CHAPTER 1

The Anatomy and Physiology of the Respiratory System
Sagittal Section of Upper Airway

Fig. 1-1. Sagittal section of upper airway.
Structure of the Nose

Fig. 1-2. Structure of the nose.

Frontal process of maxilla
Lesser alar cartilages
Nasal bones
Lateral nasal cartilage
Greater alar cartilage
Septal cartilage
Fibrous fatty tissue
Fig. 1-3. Sagittal section through nose.

- Anterior cranial fossa
- Cribiform plate of ethmoid bone
- Perpendicular plate of ethmoid bone
- Sphenoid sinus
- Sphenoid bone
- Vomer
- Nasopharynx
- Uvula
- Soft palate
- Palatine bone
- Palatine process of the maxilla
- Nasal cartilage
- Septal cartilage
- Nasal bone
- Frontal bone
- Frontal sinus
- Lip
Fig. 1-4. A. Stratified squamous epithelium. B. Pseudostratified columnar ciliated epithelium. C. Simple cuboidal epithelium. D. Simple squamous epithelium.
Fig. 1-4.  A. Stratified squamous epithelium. B. Pseudostratified columnar ciliated epithelium. C. Simple cuboidal epithelium. D. Simple squamous epithelium.
Fig. 1-4.  A. Stratified squamous epithelium.  
B. Pseudostratified columnar ciliated epithelium.  
Simple Cuboidal Epithelium

Fig. 1-4. A. Stratified squamous epithelium. B. Pseudostratified columnar ciliated epithelium. C. Simple cuboidal epithelium. D. Simple squamous epithelium.
Simple Squamous Epithelium

Fig. 1-4. A. Stratified squamous epithelium. B. Pseudostratified columnar ciliated epithelium. C. Simple cuboidal epithelium. D. Simple squamous epithelium.
Fig. 1-5. Lateral view of the head, showing sinuses.
Oral Cavity

Fig. 1-6. Oral cavity.

- Hard palate
- Soft palate
- Palatopharyngeal arch
- Palatoglossal arch
- Palatine tonsil
- Uvula
- Oropharynx
The Pharynx

Fig. 1-7. View of the base of the tongue, vallecula epiglottica, epiglottis, and vocal cords.
Fig. 1-8. An oral endotracheal tube in proper position in the trachea.
Pathology includes (1) excessive production and accumulation of thick bronchial airway secretions, (2) partial bronchial obstruction and air trapping, and (3) alveolar hyperventilation.
Fig. 1-10. A. An endotracheal tube misplaced in patient’s esophagus. B. Stomach inflated with air.
Intrinsic Muscles of the Larynx

Fig. 1-11. Cartilages and intrinsic muscles of the larynx.
Cartilages and Intrinsic Muscles of the Larynx

Fig. 1-11. Cartilages and intrinsic muscles of the larynx.
Cartilages and Intrinsic Muscles of the Larynx

Fig. 1-11. Cartilages and intrinsic muscles of the larynx.
Croup Syndrome

Fig. 1-12. Croup syndrome.
A. Acute epiglottis.
B. Laryngotracheobronchitis.
Extrinsic Laryngeal Muscles

Fig. 1-13. Extrinsic laryngeal muscles.
Intrinsic Laryngeal Muscles

Fig. 1-14. Intrinsic laryngeal muscles.
The Lower Airways

Fig. 1-15. Tracheobronchial tree.
## Structures of the Lungs

<table>
<thead>
<tr>
<th>Structures of the Lungs</th>
<th>Generations*</th>
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<tbody>
<tr>
<td><strong>Conducting Zone</strong></td>
<td></td>
</tr>
<tr>
<td>Trachea</td>
<td>0</td>
</tr>
<tr>
<td>Main stem bronchi</td>
<td>1</td>
</tr>
<tr>
<td>Lobar bronchi</td>
<td>2</td>
</tr>
<tr>
<td>Segmental bronchi</td>
<td>3</td>
</tr>
<tr>
<td>Subsegmental bronchi</td>
<td>4–9</td>
</tr>
<tr>
<td>Bronchioles</td>
<td>10–15</td>
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<tr>
<td>Terminal bronchioles</td>
<td>16–19</td>
</tr>
<tr>
<td><strong>Respiratory Zone</strong></td>
<td></td>
</tr>
<tr>
<td>Respiratory bronchioles</td>
<td>20–23</td>
</tr>
<tr>
<td>Alveolar ducts</td>
<td>24–27</td>
</tr>
<tr>
<td>Alveolar sacs</td>
<td>28</td>
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</table>

* **Cartilaginous airways**  
* **Noncartilaginous airways**  
* **Sites of gas exchange**

*NOTE: The precise number of generations between the subsegmental bronchi and the alveolar sacs is not known.*

† These structures collectively are referred to as a primary lobule (see pages 36–39) or lung parenchyma; they are also called terminal respiratory units and functional units.
Histology of the Tracheobronchial Tree

Fig. 1-16. Histology of the tracheobronchial tree.
Mast Cells in the Lamina Propria

Fig. 1-18. Cross section of a bronchus showing the mast cells in the lamina propria.
Fig. 1-19. Immunologic mechanisms.
Fig. 1-20. Tracheal bronchial tree.
Cross Section of Trachea

Fig. 1-21. Cross-section of trachea.

- Posterior view
  - Trachealis muscle
  - Elastic fibers
  - Hyaline cartilage
  - Connective tissue sheath

- Anterior view
  - Submucosal glands
  - Blood vessels
  - Epithelium
  - Parasympathetic nerves
Endotracheal Tube in Right Main Stem

Fig. 1-22. A. Endotracheal tube in right main stem. B. Same patient 20 minutes after tube pulled back.
Canals of Lambert

Terminal bronchial tree (cut-away)

Alveoli

Canals of Lambert

Terminal bronchiole

Fig. 1-23. Canals of Lambert.
Cross-section of Bronchial Area

Fig. 1-24. Cross-section of bronchial area.
The Sites of Gas Exchange

Fig. 1-25. Schematic drawing of the primary lobule.

- Terminal bronchiole
- Respiratory bronchioles
- Alveolar ducts
- Alveolar sacs
- Alveoli
- End of conduction zone
- Respiratory zone
Fig. 1-26. Alveolar-capillary network.
Fig. 1-27. Interstitium.
The Pulmonary Vascular System

- Arteries
- Arterioles
- Capillaries
- Venules and veins
Major Pulmonary Vessels

Fig. 1-28. Major pulmonary vessels.
Pulmonary Blood Vessels

Fig. 1-29. Schematic drawing of components of the pulmonary blood vessels.
Fig. 1-30. Lymphatic vessels of the bronchial airways, pulmonary arteries, and veins.
Lymph Nodes

Fig. 1-31. Lymph nodes.
Lymphatic Vessels of the Visceral Pleura

Fig. 1-32. Lymphatic vessels of the visceral pleura of the lungs.
NEURAL CONTROL OF THE LUNGS
### Some Effects of Autonomic Nervous System Activity

<table>
<thead>
<tr>
<th>Effector Site</th>
<th>Sympathetic Nervous System</th>
<th>Parasympathetic Nervous System</th>
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<tbody>
<tr>
<td>Heart</td>
<td>Increased rate &amp; Strength contraction</td>
<td>Decreased rate &amp; Contraction Strength</td>
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<tr>
<td>Bronchial smooth muscle</td>
<td>Relaxation</td>
<td>Constriction</td>
</tr>
<tr>
<td>Bronchial glands</td>
<td>Decreases secretions</td>
<td>Increases secretions</td>
</tr>
<tr>
<td>Salivary glands</td>
<td>Decreases secretions</td>
<td>Increases secretions</td>
</tr>
<tr>
<td>Stomach</td>
<td>Decreases motility</td>
<td>Increases motility</td>
</tr>
<tr>
<td>Intestines</td>
<td>Decreases motility</td>
<td>Increases motility</td>
</tr>
<tr>
<td>Eyes</td>
<td>Widens pupils</td>
<td>Constricts pupils</td>
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Table 1-2
Fig. 1-33. Anterior view of the lungs.
Medial View of the Lungs

Fig. 1-34. Medial view of the lungs.
Fig. 1-35. Anatomic relationship of the lungs and the thorax.
Lung Segments

Fig. 1-36. Lung segments.

<table>
<thead>
<tr>
<th>Right lung</th>
<th>Left lung</th>
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<tbody>
<tr>
<td><strong>Upper lobe</strong></td>
<td><strong>Upper lobe</strong></td>
</tr>
<tr>
<td>Apical</td>
<td>Apical</td>
</tr>
<tr>
<td>Posterior</td>
<td>Apical/Posterior</td>
</tr>
<tr>
<td>Anterior</td>
<td>Anterior</td>
</tr>
<tr>
<td></td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td><strong>Middle lobe</strong></td>
<td><strong>Lower division (lingular)</strong></td>
</tr>
<tr>
<td>Lateral</td>
<td>Superior lingula</td>
</tr>
<tr>
<td>Medial</td>
<td>Inferior lingula</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>Lower lobe</strong></td>
<td><strong>Lower lobe</strong></td>
</tr>
<tr>
<td>Superior</td>
<td>Superior</td>
</tr>
<tr>
<td>Medial basal</td>
<td>Anterior medial</td>
</tr>
<tr>
<td>Anterior basal</td>
<td>Lateral basal</td>
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<tr>
<td>Lateral basal</td>
<td>Posterior basal</td>
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<tr>
<td>Posterior basal</td>
<td>10</td>
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Major Structures Surrounding the Lungs

Fig. 1-37. Major structures surrounding the lungs.
Fig. 1-38. The thorax.
Fig. 1-39. The intercostal space.
The Diaphragm

Fig. 1-40. The diaphragm.
The Accessory Muscles of Inspiration

- Scalenus muscles
- Sternocleidomastoid muscles
- Pectoralis major muscles
- Trapezius muscles
- External intercostal muscles
Fig. 1-41. Scalenus muscles.
Sternocleidomastoid muscles.
Fig. 1-43. Pectoralis major muscles.
Pectoralis Major Muscles for Inspiration

Fig. 1-44. Using the pectoralis major muscles for inspiration.
Trapezius Muscles

Fig. 1-45. Trapezius muscles.
Fig. 1-46. Shrugging of shoulders typifies the action of the trapezius muscles.
Fig. 1-47. Internal and external intercostal muscles.
Accessory Muscles of Expiration

- Rectus abdominis muscles
- External abdominis obliquus muscle
- Internal abdominis obliquus muscles
- Transversus abdominis muscles
- Internal intercostal muscles
Muscles of Expiration

Fig. 1-48. Accessory muscles of expiration.

A: Rectus abdominis
B: External oblique
C: Internal oblique
D: Transversus abdominis
Muscles of Expiration

Fig. 1-49. The collective action of the accessory muscles of expiration.