Common respiratory abnormalities 1

Dr. Farida Ahmad
Lecturer physiology dept. KGMC

Objectives

At the end of the lecture students of 1st year MBBS should be able to

1) Describe hypoxia
2) Describe cyanosis
3) Describe pathophysiology of common respiratory abnormalities
4) Describe the effects of aging on lung volumes, lung and chest wall compliance, blood gases and respiratory control

Hypoxia

- Oxygen deficiency at the tissue level
- It is the decrease levels of oxygen in inspired gases, arterial blood, or tissues, without reaching anoxia
- **Anoxia:** means absence of O2 at the tissue level

Causes

1) **Inadequate oxygenation of the blood in the lungs because of extrinsic reasons.**

- Deficiency of oxygen in the atmosphere
- Hypoventilation (neuromuscular disorders).

2)Pulmonary disease.

- Hypoventilation caused by increased airway resistance or decreased pulmonary compliance.

- Abnormal alveolar ventilation-perfusion ratio.

- Diminished respiratory membrane diffusion.

3) **Venous to arterial shunts.**

4) **Inadequate oxygen transport to the tissues by the blood.**

- Anemia or abnormal hemoglobin.
- General circulatory deficiency.
- Localized circulatory deficiency.
- Tissue edema.

5) Inadequate tissue capability of using oxygen.

Poisoning of cellular oxidation enzymes.

Diminished cellular metabolic capacity for using oxygen, because of toxicity, vitamin deficiency, or other factors.

Types of hypoxia

- 1. **Hypoxic Hypoxia** - PO2 of the arterial blood is low.

2**. Anemic Hypoxia** - Amount of Hb. To carry O2 is Low

3**. Stagnant or Ischemic Hypoxia**- Blood flow to the tissue is low

4. **Histo toxic Hypoxia** – Tissue can’t utilize O2

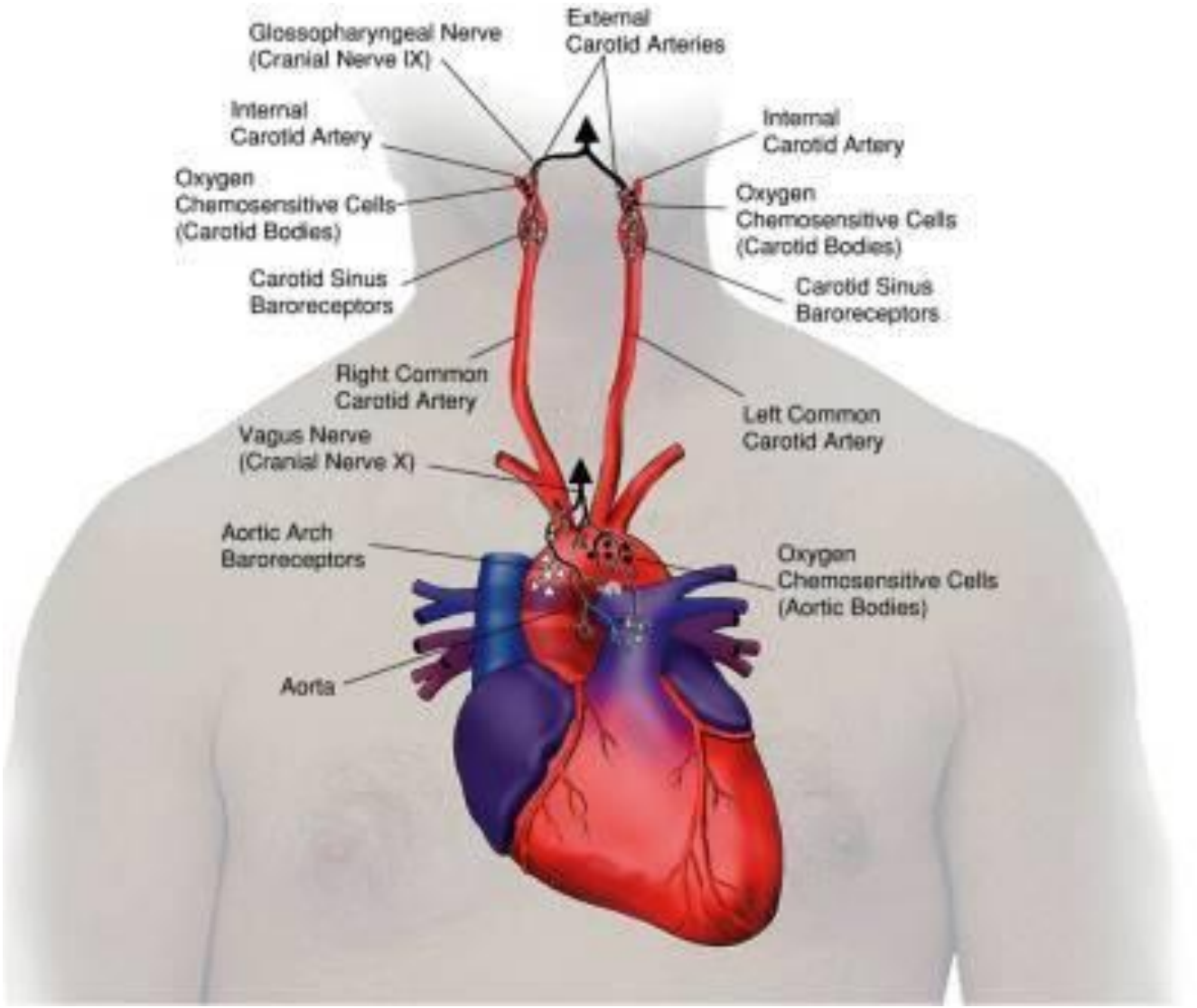
Response of body to hypoxia

Acute effects

1. **Drowsiness**
2. **Lassitude**
3. **Mental and muscle fatigue**
4. **Headache**
5. **Altered consciousness**
6. **Coma**

Chronic effects

1. Increased pulmonary ventilation caused by stimulation of peripheral chemoreceptors



2.Increased RBC

Hb% can rise upto 20gm/dl

3. Increased diffusing capacity of lungs

- Increased pulmonary capillary blood volume,
- Inc lung air volume
- Inc pulmonsry arterial pressure

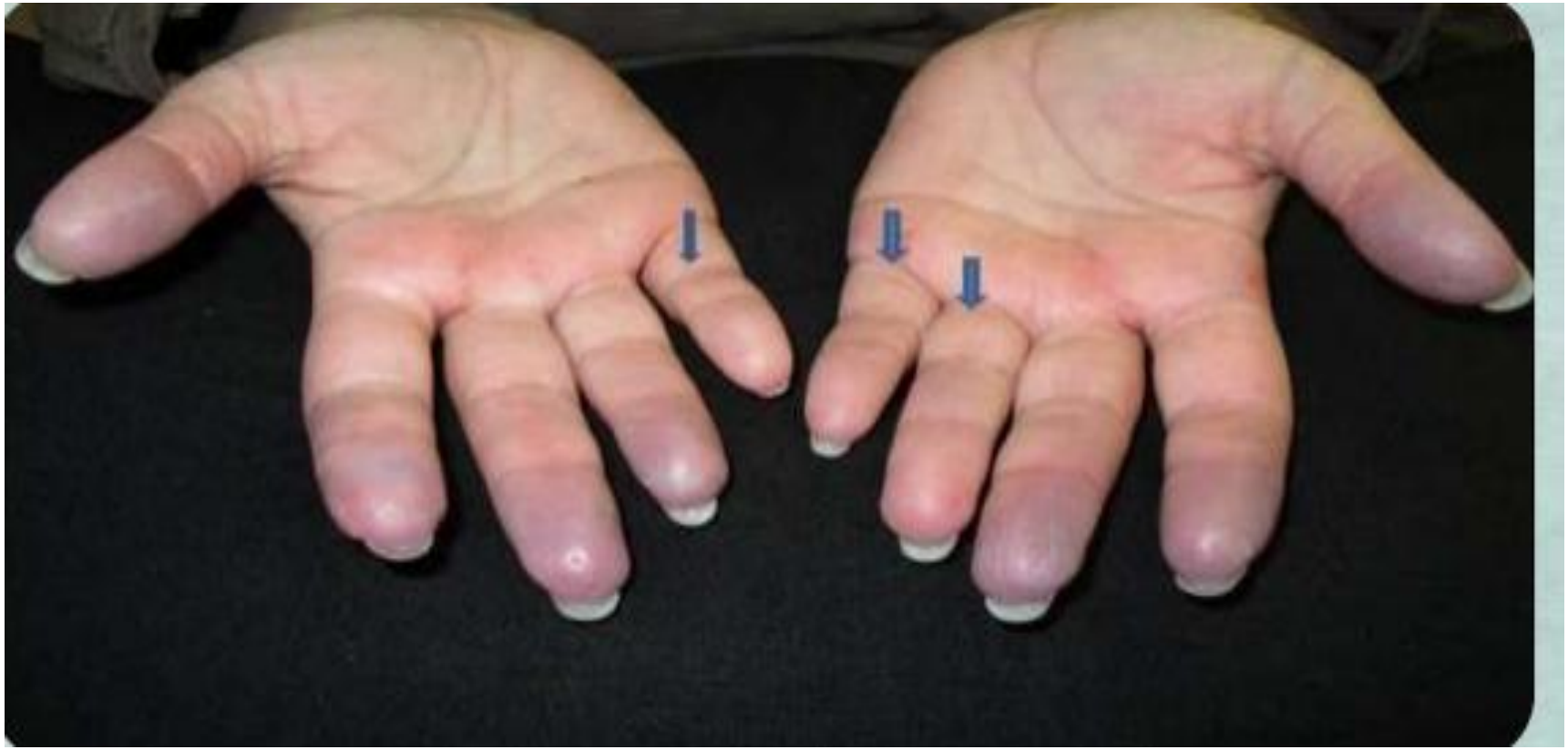
4. Peripheral circulatory changes

- Increased cardiac output initially
- Growth of capillaries (angiogenesis)

Cellular adaptations

- Increased mitochondria
- Glycolytic enzymes needed for anaerobic glycolysis
- Increased availability of NO that cause pulmonary vasodilation

Hypoxia leads to……



Cyanosis

- Cyanosis is a blue discoloration of the skin and mucous membranes Due to:
- The presence of an abnormally great amount of reduced Hb in the superficial capillaries
- Threshold of cyanosis It is the minimal concentration of **reduced Hb** In the capillary blood that leads to appearance of cyanosis. - It's **about 5gm% capillary blood**

causes of cyanosis

1-hypoxic hypoxia

2-Stagnant hypoxia

3-Asphxia

Low O2 in inspired air : High altitude

hypoventilation

a)Obstruction of air passages

b)Emphysema

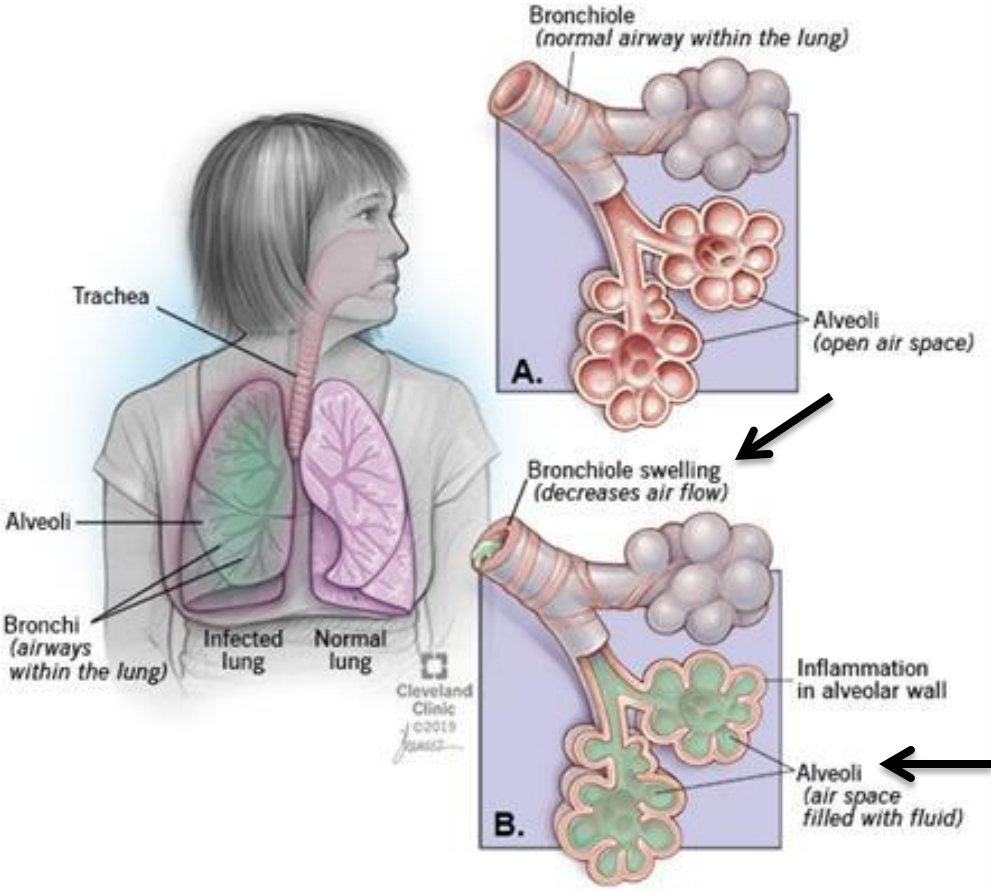
c)Depression of respiratory center

increase of the thickness of the alveo-capillary membrane leads to decrease of diffusion of gases through membrane

4-short circuit between right and left side of the heart

1)Pneumonia

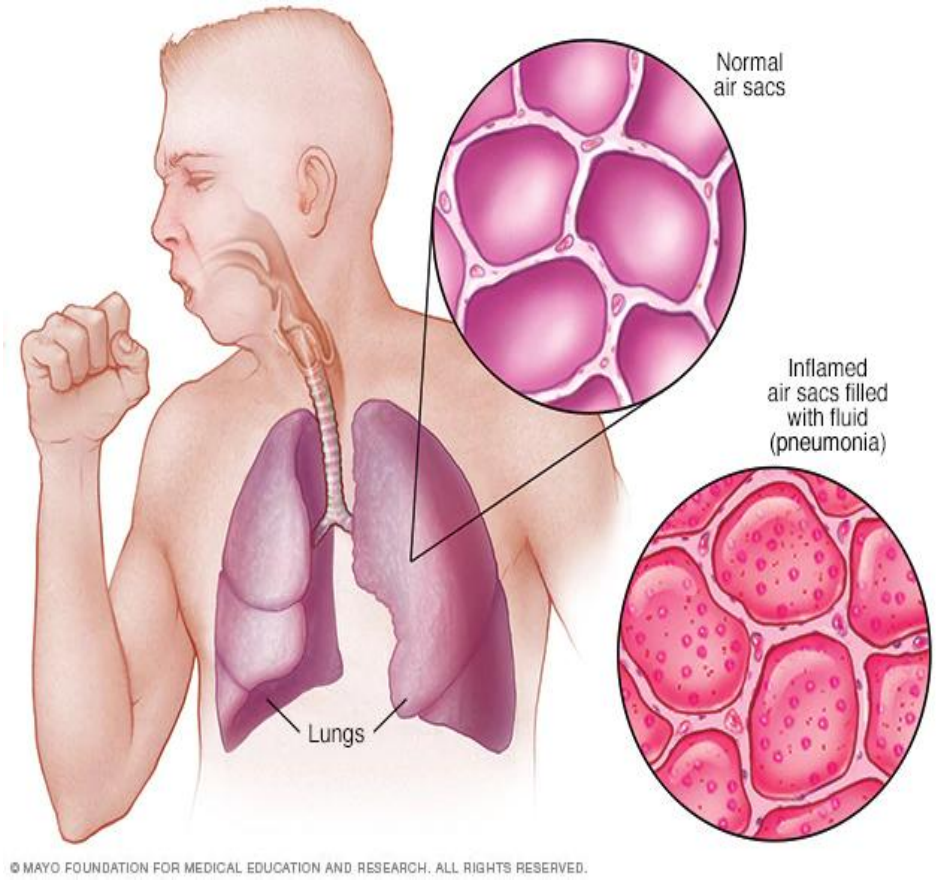
- Inflammatory condition
- Alveoli filled with fluid and blood
- It is usually caused by bacteria but can also be caused by viruses and fungi
- 50% of pneumonia is pneumococcal

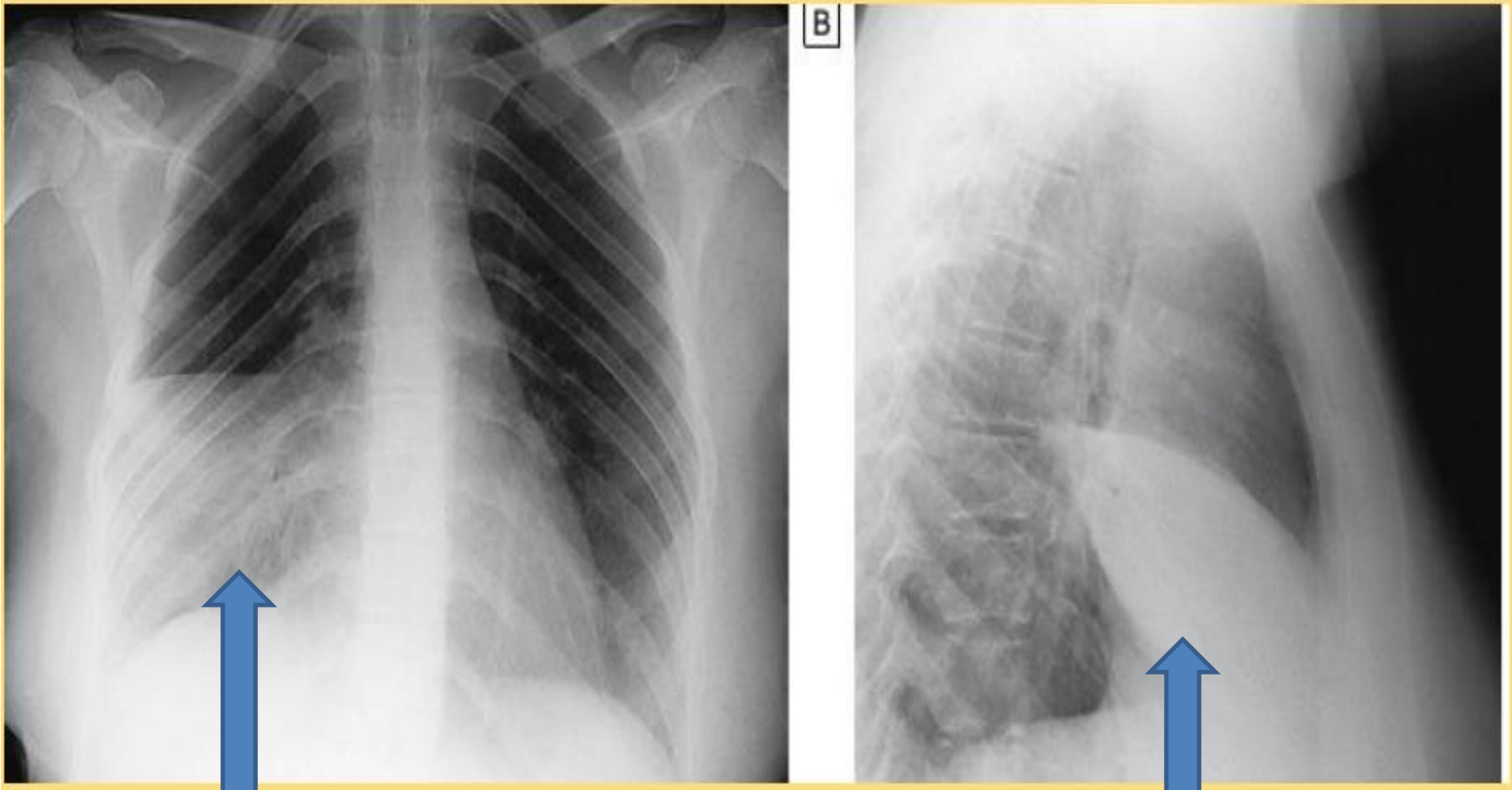


Pneumonia

Patient presents with

- cough
- purulent sputum
- breathlessness and
- fever





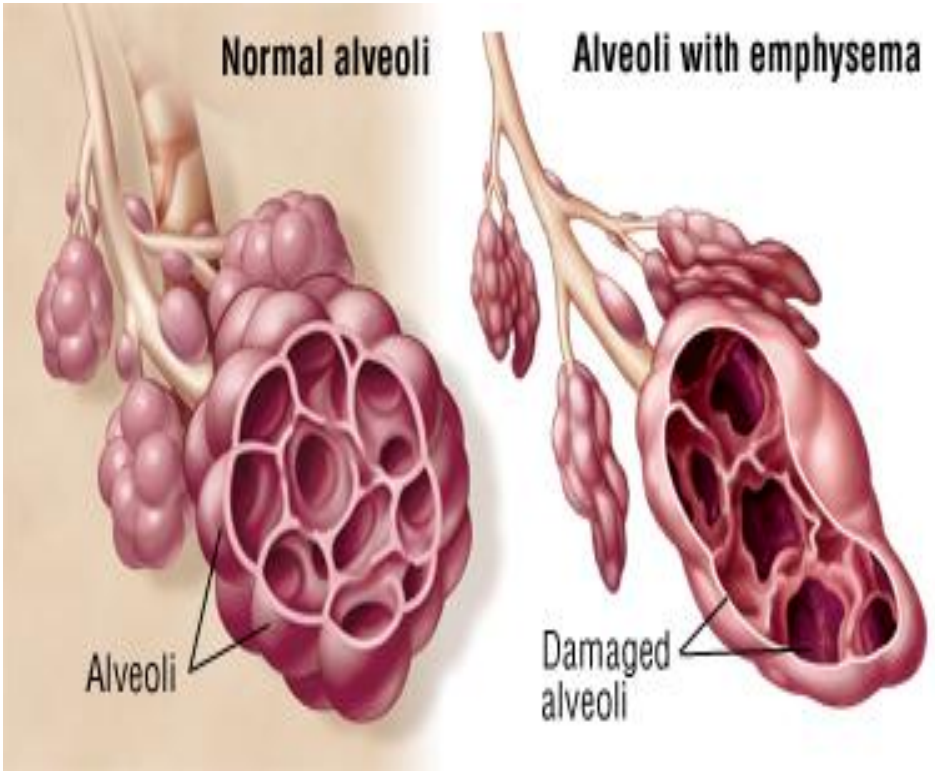
A PA view: consolidation in the right middle lobe with characteristic opacification beneath the horizontal fissure and loss of normal contrast between the right heart border and lung

B Lateral view: consolidation confined to the anteriorly situated middle lobe.

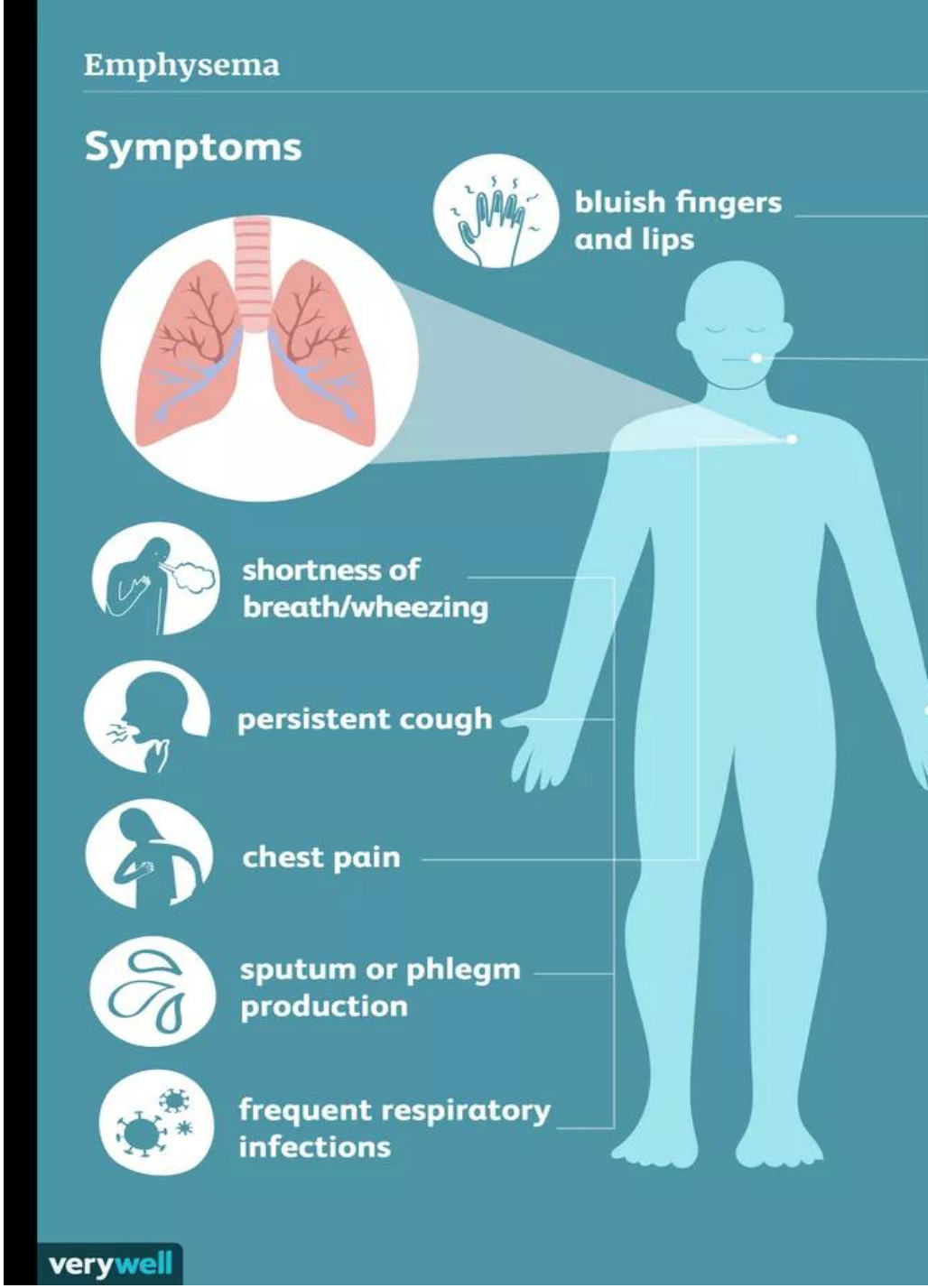
2) Emphysema

Emphysema is a condition that involves

- damage to the walls of alveoli
- Alveoli are thin-walled, very fragile **become confluent, creating large airspaces** without obvious fibrosis usually in smokers



- People who develop emphysema have an increased risk of pneumonia, bronchitis, and other lung infections



Pathophysiology of emphysema

1)Chronic infection

1)Paralysis of cilia (nicotine)
Mucous not removed easily
2) Inhibition of alveolar macrophages

2) Chronic obstruction

Air entrapment > overstretching> destruction

Physiological effects

1) Reduced available surface area of respiratory membrane

2)Decrease V/Q > hypoxia. hypercapnia

Physiological changes

- Increase work of breathing
- Decrease diffusing capacity of lungs(loss of alveolar wall)
- Abnormal V/Q
- Decrease number of capillaries (increase pulmonary vascular resistance> right sided heart failure)

taskCompare pneumonia with emphysema

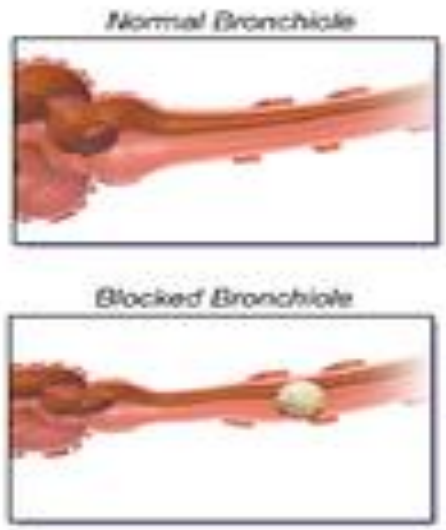
3) Atelectasis

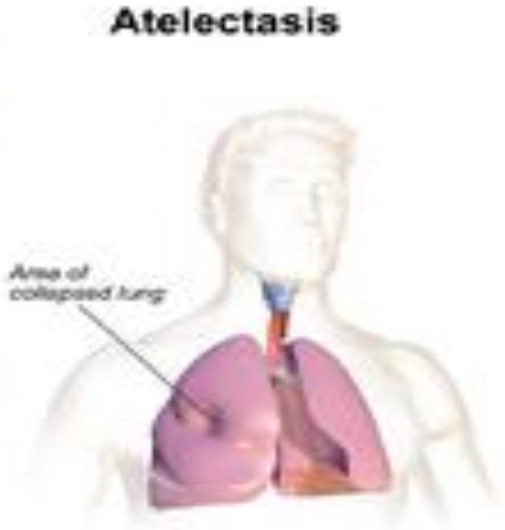
Collapse of alveoli

Causes

1) total obstruction of air way

2) lack of surfactant





Complete obstruction

alveoli becomes airless from absorption of their air without replacement of the air with breathing

Causes of complete obstruction

- Airway foreign body
- Extrinsic compression on an airway (eg, compression due to an enlarged or aberrant vessel)
- Enlarged lymph nodes that compress the airway
- Masses in the chest that compress the airway or alveoli
- Cardiomegaly or enlarged pulmonary vessels that compress adjacent airways

4) Asthma

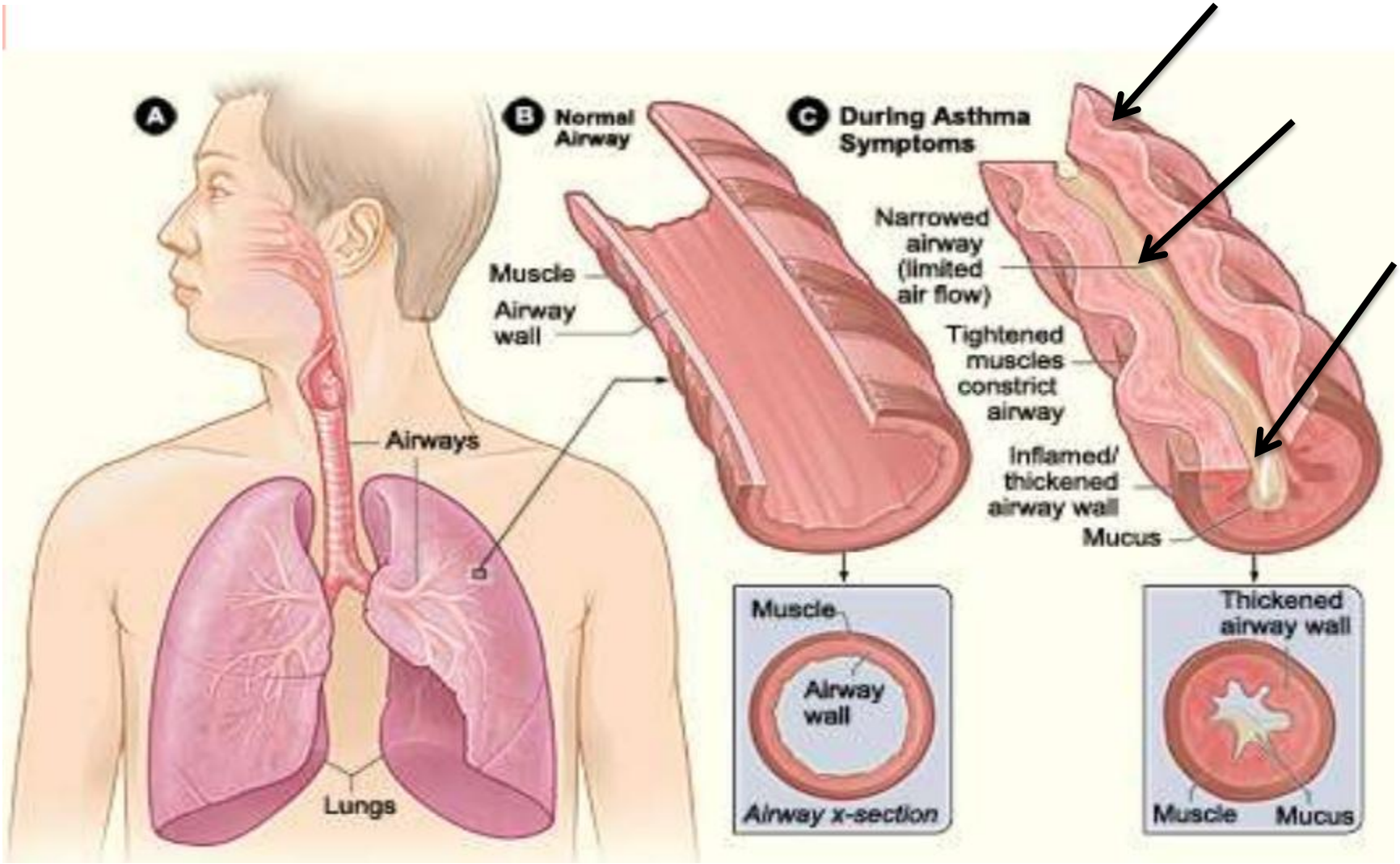
- Asthma is a chronic inflammatory disease of the airways that causes

  airway hyper responsiveness,

  mucosal edema, and

  mucus production
- differs from the other obstructive lung diseases in that it is largely reversible, either spontaneously or with treatment.
- Patients with asthma may experience symptom-free periods alternating with acute exacerbations, which last from minutes to hours or days.

Compare figure B and C
note 3 features



Effect of aging on respiration

- The **structural changes** include chest wall and thoracic spine deformities which impairs the total respiratory system compliance leading to increase work of breathing.
- The **lung parenchyma** loses its supporting structure causing dilation of air spaces: “senile emphysema”.
- **Respiratory muscle strength** decreases with age and can impair effective cough, which is important for airway clearance.

- **The alveolar dead space** increases with age, affecting arterial oxygen without impairing the carbon dioxide elimination.

- Older adults have decreased sensation of dyspnea and **diminished ventilatory response to hypoxia and hypercapnia,** making them more vulnerable to ventilatory failure during high demand states (ie, heart failure, pneumonia, etc) and possible poor outcomes

Lecture 2

OBJECTIVES

1. Describe periodic breathing
2. Describe basic mechanism of Cheyne stokes breathing
3. Define sleep apnea and central sleep apnea

Periodic breathing

- Three or more episodes of central apnea(no airway blockage) lasting at least 3 seconds, separated by no more than 20 seconds of normal breathing.
- Normal breathing is regular.

- The abnormal or uneven respiratory rhythm is called the periodic breathing.

1)Cheyane Stokes Breathing

Hyperpnoea period

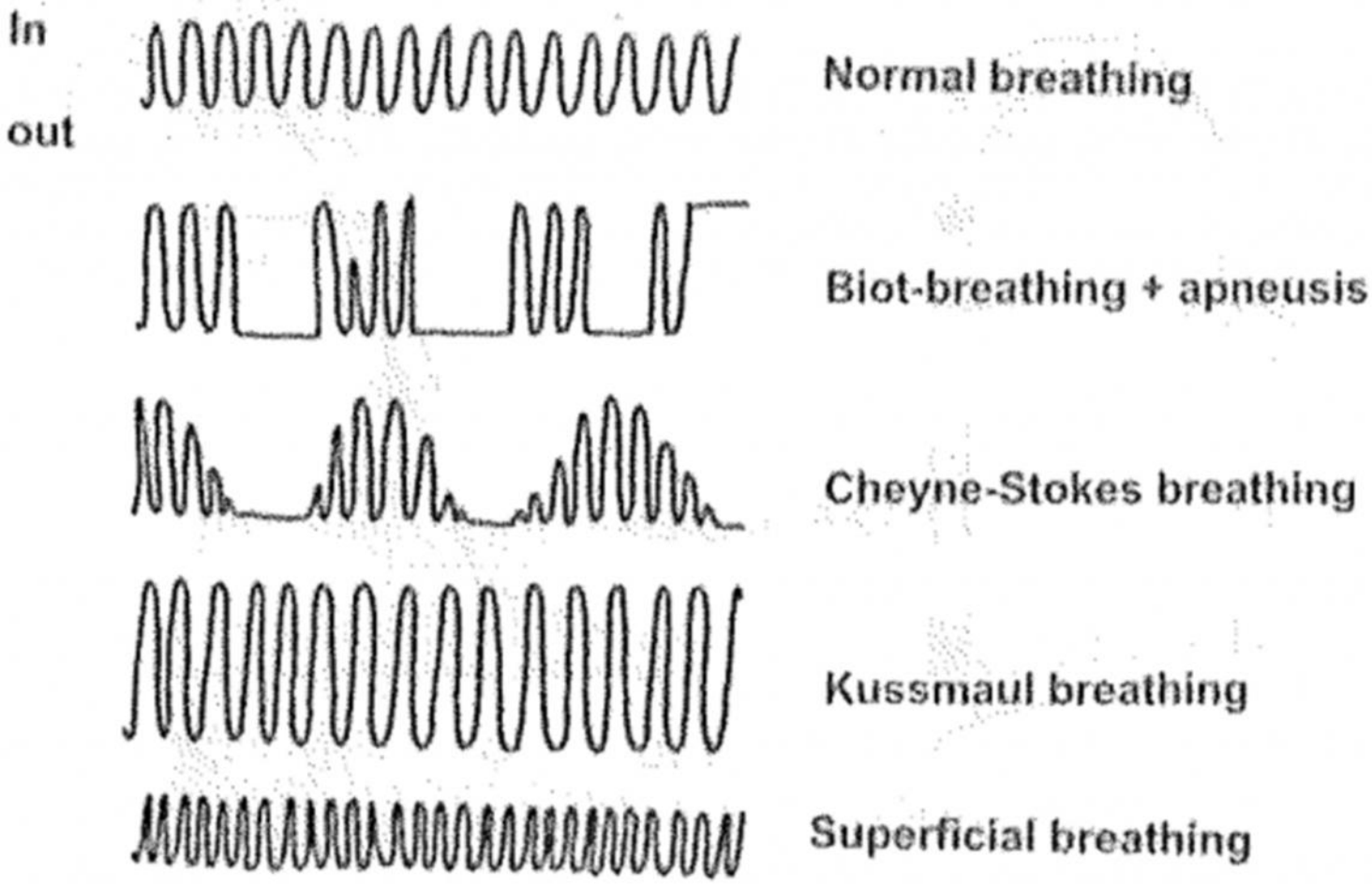
In beginning the breathing is slow. The amplitude of respiration increased gradually and reaches the maximum. Then, it decreases and reaches minimum and

is followed by apnea. This effect is called waxing and waning of breathing.

Apnea period:

When, the force of breathing is reduced to minimum, stoppage of breathing occurs for a short period. This is again followed by hyperpnoea period and the cycle gets repeated.

The pattern repeats, with each cycle usually taking 30 seconds to 2 minutes.


In
out
Normal breathing
Biot-breathing + apneusis
Cheyne-Stokes breathing
Kussmaul breathing
Superficial breathing

Causes

- **Physiological conditions**:

1. During deep sleep
2. In high altitude
3. In new born babies

- **Pathological conditions**:

1. During cardiac diseases
2. During renal diseases
3. In premature infants

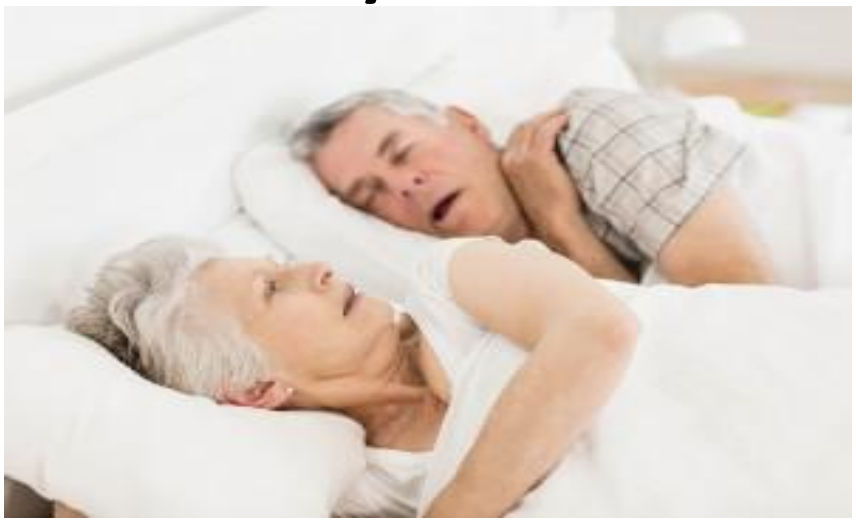
2) Sleep apnea

- Sleep apnea is a disorder that causes a person to stop breathing many times while they are sleeping.

- trigger the body to switch from deep stage IV sleep to the very light stage I sleep

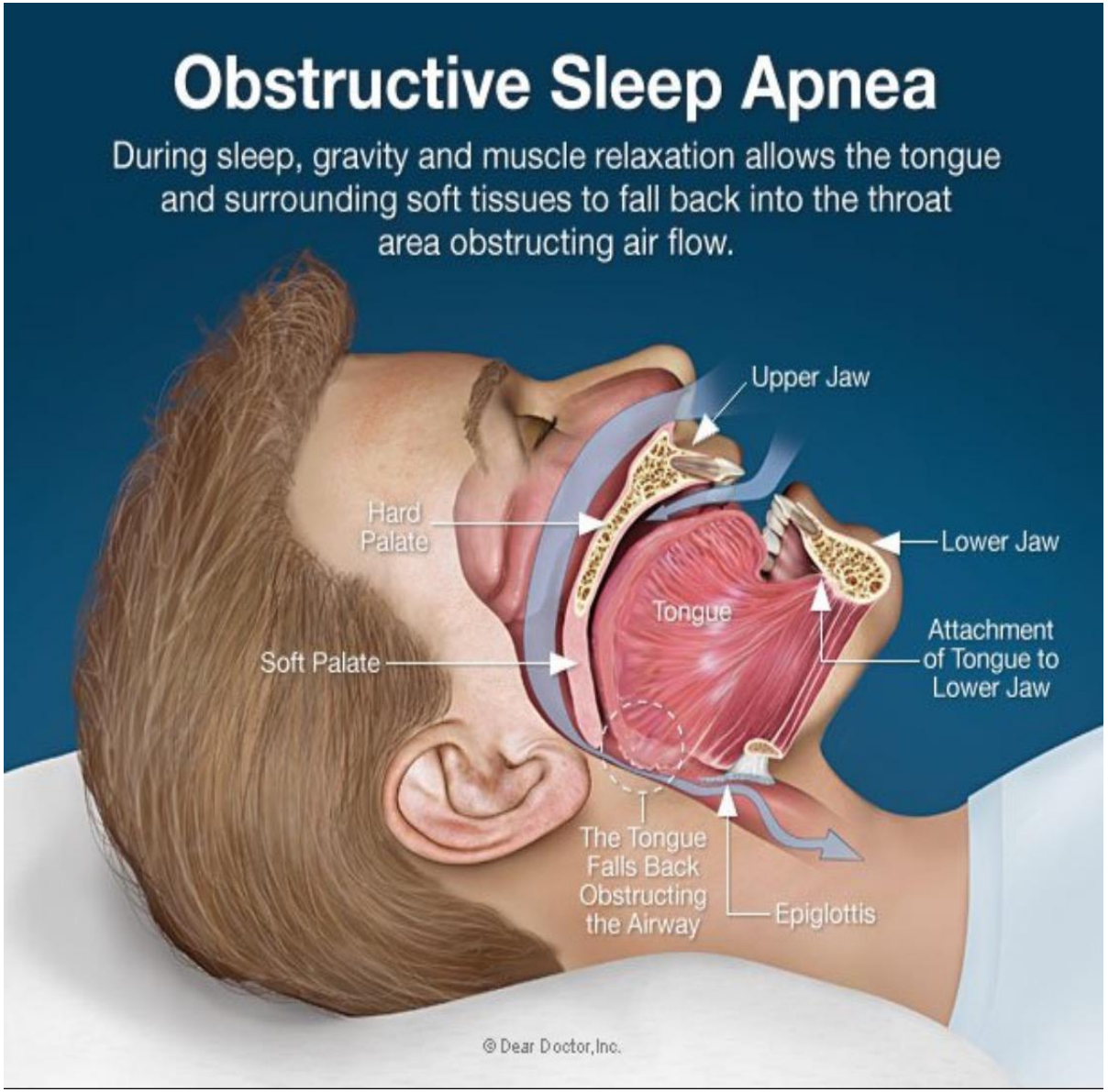
Symptoms are noted by others

- snoring,
- pauses in breathing often followed by a gasp or snort sound,
- sleepiness during daytime hours.



Obstructive sleep apnea

- At one end of the spectrum are those individuals who snore intermittently with little sleep disruption
- At the other end are those who snore heavily and have severe gas exchange disturbances and respiratory failure, causing them to gasp for air.
- ongoing respiratory efforts are observed



CENTRAL SLEEP APNEA

- lack of drive to breathe during sleep, resulting in insufficient or absent ventilation and compromised gas exchange
- makes up only 10% of all apneas.
- **Hypercapnic patients** usually present with a morning headache and daytime somnolence
- **nonhypercapnic patients** complain of insomnia and nocturnal awakenings with shortness of breath or gasping

Several Manifestations Of CSA Include

- high altitude-induced periodic breathing,
- idiopathic CSA (ICSA),
- narcotic-induced central apnea,
- obesity hypoventilation syndrome (OHS)
- Cheyne-Stokes breathing (CSB).

Central sleep apnea

majority of cases are idiopathic,

identifiable causes are

- autonomic nervous system lesions
- neurological diseases (poliomyelitis, encephalitis, and myasthenia gravis)
- congestive heart failure.

THANK YOU