Chapter 18: The Respiratory System

Phases of Respiration

Respiration

- Process of obtaining oxygen from environment and delivering it to cells

Phases of Respiration

1. Pulmonary ventilation – between air and lungs
2. External gas exchange – between lungs and blood
3. Gas transport in the blood – carries oxygen and CO2
4. Internal gas exchange – between blood and tissue cells

Figure 18-1 Overview of respiration.

From which side of the heart does blood leave to travel to the lungs? To which side does it return?

Figure 18-2 The respiratory system.

What organ is located in the medial depression of the left lung?

Structures of the Respiratory System

The Nasal Cavities – open spaces inside above hard palate

- Nasostrils (nares) – air enters here
- Nasal septum – partition that divides nostrils
- Conchae – shell-like projections inside cavity

The Pharynx – the throat

- Carries air to respiratory tract and food to digestive system
  - Nasopharynx - Superior portion near nose
  - Oropharynx - Middle portion near mouth
  - Laryngeal pharynx - Inferior portion near larynx
Structures of the Respiratory System

The Larynx

- Cartilage framework between pharynx and trachea; (Adam’s apple)
  - Epiglottis – flap that closes over larynx
  - Vocal folds (vocal cords), used for speech
  - Glottis – opening in the vocal folds

Figure 18-4 The vocal cords, superior view.

What cartilage is named for its position above the glottis?

The Trachea

- Takes air to lungs; has C-shaped rings of cartilage to keep shape
- Open at back for expansion during swallowing

The Bronchi

- Trachea divides into two primary bronchi that enter the lungs
- The lining of the air passageways
  - pseudostratified epithelium – mucus membranes that filter, warm, and moisten the air; covered with cilia

The Lungs

- Alveoli – air sacs at the end of bronchioles where gas exchange occurs; (60 square meters)
- Lung cavities and pleura
  - Diaphragm – separates abdominal and thoracic cavity
  - Parietal pleura – portion attached to chest wall
  - Pleural space – space between pleural layers contains fluid for lubrication and ease of breathing
  - Visceral pleura – layer attached to lung surface

The Process of Respiration

Pulmonary Ventilation

- Inhalation (inspiration) is active phase of quiet breathing (muscles contract)
  - Surfactant – substance released by alveoli to reduce the surface tension of fluids in lungs;
  - Compliance – the ease with which the lungs expand
- Exhalation (expiration) is passive phase of quiet breathing (muscles relax)
What muscles are located between the ribs?

The Process of Respiration

Pulmonary Ventilation

- Lung volumes
  - Tidal volume – regular relaxed breathing
  - Residual volume – volume of air left in lungs after maximum exhalation
  - Inspiratory reserve volume – breathing in beyond normal breath
  - Expiratory reserve volume – breathing out beyond normal breath
  - Vital capacity – volume breathed out after deep breath
  - Functional residual capacity – volume left after normal breath out
  - Total capacity – total volume of air in lungs

What lung volume cannot be measured with a spirometer?

Which lung capacities cannot be measured with a spirometer?

Gas Exchange

- External exchange— between alveoli and capillaries
  - Occurs in the lungs
  - Requires a pressure gradient
- Internal exchange— between body tissue and capillaries
  - Occurs in tissues
  - Requires a pressure gradient

The Process of Respiration

Gas Transport

- Transport of Oxygen
  - Hemoglobin – large molecule which carries oxygen
- Transport of Carbon Dioxide
  - Bicarbonate ion – 75% dissolves in blood fluids and is converted to this
Regulation of Respiration

Brain stem - Control center is located in medulla and pons of brain stem

Chemical Control

Central chemoreceptors
- Located near medulla
- Respond to raised CO₂ level (hypercapnia)

Peripheral chemoreceptors
- Located in neck and aortic arch
- Respond to oxygen level considerably below normal

Other factors such as pain or emotional responses can affect breathing patterns

Abnormal Ventilation

Hyperventilation
- High oxygen level and low CO₂ level (hypocapnia)
- Increases blood pH

Hypoventilation
- Insufficient air in alveoli
- Decreases blood pH

Some Terms for Altered Breathing

Hyperpnea - increase in depth and rate
Hypopnea - decrease in depth and rate
Tachypnea - excessive rate, as in exercise
Apnea - temporary cessation for short periods

Cyanosis - bluish color due to insufficient O₂
Hypoxia - lower than normal oxygen in tissues
Hypoxemia - lower than normal oxygen in blood
Suffocation - cessation of breathing due to some blockage

Disorders of the Nasal Cavities and Related Structures

Sinusitis
Deviated septum
Epistaxis
Respiratory Disorders

Infection
• Common cold (acute coryza)
• Respiratory syncytial virus (RSV)
• Croup
• Influenza
• Pneumonia
• Tuberculosis

Respiratory Disorders

Allergic Rhinitis (Hay Fever) and Asthma
• Hypersensitivity to allergens
• Watery discharge from eyes and nose
• Seasonal or chronic
• Inflammation of airway tissues
• Spasm in bronchial tubes

Respiratory Disorders

Chronic Obstructive Pulmonary Disease (COPD)
• Includes both chronic bronchitis and emphysema
• Normal air flow obstructed
• Reduced exchange of oxygen and carbon dioxide
• Air trapping and overinflation of lungs
• Dypsnea

Respiratory Disorders

Sudden Infant Death Syndrome (SIDS)
• Also called crib death
• Unexplained death
• Seemingly healthy infant
• Under 1 year old
• Usually occurs in sleep

Respiratory Disorders

Respiratory Distress Syndrome (RDS)
• Covers a range of inflammatory disorders
• Acute respiratory distress syndrome (ARDS) or shock lung
  • Usually appears in adults
• Respiratory distress syndrome of the newborn
  • Formerly called hyaline membrane disease
  • Appears in premature newborns

Figure 18-12 Chronic obstructive pulmonary disease (COPD).
Respiratory Disorders

Cancer
- Lung cancer
  - Most common cause of cancer-related deaths
  - Most important cause is cigarette smoking
- Cancer of larynx
  - Linked to cigarette smoking and alcohol consumption
  - High cure rate

Cancer
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Disorders Involving the Pleura
- Pleurisy
  - Inflammation of pleura
- Pneumothorax
  - Air in pleural space
- Hemothorax
  - Blood in pleural space

Age and the Respiratory Tract
- Tissues lose elasticity, become more rigid
- Decreased compliance, lung capacity
- Increased susceptibility to infection
- Increased incidence of emphysema
- Reduced capacity for exercise

Special Equipment for Respiratory Treatment
- Bronchoscope
- Oxygen therapy
- Suction apparatus
- Tracheostomy tube
- Artificial respiration apparatuses

Case Study
Asthma Diagnosis
- Lung function testing
Asthma Treatment
- Bronchodilators to relax smooth muscle
- Anti-inflammatories to decrease inflammation

Word Anatomy
<table>
<thead>
<tr>
<th>Word Part</th>
<th>Meaning</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>pleur/o</td>
<td>side, rib</td>
<td>The pleura covers the lung and lines the chest wall (rib cage).</td>
</tr>
<tr>
<td>spir/o</td>
<td>breathing</td>
<td>A spirometer is an instrument used to record breathing volumes.</td>
</tr>
<tr>
<td>rhin/o</td>
<td>nose</td>
<td>Rhinitis is inflammation of the nose.</td>
</tr>
<tr>
<td>atel/o</td>
<td>incomplete</td>
<td>Atelectasis is incomplete expansion of the lung.</td>
</tr>
<tr>
<td>pneum/o</td>
<td>air, gas</td>
<td>Pneumothorax is accumulation of air in the pleural space.</td>
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</tbody>
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