Oxygenation

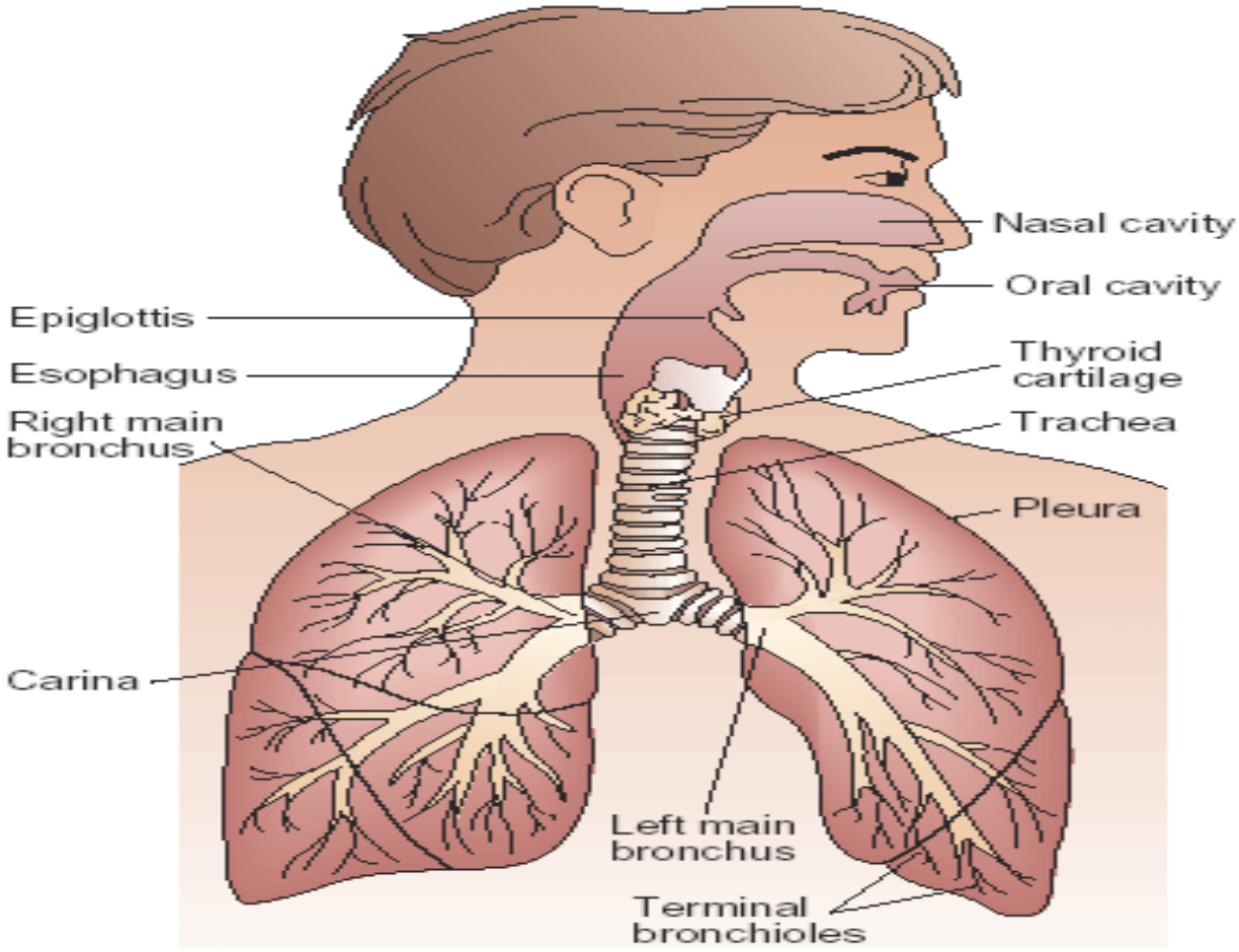
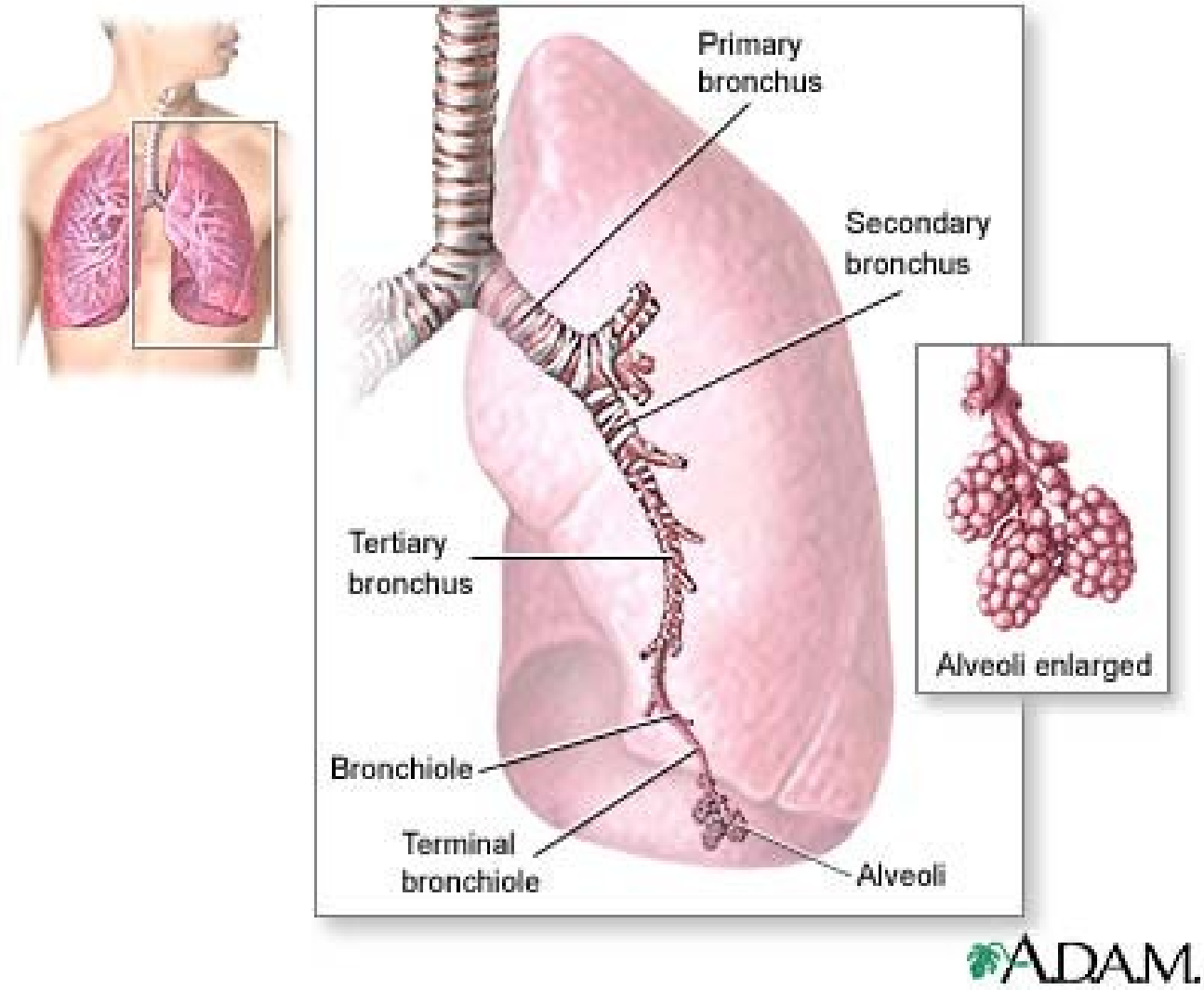
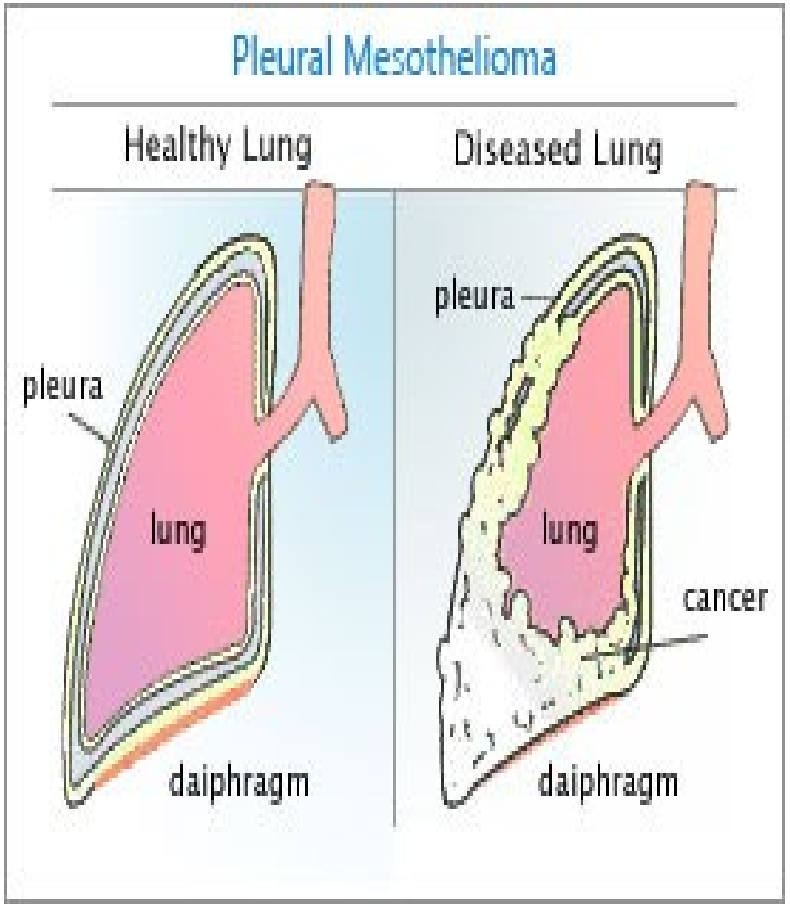
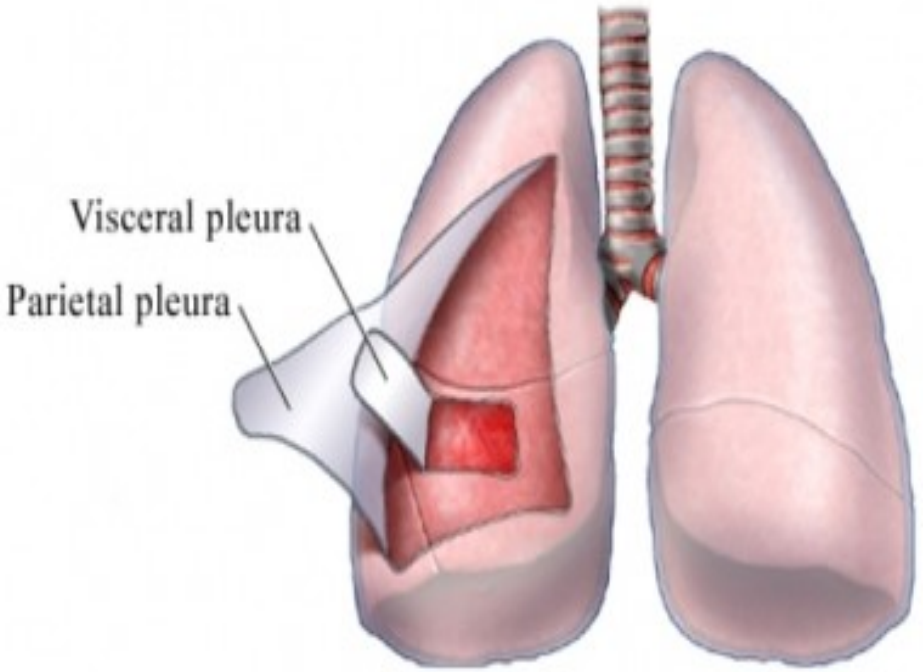
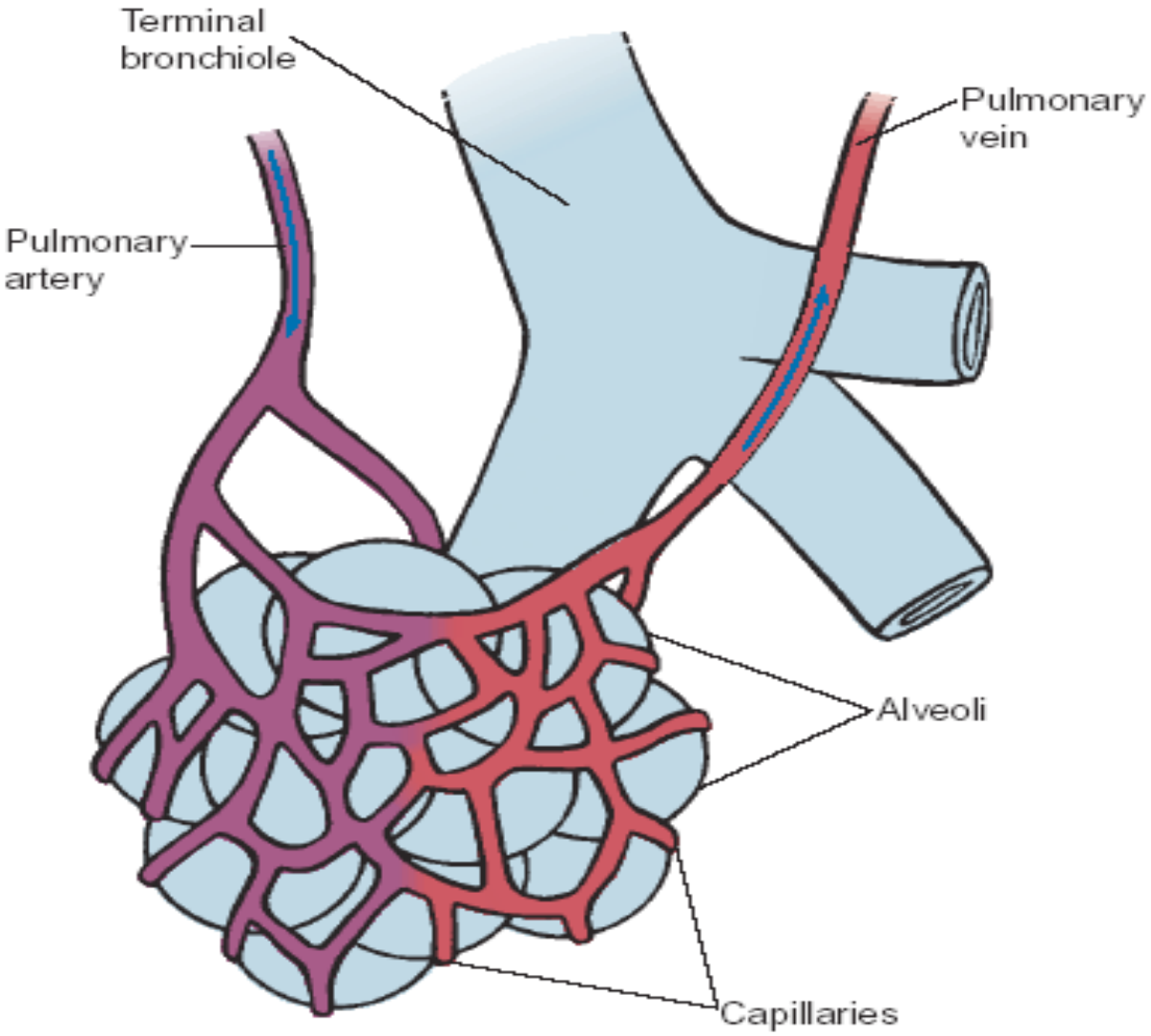


FIGURE 45-1 The organs of the respiratory tract.


Primary bronchus
Secondary bronchus
Tertiary bronchus
Bronchiole
Terminal bronchiole
Alveoli
Alveoli enlarged
A.D.A.M.


Pleural Mesothelioma
Healthy Lung
Diseased Lung
pleura
lung
daiphragm
pleura
lung
cancer
daiphragm


Visceral pleura
Parietal pleura


Terminal bronchiole
Pulmonary vein
Pulmonary artery
Alveoli
Capillaries

Pulmonary Ventilation

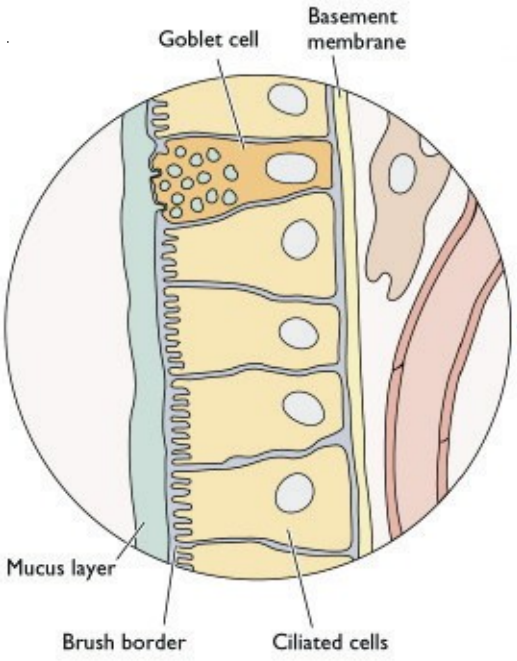
Ventilation of the lungs is accomplished through the act of breathing : inspiration and expiration.

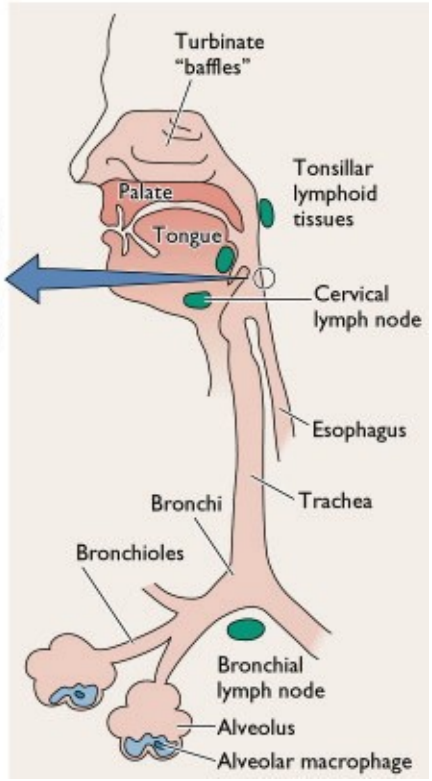
Adequate ventilation depends on several factors:

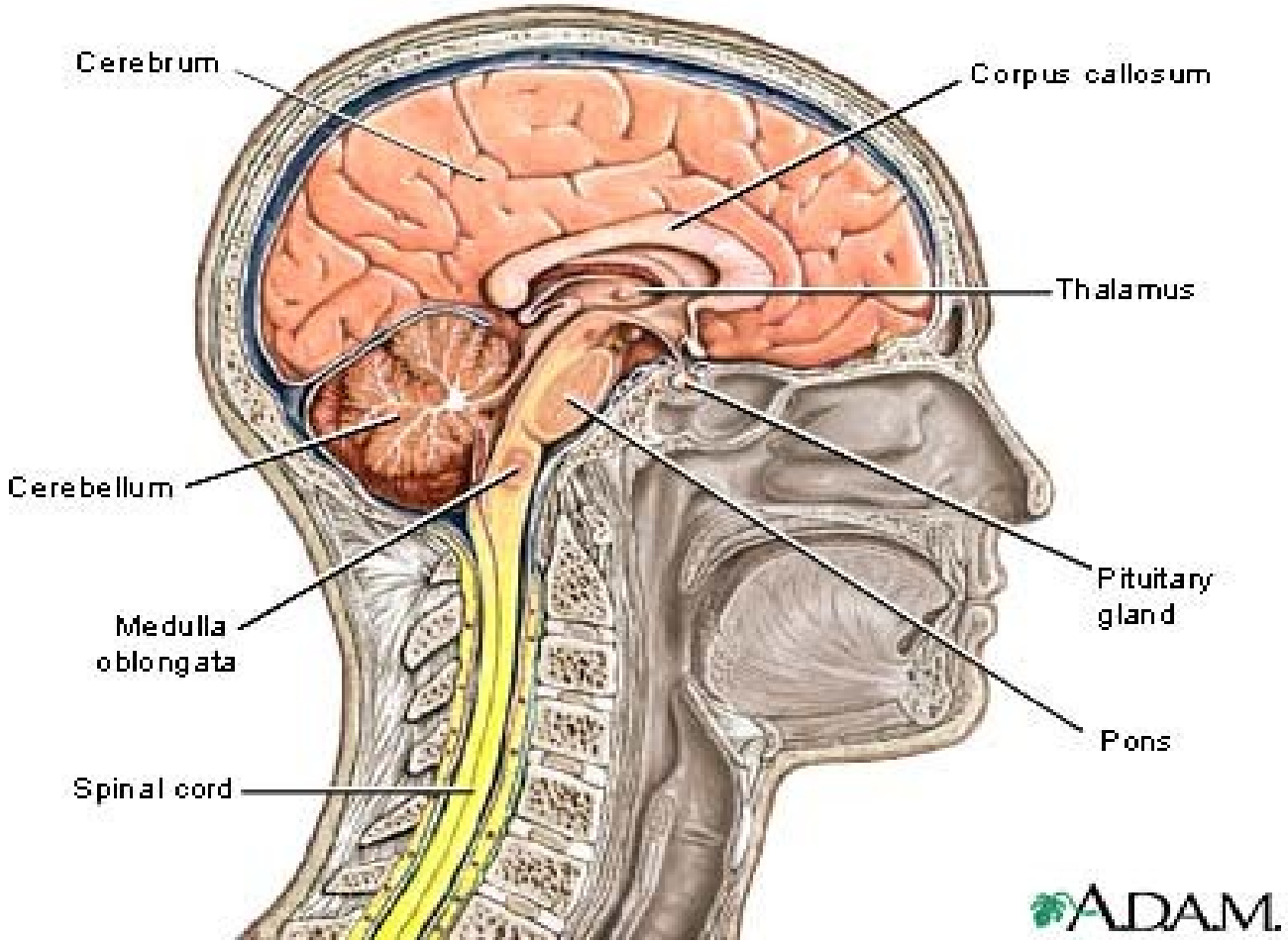
- Clear airways
- An intact central nervous system and respiratory system
- An intact thoracic cavity capable of expanding and contracting
- Adequate pulmonary compliance and recoil

Cough reflex

Ciliary action



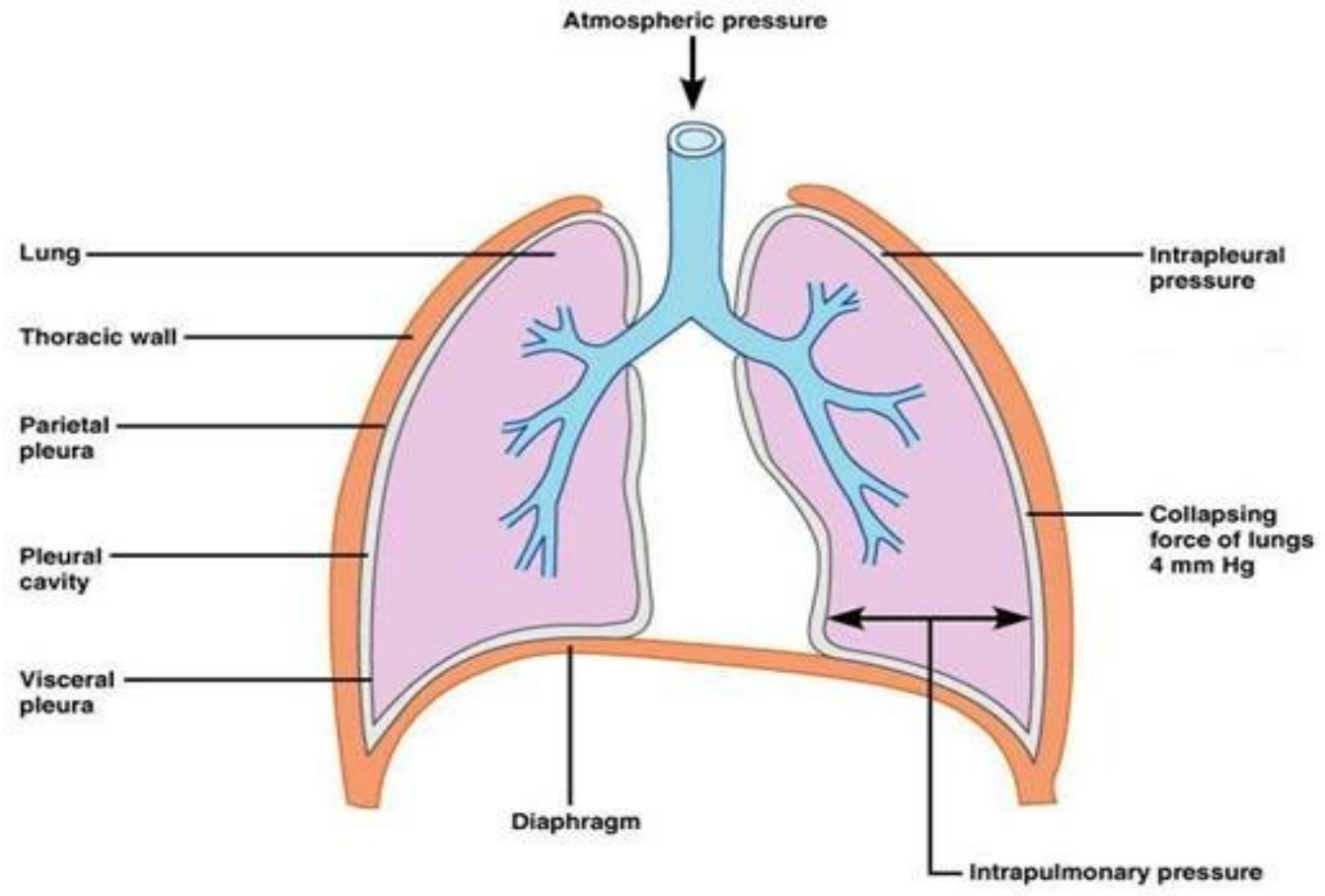



Cerebrum
Corpus callosum
Thalamus
Cerebellum
Pituitary gland
Medulla oblongata
Pons
Spinal cord
A.D.A.M.

Intrapleural pressure

Pressure in the pleural cavity surrounding the lungs.

Is always slightly negative in relation to atmospheric pressure



Intrapulmonary pressure

Pressure within the lungs

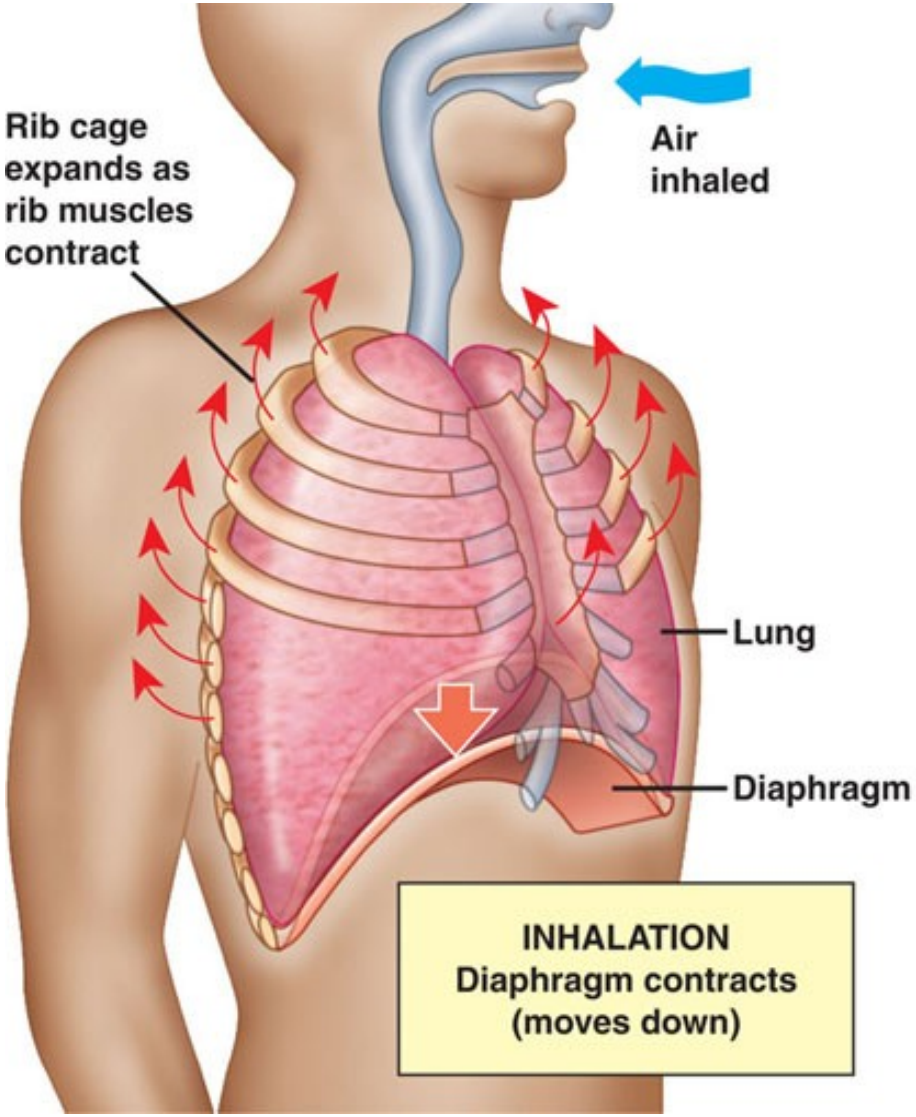
.Always equalize with atmospheric pressure

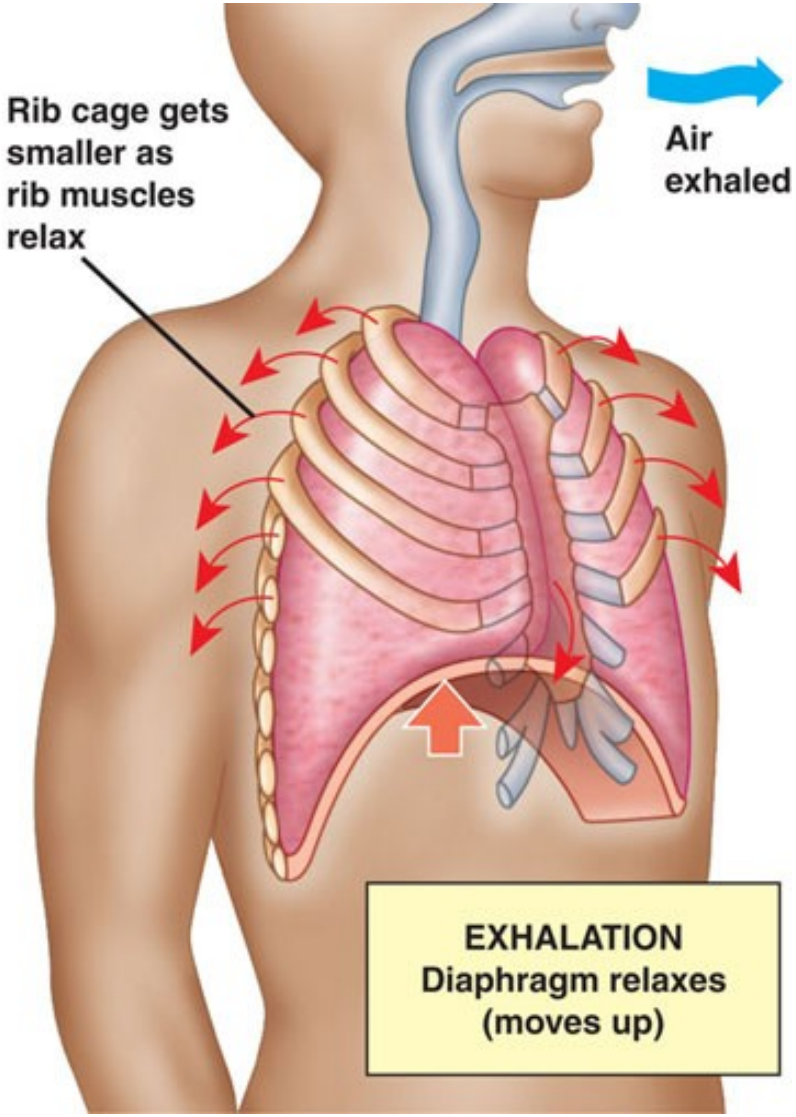
Inspiration

When the diaphragm and intercostals muscles contract ___ ↑ the size of the thoracic cavity ____ volume of the lungs ↑ ____ ↓ intrapulmonary pressure → then air moves .into the lung

Expiration

When the diaphragm and intercostal muscles relax ___ the size of the thoracic cavity ↓ ____ volume of the lungs ↓ ____ ↑intrapulmonary .pressure → then air moves out the lung


Rib cage expands as rib muscles contract
Air inhaled
Lung
Diaphragm
INHALATION
Diaphragm contracts
(moves down)


Rib cage gets smaller as rib muscles relax
Air exhaled
EXHALATION
Diaphragm relaxes
(moves up)

Tidal volume

Approx. 500ml of air is inspired and expired with each breath .

- Lung compliance

Expansibility or stretchability of lung tissue, plays a significant role in the ease of ventilation .

- Lung recoil

The continual tendency of the lungs to collapse away from the chest wall.

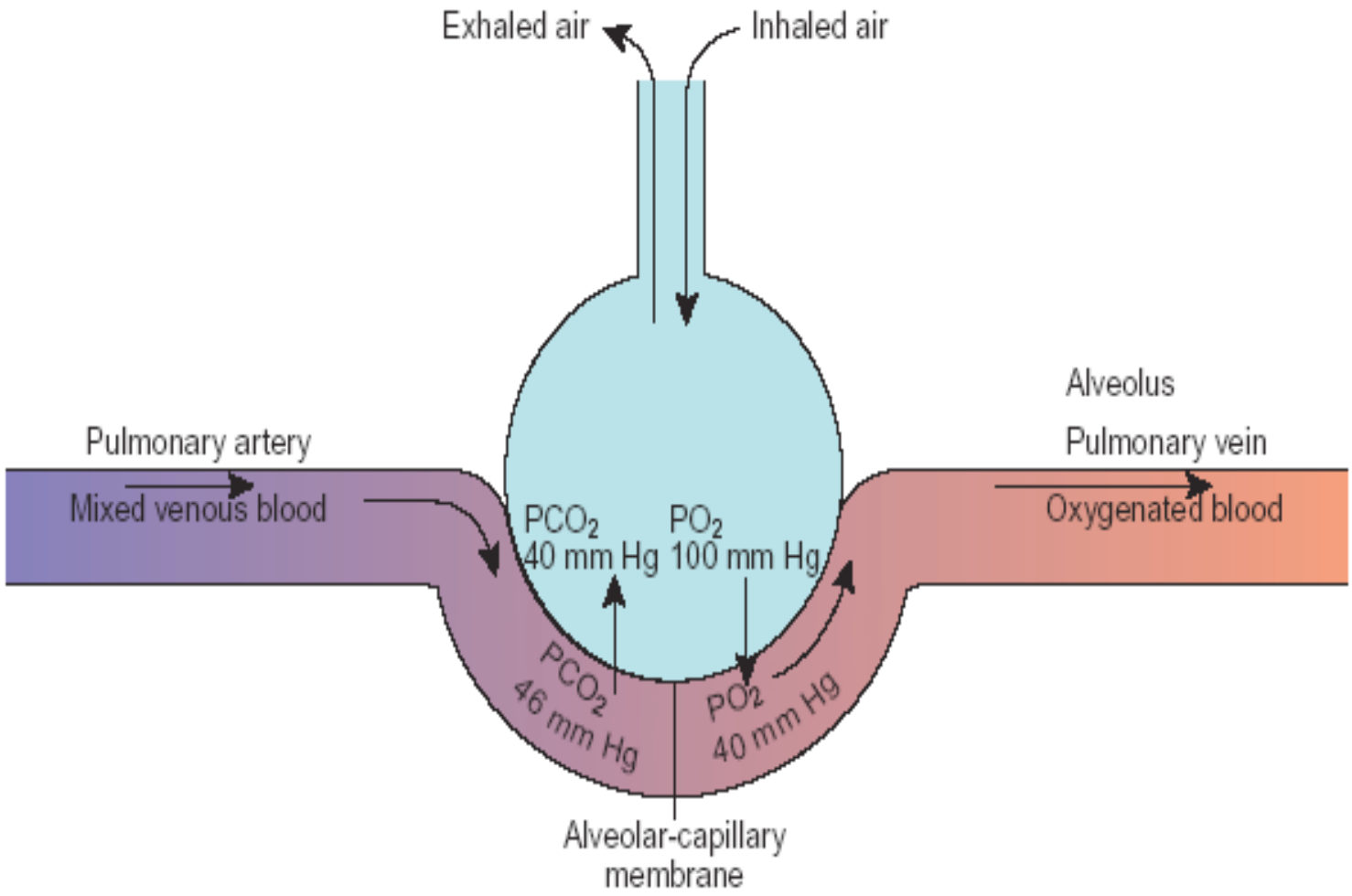
Elastic fibers in lung tissue contribute to lung recoil, also surface tension of fluid lining the alveoli.

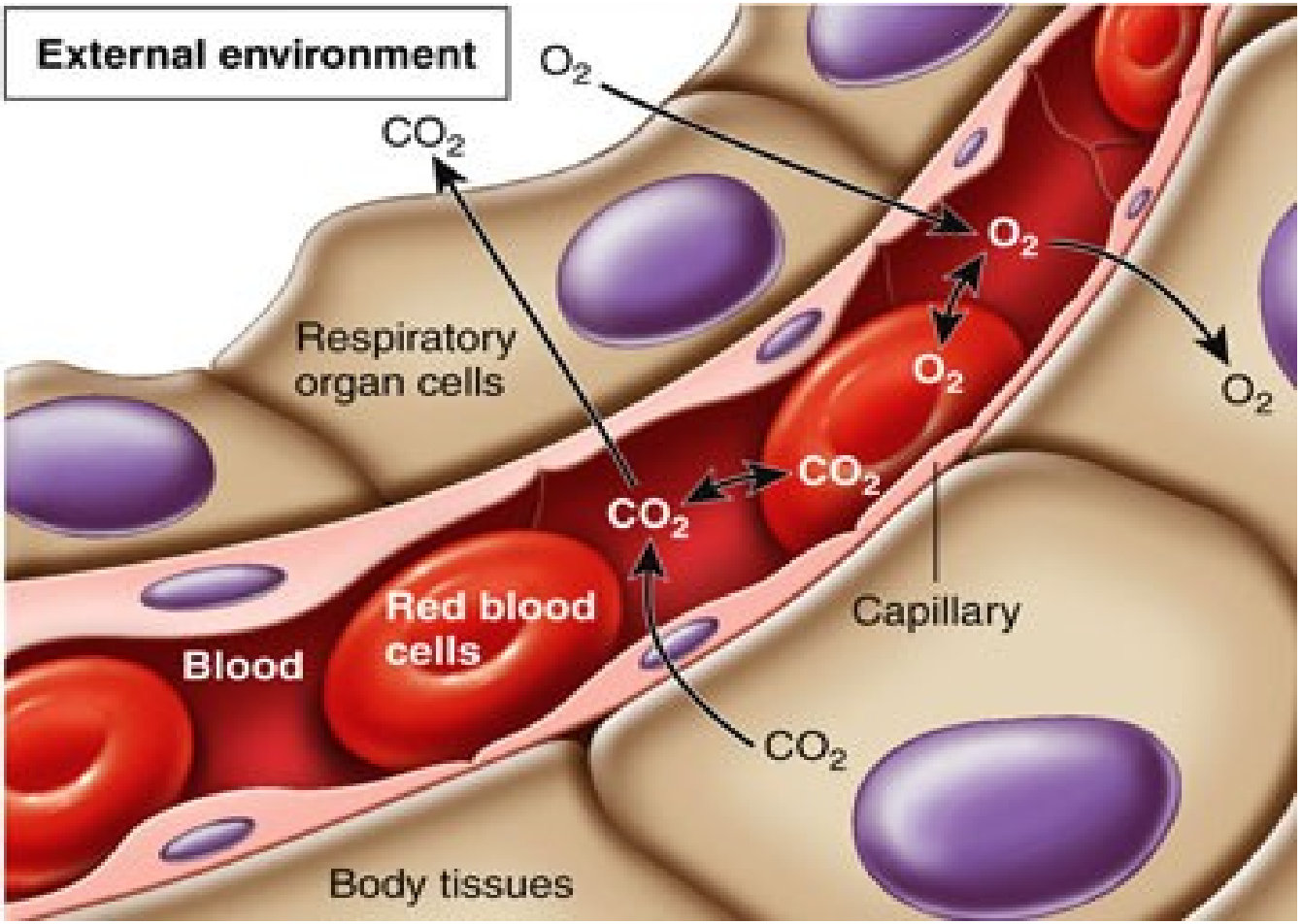
Surfactant, a detergent-like phospholipid, reduces the surface tension of the fluid lining the alveoli. When surfactant production is reduced, the lung becomes stiff and the alveoli collapse.

Alveolar Gas Exchange

Diffusion refers to the movement of oxygen and carbon dioxide between the air (in the alveoli) and the blood (in the capillaries). The appropriate gas moves passively from an area of higher pressure or concentration to an area of lesser pressure or .concentration

When the pressure of oxygen is greater in the alveoli than in the blood , oxygen diffuse into the blood. The PO2 in the alevoli is about is about 100mmHgm whereas the PO2 in the venous blood of the pulmonary arteries is about 60mmHg. Therefore PO2 diffuse from the alveoli to the blood. By contrast PCO2 in the venous blood entering the pulmonary capillaries is about 45mmHg , whereas PCO2 in the alevoli is about 40mmHg, Therefore CO2 diffuse from the blood into the alveoli.


Exhaled air
Inhaled air
Alveolus
Pulmonary artery
Pulmonary vein
Mixed venous blood
Oxygenated blood
PCO_2 40 mm Hg
PO_2 100 mm Hg
PCO_2 46 mm Hg
PO_2 40 mm Hg
Alveolar-capillary membrane


External environment
O_2
CO_2
O_2
Respiratory organ cells
O_2
O_2
CO_2
CO_2
Red blood cells
Blood
Capillary
CO_2
Body tissues

Transport of Oxygen and Carbon Dioxide

Most of O2 97% combines loosely with hemoglobin as oxyhemoglobin. The remaining is dissolved and
. transported in the fluid of the plasma and cells

Several factors affect the rate of oxygen transport from :the lungs to the tissues

Cardiac output-

Any pathologic condition that decreases cardiac output .diminishes the amount of O2 delivered to the tissues

- Number of erythrocytes and blood hematocrit

Excessive ↑ in the blood hematocrit raise the blood viscosity, reducing the C.O and therefore reducing O2 transport.

Excessive reductions in the blood hematocrit, such as .occur in anemia, reduce oxygen transport

Exercise-

In well trained athletes , oxygen transport can be ↑ up to 20 times the normal rate, due to ↑ C.O and to ↑ use

.of O2 by the cells

Carbon Dioxide

Is transported from the cells to the lungs in three ways. The majority (65%) is carried in the RBC as bicarbonate. A moderate amount of CO2 (30%) combines with hemoglobin as carbhemoglobin. Small amounts (5%) is transported in solution in the plasma and as carbonic acid

Respiratory regulation

Respiratory regulation includes both neural and chemical controls to maintain the correct concentration .of O2 and CO2

A chemosensitive center in the medulla oblongata is highly responsive to ↑in blood CO2 or hydrogen ion concentration. This center can ↑ the activity of the .inspiratory center and the rate and depth of respiration

Also there is special neural receptors sensitive to ↓ O2 concentration. ↓ in O2 concentration in carotid arteries stimulate these receptors to stimulate the respiratory . center to ↑ ventilation

FACTORS AFFECTING RESPIRATORY FUNCTION

A variety of factors affect adequate respiratory functioning.

Health status

In the healthy person, the respiratory system can provide sufficient O2 to meet the body's needs. Diseases of the respiratory system, can adversely affect the O2 of the blood.

Age

At birth the fluid filled lungs drain, the PCO2 ↑ and the neonate takes a first breath. The lungs gradually expand with each subsequent breath, reaching full inflation by 2 weeks of age .Changes of aging also affect the respiratory system

) read from the page 1362(

Medications

Opioids are chemical agents that depress the medullary respiratory center; as a result, the rate and depth of respirations decrease. This occurs especially with the use of morphine and meperidine (Demerol).

Lifestyle

see the page 1362

Environment

see the page 1362

Stress

see the page 1363

Alterations in respiratory function

Hypoxia is a condition insufficient oxygen anywhere in the body, from the inspired gas to the tissue. The clinical signs box lists signs of hypoxia. **Page 1363**

Hypoventilation that is inadequate alveolar ventilation .can lead to hypoxia

Causes

Disease of respiratory muscle-

Drugs, or anesthesia-

With hypoventilation CO2 often accumulates in the blood a condition called **hypercarbia or**

.hypercapnia

Hypoxemia refers to reduced oxygen in the blood and is characterized by

- low PaO2 or hemoglobin saturation.

Cyanosis bluish discoloration of the skin, nailbeds, and a mucous membranes, due to reduced hemoglobin – oxygen saturation.

Cyanosis requires these two conditions:

The blood must contain about 5g or more of unoxygeneated hemoglobin per 100ml of blood and the surface blood capillaries must be dilated.

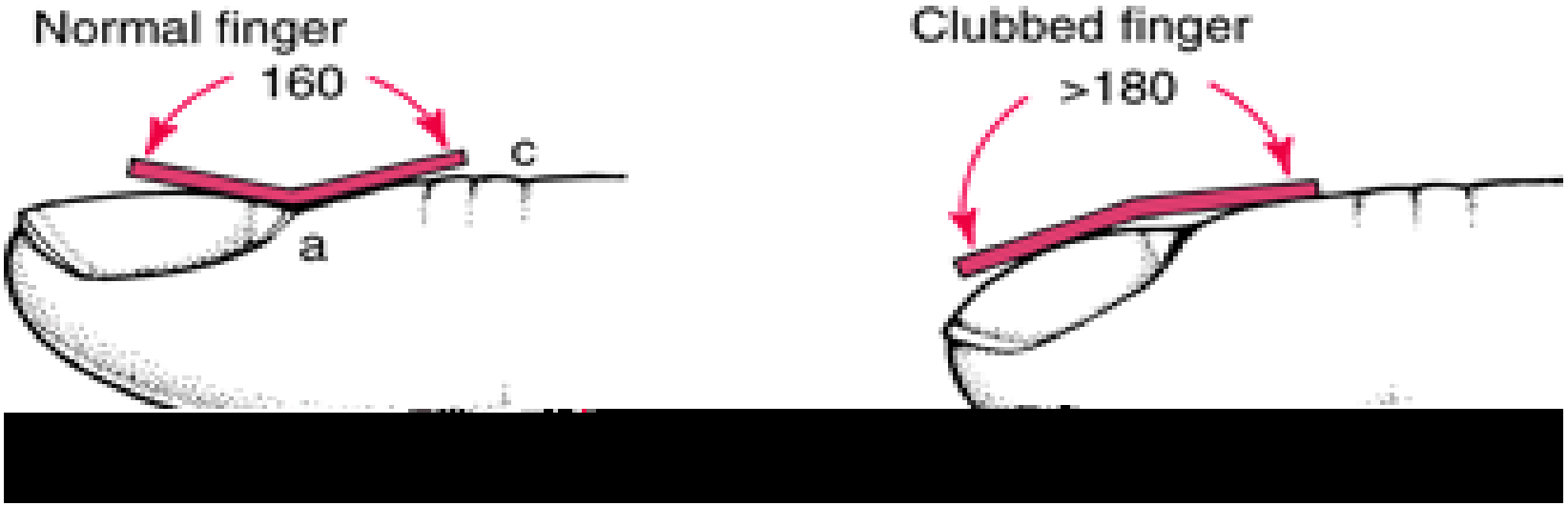
S+S for acute hypoxia

- Person appears anxious, tired, and drawn.
- Person assume sitting position, often leaning forward slightly to permit greater expansion of the thoracic cavity.

S+S for chronic hypoxia

- Person appears fatigued and is lethargic.
- Clubbed fingers and toes

With clubbing the base of the nail becomes swollen and the ends of the fingers and toes increase in size, the angle between the nail and the base of the nail increase to more than 180 degrees.


Normal finger
160
c
a
Clubbed finger
>180

Altered breathing Patterns

breathing Patterns refers to the rate, volume, rhythm, and relative ease or effort of respiration

Eupnea ….. Is quiet, rhythmic, and effortless

Tachypnea ….. Rapid rate is seen with fever, metabolic acidosis, pain, and hypercapnia or hypoxemia.

Bradypnea ….. Slow rate is seen in clients who have taken drugs such as morphine, metabolic alkalosis or have increased ICP (e.g., from brain injury).

Apnea ….. Is the cessation of breathing.

Hyperventilation ….. Is an ↑ movement of air into and out of the lungs. The rate and depth of respiration ↑ and more CO2 is eliminated than is produced.

One type of hyperventilation that accompanies metabolic acidosis is **kussmaul's breathing** by which the body attempts to compensate by blowing off the CO2 through deep and rapid breathing . Hyperventilation can also occur in response to stress or anxiety.

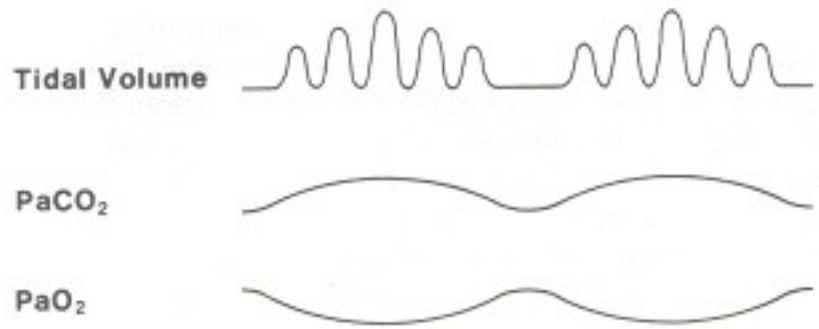
Abnormal respiratory rhythms create an irregular breathing pattern. Two abnormal respiratory rhythms are:

Cheyne – strokes respiration ….very deep to very shallow breathing and temporary apnea

Causes

- ↑ ICP , CHF, overdose of certain drugs

Cheyne-Stokes breathing



Biot's (cluster) respiration …. Shallow breaths interrupted by apnea may be seen in clients with central nervous system disorders.

Orthopnea ….. Is the inability to breath except in an upright or standing position.

Dyspnea ….Difficult or uncomfortable breathing

S+S

- Person appear anxious and may experience SOB
- Feeling of being unable to get enough air
- Flared nostrils , skin appear dusky,↑ P

Obstructed airway

An upper airway obstruction that is in the nose, pharynx, or larynx

Causes

- F.B such as food
- Tongue falls back in unconscious
- Collection of secretion in the passageways

Respiration sound gurgly or bubbly

Lower airway obstruction involves partial or complete occlusion the passage in the bronchi and lungs

Causes

- Accumulation of mucus or inflammatory exudate.

NURSING Management

Assessing

The patient's health history is an essential component for assessing respiratory functioning. Either the patient or a family member can provide this information.

Nursing History

Data should include about current and past respiratory problems, lifestyle, presence of cough, sputum or pain, medications for breathing, and presence of risk factors for impaired oxygenation status.

Physical Examination

The nurse use 4 physical examination techniques:

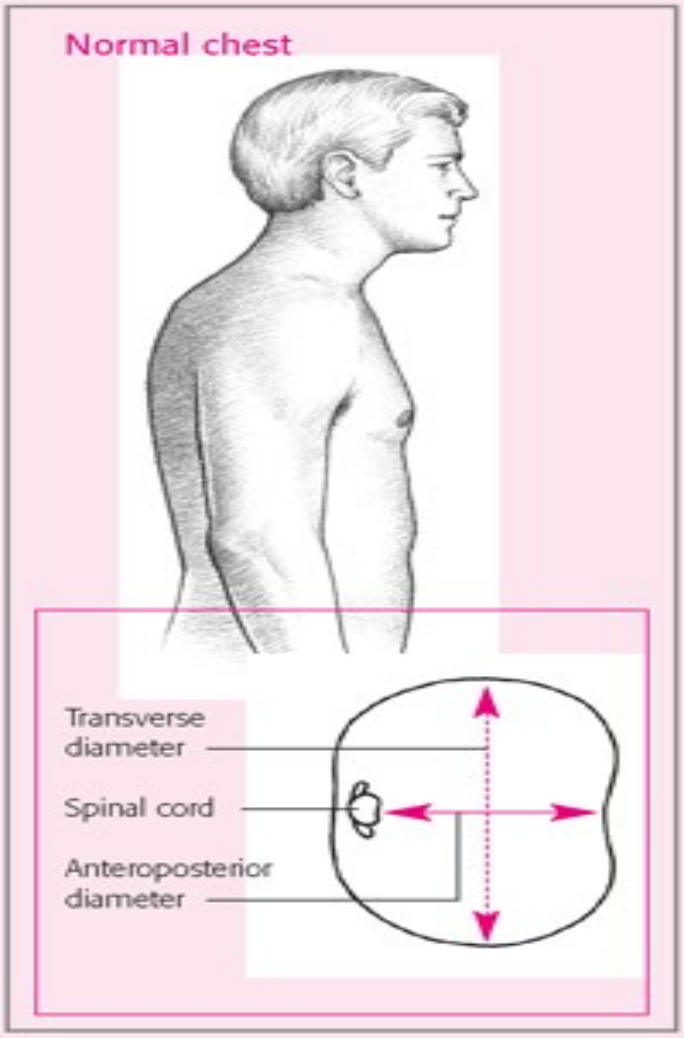
- Inspection, palpation, percussion, and auscultation.

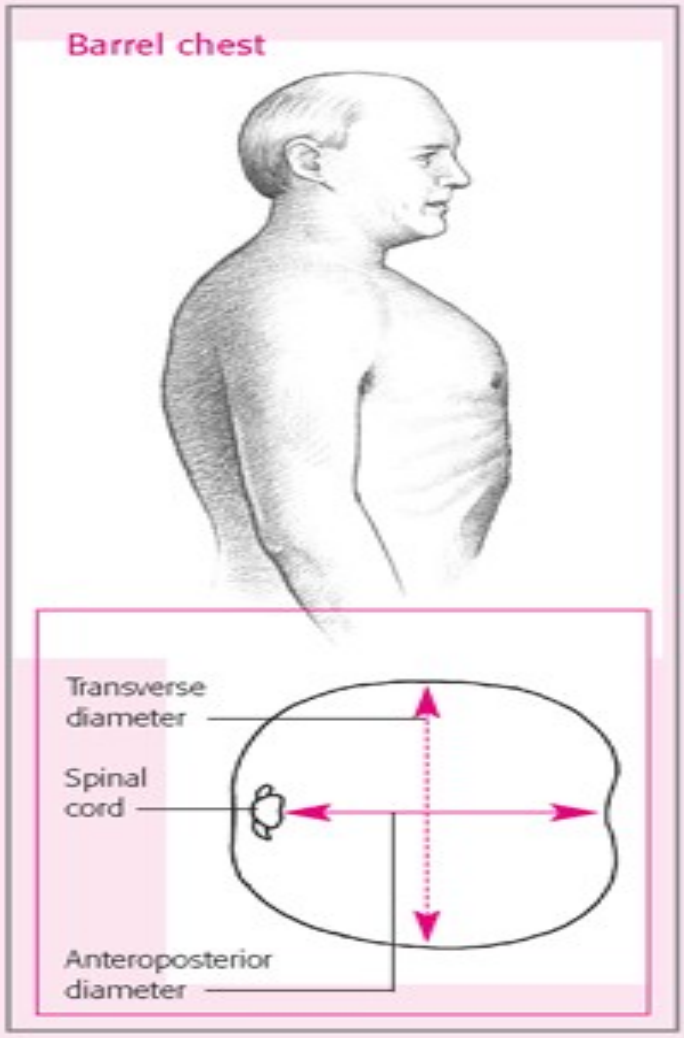
The nurse first **observes** the rate, depth, rhythm, and quality of respirations, noting the position the client assumes for breathing. Also inspects for variations in the shape of the thorax that may indicate adaptation to chronic respiratory conditions. e.g., client with emphysema frequently develop **a barrel chest**.

ASSESSMENT TIP

Recognizing barrel chest

You can determine whether your patient has a normal chest or a barrel chest by looking at the anteroposterior and transverse chest diameters. In a normal adult chest, the ratio of anteroposterior to transverse (or lateral) diameter is 1:2. In patients with barrel chest, this ratio approaches 1:1 as the anteroposterior diameter enlarges.





The nurse palpates the thorax for bulges, tenderness, or abnormal movement, detect vocal fremitus. Perform percussion posteriorly as the patient pulls the shoulders forward. Then continue with the examination proceeding down the patient's back, comparing one side to the other. Examine the anterior and lateral thorax with the patient in a supine position.

Listen carefully to the intensity and quality of each sound as the chest wall and underlying structures are percussed.

Using the diaphragm of a stethoscope, move from apex to base, comparing one side with the other side while listening to a complete respiratory cycle, inspiration and expiration. While auscultating, ask the patient to breathe through an open mouth slowly because breathing through the nose can produce falsely abnormal breath sounds. Breathing too quickly, such as with hyperventilation, may cause syncope and patient distress. If any abnormal breath sound is detected, instruct the patient to cough and auscultate again for at least two complete respiratory cycles. Record location, change in breath sounds after coughing, and phase of respiration (e.g., expiration) when any abnormal sound is noted.

Diagnostic Studies

There are various diagnostic tests to assess respiratory status included:-

Sputum specimens, throat cultures, visualization procedures, VBG, ABG, Pulmonary function test.

Pulmonary function tests measures lung volume and capacity.

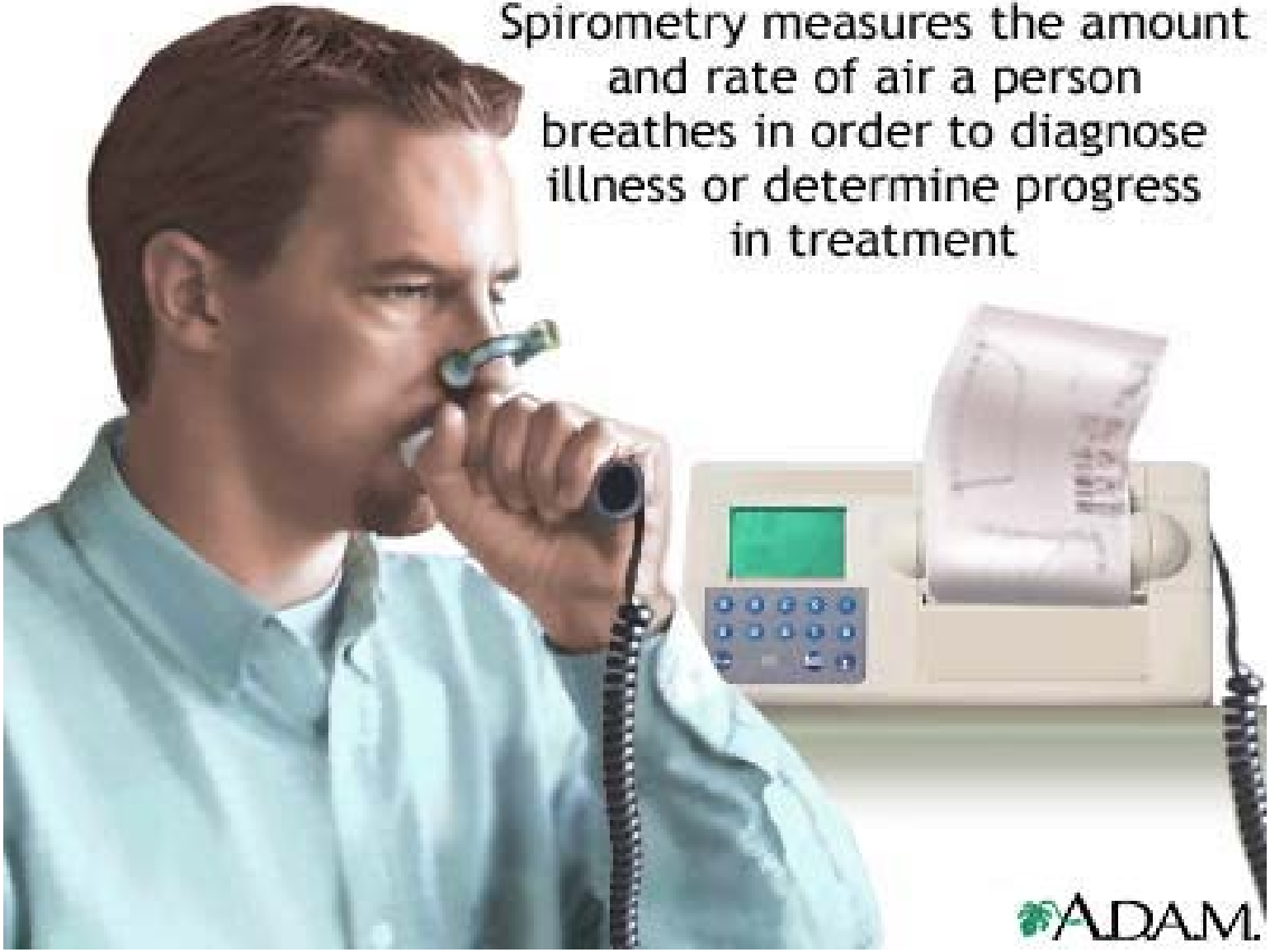
See table 50-1

Pulmonary function tests measure the following lung volumes and capacities:

- Tidal volume (TV): the amount of air inspired and expired in a normal respiration. Normal is 500 mL.
- Inspiratory reserve volume (IRV): Maximum amount of air that can be inhaled over and above a normal breath . Normal is 3,100 mL.
- Expiratory reserve volume (ERV): Maximum amount of air that can be exhaled following a normal exhalation. Normal is 1,200 mL.
- Residual volume (RV): the amount of air remaining in the lungs after a maximal expiration. Normal is 1,200 mL.

- Total lung capacity (TLC): the total volume of the lungs at maximum inflation calculated by adding the TV, IRV, ERV, and RV. Normal is 6,000 mL.
- Vital capacity (VC): the amount of air that can be exhaled after a maximal inspiration. Calculated by adding the TV,IRV, AND ERV. Normal is 4,800 mL.
- Inspiratory capacity (IC): the total amount of air that can be inhaled following normal quiet exhalation. Calculated by adding the TV,IRV . Normal is 3,600 mL.
- Functional residual volume (FRV): The volume left in the lungs after normal exhalation Calculated by adding the ERV and RV. Normal is 2,400 mL.


Micro Medical


Spirometry measures the amount and rate of air a person breathes in order to diagnose illness or determine progress in treatment
A.D.A.M.

Spida

Exit Options Help

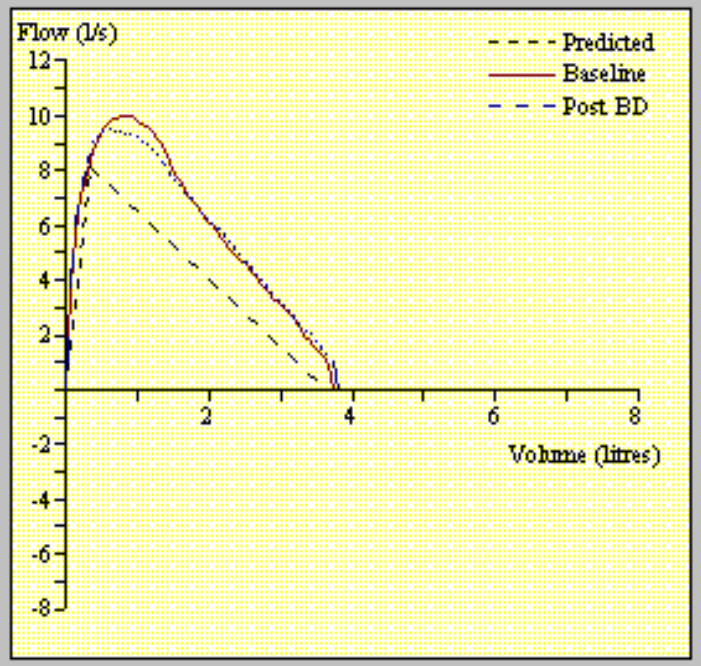
Spirometry Details

Patient ID ABBOT1 **First Name** Allen **Date & time** 07/10/96 13:29:19

Last Name Abbot **Age at test** 37

		Base	%Pred	Range	Post BD	%Chg
FVC	l	3.76	103	2.63 - 4.63	3.81	1
FEV1	l	3.84	123	2.26 - 3.94	3.90	2
PEF	l/s	10.01	124	6.09 - 10.07	9.48	-5
FER	%	100.00	124	69 - 92	100.00	0
F25	l/s	3.54	202	0.46 - 3.02	3.52	-1
F50	l/s	6.28	143	2.21 - 6.55	6.04	-4
MEF	l/s	6.10	148	2.41 - 5.83	6.24	2

Interpretation Normal spirometry



For Help, press F1 NUM RECSEL

Diagnosing

See page 1365, 1366

Planning

See page 1366

Implementing

Promoting Oxygenation-

Deep breathing and coughing-

One common breathing exercise is **abdominal** (**diaphragmatic**) and **pursed – lip breathing.**
Advantage of this exercise

Abdominal breathing permits deep full breaths with little effort. Pursued lip breathing helps the client develop control over breathing, also create resistance to the air flowing out of the lungs, thereby prolonging exhalation and preventing airway collapse by maintaining positive airway pressure also this tightening abdominal muscles to exhales more effectively. The client usually inhales to a count 3 and .exhales to a couunt of 7

Hydration-

Adequate hydration maintains the moisture of the respiratory mucous membranes. When the client is dehydrated or when environment has a low humidity, the respiratory secretions can become thick and .tenacious

Humidifiers are devices that add water vapor to inspired air, to prevent mucous membranes from drying and becoming irritated and to loosen secretions for easier .expectoration

Humidifiers

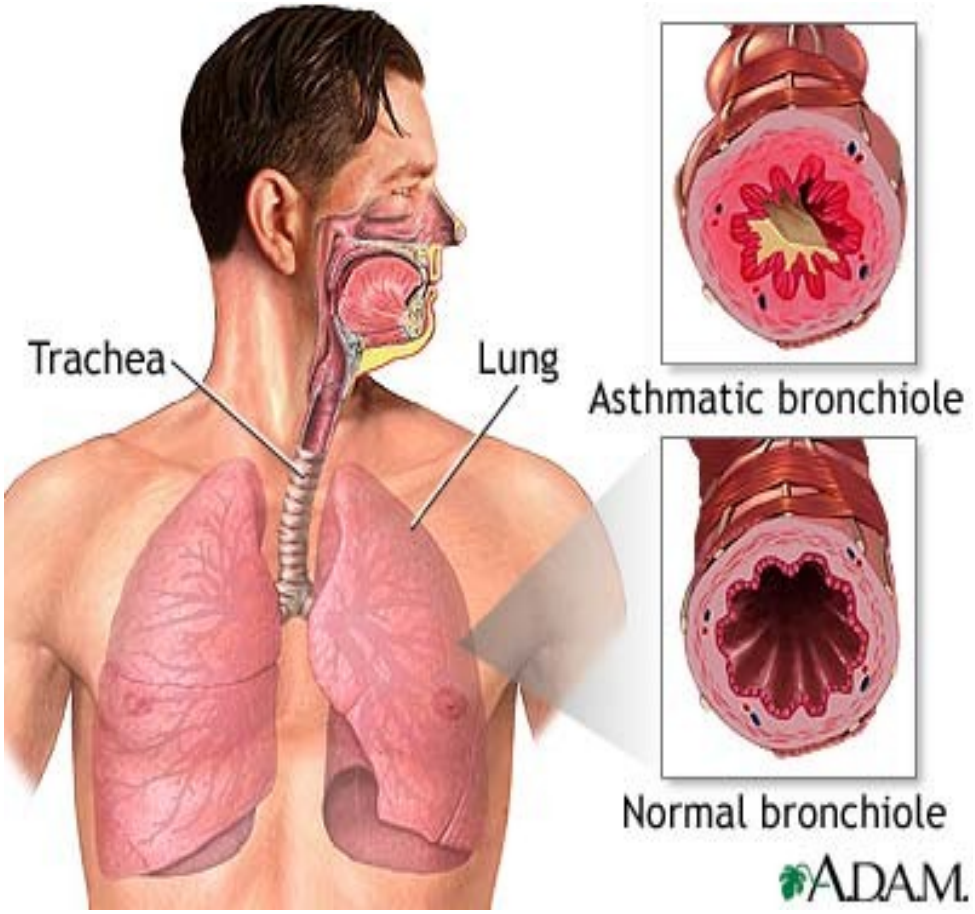
Medication-

A number of types of medication can be used for clients with oxygenation problem

Bronchodilators*

Reduce bronchospasm, opening tight or congested airways and facilitating ventilation. Route P.O, IV but the prefered route is by inhalation

Side effect include ↑ P, ↑ BP, anxiety, restlessness


Trachea
Lung
Asthmatic bronchiole
Normal bronchiole
A.D.A.M.

Anti- inflammatory drugs such as glucocorticoids

.Route : PO, IV, Inhaler

Action : ↓ edema and inflammation in the
. airways and allowing a better air exchange

Leukotriene modifiers*

These medications suppress the effects of Leukotriene on the smooth muscle of the respiratory tract. Leukotriene cause bronchoconstriction, mucous production, edema of the respiratory tract .

Expectorants*

Help breakup mucus, making it more liquid and easier to expectorate. E.g., Guaifenesin

When frequent or prolonged coughing interrupts sleep, a cough suppressant such as codeine.

Digitalis glycosides act directly on the heart to* improve the strength of contraction and slow the heart rate.

Beta-adrenergic blocking agents e.g., Propranolol*

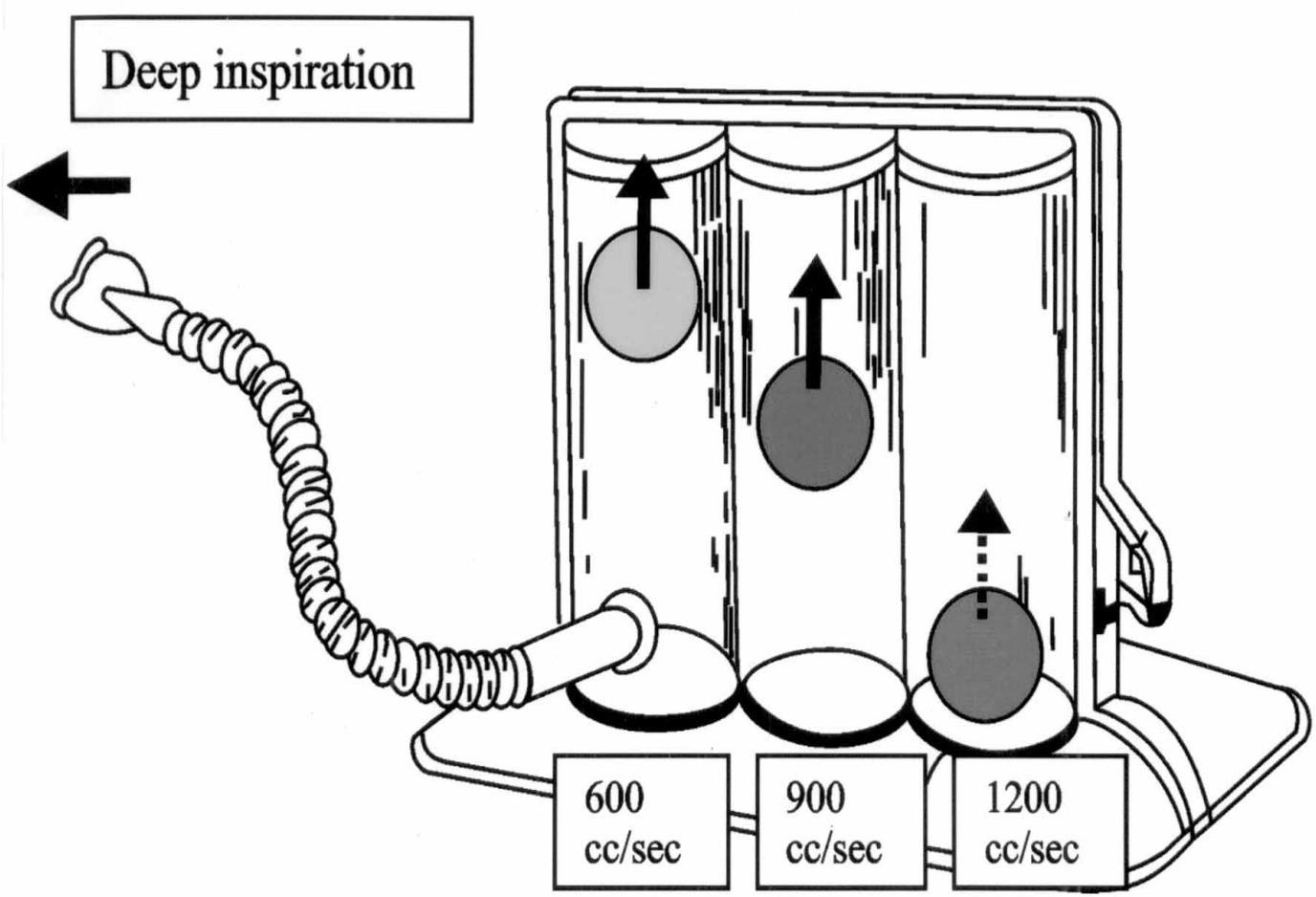
Affect the sympathetic nervous system to reduce the
. workload of the heart

Incentive spirometry …. Measure the flow of air-
. inhaled through the mouthpiece

Advantages ….. Page 1370

Percussion, Vibration, and Postural drainage-

Percussion ….. Sometimes called clapping, is forceful striking of the skin with cupped hands. Percussion can mechanically dislodge tenacious secretions from the bronchial walls. Cupped hands .trap the air against the chest


Deep inspiration
600
cc/sec
900
cc/sec
1200
cc/sec

Vibration …… is a series of vigorous quiverings produced by hands that are placed flat against the client's chest wall .

Postural drainage ….. Is the drainage by gravity of secretions from various lung segments. A wide variety of positions is necessary to drain all segments of the lungs . The lower lobes require drainage most frequently because the upper lobes drain by gravity.

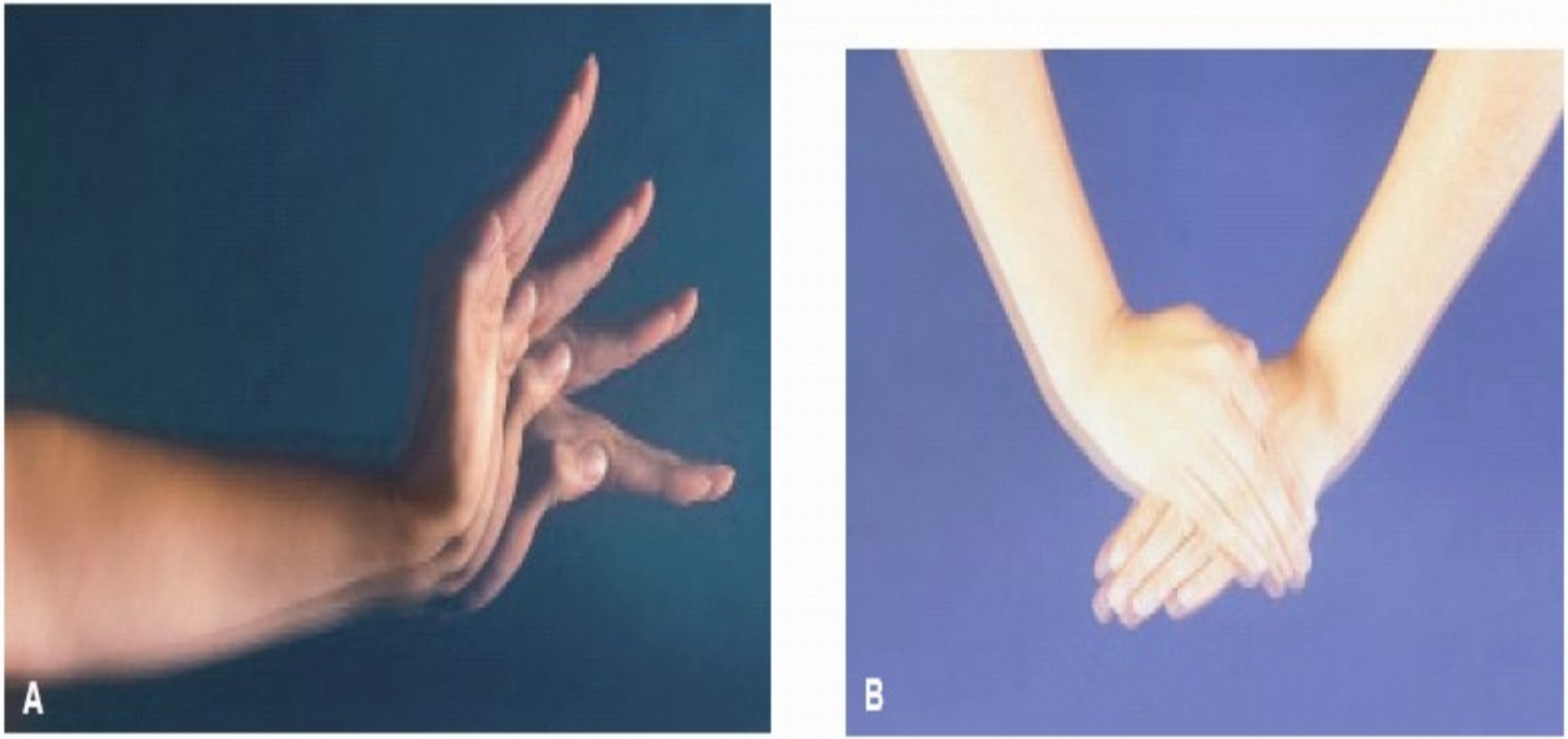


FIGURE 45-9 (**A**) The cupping position and action of the hand on manual percussion of the lung area. (**B**) The position and action of the hands necessary to use vibration to loosen respiratory secretions in the lungs. (Photos © B. Proud.)

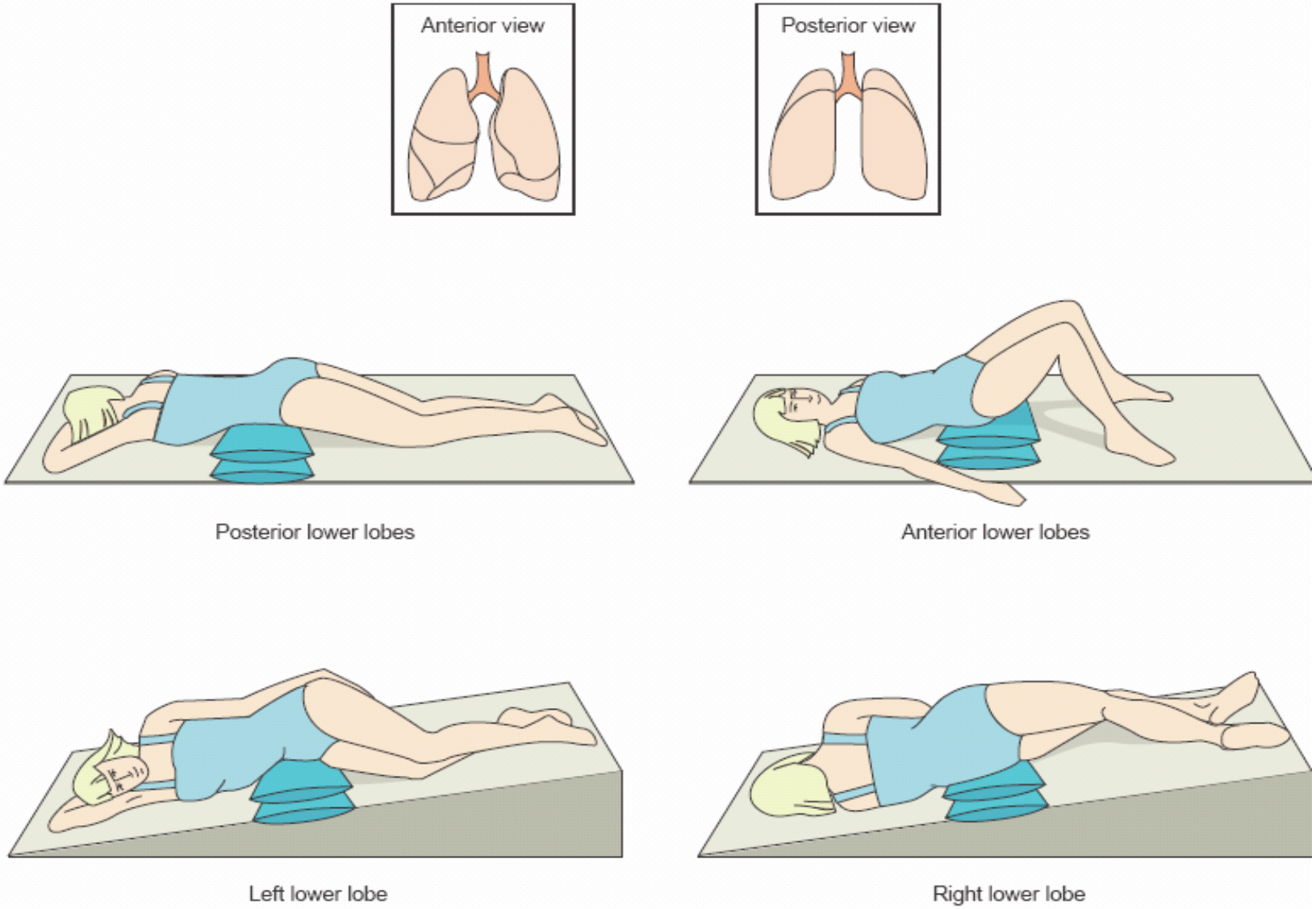


FIGURE 45-10 Postural drainage. Shown are four positions that use the force of gravity to assist the drainage of secretions from the smaller bronchial airways into the main bronchi and trachea so the patient is able to cough them up.

Oxygen Therapy

Clients who have difficulty ventilating all areas of their lungs, those whose gas exchange is impaired, or people with heart failure may benefit from oxygen therapy to prevent hypoxia.

Oxygen therapy safety precautions … Page 1373

Oxygen delivery systems

The choice of system depends on the client's oxygen needs, comfort, and developmental considerations.

- **Cannula (nasal prongs)**

Advantage

- Does not interfere with the client's ability to eat or to talk. It also is relatively comfortable, permits some freedom of movement and is well tolerated by the client.

It delivers a relatively low concentration of O2 (24% - to 45%) at flow rates of 2 to 6 L /min . Above 6 L/min the client tends to swallow air and the Fio2 is not increased .

Disadvantage

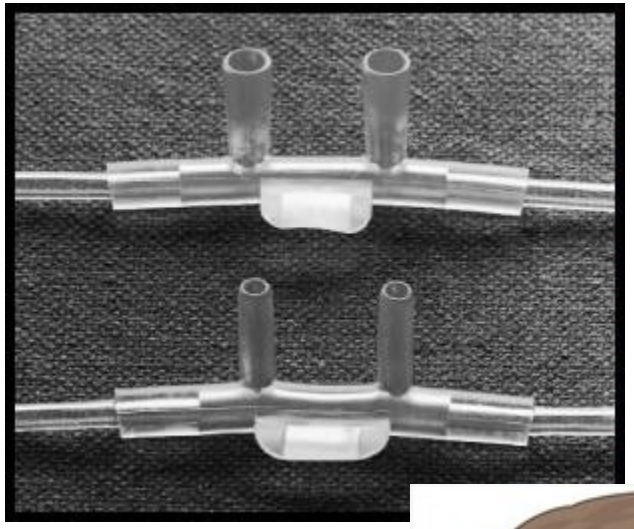
Inability to deliver higher concentrations of O2, and it- can be drying and irritating to mucous membranes .

Face mask-

Simple face mask delivers O2 concentrations from 40% to 60% at flow rates of 5 to 8 L/min .

Partial rebreather mask delivers O2 concentrations of 60% to 90% at liter flows of 6 to 10 L/min .

The partial rebreather bag must not totally deflate .during inspiration to avoid carbon dioxide buildup



Nonrebreather mask delivers the highest oxygen concentration possible 95% to 100% at liter flows of 10 to 15 L/min. One way bag valves on the mask and between the reservoir bag and the mask prevent the room air and the client's exhaled air from entering the . bag so only the oxygen in the bag is inspired

Venturi mask delivers oxygen concentration varying from 24% to 40% or 50% at liter flows of 4 to 10 L/min.

Face tent Can replace oxygen masks when masks- are poorly tolerated by clients. Face tents provide varying concentrations of O2 , for example, 30% to .50% concentration of oxygen at 4 to 8 L/min

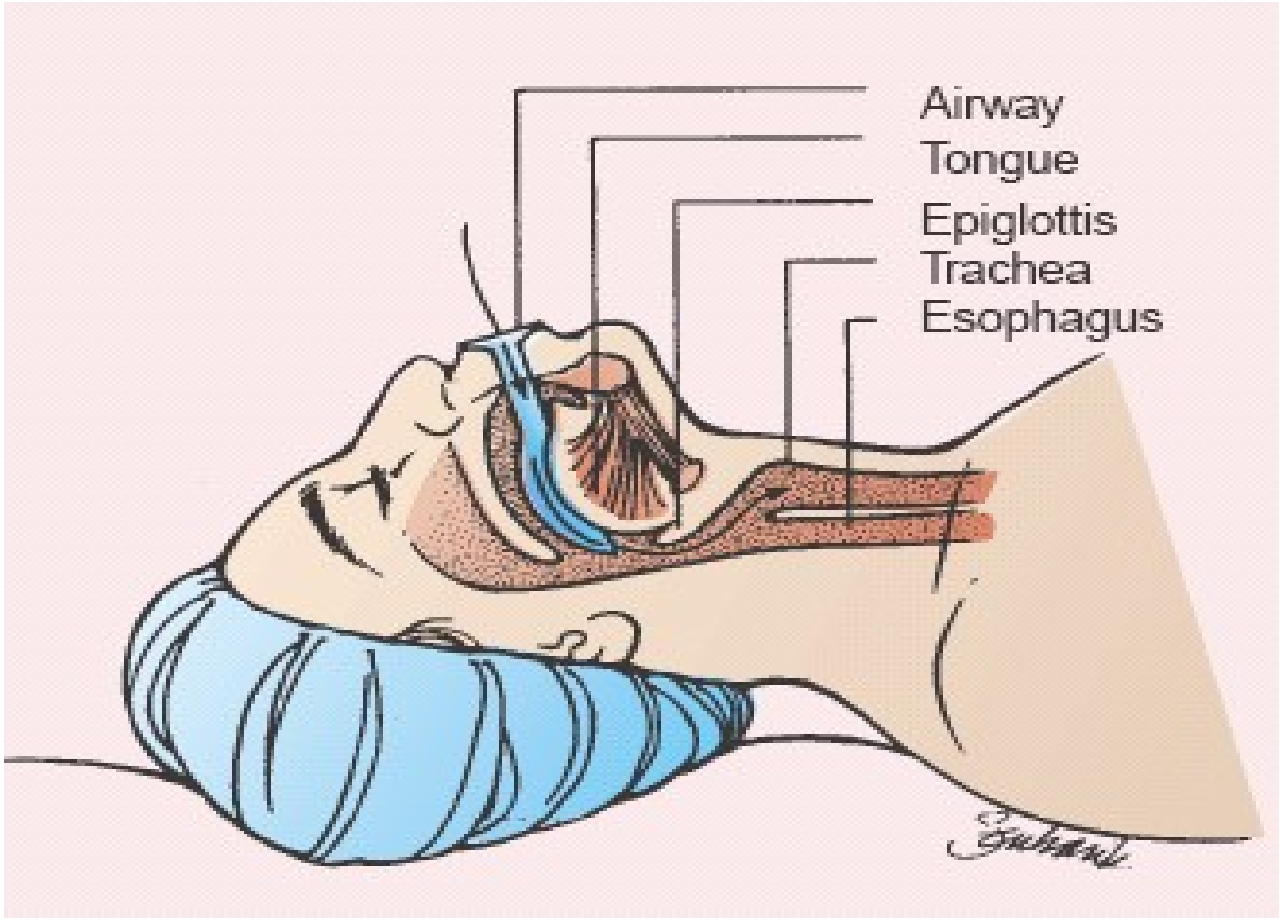
Artifical airways

Are inserted to maintain a patent air way passage for clients whose airway has become or may become :-obstructed. Four common types of airways are

Oropharyngeal and nasopharyngeal airways- 1

are used to keep the upper air passage open when they . may become obstructed by secretions or the tongue

Oropharyngeal airways stimulate the gag reflex and are only used for clients with altered levels of consciousness (e.g., general anesthesia, overdose, or) .head injury


Airway
Tongue
Epiglottis
Trachea
Esophagus

Endotracheal tubes use for clients who have- 2

general anesthetics or for those in emergency

. situations where mechanical ventilation is required

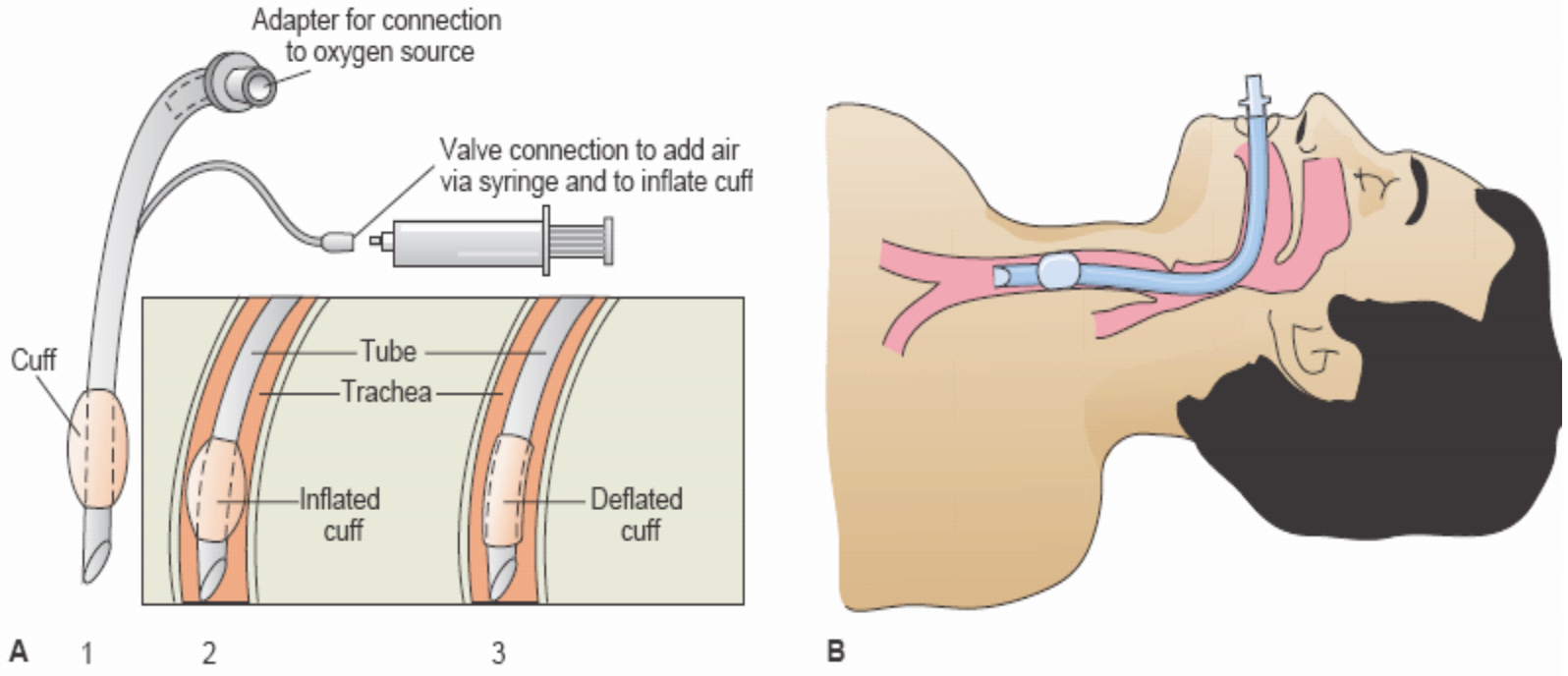


FIGURE 45-12 Endotracheal tube. (**A**) (1) Parts of a cuffed endotracheal tube; (2) tube in place with the cuff inflated; (3) tube in place with the cuff deflated. (**B**) Endotracheal tube in place.

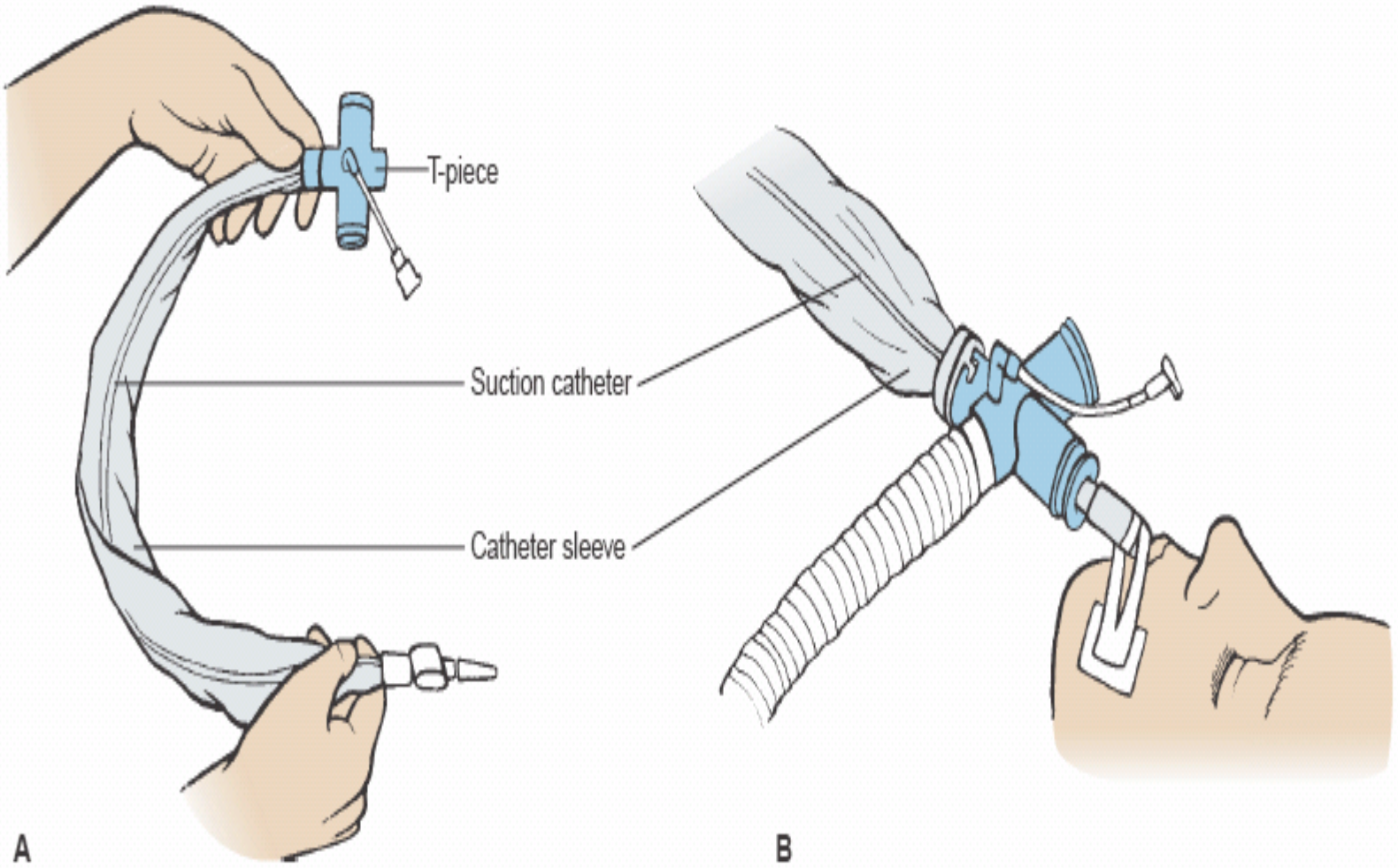


FIGURE 45-13 Closed airway suction system. (**A**) Closed tracheal suction system. (**B**) Closed system connected by a T-piece to the endotracheal tube and ventilator.

Tracheostomy. Clients who need long term **- 3**

. airway support may have a tracheostomy

Tracheostomy is an opening into the trachea through the neck

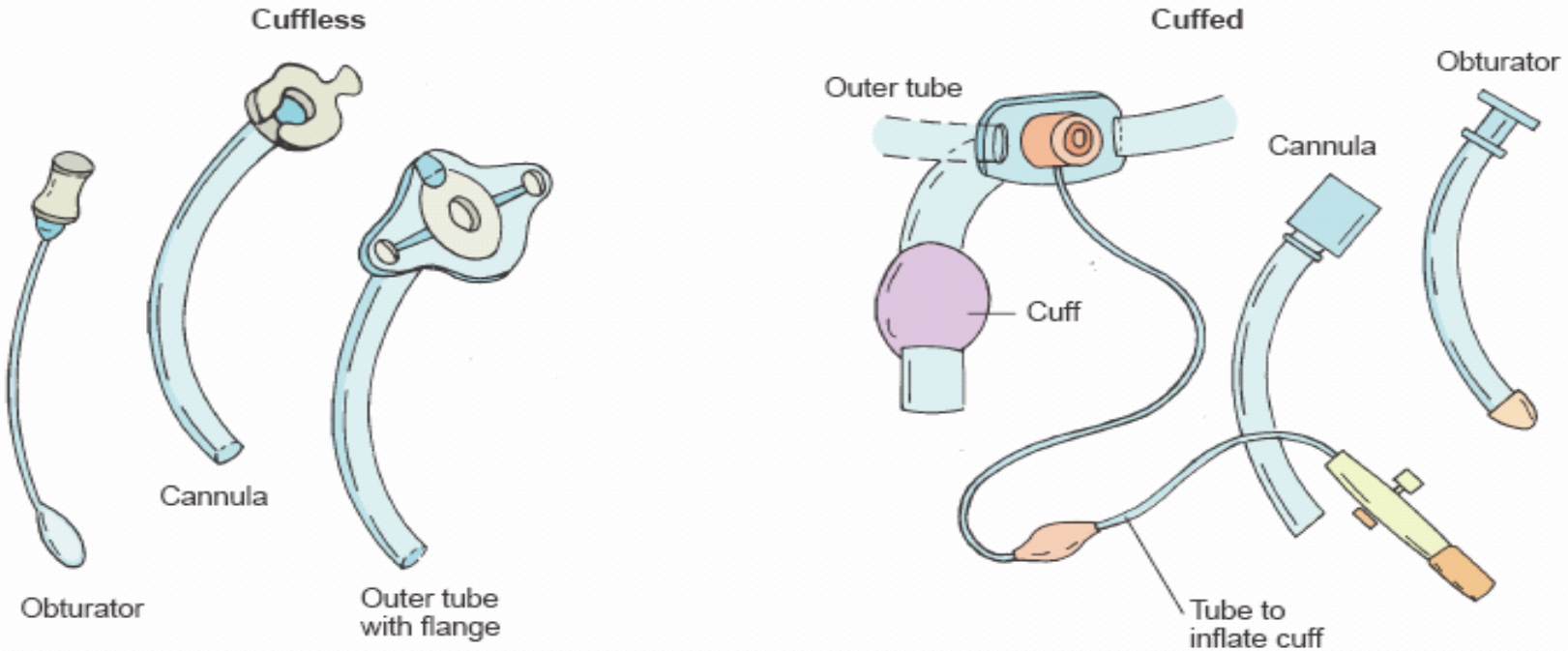
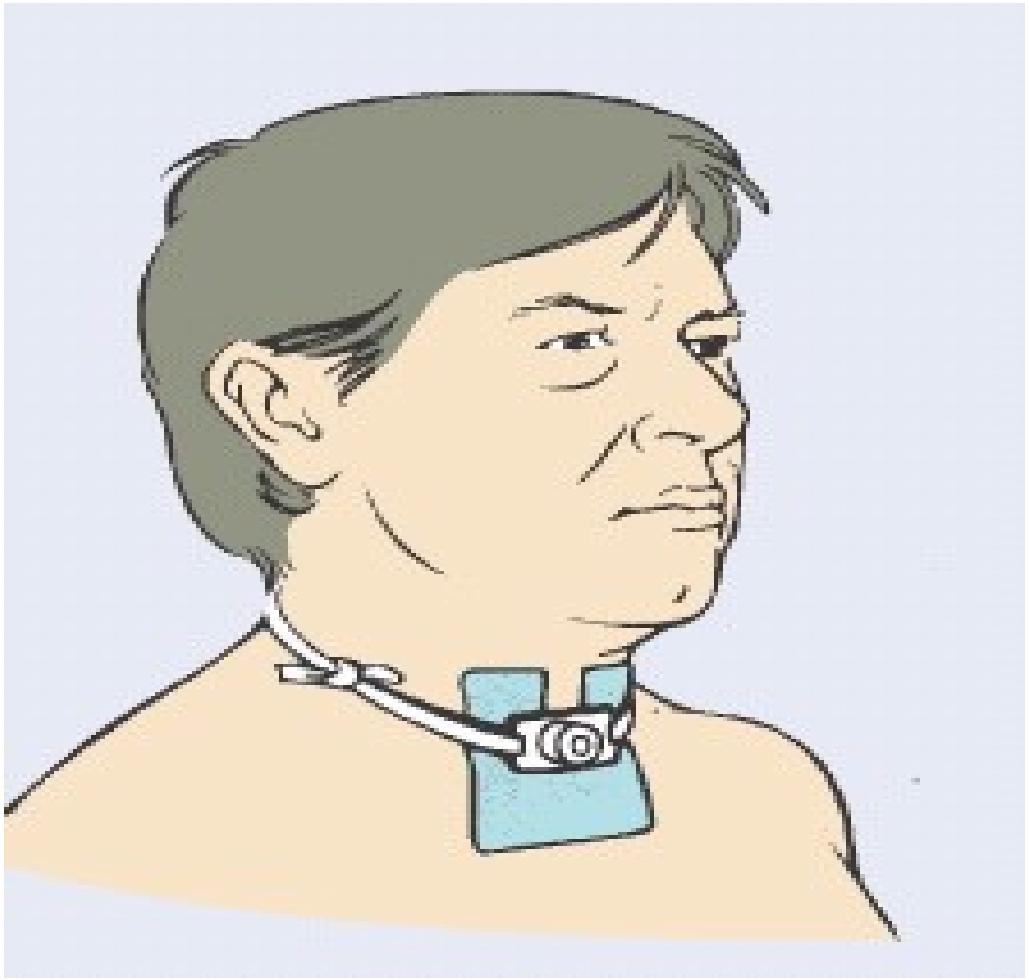


FIGURE 45-14 Two types of tracheostomy sets: cuffless and cuffed.



Suctioning

Is aspirating secretions through a catheter connected to .a suction machine or wall suction outlet

Indication of suction

Signs of respiratory distress-

The client unable to cough up and expectorate- secretions

Dyspnea, bubbling, rattling breath sounds, poor skin- color, ↓ oxygen saturation levels

Complications : hypoxemia, trauma to the airway, . nosocomial infection, cardiac dysrhythmia

The following techniques are used to minimize or : decrease these complications

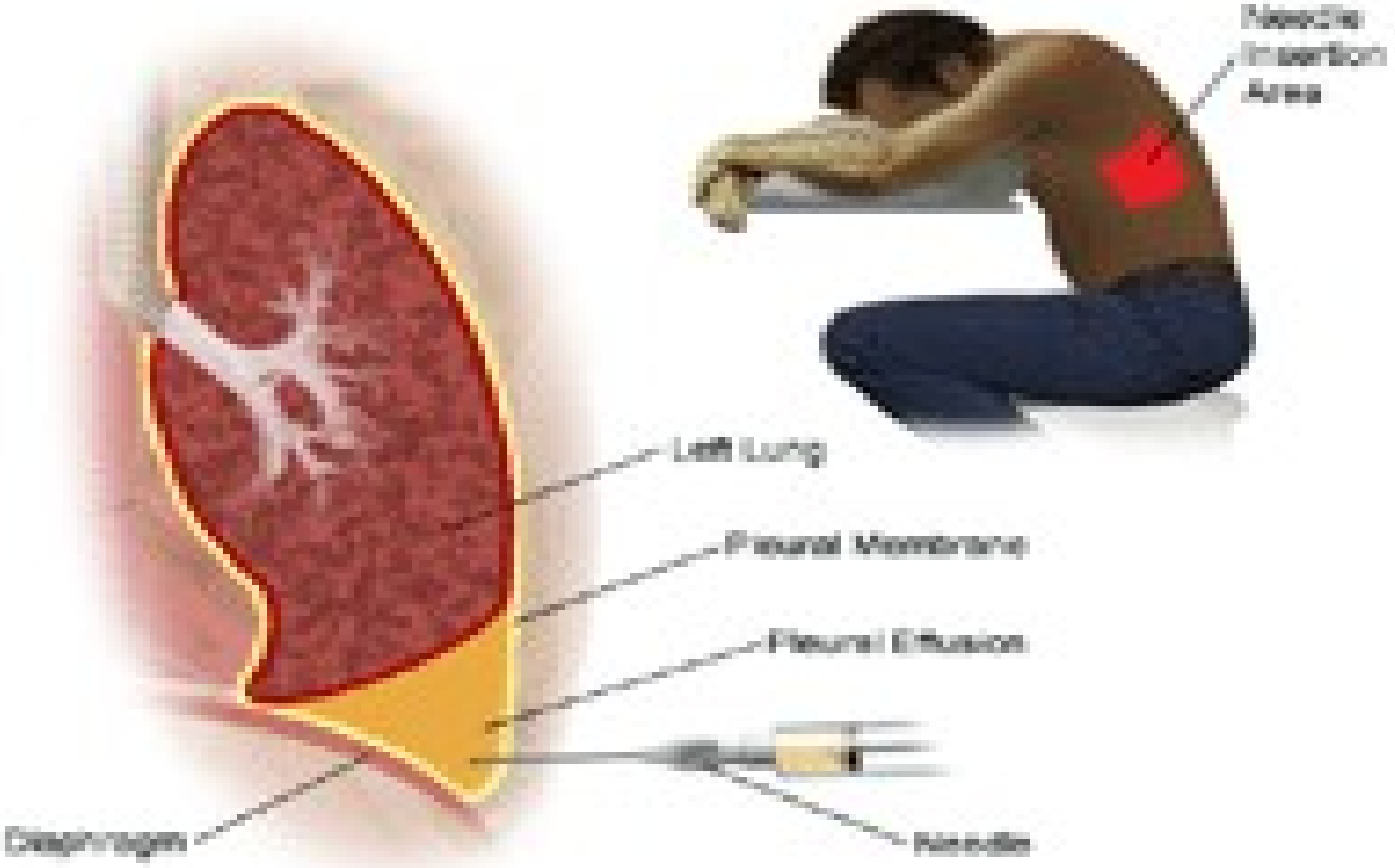
Hyperinflation-

Hyperoxygenation-

Chest Tubes and drainage systems

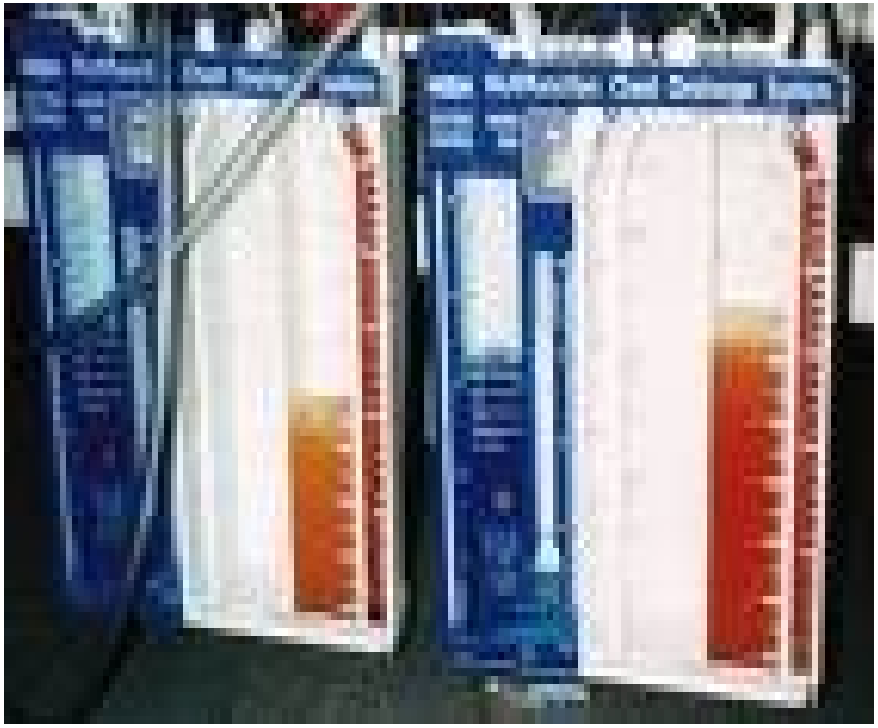
If the thin, double layered pleural membrane is disrupted by lung disease, surgery, or trauma, the negative pressure between the pleural layers may be lost. The lung then may be collapses . Chest tubes may be inserted into the pleural cavity to restore . negative pressure and drain collected fluid or blood

Example of Thoracentesis



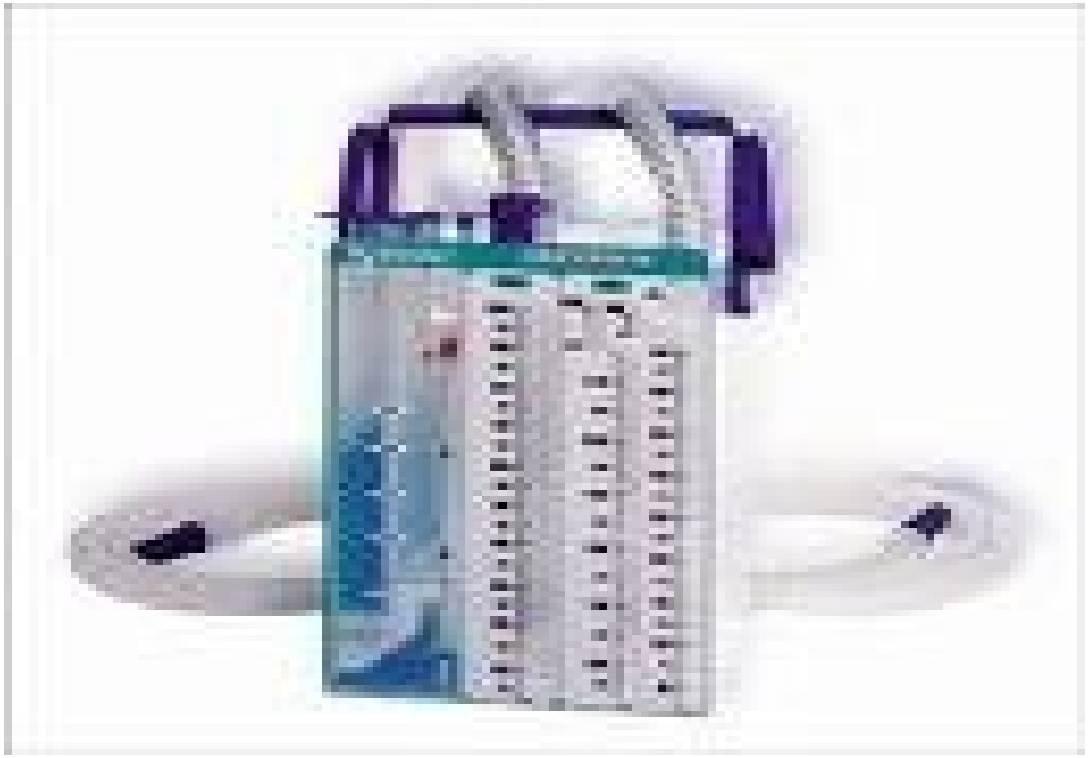
Managing Chest Tubes

Patients with fluid (**pleural effusion**), blood (**hemothorax**), or air (**pneumothorax**) in the pleural space require a chest tube to drain these substances and allow the compressed lung to reexpand.. Once inserted, the tube is secured with a suture and tape, covered with an airtight dressing, and attached to a drainage system that may or may not be attached to . suction



Heimlich chest drain valve

Pneumostat chest drain



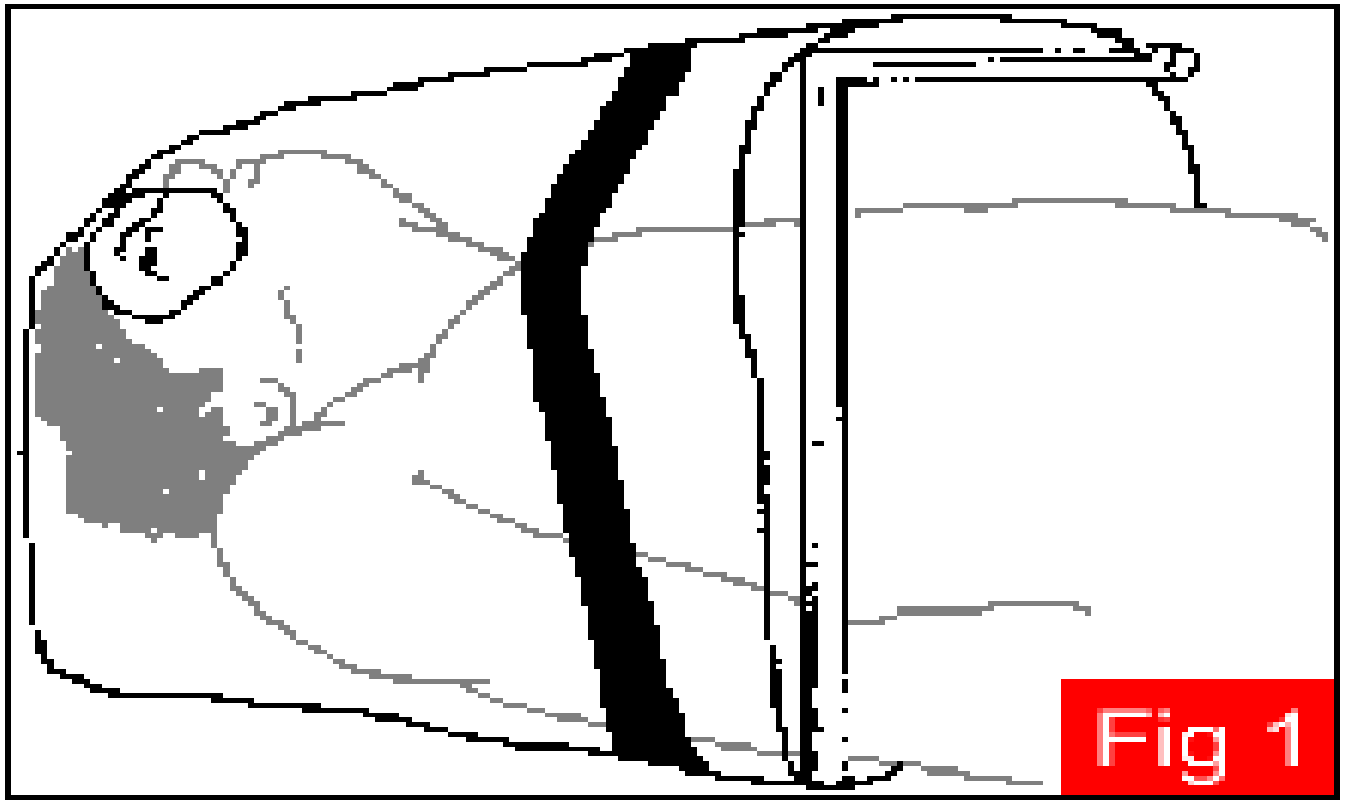


Fig 1

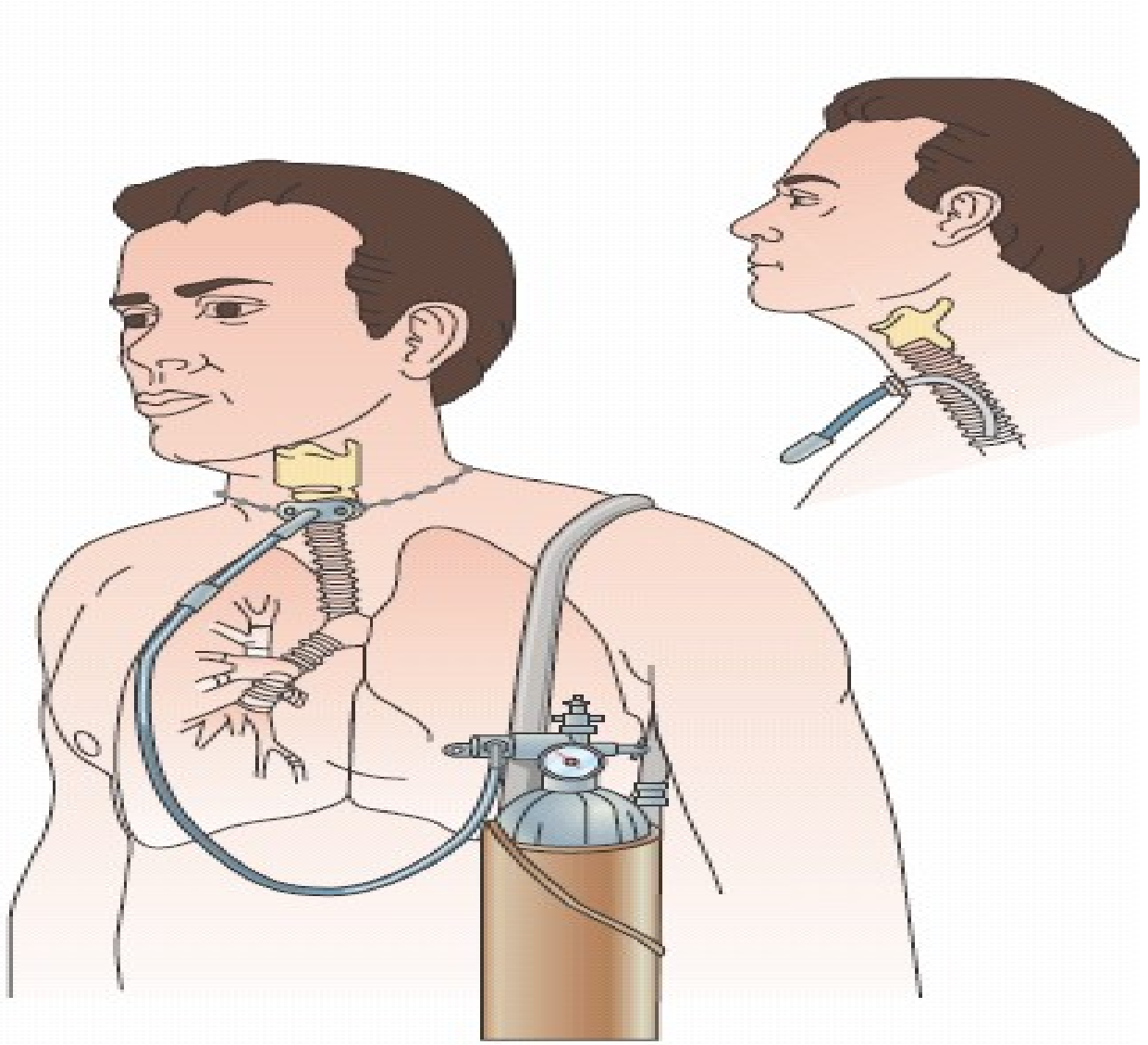


FIGURE 45-11 A transtracheal oxygen setup.

THANK YOU