

# **PULMONARY DISORDERS**

## **(CHAPTERS 17, 18, AND 20)**

# PART 1, QUESTION 1

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Compare dyspnea, apnea, and tachypnea.

**dus-** (bad)

**pnoế** (breathing)

# DYSPNEA

"difficult or labored breathing; **shortness of breath**"

**a-** (absence of)  
**pnoĕ́** (breathing)

# APNEA

"the (often temporary) **cessation of breathing**"

**takhús** (swift)

**pnoě** (breathing)

# TACHYPNEA

"an increased **rate** of breathing, leading to **hyperventilation**"



For your reference, the opposite of tachypnea is **bradypnea** (abnormally **slow** breathing.)

# PART 1, QUESTION 2

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Compare hyper- and hypoventilation. What would be the consequences on acid-base balance?

**hyperventilation – increased** gas exchange in the lungs due to **faster** or **deeper** breathing

Can be caused by anxiety, trauma to the CNS, or to correct for hypoxemia

**hypoventilation – decreased** gas exchange in the lungs due to **slower, shallower, or less effective** breathing

Can be caused by obstruction of the airways, decreased lung compliance, or CNS depression (e.g. as a side effect of opioid analgesics)

**Hyperventilation** will tend towards **respiratory alkalosis** as **more** carbonic acid is blown off as  $\text{CO}_2$ .

**Hypoventilation** will tend towards **respiratory acidosis** as **less** carbonic acid is blown off as  $\text{CO}_2$ .

# PART 1, QUESTION 3

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How could a productive cough be helpful diagnostically?

A cough can be either **productive** (coughing up sputum) or **non-productive** (dry, hacking cough.)

**Qualities** of the sputum produced (amount, color, consistency, presence of blood, etc.) can be clinically significant.

For example, **frothy** or **foamy** sputum suggests pulmonary edema.

**Rust-colored** sputum suggests pneumonia or tuberculosis.

Sputum can also be **cultured** to determine the underlying pathogen and direct antibiotic therapy.



# PART 1, QUESTION 4

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List some clinical signs of hypoxemia.

**cyanosis** – bluish discoloration of the skin due to increased levels of **deoxygenated** hemoglobin  
Can present as **central** or **peripheral** cyanosis.

**Central** cyanosis tends to be caused by insufficient **respiration**, leading to **systemic** hypoxemia.

**Peripheral** cyanosis tends to be caused by poor **circulation** to the extremities.

**clubbing** – mild to severe swelling or bulging of the fingertips due to **prolonged** peripheral hypoxia

Mild clubbing presents as an **increased angle** between the nailbed and cuticle (normally 165 degrees or less)

Severe clubbing can present as **gross swelling** of the entire distal portion of the finger.

**pulse oximetry** – direct measurement of blood oxygenation status via infrared light

Expressed as a percentage of oxygenated hemoglobin.  
>90–95% is normal, lower indicates hypoxemia.

# PART 1, QUESTION 5

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Describe some consequences of gastric aspiration.

Aspiration (breathing in) of gastric acid droplets results in **chemical damage** to the alveoli.

Can be a complication of gastroesophageal reflux disease (GERD.)

Long-term exposure of alveoli to gastric secretions can result in pulmonary **fibrosis**.



# PART 1, QUESTION 6

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What is the term for collapse of part or a whole lung?  
What could cause this?

**atelēs** (incomplete)

**éktasis** (extension)

# ATELECTASIS

"**collapse** of all or part of a lung, leading to reduced lung capacity"

Commonly occurs **after surgery** due to effects of anesthesia and intraoperative mechanical ventilation.

Treatment/prevention of post-surgical atelectasis is **incentive spirometry**, which you'll learn about in Concepts.

Other causes include **pleural effusion, tumors, and thoracic trauma.**

# PART 1, QUESTION 7

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Which disorder could cause non-cardiogenic pulmonary edema?

Pulmonary edema is **usually** caused by LHF, as we talked about in the unit on Fluid Balance.

Most **non-cardiogenic** (not heart-related) PE is related to **acute respiratory distress syndrome** (ARDS.)

# PART 1, QUESTION 8

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What is the underlying cause of acute respiratory distress syndrome (ARDS?) What is the mortality rate? Would this condition affect compliance? What are some of the signs and symptoms?

ARDS is a **severe medical emergency** and often requires mechanical ventilation in an ICU.

The mortality rate is estimated at approximately **50%**.



Pulmonary edema in ARDS results from increased **permeability** of the alveolar membrane, causing fluid to leak into the alveoli from the capillaries.

Diffuse alveolar injury also results in decreased production of **pulmonary surfactant**, which is required to maintain normal lung compliance and prevent collapse.

Major symptoms are **dyspnea**/SOB and **dry cough**  
(unable to clear fluid from lungs.)

May see **tachypnea** as a compensatory response, and  
lack of surfactant can cause **atelectasis**.

Impaired gas exchange will also result in decreased  
**oxygen saturation**/hypoxemia.

# PART 1, QUESTION 9

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Inhalation of which particles may be involved in pneumoconiosis? This disorder may progress to a serious, irreversible lung disorder—what is it? Would it affect compliance? Is it a restrictive or obstructive disease?

Types of pneumoconiosis are characterized by the etiologic agent:

- **Silicosis** – silica (ceramics, stone and concrete grinding)
- **Coal worker's pneumoconiosis** (CWP) or "black lung" – coal dust
- **Asbestosis** – asbestos (old fireproofing/insulation material)

Inflammation from pneumoconiosis can progress to **pulmonary fibrosis**, or permanent scarring inside the lungs.

The presence of tough scar tissue decreases lung **compliance**, making fibrosis a **restrictive** pulmonary disorder.

Pneumoconiosis is also associated with an increased rate of **lung cancer** and some other cancers such as mesothelioma.

# PART 1, QUESTION 10

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List some obstructive pulmonary diseases.



**Chronic obstructive pulmonary disease (COPD)**

(representing **emphysema** or **chronic bronchitis**)

**Asthma**

**Cystic** fibrosis (different from **pulmonary** fibrosis!)

# PART 1, QUESTION 11

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Secretion of large amounts of mucus in the pulmonary system puts a patient at risk for what type of problems?

Over-secretion of mucus can impede the flow of air within the lungs, leading to **obstructive** pulmonary issues.

# PART 1, QUESTION 12

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Which enzyme may be involved in emphysema? What is the function of this enzyme? Describe the major clinical sign of emphysema.

Smoking increases the levels of **protease** in the lungs and decreases the action of **anti-protease**, causing the breakdown of the alveolar wall.

Proteases **break down proteins** and normally play an important role in cell regeneration and repair, but in emphysema, overactive proteases cause progressive damage.

Major clinical signs include:

**"barrel chest"** – torso becomes rounder in cross-section, often nearly as deep in front-to-back dimension as it is wide

**tripod positioning** – patient naturally leans forward on outstretched arms to increase lung expansion

# PART 1, QUESTION 13

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What is the underlying problem in cystic fibrosis? What is the consequence for the patient? The patient is at risk for which type of pulmonary disease?



CF is caused by a recessive mutation in the gene coding for a protein called **cystic fibrosis transmembrane conductance regulator** (CFTR.)

This protein plays an important role in pulmonary secretions by moving **chloride ions** (and thus water) across the cell membrane.

This impaired electrolyte transport causes pulmonary secretions to be **abnormally thick**, as they contain less water than they should.

**Cystic** fibrosis, unlike **pulmonary** fibrosis, is an **obstructive** pulmonary disorder as it affects the mucus **inside** the airways.

It also affects many other organs, such as the heart, pancreas, biliary system, digestive tract, and male reproductive system.

# PART 1, QUESTION 14

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Pneumonia may be caused by which pathogens?  
Which is most serious?

Pneumonia can be **bacterial** (*Streptococcus pneumoniae*,) **viral**, or **fungal**.

Bacterial pneumonia caused by **methicillin-resistant Staphylococcus aureus** (MRSA,) while rare, has a mortality rate of about 50%.

# PART 1, QUESTION 15

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What is the causative agent in tuberculosis?

TB is caused by the bacterium *Mycobacterium tuberculosis*.

# PART 1, QUESTION 16

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What are the clinical signs and symptoms of TB? How is it treated?



## Symptoms:

- **Productive cough**, classically with rust-colored sputum
- **Fatigue and lethargy**
- Dietary changes: **anorexia** (loss of appetite,) **weight loss**

Treatment usually involves four specific antibiotics known to be effective against TB:

**rifampin, isoniazid, pyrazinamide, ethambutol**

The antibiotic regimen for TB lasts for **6-9 months**, so patients often become noncompliant.

# PART 2, QUESTION 1

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What is the normal pulmonary circulatory pressure? At what pressure do we diagnose the patient with pulmonary hypertension?

Normal **pulmonary arterial pressure** (PAP) is **15–25 mmHg** (systolic) over **8–15 mmHg** (diastolic.)

Note that this is **much** lower than the systemic blood pressure (e.g. 120/80!)

Pulmonary hypertension is defined as a systolic PAP of **over 25 mmHg.**

## PART 2, QUESTION 2

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List some causes of pulmonary hypertension.

**Heart problems:** LHF, mitral regurgitation

**Lung problems:** COPD, pulmonary fibrosis, embolism

Sometimes pulmonary hypertension is simply  
**idiopathic** 🙄

## PART 2, QUESTION 3

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List the four major types of lung cancer.

**Small cell carcinoma** — most aggressive form, high mortality rate but very rare

Non-small cell lung cancers (NSCLC):

- **Adenocarcinoma** – Most common type (40%); peripheral, grows slowly
- **Squamous cell carcinoma** – Second most common (30%); bronchi/hilar region
- **Large cell carcinoma** – any NSCLC that isn't one of the other types



# PART 2, QUESTION 4

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Describe the problem in infant respiratory distress syndrome. Is compliance altered? Why?

IRDS is most commonly seen in **premature** infants,  
with most being 8+ weeks early.

Production of pulmonary surfactant has not kicked in  
yet, leading to decreased **compliance**.

# PART 2, QUESTION 5

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Name some neuromuscular diseases that may affect pulmonary function.

Neuromuscular diseases can affect the **diaphragm** and **intercostal muscles**, causing impaired breathing.

Examples include:

- Poliomyelitis (polio)
- Amyotrophic lateral sclerosis (ALS)
- Muscular dystrophy
- Guillain-Barré syndrome
- Myasthenia gravis