Revision Respiratory Physiology Lec 1-9

Presented by

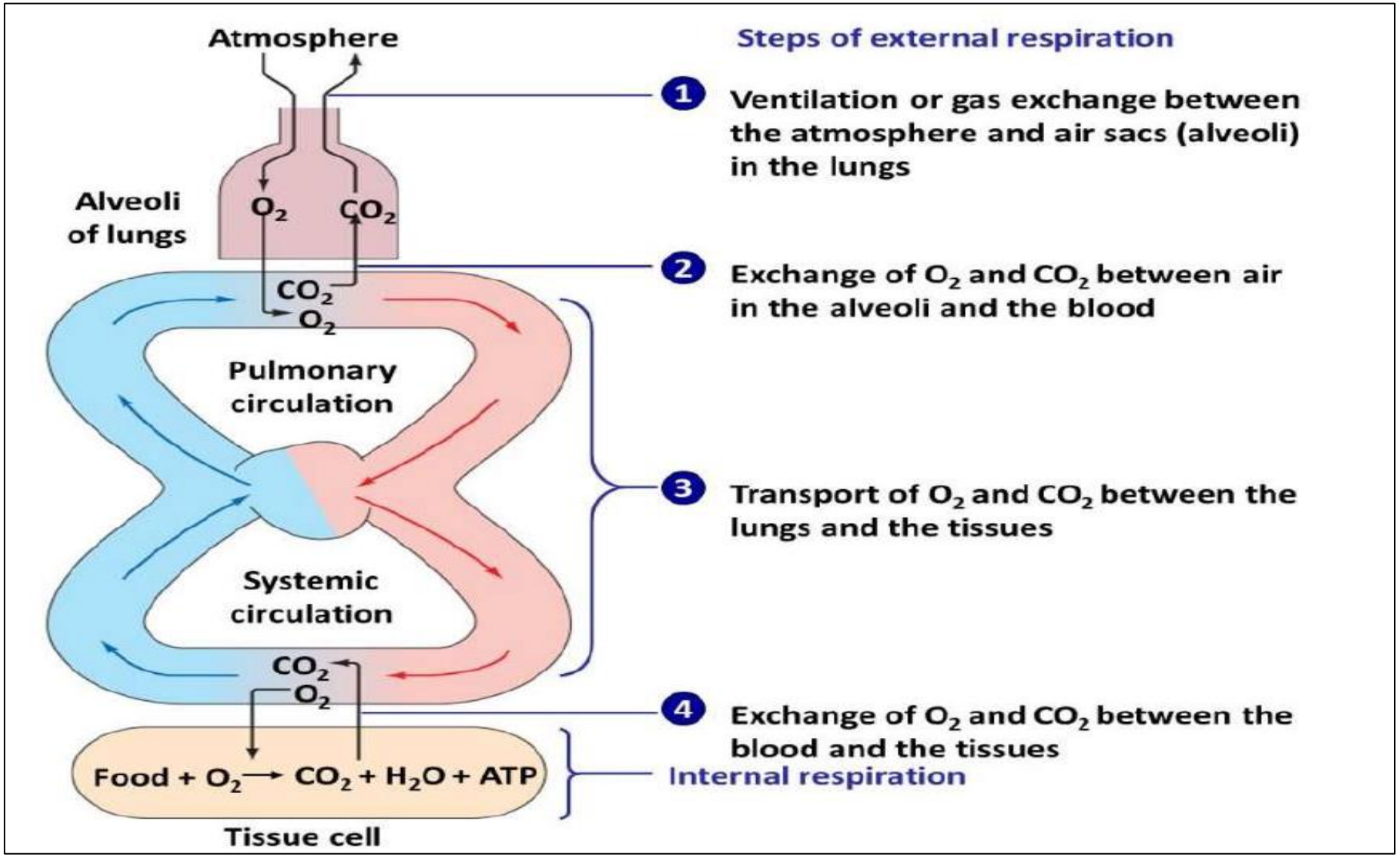
Dr. Amr Elkady

Lecturer of Medical Physiology

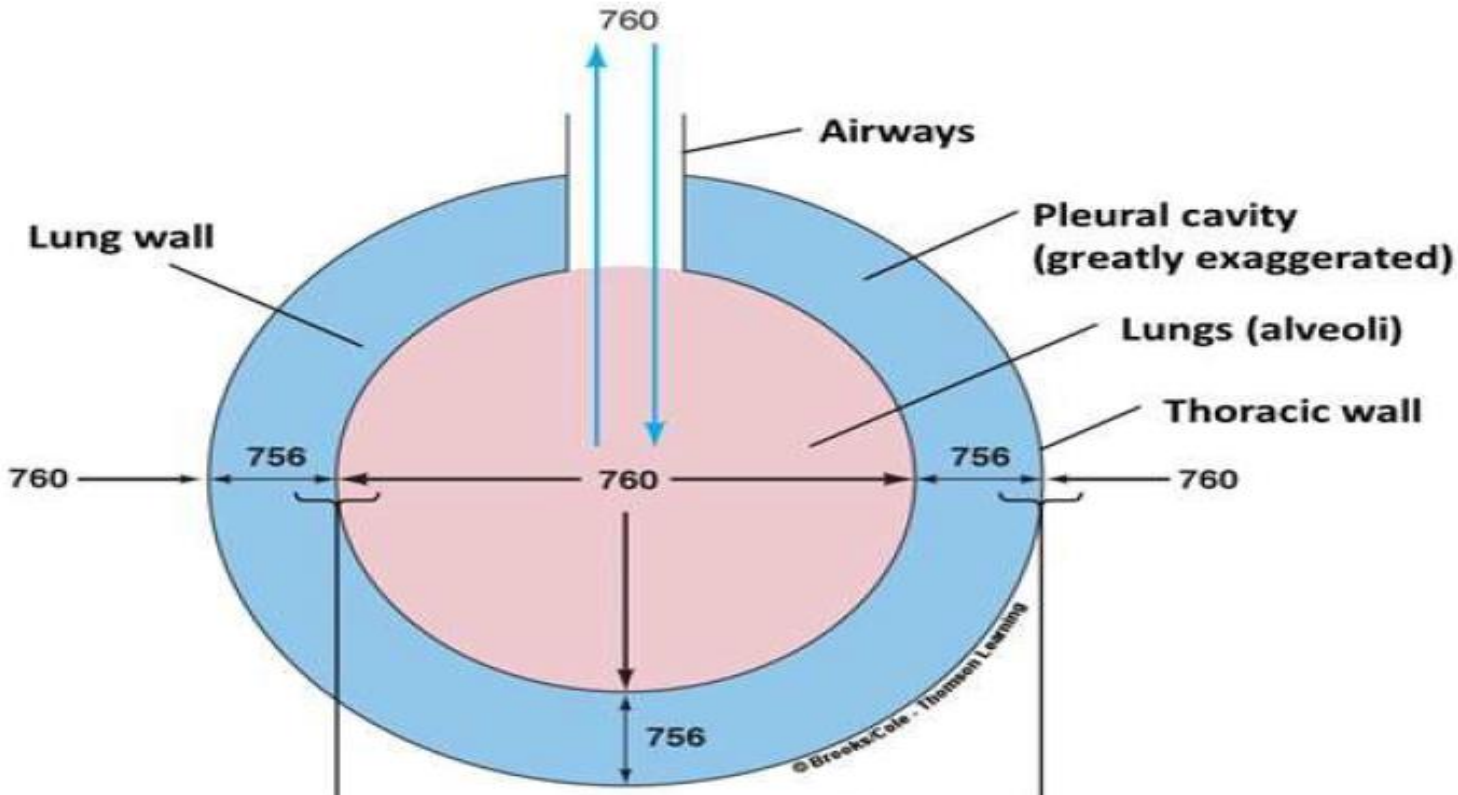
Faculty of Medicine- Ain Shams University

Lectures 1 & 2

Steps of Respiration



Transmural Pressure Gradient

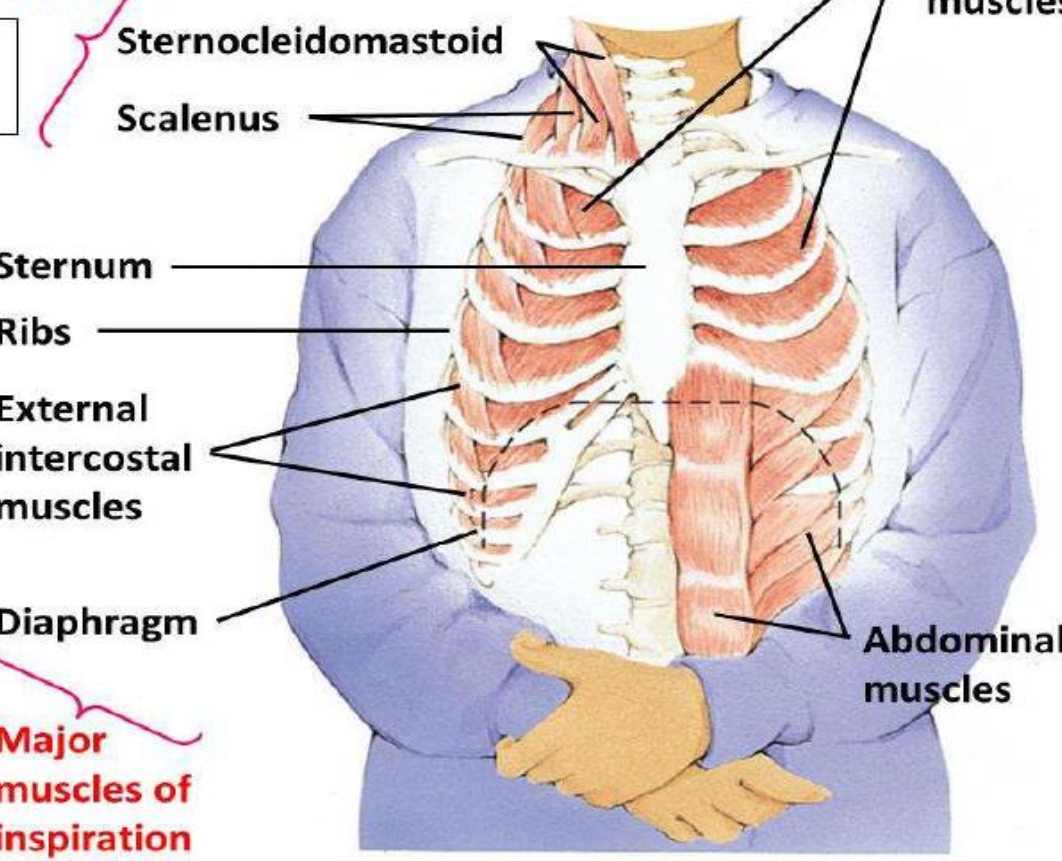


Transpulmonary pressure gradient = intra-alveolar pressure minus intrapleural pressure

Transthoracic pressure gradient = intrapleural pressure minus atmospheric pressure

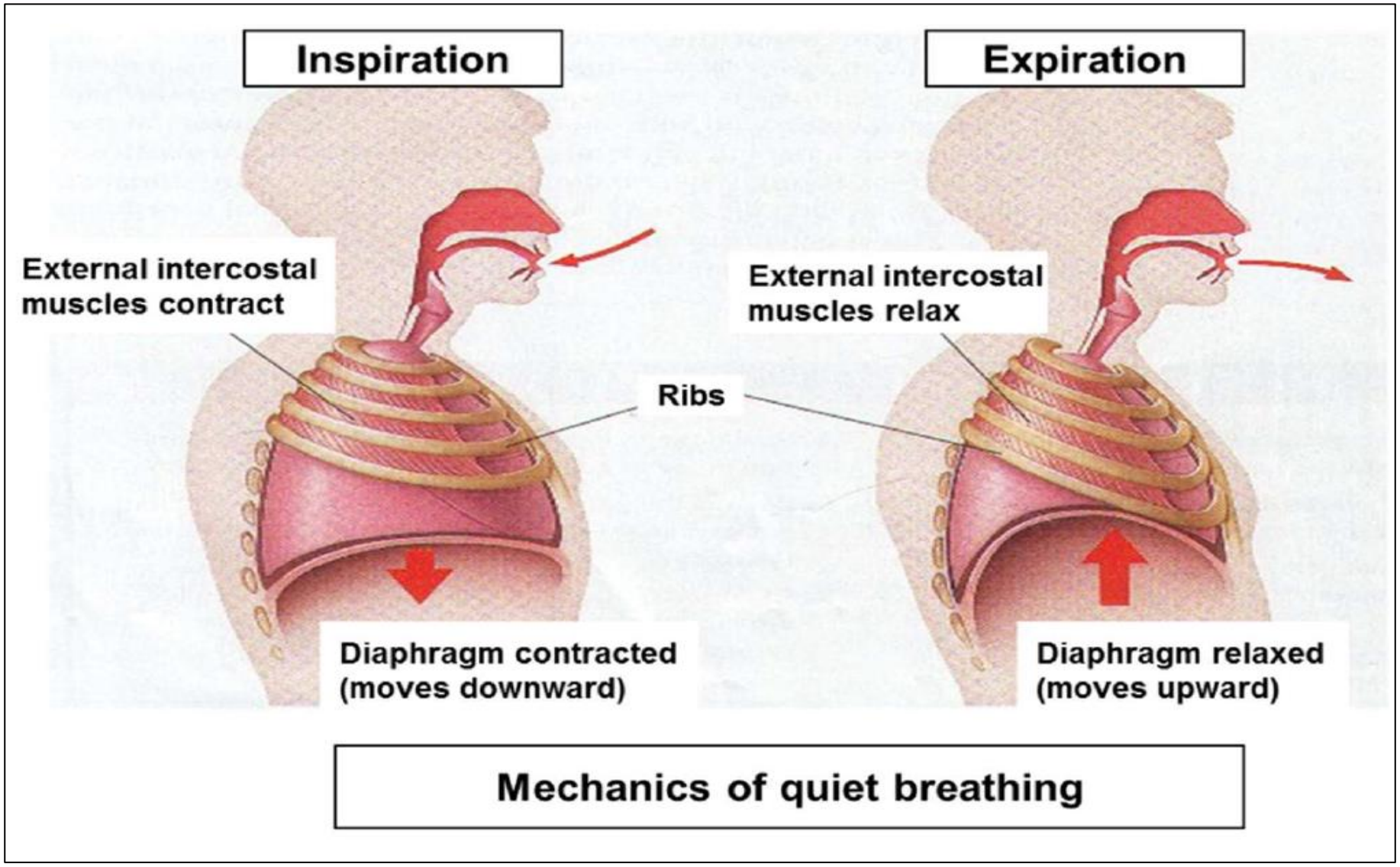
Transmural pressure gradient (numbers are mm Hg pressure)

Muscles of Respiration

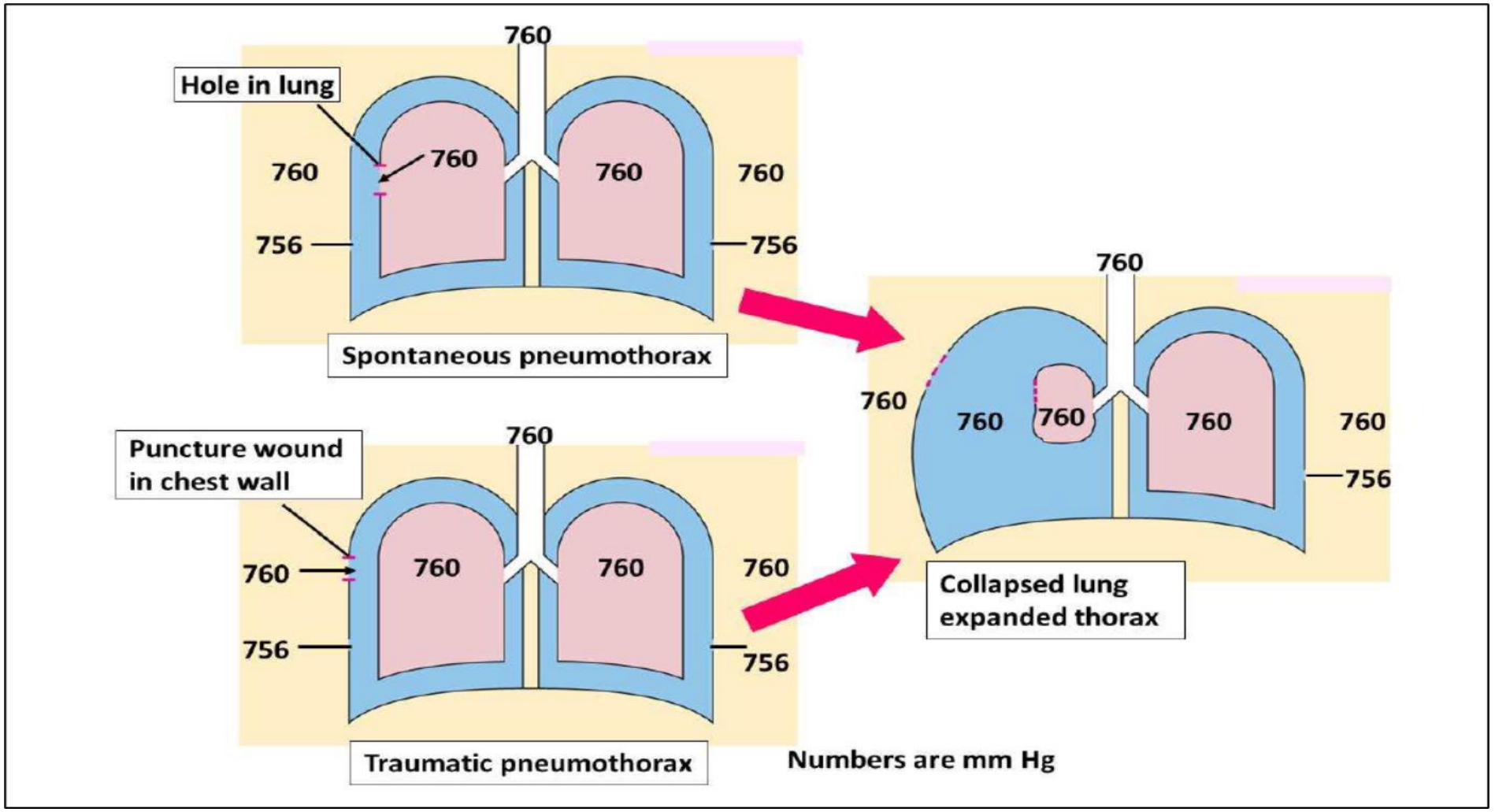


Anatomy and function of the respiratory muscles

Mechanics of Quiet Breathing



Pneumothorax



Q1: List the steps of external respiration?

1. Ventilation
2. Gas exchange between air in the alveoli and blood within pulmonary capillaries.
3. Gas transport between the lungs and the tissue
4. Gas exchange between the tissue and the blood across the systemic tissue capillaries

Q2. Delineate the endocrine functions of the lungs?

Synthesis of:

- Histamine.
- Angiotensin converting enzyme.
- Some prostaglandins.

Q3. Define Trans-pulmonary Pressure Gradient

It is the pressure difference between the intra-alveolar pressure and the intrapleural pressure.

= 760 – 756 = + 4 mmHg

(distending pressure)

Q4. Define Trans-thoracic Pressure Gradient

It is the pressure difference between the intrapleural pressure and the atmospheric pressure

= 756 – 760 = - 4 mmHg

(Compressing pressure)

Q5. Complete:

At the end of both inspiration and expiration, intra-alveolar pressure is ……..atmospheric pressure

At the end of both inspiration and expiration, intra-alveolar pressure is **equal to** atmospheric pressure

Pressure changes during the respiratory cycle

- **During** inspiration, intra-alveolar pressure is **less than** atmospheric pressure.
- **During** expiration, intra-alveolar pressure **is greater** than atmospheric pressure.
- **At the end** of both inspiration and expiration, intra-alveolar pressure is **equal to** atmospheric pressure because the alveoli are in direct communication with the atmosphere, and air continues to flow down its pressure gradient until the two pressures equilibrate.

Pressure changes during the respiratory cycle

- **Throughout the respiratory cycle**, the intrapleural pressure (IPP) **is lower than** the intra-alveolar pressure. Thus, a trans-pulmonary pressure gradient always exists, and the lungs are always stretched (inflated) to some degree, even during expiration.
- Although IPP exceeds the atmospheric pressure during forced expiration, the lungs do not collapse. This is due to the corresponding increase in intra-alveolar pressure that maintains the **trans-pulmonary pressure gradient**, thus keeping lungs stretched.

MCQ

1. **Removal of which of the following substances can be achieved by the respiratory system?**

A. Surfactant

B. Angiotensin II

C. Histamine

D. Serotonin

E. Tissue plasminogen activator

D

MCQ

2. Which of the following is not a function of the respiratory system?

A. Shares in phonation

B. Maintenance of acid-base balance

C. Enhancement of venous and lymphatic return

D. Transport oxygen and carbon dioxide to and from the tissues

E. Removal of small particles more than 2 µm

D

MCQ

3. The conducting portion of the respiratory system is important for?

A. synthesis of surfactant

B. air conditioning

C. vascular reservoir

D. increasing venous return

E. maintenance of acid-base balance

B

MCQ

4. During quite respiration, which of the following events occur?

A. Internal intercostal muscles contract in the expiratory phase

B. Intra-alveolar pressure is always sub atmospheric

C. Intra- pleural pressure is always sub atmospheric **C**

D. Volume of air left in the lungs at the end of expiration constitutes the residual volume

E. Volume of air left in the lungs at the end of inspiration constitutes the vital capacity

MCQ

Q5. The process of forced expiration involves:

A. contraction of diaphragm and internal intercostal muscles

B. contraction of external intercostal muscles

C. contraction of internal intercostal and abdominal muscles

C

D. relaxation of diaphragm and external intercostal muscles

E. relaxation of diaphragm and contraction of abdominal muscles

MCQ

Q6. Which of the following is the intrapleural pressure during forced inspiration?

A. -30 mmHg — **Forced Inspiration**

B. -6 mmHg — **at the end of normal (quiet) inspiration**

C. -4 mmHg — **at the end of normal (quiet) expiration**

D. 0 mmHg — **Cannot be zero as no direct communication with the with the intra-alveolar pressure or atmospheric pressure**

E. +30 mmHg — **Forced expiration**

A

MCQ

Q7. During normal quiet inspiration which of the following events occurs?

A. Contraction of abdominal muscle

B. Intrapulmonary pressure becomes negative

C. Intrapleural pressure become positive

D. Contraction of the internal intercostal muscle

E. Decrease of the transmural pressure gradient across the lungs

B

MCQ

Q8. A 22-year-old man was exposed to stab wound during fighting. Which of the following is expected to occur?

A. The thoracic wall is compressed

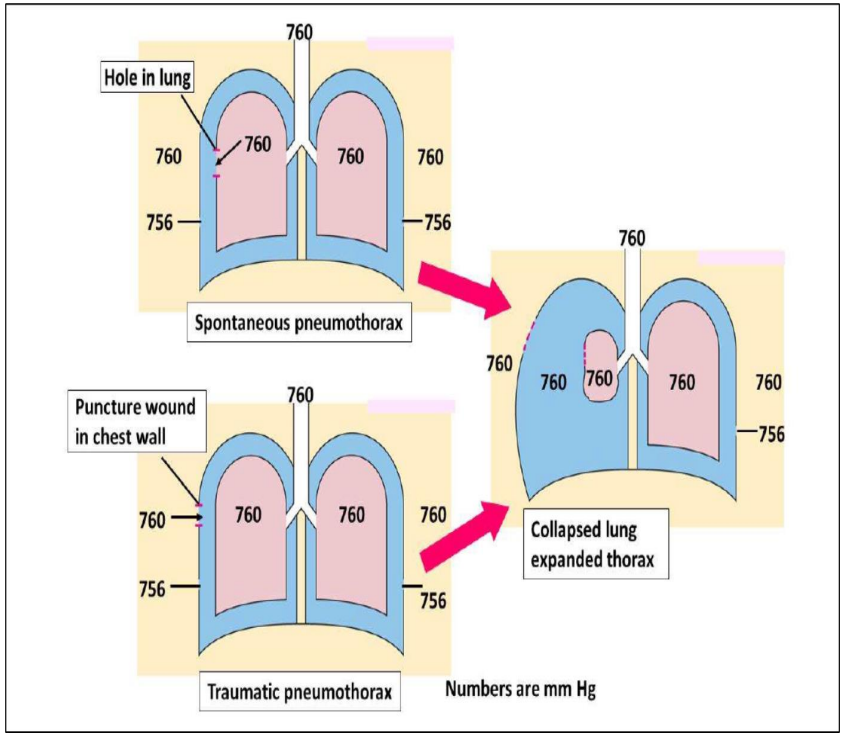
B. The lungs get inflated

C. The lungs get collapsed

D. Intra thoracic pressure becomes more negative

E. Intrapleural pressure becomes higher than Intra-alveolar pressure

C



Lecture 3

Air flow & Resistance

Air flow in and out of the lungs depends on

- ***The pressure gradient*** between the alveoli and the atmosphere
- ***The resistance*** to the flow offered by the airways

$$F = \frac{\Delta P}{R}$$

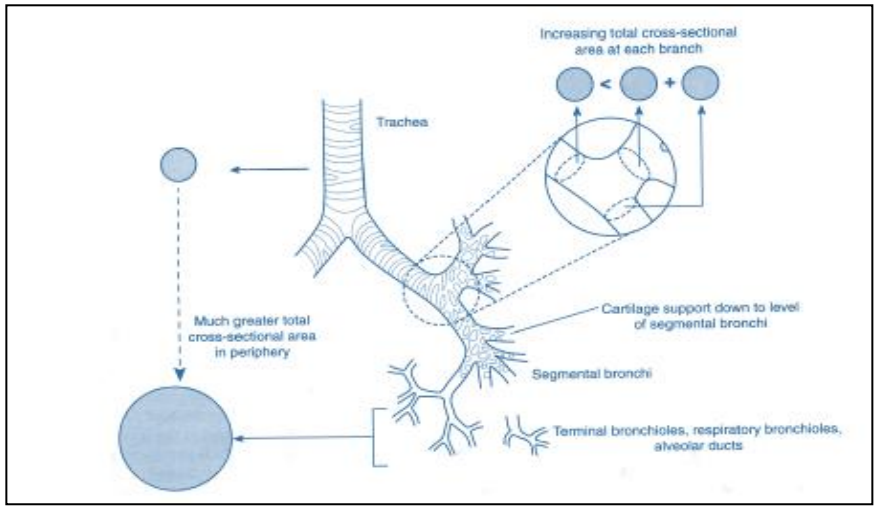
- ***Air Flow is directly proportional to pressure gradient & inversely proportional to the airway resistance***

$$\text{The resistance} = \frac{8 \eta L}{\pi r4}$$

- ***The resistance*** **to the air flow offered by the airways** is directly proportional to the viscosity air and length of the airway and inversely proportional to fourth power of the *radius of airways (Total cross section area)*.

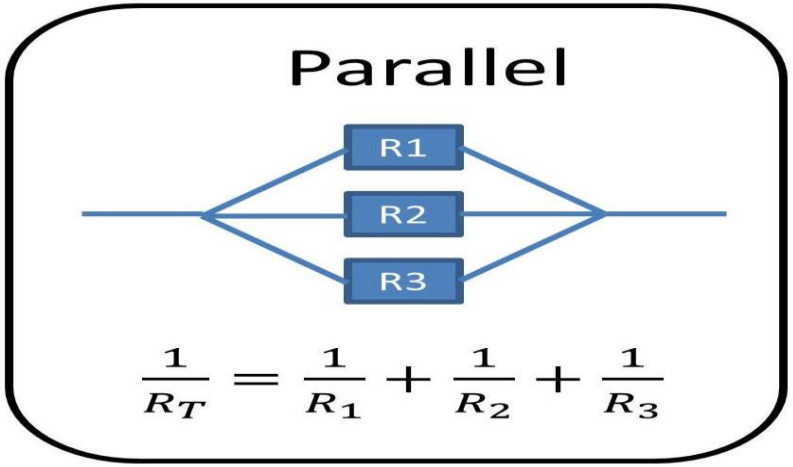
Q1. Explain why the airway resistance is low in the small airways?

(1) Their multiple divisions.



(2) Their arrangement in parallel.

$$\text{The resistance} = \frac{8\,\eta\,L}{\pi\,r4}$$



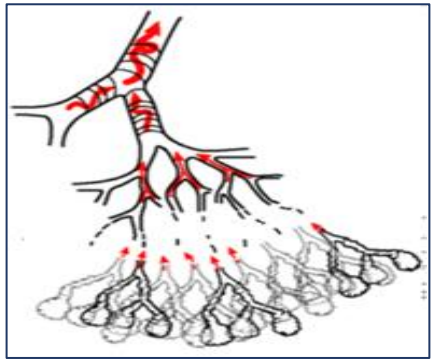
Thus, the total cross-sectional area of the smaller airways (e.g., terminal bronchioles) is much greater than that of the larger airways (e.g., bronchi)

Q2. What is the advantage of Increased total cross-sectional area of the smaller airways (e.g., terminal bronchioles) than that of the larger airways (e.g., bronchi)?

Increased total cross-sectional area of the smaller airways (e.g., terminal bronchioles) than that of the larger airways (e.g., bronchi)

$R \alpha \frac{1}{r4}$

Decreased resistance to airflow in smaller airways than in larger airways.

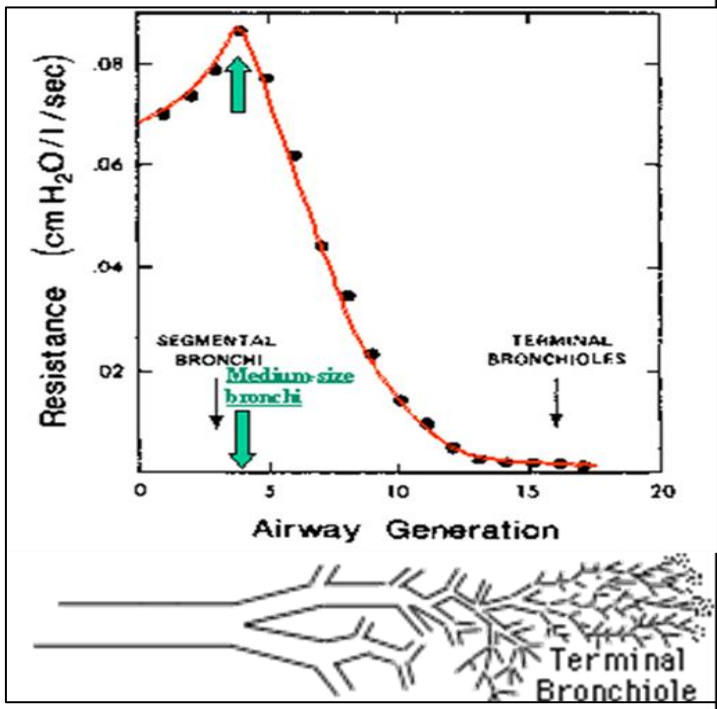


$V \alpha \frac{1}{TCSA}$

Decreased velocity of airflow in the small airways to very low values gives sufficient time for gas exchange in the alveoli.

Q3. Where is the highest and where is the lowest airway resistance in the respiratory system?

- ***Highest*** airway resistance occurs in ***medium sized bronchi.***
- ***Lowest*** airway resistance occurs in ***smallest airways (respiratory bronchioles)*** *because the combined cross-sectional area of these airways is much larger than that of the medium sized bronchi.*



Q4. Discuss the factors Keeping Small Airway Opened?

Transmural pressure gradient across airways

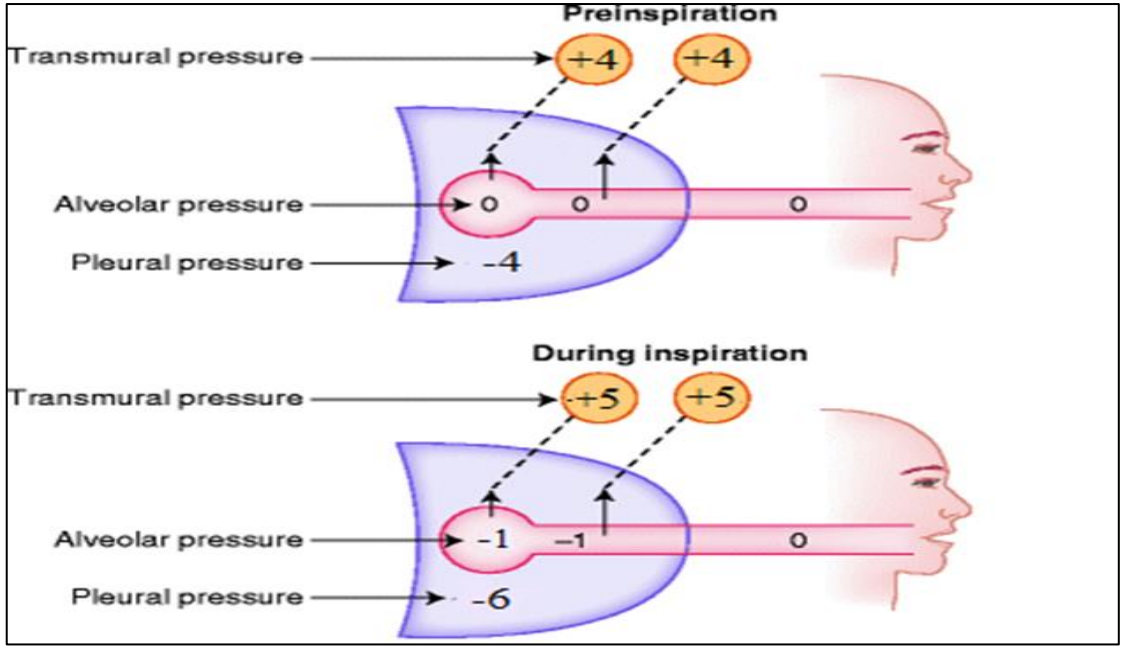
- It is the major factor preventing small airway collapse.
- It equals airway pressure minus intrapleural pressure.
- During inspiration, the trans-mural pressure gradient increases, resulting in increased airway diameter with reduction of airway resistance

Elastic lateral (radial) traction

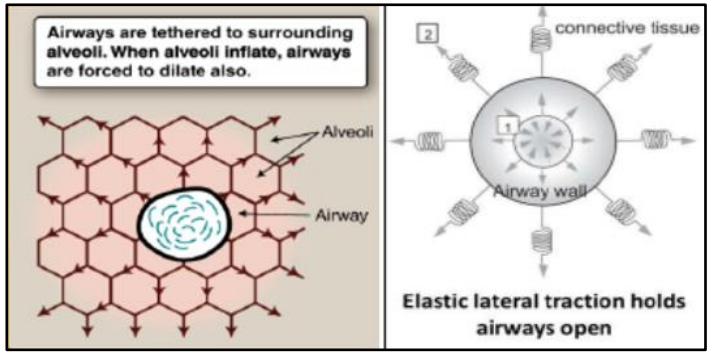
- holds airways open by the continuous outward pulling on the sides of the airways, with reduction of airway resistance.

Q4. Discuss the factors Keeping Small Airway Opened?

Transmural pressure gradient across airways



Elastic lateral (radial) traction



Q 5. Mention why airway resistance decreases in each of the following:

A. breathing through mouth than through nose.

B. terminal bronchioles than in medium sized bronchi.

A. airway resistance decreases in breathing through mouth than through nose due to decrease in length of respiratory pathway.

B. airway resistance decreases in terminal bronchioles because of larger surface area due to multiple parallel branches.

Q6. Describe the effect of autonomic nervous system and alveolar CO_2 on airways resistance?

- **Parasympathetic stimulation and decreased alveolar CO_2** causes Bronchoconstriction with increase of airway resistance
- **Sympathetic stimulation and increased alveolar CO_2** causes Bronchodilation with reduction of airway resistance

MCQ

1. **Which of the following is correct about airflow through pulmonary bronchioles?**

A. increases by decreased CO_2 in alveoli.

B. decreases by lowering intrapleural pressure (i.e., more negative) during inspiration.

E

C. is inversely proportional to pressure gradient between alveoli and atmosphere.

D. is directly proportional to airway resistance.

E. decreases in situations of parasympathetic overactivity.

MCQ

2. Which of the following factors increases the air flow?

A. Decreased the absolute pressure in airways

B. Increased viscosity of the air

C. Increased Length of the airways

D. Increased airway radius

E. Decreased air pressure gradient

D

Lecture 4 & 5

Compliance of the lung

➢ ***Compliance of the lung:*** **Lung compliance (C) is the change in lung volume (ΔV) per unit change in transpulmonary pressure gradient (ΔP) (i.e., distending pressure).**

It is an index for lung distensibility.

$$C = \frac{\Delta V}{P}$$

- Compliance denotes the ***ease*** with which lungs can be stretched (distended).
- In lungs with ***high compliance***, a *small change* in **distending pressure** will cause a *large change* in **lung volume**, i.e., lungs are easily inflated. Thus, less work is required.

Q1. Describe Factors Affecting pulmonary compliance?

Compliance is reduced in

1) **Pulmonary congestion and edema**.
2) **Pulmonary fibrosis** (increased collagen in lung tissue).
3) **Respiratory distress syndrome**.
4) **Persons with only one lung** (pneumonectomy).

➢ ***In these conditions, the patient will need more pressure to inflate the lungs.***

Compliance is increased in

1) **Old age:** due to Loss of lung elastic tissue, decreasing elastic recoil of the lung
2) **Emphysema:** due to destruction of alveolar walls with reduction of tissue elastic forces, thus increasing lung distensibility.

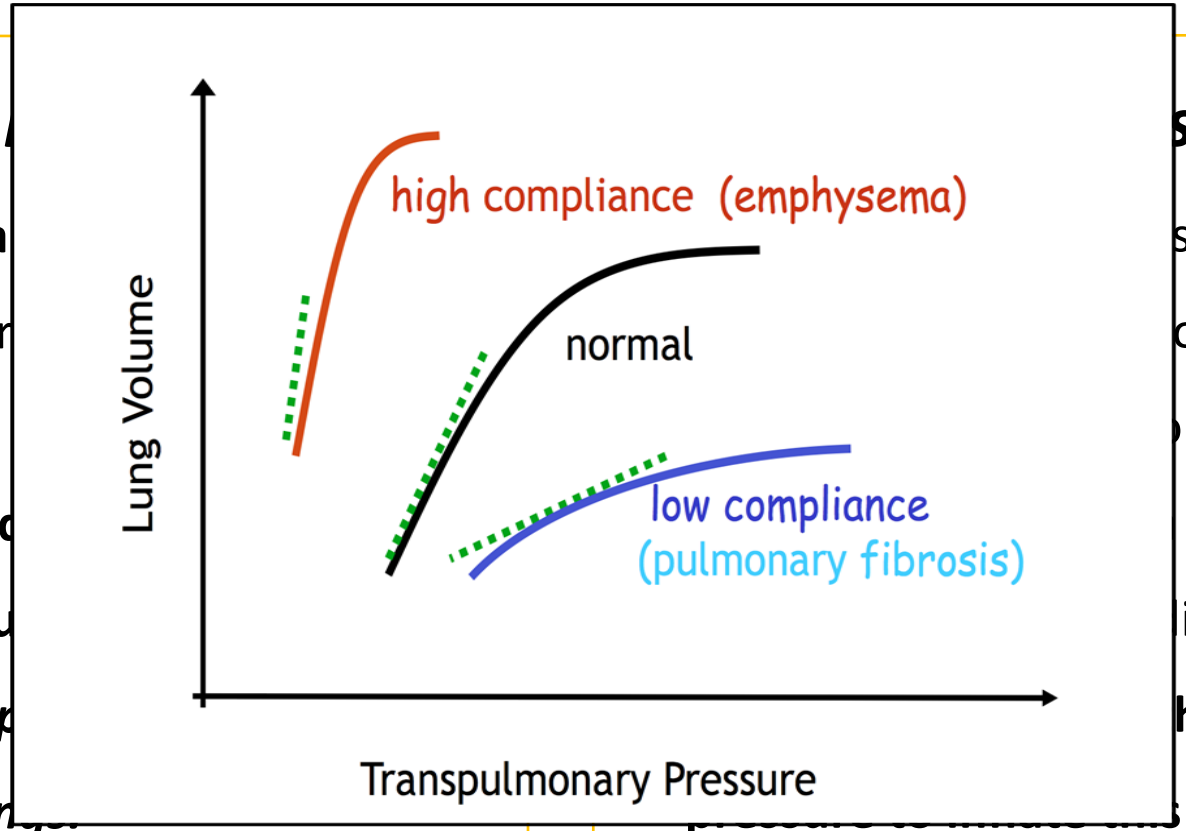
➢ **In these conditions, the patient will need less pressure to inflate this lung.**

Q1. Describe Factors Affecting pulmonary compliance?

Compliance is

1) **Pulmonary congestion a**
2) **Pulmonary fibrosis** (incr
   tissue).
3) **Respiratory distress sync**
4) **Persons with only one lu**

➢ ***In these conditions, the p***
pressure to inflate the lung.



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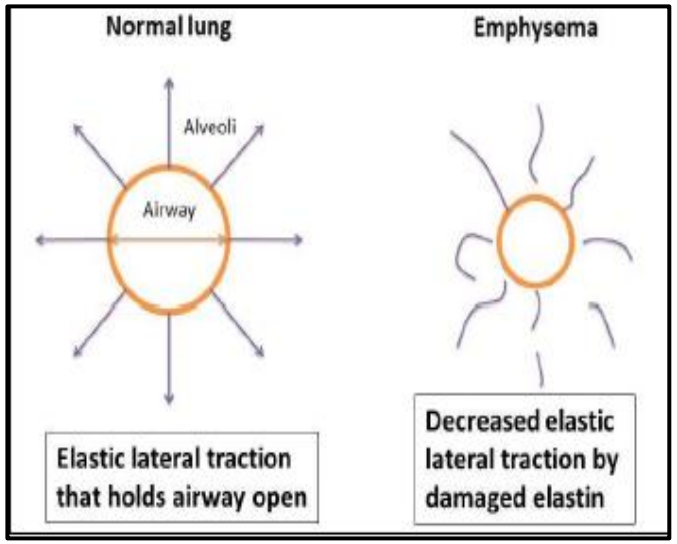
ss of lung elastic tissue,
oil of the lung
destruction of alveolar
of tissue elastic forces,
listensibility.

he patient will need less
s lung.

Q2. Explain why the Loss of lung elastic tissue results in great difficulty in expiration?

A. **Decreased elastic lateral traction** (that holds airways open during expiration), leading to early collapse (closure) of small airways with increased airway resistance.

B. **The decreased elastic recoil** makes passive expiration not enough to empty the lungs, so abdominal muscles contract to aid in emptying the lungs, producing active expiration even during rest, thus increasing the work of breathing.



Q3. List causes of the recoil tendency of the lungs?

Elastic forces of the elastic tissue in the lungs (Lung elasticity): (1/3)

- It is determined by the *elastin* and *collagen* fibers present throughout the lung tissues.
- Both lungs and thoracic wall contain elastic tissue. So, they can be distended, and once the distending force is released, they recoil back**.**

Elastic forces caused by alveolar surface tension: (2/3)

- It is produced by the *attractive forces between the water molecules* at the surface of the liquid film that lines the alveoli, which make alveoli resist inflation and become less in size.
- This surface tension tends to cause the alveoli to collapse, and therefore the lungs recoil away from the chest wall.

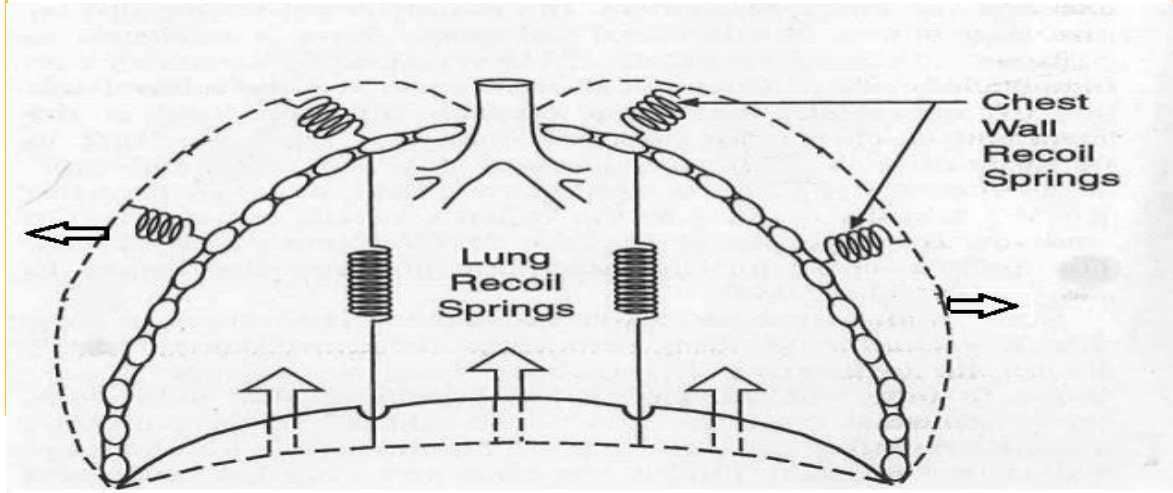
❖ **Thus, lung expansion requires energy to:**

a. Stretch the elastic tissue of the lungs

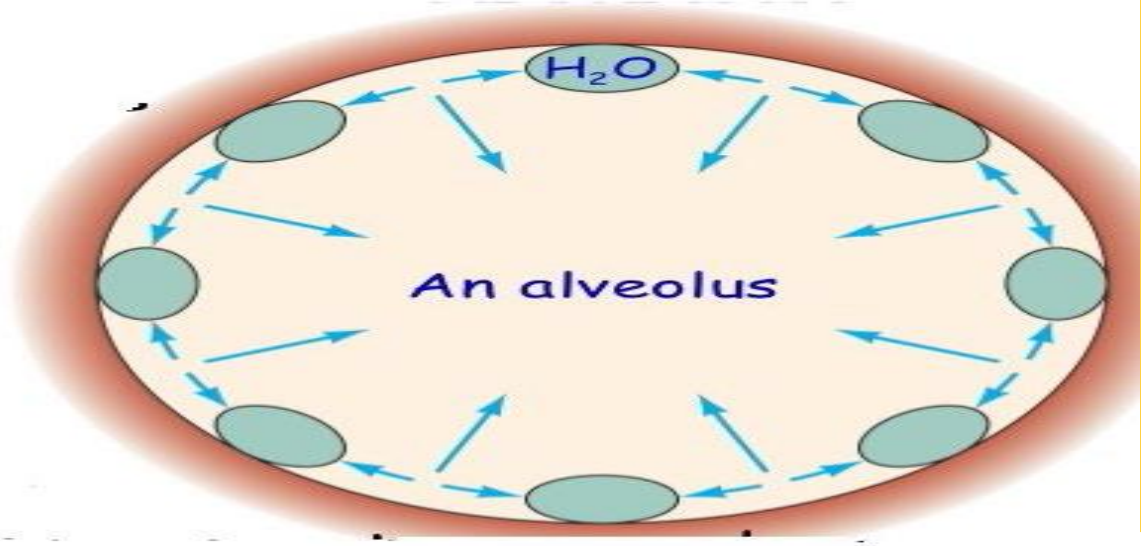
b. Overcome the surface tension force of the fluid layer lining the alveoli

Q3. List causes of the recoil tendency of the lungs?

Elastic forces of the elastic tissue in the lungs (Lung elasticity): (1/3)



Elastic forces caused by alveolar surface tension: (2/3)



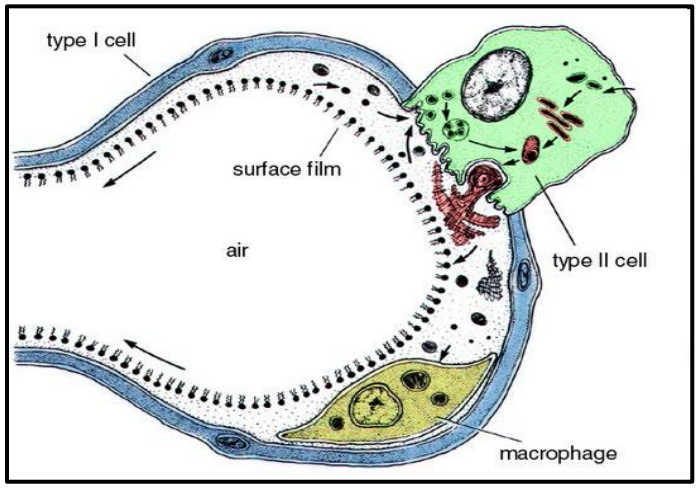
- **Thus, lung expansion requires energy to:**

  a. Stretch the elastic tissue of the lungs

  b. Overcome the surface tension force of the fluid layer lining the alveoli

Pulmonary Surfactant

- **It is a lipid *surface tension-lowering agent* secreted by specific secreting cells *(Type II alveolar epithelium)* and spreads over the surface of the water in the alveoli.**

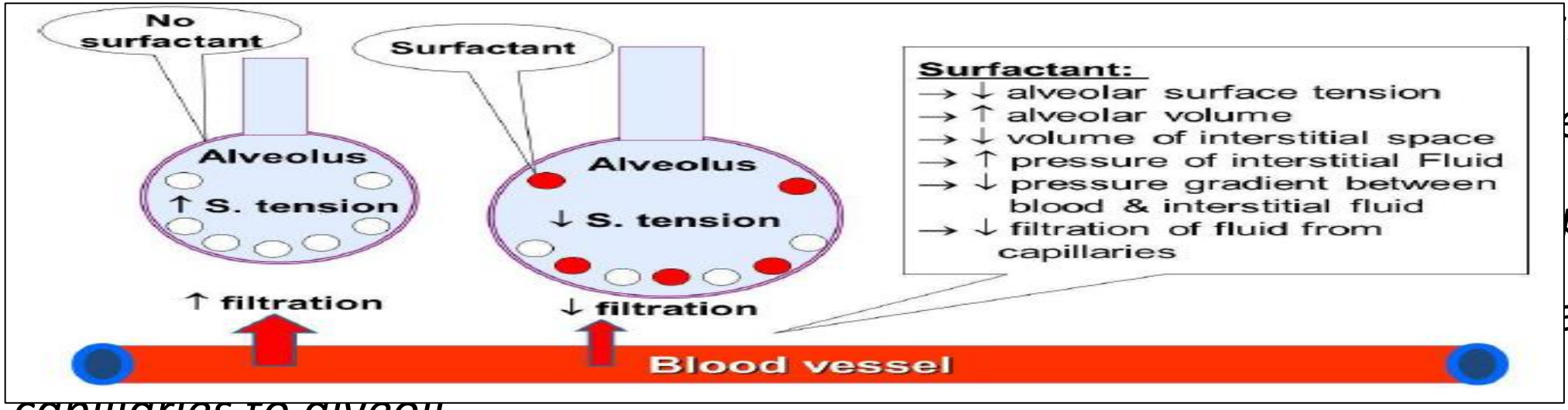


- **Alveolar surface tension is produced by the *attractive forces between the water molecules* at the surface of *the liquid film that lines the alveoli*.**
- This surface tension tends to cause the ***alveoli*** to ***collapse***.

Q4. List Importance of pulmonary surfactant?

1. *It lowers alveolar surface tension by 2-10 folds*
2. *It increases pulmonary compliance, thus facilitating work of breathing and reducing the work of breathing.*
3. *It reduces the tendency of alveoli to recoil, thus preventing alveolar collapse*
4. *It keeps the alveoli dry and prevents pulmonary edema*
5. *Helps to stabilize the sizes of alveoli by equalizing the pressure inside alveoli of different sizes*

Q5. Explain development of pulmonary edema in premature babies?



h would

ease the

pressure

ent from

capillaries to alveoli.

Q5. Explain development of pulmonary edema in premature babies?

Premature babies suffer from inadequate synthesis of surfactant which would increase alveolar surface tension → decrease the alveolar size → increase the volume of interstitial space and decrease its pressure → increase the pressure gradient between blood and interstitial fluid → increase fluid movement from capillaries to alveoli.

Q6. Delineate factors promoting alveolar collapse and factors keeping the alveoli open?

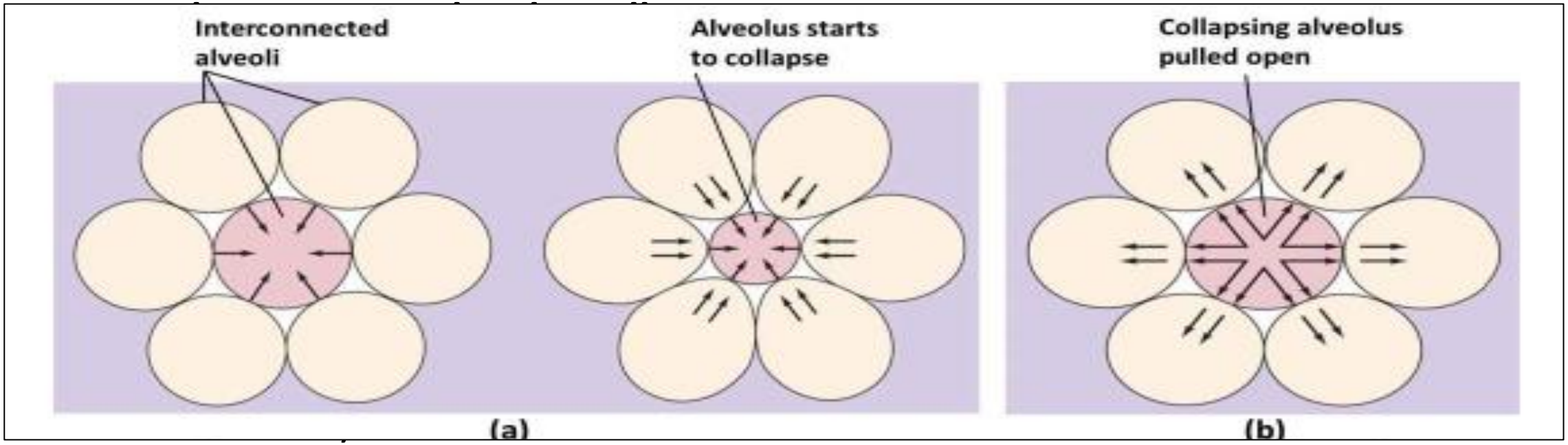
Factors that promote alveolar collapse:

- Elastic connective tissue of the lungs.
- Alveolar surface tension

Factors that keep the alveoli open:

- Transmural pressure gradient across the lung wall: distends the alveoli.
- Pulmonary surfactant: decreases the surface tension.
- Alveolar interdependence.

Q6. Delineate factors promoting alveolar collapse and factors keeping the alveoli open?



- Alveolar interdependence.

Work of Breathing

It is the work performed by respiratory muscles during breathing

Normal quiet breathing

Inspiration (Active)

The inspiratory muscles must work to

a. Expand the lungs against the *elastic forces of the lung and chest wall*, i.e., elastic tissue and *alveolar surface tension*. This is called **elastic work** which equals **65% of work of breathing**.

b. Overcome the resistance opposing air flow, i.e., *airway resistance* and *tissue resistance*. This is called **resistive work** which equals **35% of work of breathing.**

Expiration (Passive)

Done by elastic recoil of the lungs and thoracic wall. So, no work is performed.

Q7. List the conditions that increase the work of breathing?

1. Decreased pulmonary compliance (as in lung fibrosis and respiratory distress syndrome).
2. Increased airway resistance (e.g. COPD).
3. Increased ventilation (e.g. during exercise).
4. decreased elastic recoil (e.g. emphysema).

N.B

- *Tissue resistance represents 20% of the resistive work and is caused by the friction produces as the lung tissues move against each other as the lung expands.*
- *Airway resistance represents 80% of the resistive work.*
- *Resistive work of breathing is elevated in:*
  - *Increase tissue resistance as in sarcoidosis.*
  - *Increase in airway resistance as in asthma, bronchitis and emphysema.*
- *Elastic work of breathing is elevated in pulmonary fibrosis and in deficiency of pulmonary surfactant.*

MCQ

1. An infant born prematurely has neonatal respiratory distress syndrome.

Which of the following would be expected in this infant?

A. Normal arterial oxygen

B. Collapse of the alveoli

C. Increased lung compliance

D. Normal respiratory rate

E. Decreased work of breathing

B

MCQ

2. The volume–pressure curves shown here were obtained from a normal subject and a patient suffering from a pulmonary disease. Which of the following abnormalities is most likely present in this patient?

A. Emphysema

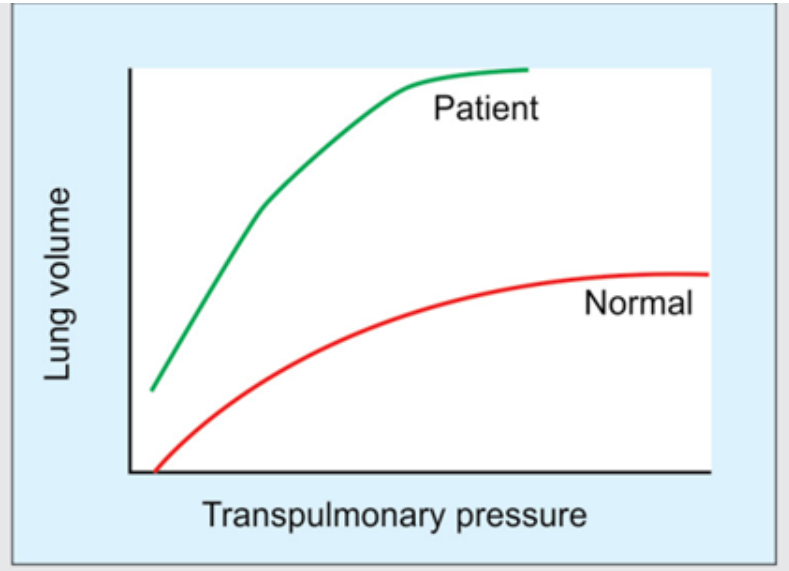
B. Pulmonary fibrosis

C. Pulmonary congestion

D. Respiratory distress syndrome

E. Patient had pneumonectomy before

A



MCQ

3. Elastic work of breathing increases by

A. Increase of alveolar surface tension

B. Increases of lung tissue resistance

C. decrease of airway diameter (i.e., bronchoconstriction)

D. B2- adrenergic antagonists

E. Parasympathetic stimulation

A

MCQ

4. Increased alveolar surface tension leads to an increase in:

A. airway resistance.

B. alveolar collapse.

C. lung compliance.

D. alveolar surface area.

E. stability of alveolar size.

B

MCQ

5. Work of breathing is lower in which of the following conditions?

A. Emphysema

B. Pulmonary fibrosis

C. Strenuous exercises

D. Normal quiet breathing

E. Respiratory distress syndrome

D

MCQ

6. Which of the following is correctly related to pulmonary surfactant?

A. is formed by type I alveolar cells.

B. increases airway resistance.

E

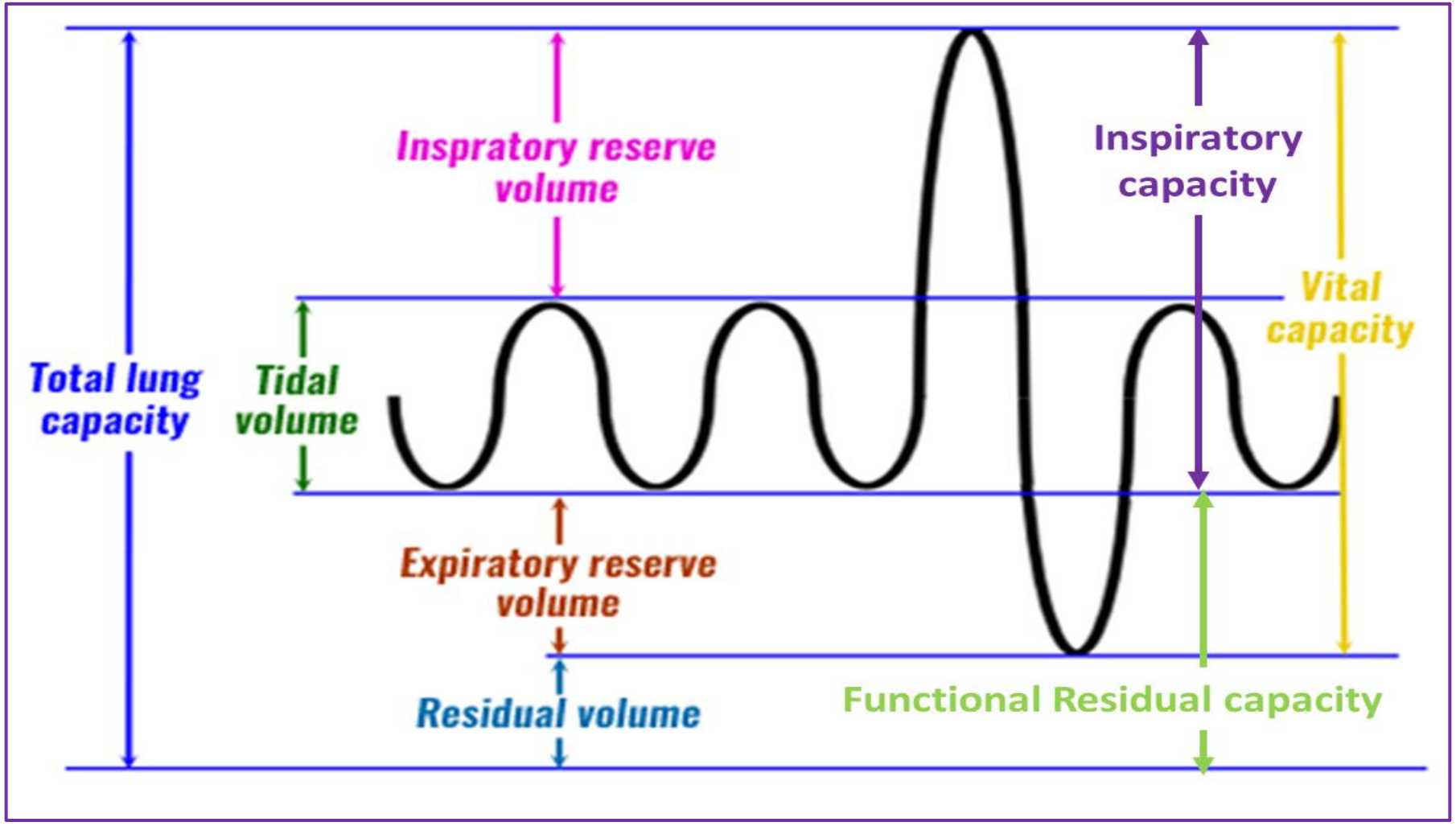
C. is distributed between the liquid layer and alveolar epithelium.

D. is usually at high concentration in the lungs of the premature infant.

E. decreases surface tension in small alveoli more than in large alveoli.

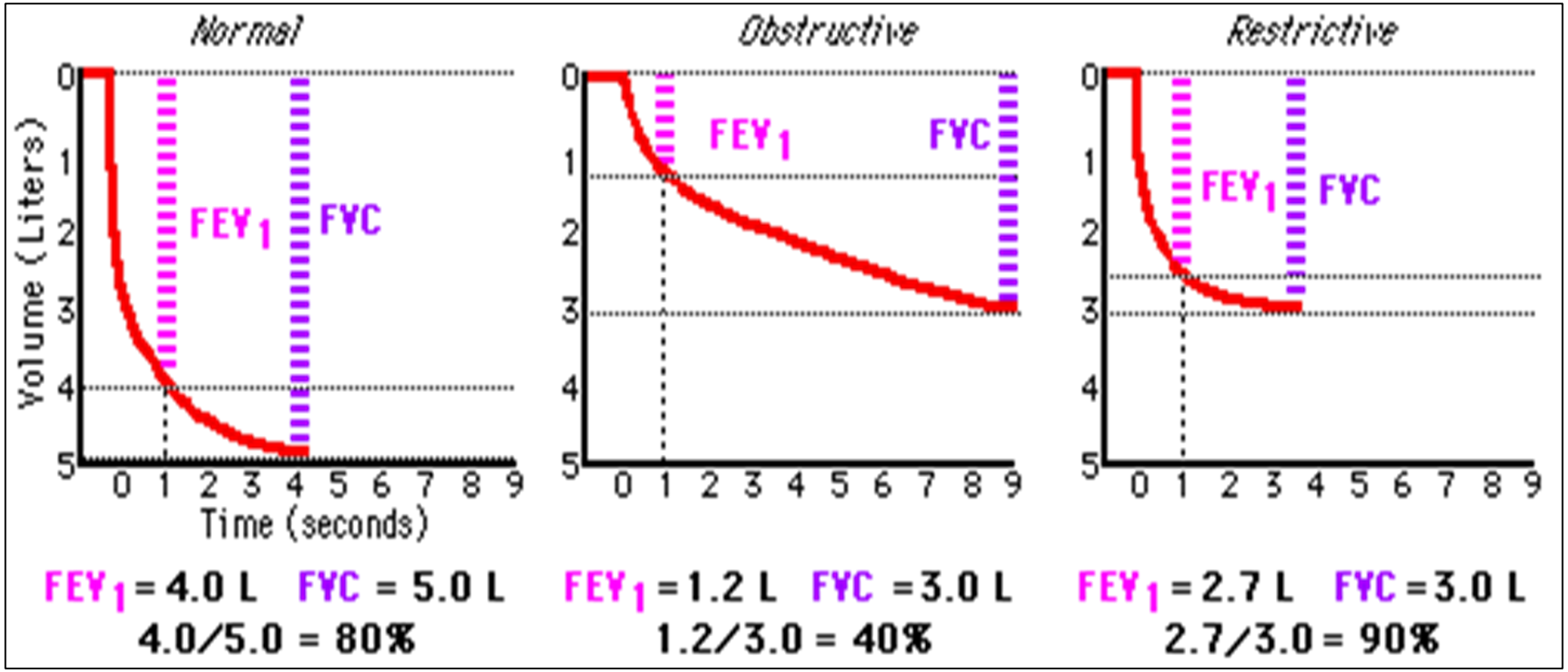
Lecture 6 & 7

Lung volumes & Capacities



Clinical importance of measuring FVC and FEV1

- FEV1/VC% is particularly useful in distinguishing between obstructive and restrictive lung disease.



Q1. List static lung volumes and define each one of them.

1. **Tidal volume**: amount of air inspired or expired during one resting breath
2. **Inspiratory reserve volume**: amount of air inspired by forced deep inspiration after normal tidal inspiration
3. **Expiratory reserve volume**: amount of air expired by forced deep expiration after normal tidal expiration
4. **Residual volume**: amount of air remaining in lung after deepest expiration

Q2. Explain the importance of the residual volume?

1. It maintains aeration of blood between breaths.
2. It prevents marked changes in arterial concentration of O_2 and CO_2 with each breath which may disturb the respiratory function.
3. It prevents lung collapse and helps easy inflation of lung since collapsed alveoli require great inspiratory effort to reinflate.
4. Normally, it represents 20% of total lung capacity. The residual volume increases in lung diseases characterized by difficult expiration because air is trapped in the alveoli as bronchial asthma and emphysema.

Explain the importance of the residual volume

5. Medicolegal importance: to detect if a dead baby was born alive (infanticide) or born dead (feticide). This is by placing lung in water. If lung floats, it indicates the presence of minimal air (the baby has breathed after birth) → baby was born alive then died. If the lung sinks, it indicates absence of minimal air (the baby has never breathed after birth) → baby was born dead.

MCQ

1. Which of the following is a function of residual volume?

A. Keeps gas exchange in between breaths

B. Represents 30% of total lung capacity

C. Is a measurement for fitness

D. Changes composition of expired air

E. Determines airway resistance

A

MCQ

2. Which of the following is the air that exists in the lung at the end of forced expiration?

A. Inspiratory reserve volume

B. Expiratory reserve volume

C. Functional residual capacity

D. Total lung capacity

E. Residual volume

E

MCQ

3. Which of the following best describes average lung volumes and capacities of a person?

A. TLC > VC > TV > FRC

B. TLC > FRC > VC > TV

C. TLC > TV > VC > FRC

D. TLC > VC > FRC > TV

E. TLC > FRC > TV > VC

D

MCQ

4. Vital capacity is increased in which of the following conditions?

A. Elderly

B. Myopathy

C. Pregnancy

D. Sitting position

E. Pulmonary fibrosis

D

MCQ

5. A 65 year old man was diagnosed as left–sided heart failure. On examination his respiratory rate was found to be 30 breaths per minute and air inhaled during each breath was 200 ml. Which of the following is the alveolar ventilation of this patient?

A. 500 ml/min.

B. 1000 ml/min.

C. 1500 ml/min.

D. 4500 ml/min.

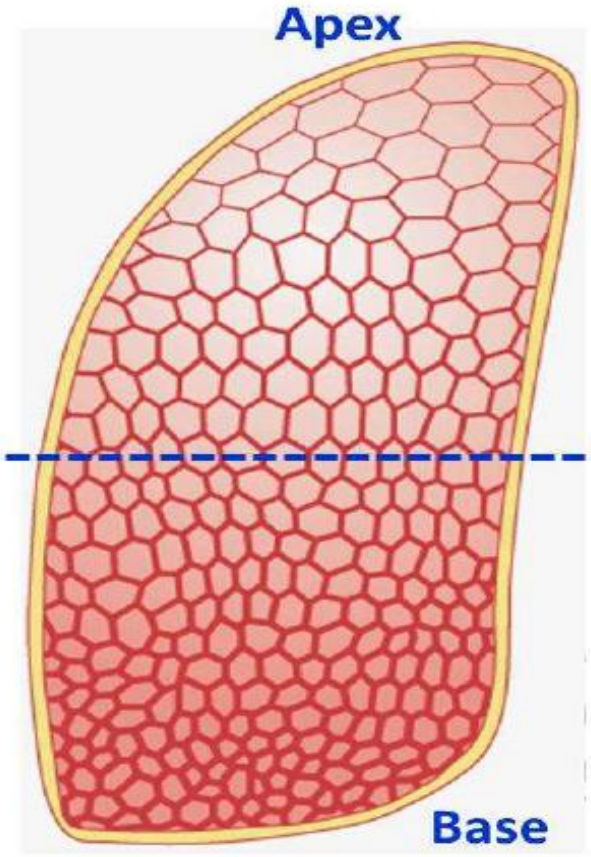
E. 6000 ml/min.

C

Lecture 8

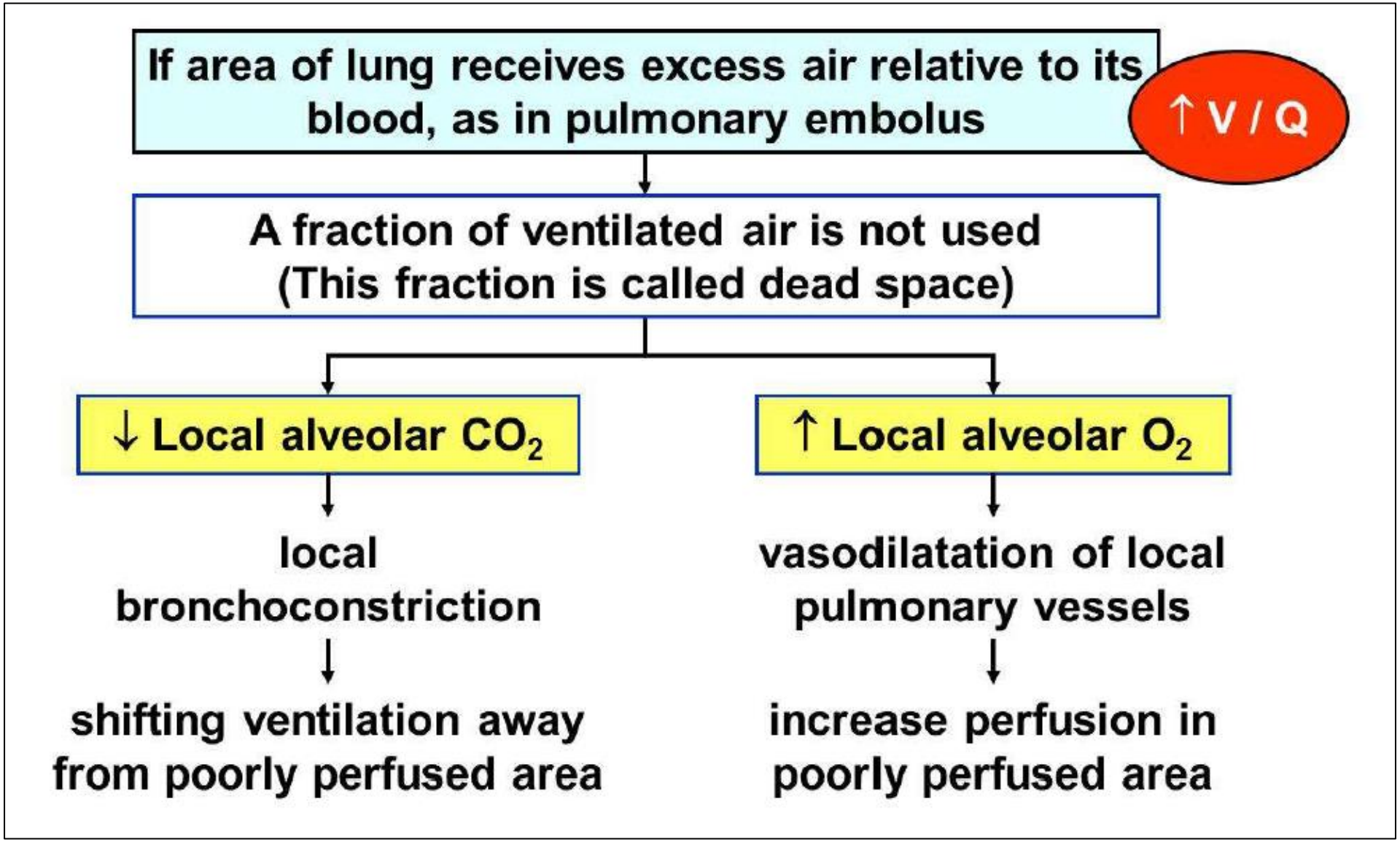
Regional differences in ventilation (left) and perfusion (right) in the normal upright lung

Ventilation	Perfusion
↑ Negative intrapl. P.	↓ Pulm. arterial P.
↑ Transpulm. P. grad.	↓ Recruitment
↑ Alveolar size	↓ Distention
↓ Compliance	↑ Resistance
↓ Ventilation	↓ Blood flow
↓ Negative intrapl. P.	↑ Pulm.arterial P.
↓ Transpulm. P. grad.	↑ Recruitment
↓ Alveolar size	↑ Distention
↑ Compliance	↓ Resistance
↑ Ventilation	↑ Blood flow

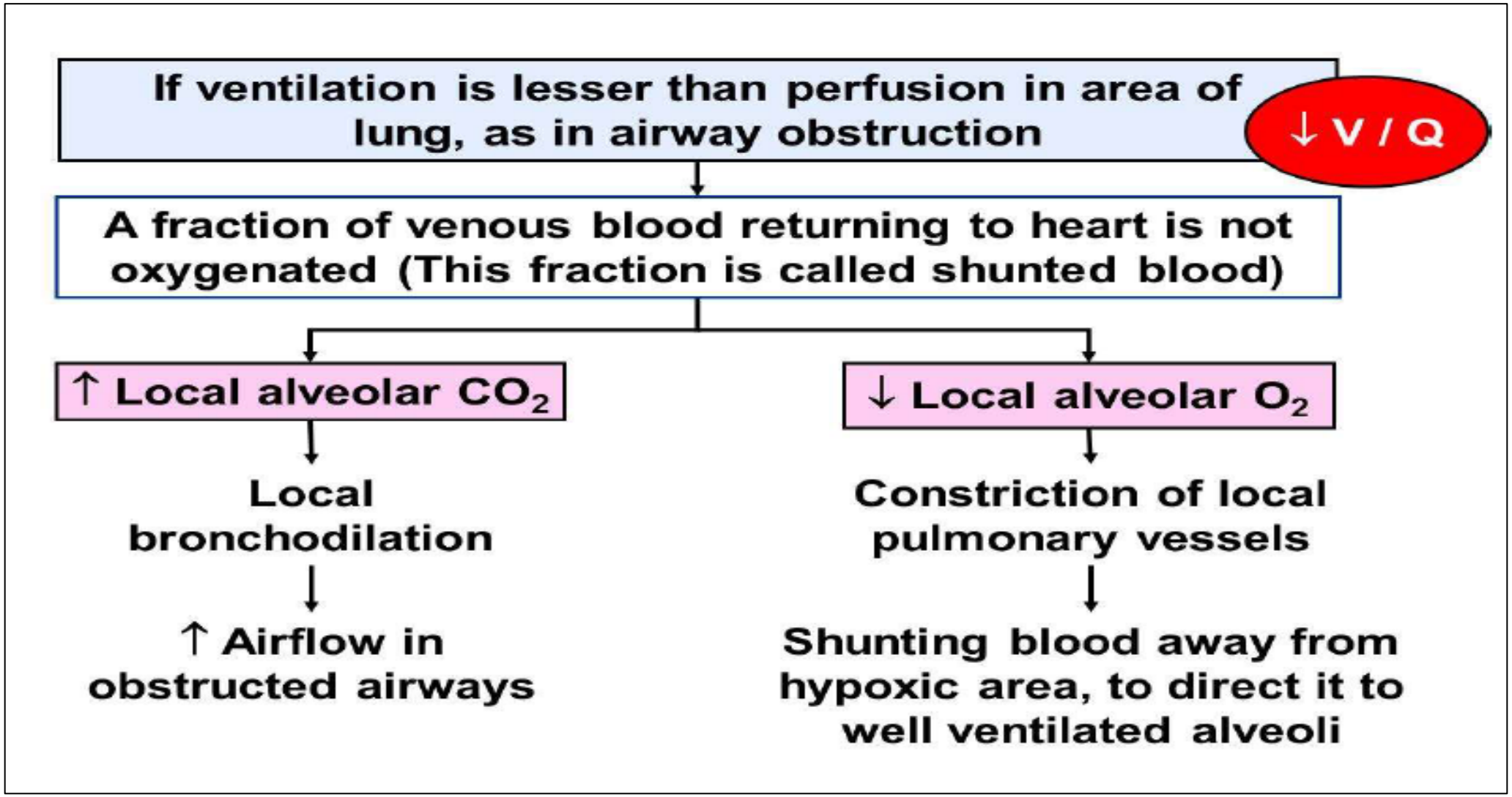


Regional differences in ventilation (left) and perfusion (right) in the normal upright lung

Local control to adjust ventilation and perfusion in a lung area with high V/Q



Local control to adjust ventilation and perfusion in a lung area with low V/Q



Q1. Describe ventilation at lung base in the upright position?

At lung base, under effect of gravity:

→ ↑ intrapleural pressure (becomes less negative)

→ ↓Transpulmonary pressure gradient (less distending pressure)

→ ↓ Alveolar size

→ ↑ compliance (smaller alveoli are more compliant than larger ones)

→ ↑ ventilation at lung base

Q2. Explain why air flow towards base of lung is more than that to apex in erect position?

In the erect position, by effect of gravity the intrapleural pressure is increased (less negative) at base, thus decreasing transmural pressure gradient. This causes less distention of basal alveoli compared to apical alveoli. The smaller alveoli at the base can accept more air as it is easily distended, i.e., more compliant.

MCQ

1. **In the erect position which of the following decreases in the lung apex:**

   A. Alveolar size

   B. Negativity of intrapleural pressure

   C. Lung compliance

   D. V/Q ratio

   E. Transpulmonary pressure gradient

C

MCQ

2. Which of the following is correct in a condition of a decrease in the V/Q ratio in one lung?:

a. Lower systemic arterial oxygen content.

b. There is a wasted ventilation.

c. Increase the physiological dead space.

d. Lower systemic arterial carbon dioxide content.

e. Can occur in cases like pulmonary embolism.

A

MCQ

3. In a lung area with low ventilation/perfusion ratio (↓V/P), which of the following occurs:

A. PO_2 increases

B. PCO_2 decreases

C. Airway diameter increases

D. Vascular resistance decreases

E. Airway resistance increases

C

MCQ

4. In erect position the base of lung compared to apex had: :

A. Lower ventilation

B. Lower perfusion

C. Lower ventilation/perfusion ratio.

D. Lower compliance

E. Wasted ventilation

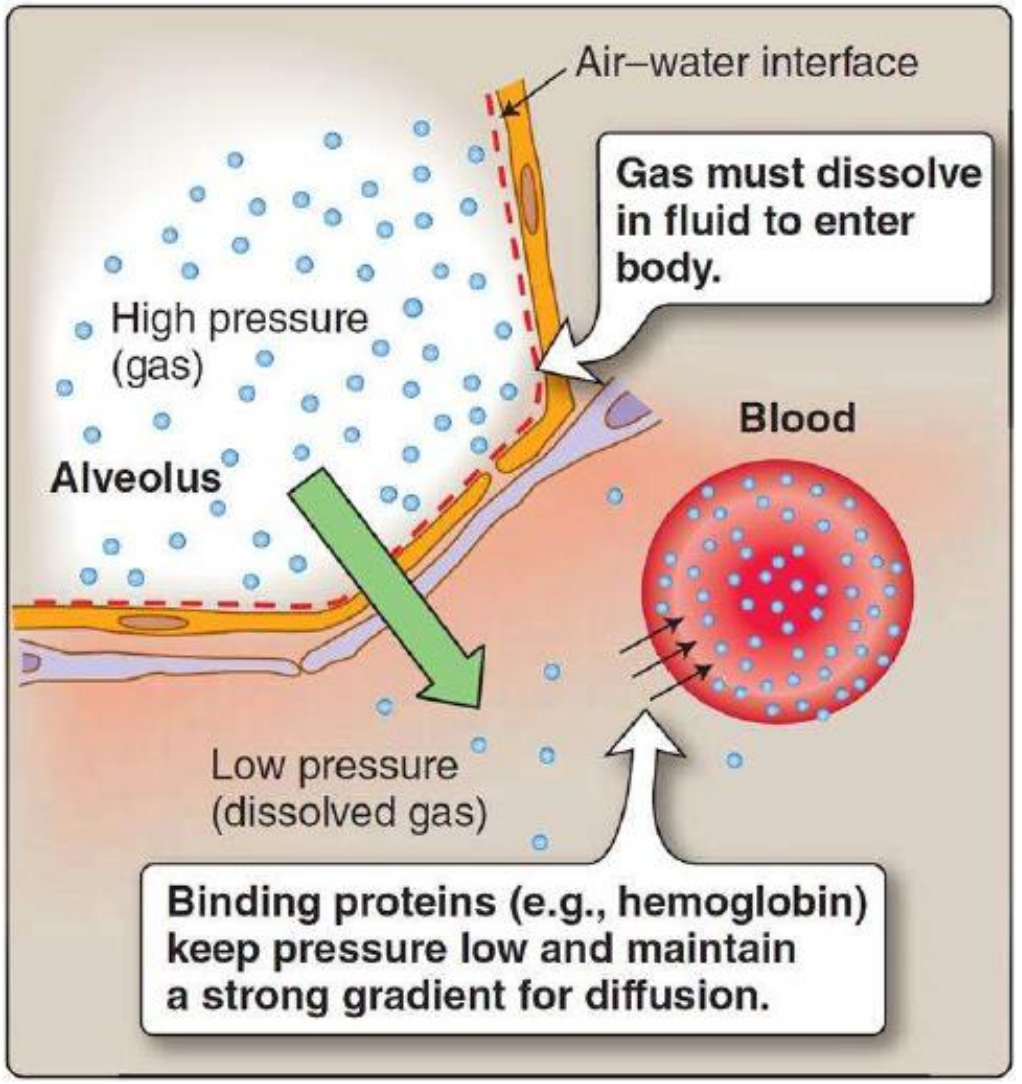
C

Lecture 9

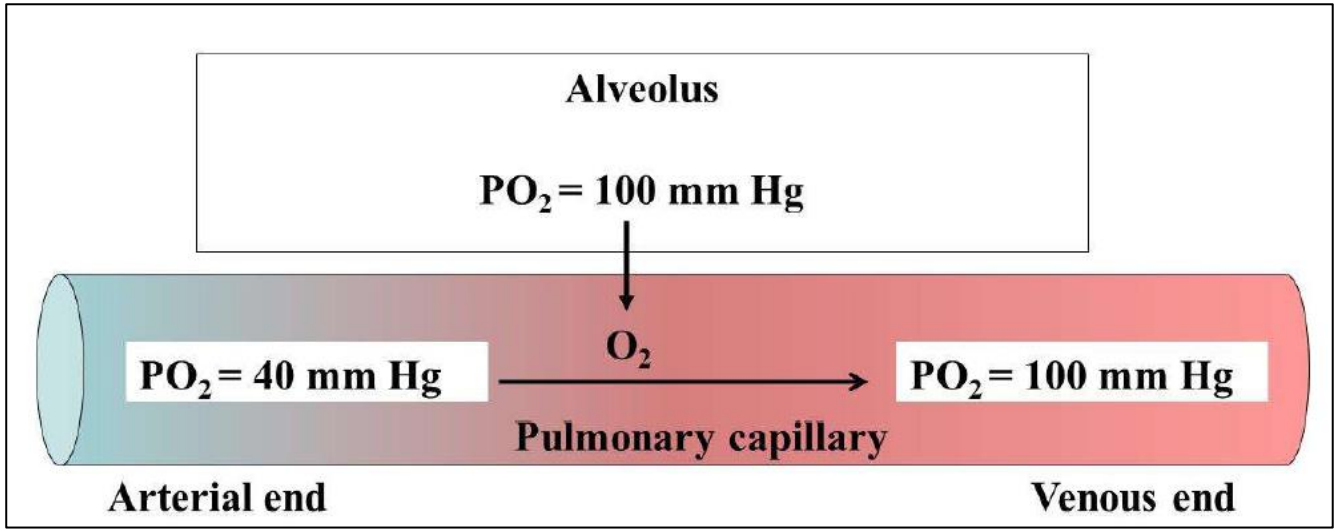
Gas Exchange

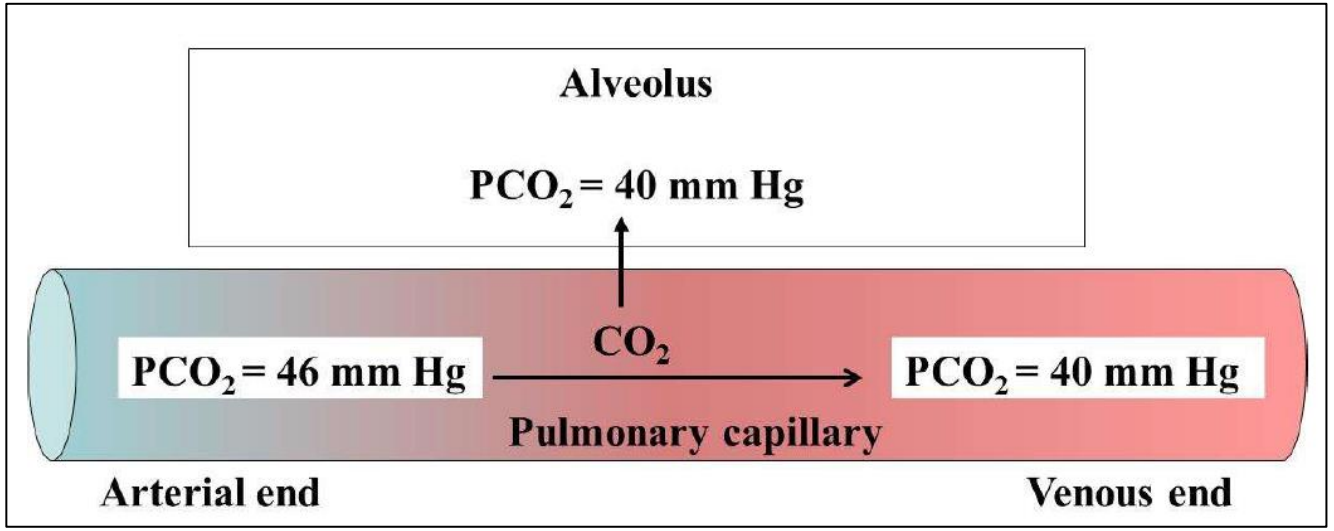
Gas Exchange:

- Gas exchange whether at the lungs or at the tissues, occurs by simple diffusion down partial pressure gradient (i.e. from high to low partial pressure).



Diffusion of O_2 & CO_2 through Alveolocapillary membrane





Gas Exchange

Factors affecting the rate of gas diffusion across the alveolar-capillary membrane:

$$\textit{Rate of gas diffusion} = \text{DC X } \frac{\text{Pgas X SA}}{\text{Thickness of the membrane}}$$

1. Partial pressure gradient of the gas across the membrane (Pgas)
2. Surface area of the membrane (SA)
3. Thickness of the membrane
4. Diffusion coefficient of the gas (DC) that depends on:
   - o Gas solubility
   - o Molecular weight of the gas (MW)

$$\text{Diffusion coefficient } \alpha \frac{\text{Solubility of the gas}}{\sqrt{\text{MW of the gas}}}$$

The diffusion capacity of the respiratory membrane

- The volume of gas that diffuses through the membrane/min for a pressure difference of 1 mm Hg.

O_2 = 20 ml/min/mm Hg

CO_2 = 400 ml/ min/ mm Hg

- Diffusion capacity or diffusion coefficient for **CO_2** is **20 times** higher than of **O_2**, because:

✓ CO_2 is 24 times more soluble in tissues than O_2 is, **but** the molecular weight of CO_2 is 1.4 times greater than that of O_2.

Although diffusion coefficient of CO_2 is higher than that of O_2, equilibration of CO_2 across alveolar-capillary membrane occurs at the same rate as O_2, as, CO_2 pressure gradient (6 mm Hg) is less than O_2 pressure gradient (60 mmHg) across alveolar capillary membrane

The diffusion capacity of the respiratory membrane

Diffusion Capacity of Respiratory membrane

Increased

During Exercise

- Increased alveolar expansion by deeper breathing that increases alveolar surface area and decreases thickness of alveolar wall.
- Increased number of open pulmonary capillaries by increased COP that increases blood surface area exposed for gas exchange.

Decreased

↑ thickness of the alveolar-capillary membrane

- Pneumonia, pulmonary fibrosis, pulmonary edema, and pulmonary congestion

↓ the effective area for diffusion

- Lung collapse and emphysema.

Ventilation/Perfusion mismatch

- Emphysema

Q1: Explain the effect of the following on diffusion of gasses along the alveolar capillary membrane.

A. pulmonary edema. **B. Emphysema.**

1. **Pulmonary edema** cause increase in thickness of membrane and decrease in the diffusion.
2. **Emphysema** is associated with breakdown of the wall of some alveoli, turning them into one large sac, thus decreasing the surface area for diffusion

Q2. Explain the effect of pulmonary fibrosis on O_2 and CO_2 diffusion across alveolar capillary membrane?

- Pulmonary fibrosis decreases diffusion of both O_2 and CO_2, but CO_2 is **less affected** because it is **more soluble** in tissue fluids than O_2 by 24 times

MCQ

1. Compared to CO_2 diffusion in the lung, the diffusion of O_2 is characterized by which of the following?

A. Has more pressure gradient

B. Has more solubility in alveolar-capillary membrane

C Has higher molecular weight

D. Has higher diffusion capacity

E. Reaches to equilibrium in diffusion across alveolo-capillary membrane rapid before CO_2

A

MCQ

2. Which of the following increases pulmonary diffusion capacity?

A. Atelectasis.

B. Pneumonia.

C. Pulmonary edema.

D. Deep breathing.

E. Surfactant deficiency.

D

MCQ

3. The rate of diffusion across the respiratory membrane is inversely proportional with?

A. The surface area available for gas exchange

B. The solubility of the gas.

C. Diffusion coefficient of the gas

D. The partial pressure gradient.

E. The molecular weight of the gas.

E

MCQ

4. Which of the following is true about the alveolar dead space?

A. It is always equal to anatomic dead space.

B. It is caused by blockage of a bronchus.

C. It is affected by perfusion.

D. It is increased by increasing breath rate.

E. It is increased by shallow breathing.

C

MCQ

5. The atmospheric partial pressure of O2 in mm Hg is about?

A. 0.5

B. 5

C. 50

D. 100

E. 160.

E

THANK YOU