavity and keep Intrapleural pressure negative, all the followings are correct EXCEPT?

a. Elasticity of the lung
b. Surface tension
c. Elasticity of the chest wall
d. Lymphatic drainage
e. Gravity

59) CO2, choose the wrong statement?

a. About 10% of the CO2 in our blood is simply dissolves in plasma
b. The carbonic anhydrase of the RBC combine C02 and H2O to form H2CO3
c. Increase in pCO2 causes a left shift to Hb-02 dissociation curve meaning additional O2 can suppl the tissue
d. About 20% of CO2 is transported as carbamino hemoglobin
e. Respiratory acidosis may occur when there is retention of C02

50) If carbon dioxide levels rise in the lungs, then the hydrogen ion levels in the blood?

a. Will drop because additional bicarbonate ions are formed (via carbonic anhydrase), and this is a base that eliminates hydrogen ions.
b. Will rise because carbon dioxide binds to bicarbonate ions.
c. Will rise because the formation of bicarbonate ions also creates hydrogen ions.
d. Will drop because more carbon dioxide will be dissolved in the blood rather than forming carbonic acid.
e. Will remain constant.

47) Hering-breuer inflation reflex?

a. Generated by pulmonary irritant receptors located in bronchioles and bronchi.
b. signals from these receptors travel via the vagus nerve to the respiratory center.
c. Causes stimulation of inspiration.
d. Active during normal quiet breathing.
e. stimulated by alveolar inflammation, pulmonary congestion and lung deflation.

28) The most important implication in alveolar ventilation equation?

a. Calculating total ventilation
b. Calculating P02
c. Calculating alveolar ventilation rate
d. Calculating PC02
e. Calculating VC02 rate

24) Regarding the most important air way cross sectional implication in lung disease? except

a. The total cross-sectional area of each generation of air way doesn't change at all
b. Like trumpet where you have got a long initial part and flaring at the end of trumpet
c. The forward of gas velocity in enormous cross-sectional area becomes very small by convection
d. Bronchitis the first changes take place in terminal bronchi
e. The diffusion rate of pollutants is much small and massive compared to the air way particles

26) If you have given the following values in hypoxic patient; PAO2=50mmHg and PACO2= 80mmHg What inspired O2 concentration is required to return the alveolar P02 to normal?

a. 28% b. 100% c. 40%
d. 50% e. 80%

15) A person with alveolar hypoventilation has?

a. Arterial hypoxemia only
b. Arterial hypoxemia and hypocapnea
c. increased Alveolar— arterial oxygen gradient
d. Arterial hypoxemia and hypercapnea
e. Normal PaC02 and Pao2

8) Regarding ventilation / perfusion (V/Q) relationships, which statement is INCORRECT?

a. V/Q ratio is greatest at the lung apex
b. V/Q ratio is about one at level of third rib when upright
c. Ventilation decreases proportionately more than perfusion from base to apex
d. V/Q ratio for whole lung at rest is about 0.8
e. Exercise increases the V/Q ratio

5) The Alveolar - arterial oxygen (A—a P02) gradient?

a. Is normally about 5 kPa (39.5 mmHg) in a young person
b. Is increased by hypoventilation
c. is usually increased by either right-to-left shunts or ventilation-perfusion mismatching.
d. Oxygen therapy can significantly improve oxygen saturation of the blood emerging from regions with a low ventilation-perfusion ratio
e. Is within normal range in case of pulmonary infarction

6) One of the following matched pairs is NOT TRUE?

a. External intercostals and diaphragm- Quit Inspiration
b. Intrapleural pressure minus 7mmHg- Forced inspiration
c. Sternocloidmastoid and scalenes- Quit Expiration
d. Abdominal Muscles'Forced Expiration
e. Intrapleural pressure minus 3mmHg-Forced Expiration

4) By comparing between pulmonary and systemic circulation, which of the following is NOT TRUE?

a. Pulmonary vascular resistance is 1/10 of Systemic vascular resistance
b. The right ventricle receives mixed venous blood and pumps it through the pulmonic valve, which marks the beginning of the pulmonary circulation
c. Pulmonary capillary blood flows in thin sheets, as opposed to the distinctly tubular flow in systemic capillaries
d. The thin walls of pulmonary vessels and vast area of the capillary bed make the pulmonary vasculature highly distensible compared with the systemic vasculature
e. The diffusion distance between air and blood in pulmonary circulation is ten times of the diffusion distance that exists between systemic capillaries and tissue cells

33) Regarding the implications of starling law in edema, which of the following is NOT true?

a. Any factor that causes the pulmonary interstitial fluid pressure to rise from the negative range into the positive range
b. Left-sided heart failure or mitral valve disease
c. Damage to the pulmonary blood capillary membranes
d. The pulmonary capillary pressure must rise from the normal level of7 mm Hg to more than 28mm Hg
e. In chronic left-sided heart failure, in which the pulmonary capillary pressure does rise to 40 mmHg. death frequently ensues in less than 30 minutes

Physio

13) Which of the following statements is true?

a. Lowering the pH shifts the oxygen dissociation curve of hemoglobin to the right
b. The acidic environment allows hemoglobin to bind 02 more strongly
c. The affinity of hemoglobin for 02 is improved by high concentrations of C02.
d. In the lungs, the presence of higher concentrations of H+ and C02 allows hemoglobin to become more oxygenated.
e. In the lungs, the presence of higher concentrations of 02 promotes the binding of C02 and H+.

Physio

21) Which of the following is NOT CONSISTENT with respiratory system under stress in high attitudes?

a. Increases production of 2, 3-Diphosphoglycerate
b. Right shift of oxyhemoglobin dissociation cure
c. At very high attitude left shift of oxyhemoglobin dissociation curve could happen due to increase pH
d. Respiratory alkalosis
e. Increase PA02 due to hyperventilation

Physio

68) With regard to control of ventilation?

a. Impulse from pneumotaxic center may reduce inspiratory phase
b. Apneustic center is in the medulla
c. The pontine respiratory center is responsible for intrinsic respiratory rhythm
d. The expiratory area is active during normal breathing
e. Firing of the carotid body chemoreceptor respond most to changes in pCO2.

Physio

66) The binding of O2 to haemoglobin in humans is favoured by?

a. The carbamino reaction
b. High altitude adaptation
c. High pH
d. High C02 concentration
e. High BPG concentration

Physio

52) Ventilation & perfusion relationships vary in the upright lung?

a. ventilation is greater at apex than base
b. perfusion is greater at apex than base
c. V/Q approaches unity at apex
d. V/Q is more than 3 times greater at apex than base
e. V/Q is greater at base of lung than apex

Physio

45) The peripheral chemoreceptors?

a. Are located in the pulmonary artery and aortic arch
b. Are responsible for 80% of the ventilatory response to increased Pco2
c. Respond to changes in arterial pH
d. Contain type II cells which detect hypoxia
e. Have low blood flow

21) Which of the following is NOT CONSISTENT with respiratory system under stress in high attitudes?

a. Increases production of 2, 3-Diphosphoglycerate
b. Right shift of oxyhemoglobin dissociation cure
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d. Respiratory alkalosis
e. Increase PA02 due to hyperventilation

Physio

32) Regarding Blood Gas Barrier ultrastructural changes?

a. Polarized
b. The alveolar side is thinner than capillary side
c. Stress Failure
d. One third of micron
e. Type Four of collagen

23) What effect does the binding of C02 and H+ to hemoglobin (Hb) in the peripheral tissues have on the body. choose the wrong statement?

a. The binding of C02 stabilize the tense form of Hb
b. Binding of H+ to Hb serves as a buffer to regulate the pH of peripheral tissues
c. It facilitates the release of 02 in the peripheral tissues
d. The H+ released bind amino acid histidine number 143 in the two beta chains of adult Hb and serine in gamma chain in fetal
e. The binding of H+ stabilize the tense form of Hb

18) The most important clinical implication of Dalton's law in alveolar ventilation?

a. Blood Gas Exchange
b. Oxygen Mole fraction
c. Hemoglobin dissociation curve
d. Oxygen Partial Pressure
e. Dynamic movement of oxygen and carbon dioxide into and out of blood stream

11) Volumes and flows in the lung?

a. The ventilation rate is approximately7500ml/min
b. The ventilation rate is approximately 5250ml/min
c. The volume reaching the blood gas per a minute on the gas side and the blood side is different
d. The volume of alveolar gas and the volume of blood capillary at any instant in time is the same
e. The fact is that the ratio of ventilation to pulmonary blood flow is more than one

13) Which of the following is NOT describing the pulmonary circulation?

a. If you reduce the capillaries pressure below the alveolar pressure; the capillaries would be compressed
b. The pressure of the extra alveolar vessels affected by the tension of the lung parenchyma
c. Pulmonary vascular resistance is affected by upstream and downstream pressure
d. Increase the arterial or venous pressure one at a time would increase the pulmonary vascular resistance because of capillary recruitment and distension
e. Increase or decrease the lung volume would increase the pulmonary vascular resistance so we tend to breath at minimum pulmonary vascular resistance