Clinical Physical Therapy and Rehabilitation for Cardiothoracic Diseases and Surgery

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Content

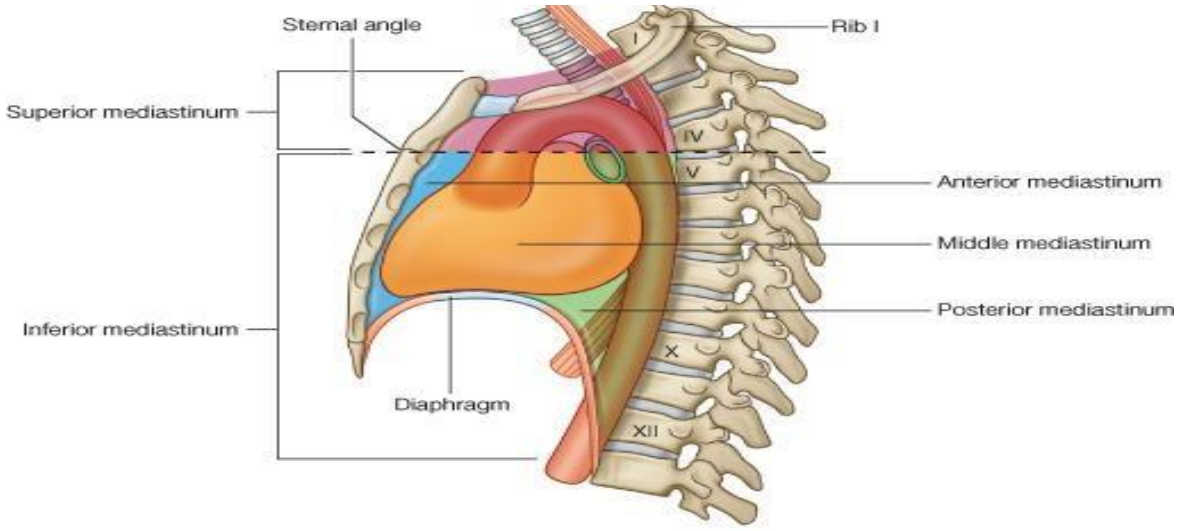
Anatomy of the respiratory system

Thoracic function:

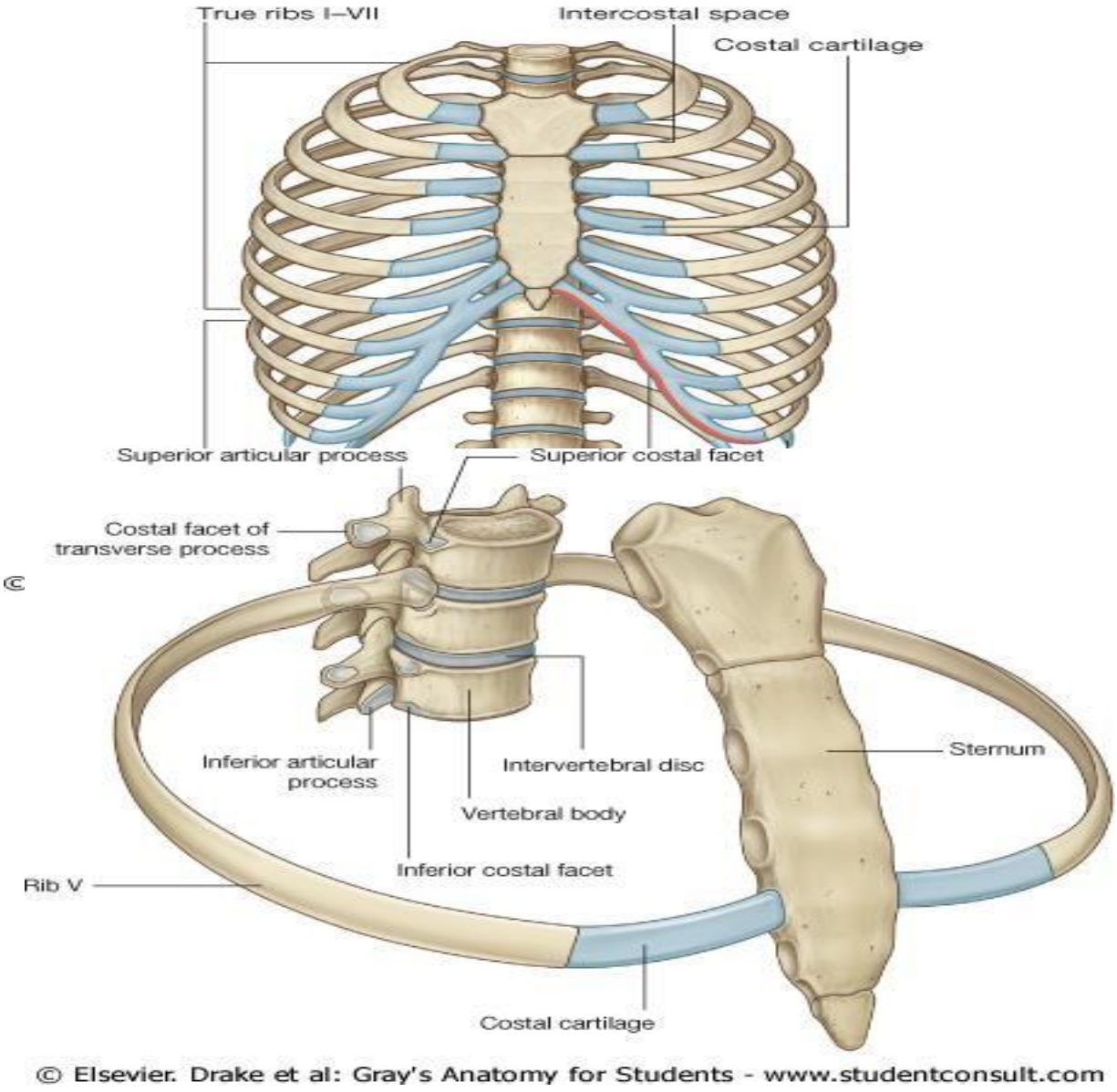
- **Breathing**
- **Protection of vital organs:** heart, lungs, and great vessels. Much of the liver lies under the right dome of the diaphragm. Stomach and spleen lie under the left dome.
- **Conduit for:** esophagus, vagus nerves, thoracic duct, phrenic nerves and other structures such as the trachea, thoracic aorta, and superior vena cava.

Thorax

- The posterior surface is formed by the 12 thoracic vertebrae and the posterior part of the 12 ribs**.**
- The anterior surface is formed by the sternum and the costal cartilage**.**



- The lateral surfaces are formed by the ribs.

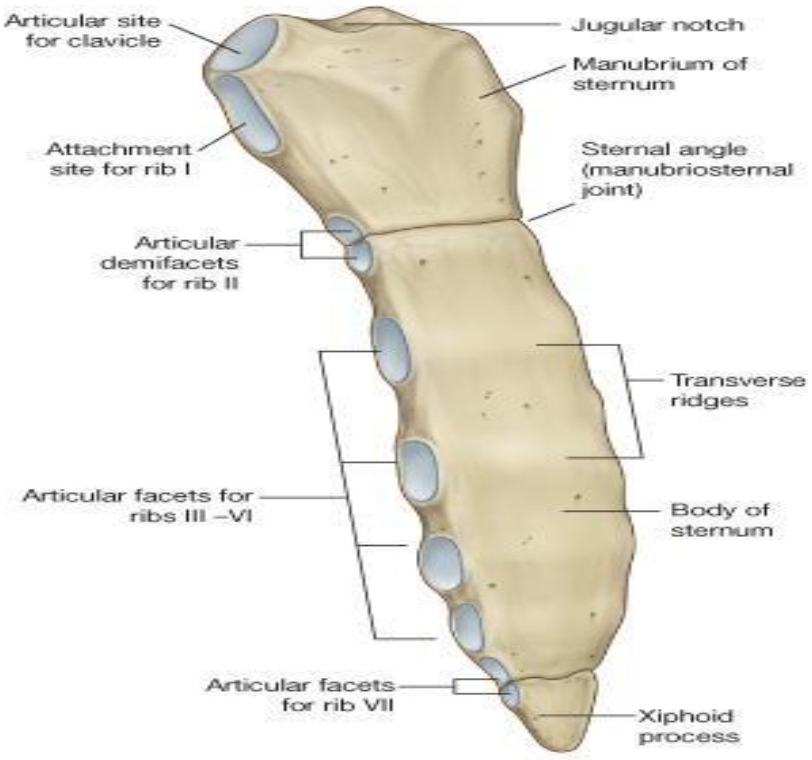


- The thoracic cavity is subdivided into **three major compartments**: a left and a right pleural cavity, each surrounding a lung and the mediastinum.

- At birth, the thorax is nearly circular, but during childhood and adolescence, it becomes more elliptical until adulthood. It is wider from side
- to side than it is from front to back.

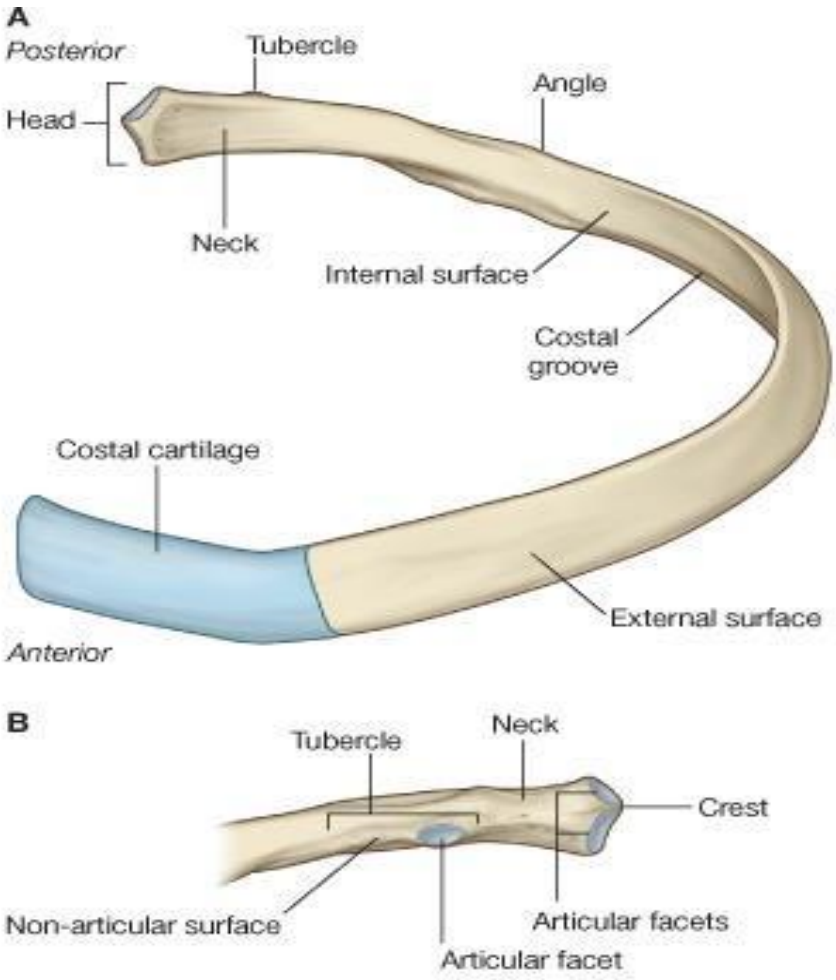
Sternum:

- The sternum, or breastbone, is a flat bone with three parts: the manubrium, body, and xiphoid process.
- Its lower border articulates with the upper border of the body at a slight angle, the **sternal angle or angle of Louis**.
- This angle can be easily palpated, is a landmark located between thoracic vertebrae T4 and T5, and is on a level with the second costal cartilages and the tracheal bifurcation.



Ribs

- 12 ribs located on either side of the sternum.
- The first seven true ribs connect posteriorly with the vertebral column and anteriorly through costal cartilages with the sternum.
- The remaining five ribs are known as the false ribs. The first three have their cartilage attached to the cartilage of the rib above. The last two are free or floating ribs.



Movements of the thorax

During breathing, the dimensions of the thorax change in the vertical, lateral, and anteroposterior directions.

Two types of movements have been described-the pump-handle movement and the bucket-handle movement.

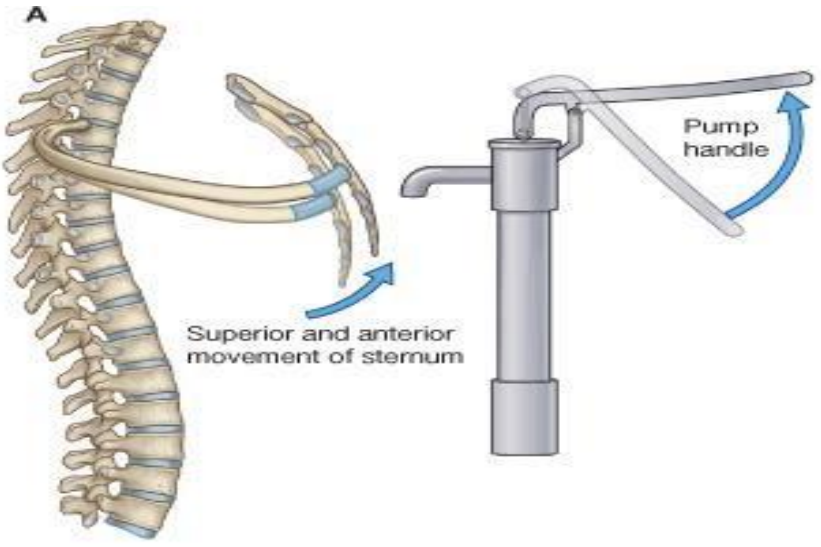
Pump handle movement

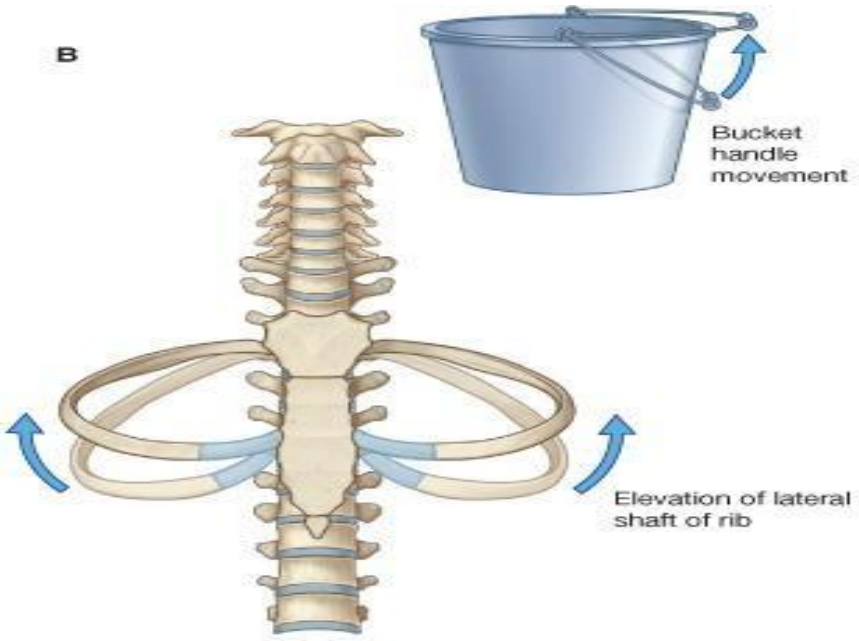
Because the anterior ends of the ribs are inferior to the posterior ends, when the ribs are elevated, they move the sternum upward and forward. When the ribs are depressed, the sternum moves downward and backward. This 'pump handle' type of movement changes the dimensions of the thorax in the anteroposterior direction.

Bucket handle movement

As well as the anterior ends of the ribs being lower than the posterior ends, the middles of the shafts tend to be lower than the two ends. When the shafts are elevated, the middles of the shafts move laterally.

This 'bucket handle' movement increases the lateral dimensions of the thorax.





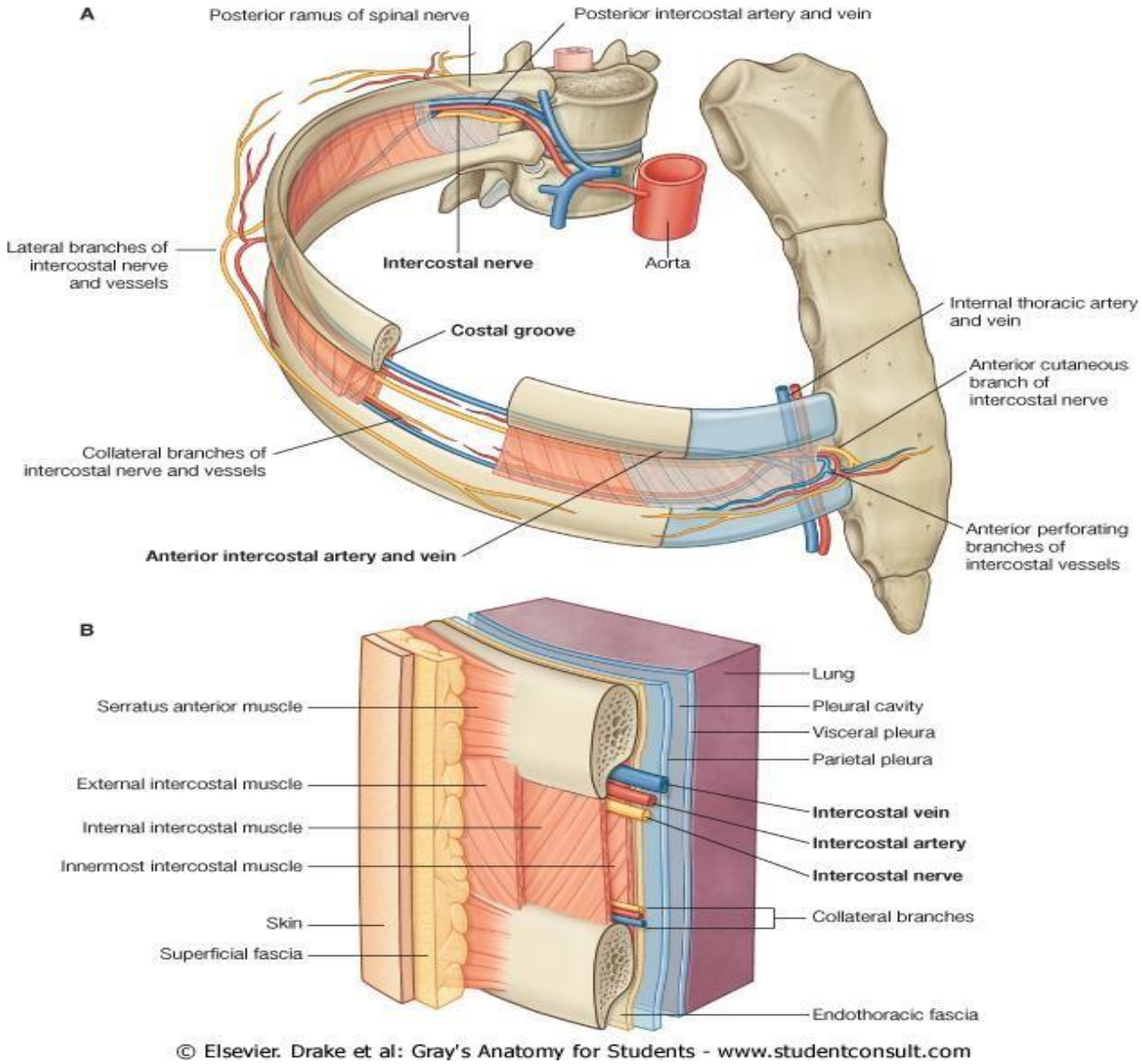
Muscles of respiration

Inspiration: is an active movement involving the contraction of the diaphragm and intercostals. Additional muscles may come into play during exertion in health.

- Diaphragm
- External intercostals
- Sternocleidomastoids
- Scalenes
- Serratus Anterior
- Pectoralis Major
- Pectoralis Minor
- Trapezius
- Erector Spinae

Expiration: is a passive process, occurring when the intercostals and diaphragm relax.

- Abdominal Muscles (rectus abdominis, obliquus externus abdominis, obliquus internus abdominis, transversus abdominis)
- Internal intercostals: lower and invert the ribs.
- Serratus posterior (inferior): It lowers and fixes the lower 3 ribs.

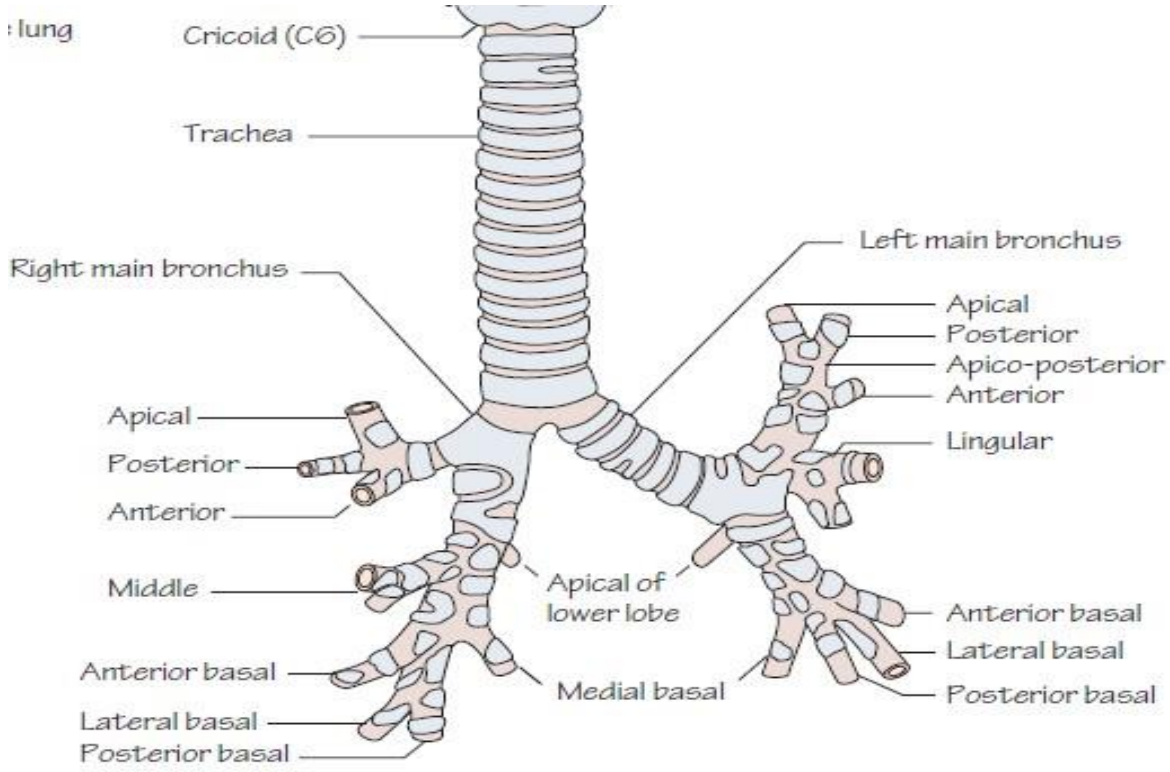


Conducting airways

Upper conducting airways: contain the nose, mouth, pharynx, and larynx.

The lower conducting airways: begin with the trachea, which branches into the right and left main stem bronchi.

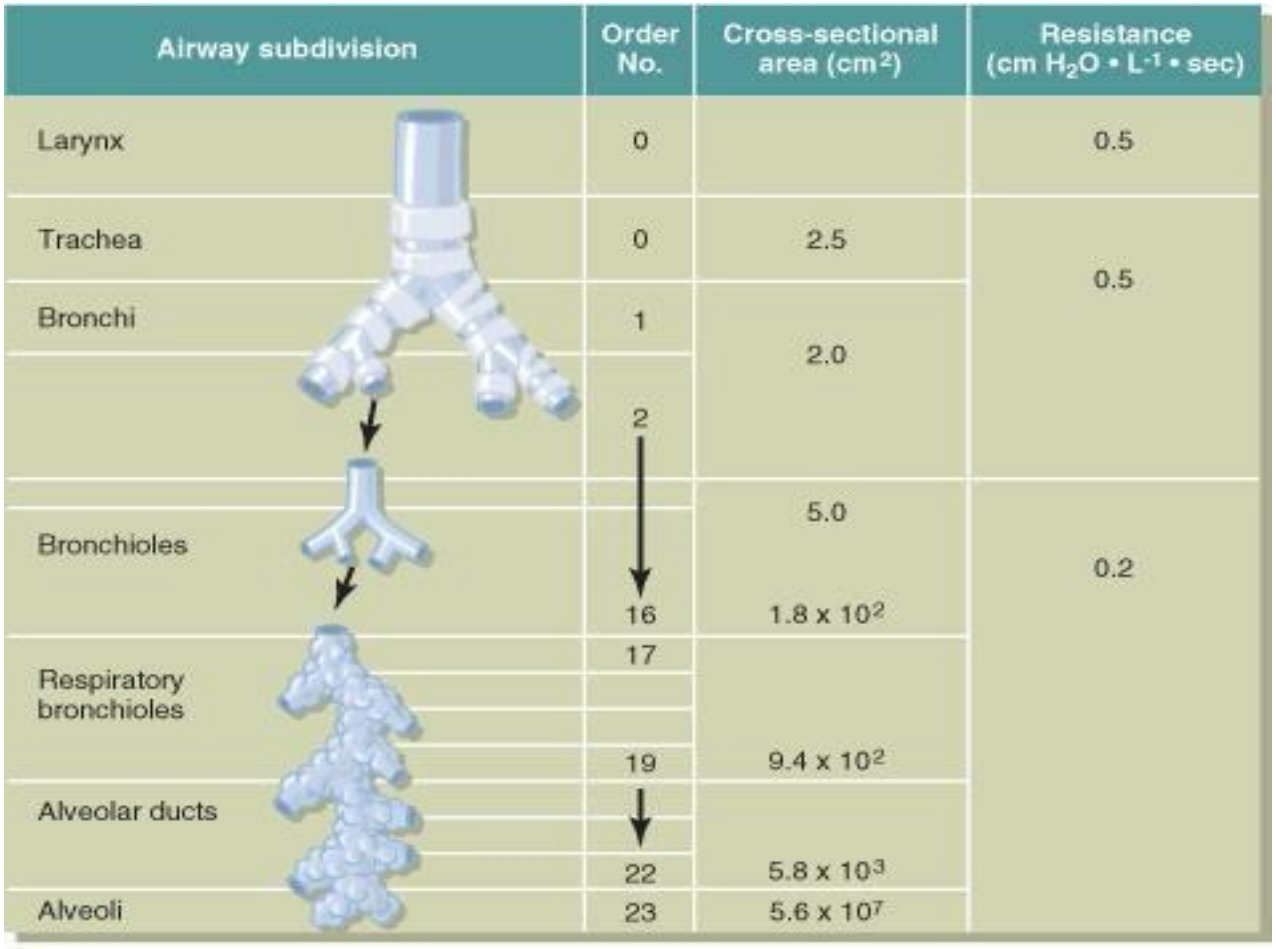
The bronchi further branch into lobar bronchi and segmental bronchi for generation until they terminate in the bronchioles. The most distal airway is called the terminal bronchiole.



RespiratoryUnit

(respiratory lobule): composed of a respiratory bronchiole, alveolar ducts and alveoli. There are about 300 million alveoli in the two lungs.

Gas exchange takes place in the branches from the respiratory bronchioles to the alveoli, called the respiratory zone

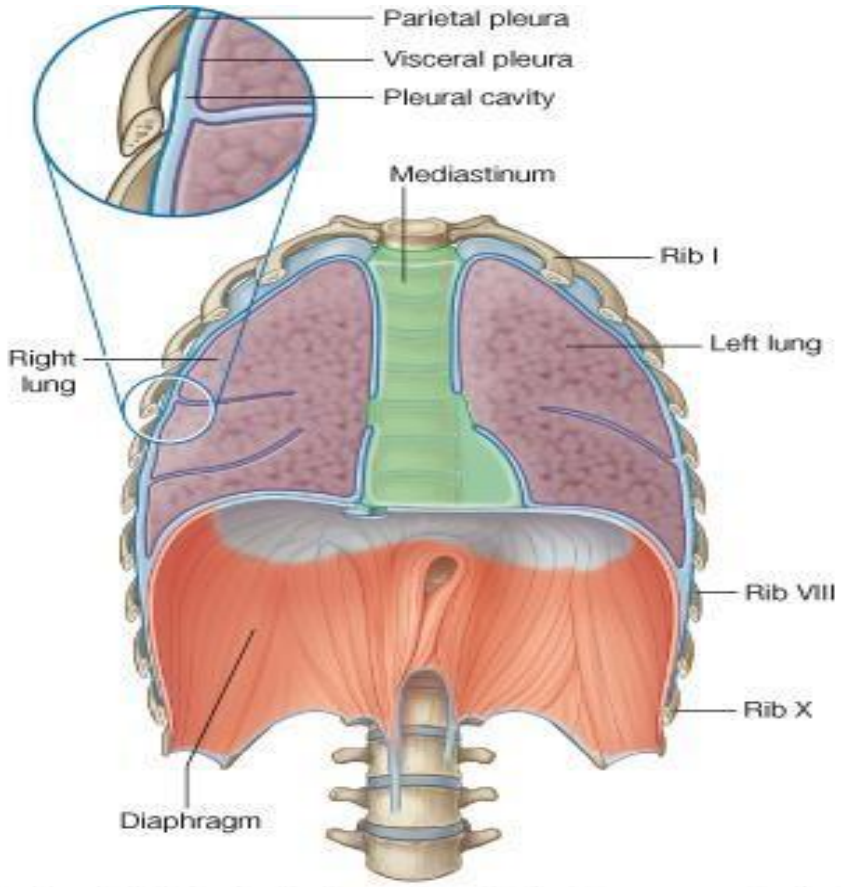


Airway subdivision	Order No.	Cross-sectional area (cm^2)	Resistance ($cm\ H_2O \cdot L^{-1} \cdot sec$)
Larynx	0		0.5
Trachea	0	2.5	0.5
Bronchi	1	2.0	
	2		
Bronchioles	16	5.0 1.8×10^2	0.2
Respiratory bronchioles	17 19	9.4×10^2	
Alveolar ducts	22	5.8×10^3	
Alveoli	23	5.6×10^7	

Pleura

Each lung is surrounded by a closed sac “the pleural sac" the pleura is composed of a parietal layer which lines the chest, and a visceral layer which covers the lungs.

The intra pleural pressure is always negative as during lung recoil it pulls with it the parietal pleura which is fixed to the rigid chest wall.



Lungs

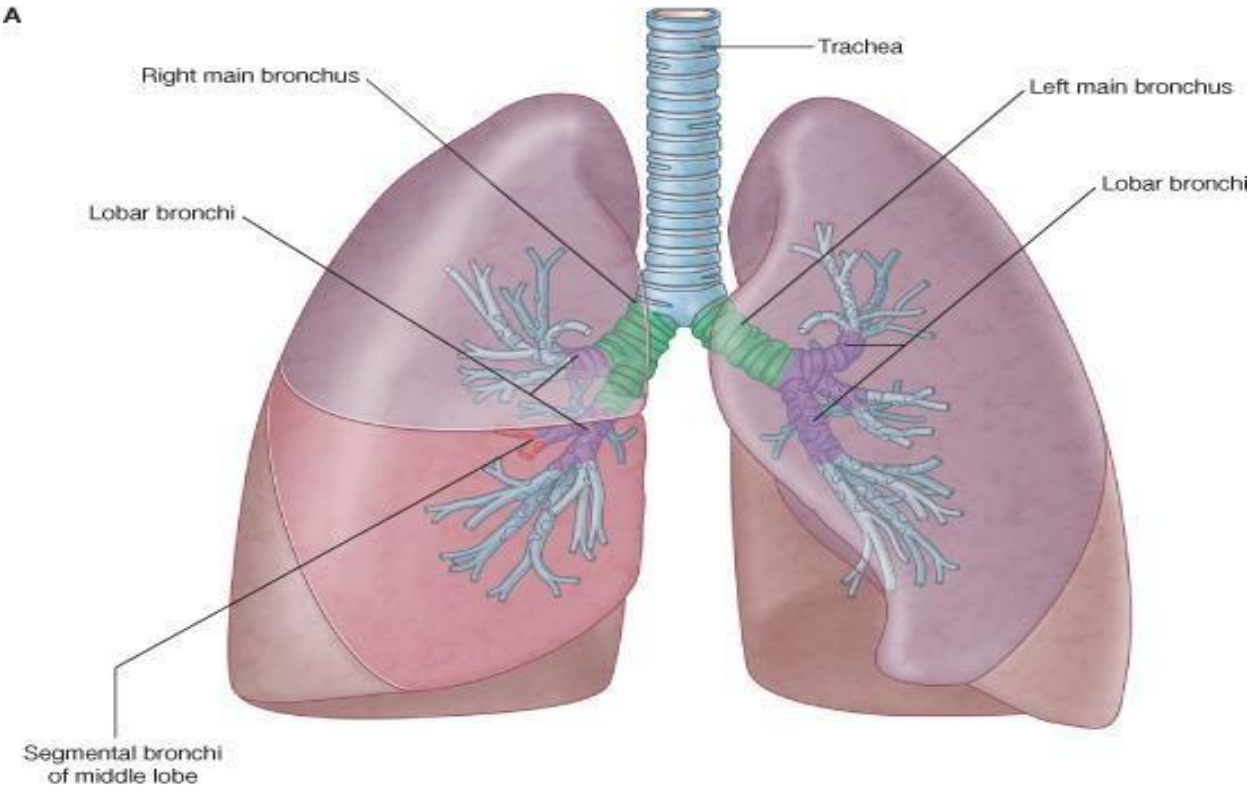
Each lung has an apex, a base, a costal surface, and a mediastinal surface. The apex may reach as high as 1.5 to 2.5 cm above the clavicle. The base of the lung is concave , and rest on the diaphragm.

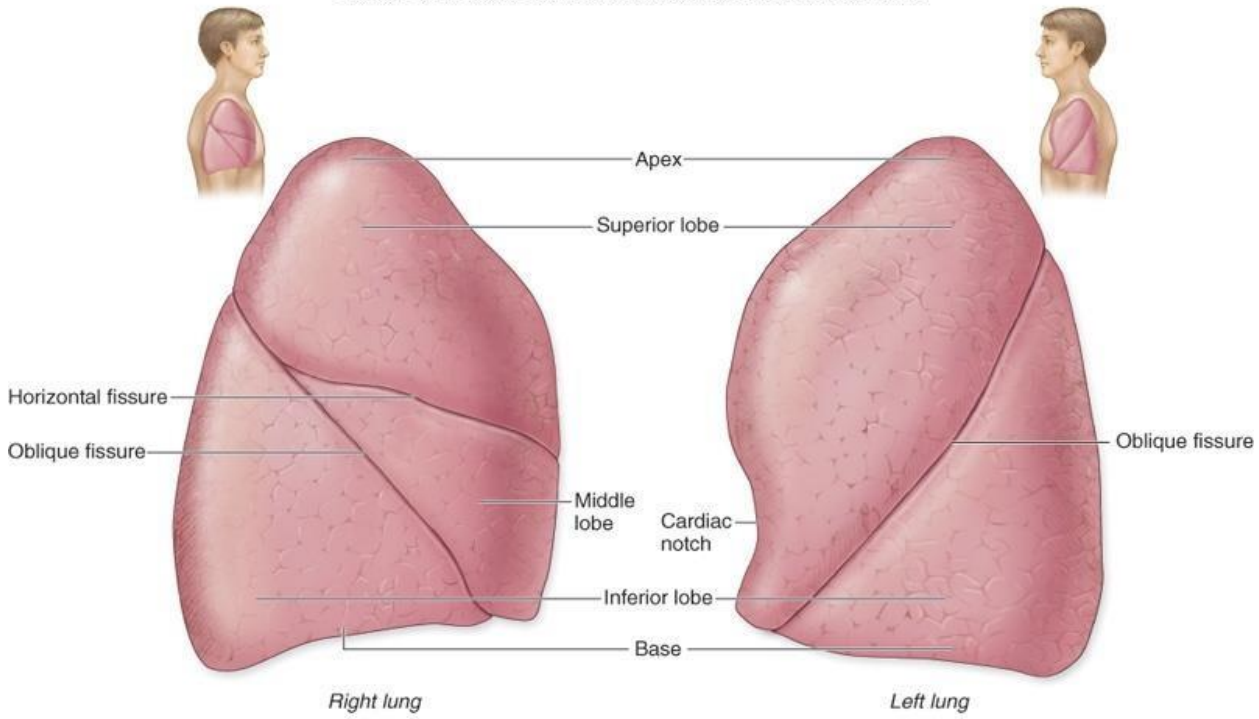
The left lung has one fissure line , the oblique fissure, which separates the upper and the lower lobes.

The right lung also has an oblique fissure; it separates the upper lobe from the lower lobe posteriorly . The right lung contain a horizontal or transverse fissure that divides the upper and the middle lobe anteriorly.

The alveolar lining cells are predominantly flat, type I pneumocytes, which rest on a very thin basement membrane and allow rapid diffusion of gases to and from the adjacent capillary blood.

Type II pneumocytes, about 5% of the alveolar lining cells, are round and secrete surfactant, a complex lipoprotein that coats the alveolar surface and decreases surface tension, thus stabilizing alveoli against collapse at low volumes. Type II cells are capable of regeneration and repair and are also the precursors of type I cells.





(a) Lateral views

Lung volumes and capacities

Lung volumes and lung capacities refer to the volume of air associated with different phases of the respiratory cycle. Lung volumes are directly measured; Lung capacities are inferred from lung volumes.

The healthy adult averages 12 respirations a minute and moves about 6 liters of air into and out of the lungs while at rest.

Tidal volume: the total amount of air moves into and out of the airways with each inspiration and expiration during normal quiet breathing. [vT][500ml]

The minute volume of respiration [MVR] or minute ventilation: The total volume of air taken in during 1 minute. It is calculated by multiplying the tidal volume by the normal breathing rate per minute. [500×12= 6000 ml/mt].

The alveolar ventilation rate [AVR]: is the volume of air per minute that reaches the alveoli.

The anatomic dead space: About 150 mL of it (typically 1 mL per pound of body weight) fills the conducting division of the airway. Since this air cannot exchange gases with the blood, it is called dead air.

Physiologic (total) dead space: is the sum of anatomic dead space and any pathological alveolar dead space that may exist. In healthy people, few alveoli are nonfunctional, and the anatomic and physiologic dead spaces are identical.

Inspiratory reserve volume (IRV) [3,000 mL]: Amount of air in excess of tidal inspiration that can be inhaled with maximum effort.

Expiratory reserve volume (ERV) [1,200 mL]: Amount of air in excess of tidal expiration that can be exhaled with maximum effort.

Residual volume (RV)[1,300 mL]: Amount of air remaining in the lungs after maximum expiration; keeps alveoli inflated between breaths and mixes with fresh air on next inspiration.

Vital capacity (VC)[4,700 mL]: Amount of air that can be exhaled with maximum effort after maximum inspiration (TV + IRV + ERV); used to assess strength of thoracic muscles as well as pulmonary function.

Inspiratory capacity (IC) [3,500 mL]: Maximum amount of air that can be inhaled after a normal tidal expiration (TV + IRV).

Functional residual capacity (FRC) [2,500 mL]: Amount of air remaining in the lungs after a normal tidal expiration (RV + ERV)

Total lung capacity (TLC) [6,000 mL]: Maximum amount of air the lungs can contain (RV + VC).

Respiration

Respiratory cycle: The normal rate of respiration in adult during rest is 12-16 times (cycles) /min. Each respiratory cycle consists of: Inspiration, Expiration, Expiratory pause.

Regulation of Respiration

Respiratory Center

The respiratory center is composed of several groups of neurons located bilaterally in the medulla oblongata and pons of the brain stem.

1- Dorsal Respiratory Group of Neurons (inspiratory neurons)

- Located bilaterally in the medulla and is responsible for the
- basic rhythm of respiration.
- The nervous signal transmitted to the inspiratory muscles is not an instantaneous burst of action potentials but it begins weakly and increases steadily in a ramp manner (inspiratory ramp) for about 2 seconds.

- Then it ceases abruptly for approximately the next 3 seconds, which turns off the excitation of the diaphragm and allows elastic recoil of the lungs and the chest wall to cause expiration.
- The obvious advantage of the ramp is that it causes a steady increase in the volume of the lungs during inspiration, rather than inspiratory gasps.
- Normal quiet breathing is caused only by repetitive inspiratory signals from the dorsal respiratory group transmitted mainly to the diaphragm, and expiration results from elastic recoil of the lungs and thoracic cage.

2- Ventral Respiratory Group of Neurons (inspiratory and expiratory neurons) Located bilaterally in the medulla remaining almost totally inactive during normal quiet respiration and operates when high levels of pulmonary ventilation are required, especially during heavy exercise.

3- Pneumotaxic Center (in the upper pons): Controls the "switch-off" point of the inspiratory ramp.

4- Apneustic center (in the lower pons): Controls the switch-on point of the inspiratory ramp.

Regulation of Respiration

I- Chemical Control of Respiration

1. Central chemoreceptors: in the chemosensitive area of medulla

Excitation of Chemosensitive Neurons by H+ in the CSF (Primary Stimulus). Co2 has indirect effect in stimulating the neurons in the chemosensitive area.

2. Peripheral chemoreceptors: nerve endings outside CNS (carotid and aortic bodies)

Oxygen: When the oxygen concentration in the arterial blood falls below normal, the chemoreceptors become strongly stimulated.

An increase in either Co2 concentration or H+ concentration also excites

the chemoreceptors and increases respiratory activity.

II- Nervous control: regulation of respiratory center by impulses from higher centers and sensors in lung, muscles, skin and viscera.

Physical therapy sheet

History taking

Personal history:

Name:

Age: sex: marital status: Address:

Occupation:

Habits:

Referring physician:

Medical diagnosis:

……

……

Family history:

……

……

Past history: (previous disease, operations, traumas,…..)

……

……

Chief complain:

…….

Present history:

- Onset:
- Course:
- Duration:
- Management:
- Date of hospital admission:
- Date of surgical operation:

Physical examination

By observation:

General examination:

- Level of consciousness: Alert ( ) Confused ( )

Semi Comatose ( ) Comatose( )

- Body Type: Average ( ) Obese ( ) Thin ( )
- Body posture:

o Spinal deformities:

o Patient position in bed:

Local examination:

Facial expressions: Facial color:

Neck evaluation:

Chest examination:

- **Unmoving chest:**
  - Skin:
  - Chest deformities:
  - Rib angles and intercostals space:
  - Symmetry of chest sides:
- **Moving chest:**
  - Respiratory rate:
  - Respiratory rhythm:
  - Breathing pattern:
  - Chest synchronization:
  - I/E ratio:

Cough: present ( ) absent ( ) productive ( ) dry ( )

Sputum: color: Oder: quantity:

Position: time: Consistency:

Limb examination:

……

……

……

Examination by palpation:

- Neck muscles:
- Tracheal alignment:
- Tenderness: present ( ) absent ( )

Site:…….

- Chest motion: Rt. Lt.
  - Upper chest
  - Middle chest:
  - Lower chest:
  - Diaphragmatic motion:

Percussion:

- Site of examination:
- Sounds:
- Diaphragmatic excursion:

……

……

TVF: present ( ) absent ( )

- o Upper lobe:
- o Middle lobe:
- o Lower lobe: Auscultation:

- Respiratory sounds:
  - o Tracheal sounds:
  - o Bronchial sounds:
  - o Bronchovesicular sounds:
  - o Vesicular sounds:
- Adventitious sounds:
  - o Rub:
  - o Rales/crackles:
  - o Wheezing/ Ronchi:

Site of the adventitious sounds: ……

- Cardiac sounds:

Vital signs:

- o Respiratory rate:
- o heart rate:
- o Blood pressure:
- o temperature:

Comments:

……

……

Laboratory investigations

Lab. tests:……...

Findings:……

……..

Radiological examination

Investigation method:

……

……

Findings:

……

……

Problems list:

1.

2.

3.

4.

5.

Goals of treatments

- Short term goals:

1.

2.

3.

4.

5.

- Long term goals:

1.

2.

3.

4.

5.

Therapeutic modalities

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……

……

……

……

……

Home program:

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……

……

Name of examiner: Signature:

Date:

Physical therapy evaluation of chest diseases

I. History

1. Personal history
2. Complaint
3. Present history
4. Past history
5. Family history

II. Examination

A. General examination:

1. Vital signs
2. Decubitus
3. Body built
4. Mentality
5. Face
6. Eyes
7. Neck
8. Skin
9. Extremities

10. Cyanosis

A. Local examination: 1. Inspection. 2.Palpation. 3.Percussion.

Local examination

Local examination of the chest includes:

- Inspection.
- Palpation.
- Percussion.
- Auscultation.

Inspection

1. Shape and form of the chest.

2. Respiratory movement.

3. Chest wall lesions: Dilated veins, pigmentation, sinuses, fistula, nodules, scars of previous operations, skin rashes.

Shape and form of the chest

Normal chest has the following criteria:

- Elliptical in shape.
- Both halves are symmetrical.
- Anteroposterior diameter equals1/2 of the transverse diameter.
- Ribs are oblique and make an angle of 45 with vertebral column.

- Subcostal angle 90 ˚ ± 20˚.
- Moves freely with respiration.

Abnormalities of the shape of the chest:

1. Barrel shaped chest (emphysematous chest): It is characterized by:

- Anteroposterior diameter equals the transverse.
- Horizontal ribs with wide intercostal spaces and sternum are pushed forward.
- Wide subcostal angle.
- Limitation of expansion.

2. Pigeon shaped chest (Pectus carinatum): Forward protrusion of the sternum. Associated with Marfan's syndrome.

3. Funnel shaped chest (Pectus excavatum) inward depression of lower sternum usually congenital and may be acquired in shoe makers. Affects cardiac function. Associated with mitral valve prolapse.

4. Flat chest (Alar chest) decreased anteroposterior diameter.

5. Kyphoscoliosis.

Pectus carinatum

Pectus excavatum

Kyphosis

Scoliosis

Symmetry of the chest

- Normal chest is symmetrical.

Abnormalities of the symmetry of the chest:

A. Bulge: May be due to:

- Precordial bulge.
- Chest wall causes as abscess, lipoma,…….etc.
- Massive pleural effusion.
- Tension pneumothorax.
- Hydropneumothorax.
- Unilateral emphysema.

B. Retraction: May be due to:

- Lung collapse.
- Lung fibrosis.

2-Respiratory movement:

- Type or pattern of breathing:

– Thoraco-abdominal respiration in females.

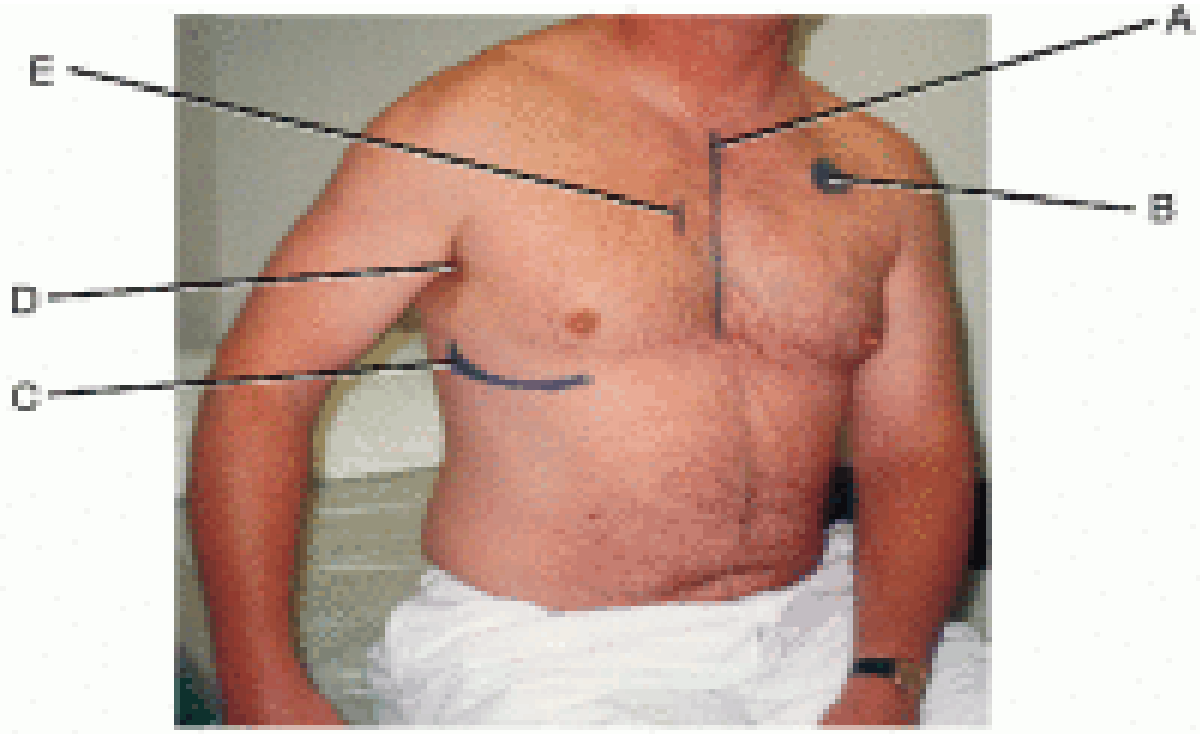
– Abdomino-thoracic respiration in males.

– Abdominal breathing abnormally in pulmonary or pleural diseases such as COPD, pneumonia, severe tuberculosis and pleurisy, or chest wall diseases such as intercostal neuralgia or paralysis, rib fracture and ankylosing spondylitis.

– Thoracic breathing abnormally in phrenic nerve palsy and abdominal distension, peritonitis, massive peritoneal effusion, extreme enlargement of the liver or spleen, tremendous intraperitoneal tumor and advanced pregnancy.

3- Chest wall lesions:

- Pulsations.
- Dilated veins.
- Scars of previous operations.
- Pigmentation, sinuses, fistula, nodules, skin rashes.



Scar sites for various procedures. A. Median thoracotomy. B. Placement of pacemaker. C. Lobectomy. D. Chest tube placement. E. Right parasternal (Chamberlain) scar

Palpation of the chest

- **Superficial palpation.**

  - Localized tenderness.

  - Accessory muscles.

- **Position of the mediastinum.**
  - Heart apex position.
  - Tracheal shift.
- **Chest expansion.**
- **Tactile Vocal Fremitus (TVF).**
- **Palpable rhonchi or pleural rub.**

Superficial palpation

Causes of chest wall tenderness:

- Fractured rib.
- Intercostal tenderness from intercostal muscle strain due to chronic cough in COPD patients.
- Right lower intercostal tenderness in amoebic hepatitis.
- Tender sternum in leukaemia (Leibman's sign).

Position of the mediastinum

Cardiac apex position: 5th intercostal space at midclavicular line.

If shifted:

Pulled: fibrosis or collapse

Pushed: pleural effusion, pneumothorax or tumor.

Upward: diaphragmatic paralysis.

Absent: emphysema or congenital dextrocardia

Examination of the Trachea:

Inspection:

Trail's Sign: bulging of the lower end of the tendon of sternomastoid in front of deviated trachea.

Palpation:

- Position: Normally it is central in its upper part and slightly deviated to the right in its lower part.

Causes of Tracheal Shift:

A. Tracheal shift to the same side:
   - Lung collapse.
   - Lung fibrosis.

B. Tracheal shift to the other side:
   - Pneumothorax.
   - Massive pleural effusion.

Chest expansion:

A. Upper chest expansion: Upper lobe or apical movement
B. Middle chest expansion: Middle lobe
C. Lower chest expansion: Diaphragmatic movement
D. Basal expansion

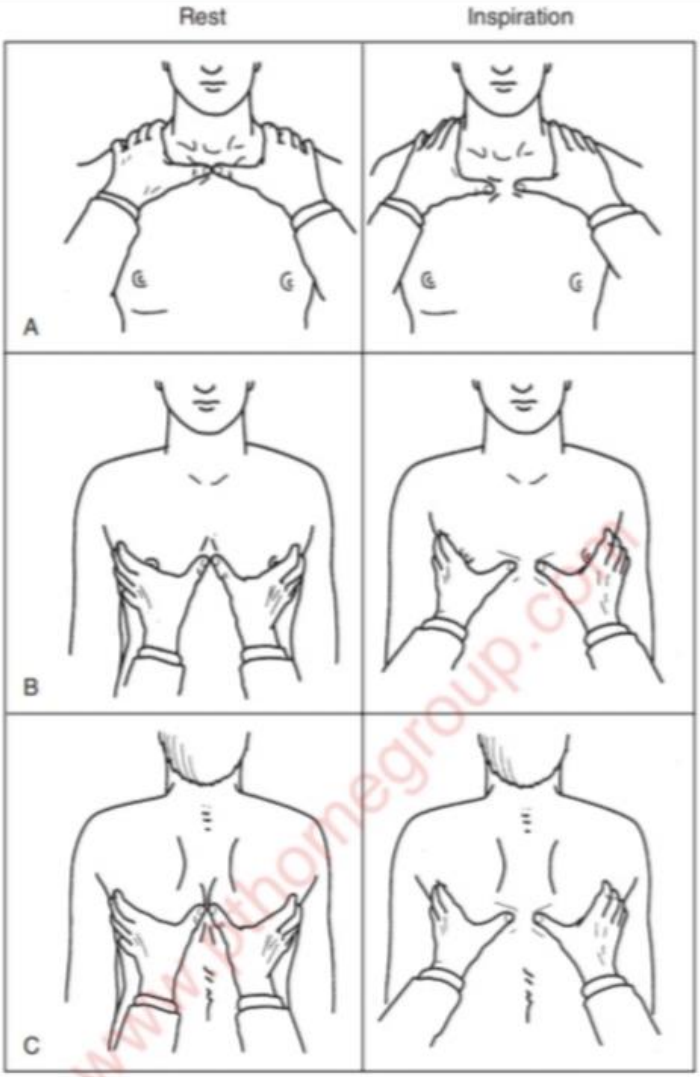


Figure 16-19 **A,** Palpation of upper lobe motion. **B,** Palpation of right middle and left lingula lobe motion. **C,** Palpation of lower lobe motion. (Redrawn from Cherniack RM, Cherniack L. Respiration in Health and Disease. 2nd ed. Philadelphia, WB Saunders, 1972.)

Tactile Vocal Fremitus (T.V.F.)

- Tactile = Palpable.
- Vocal = Arise from vocal cords.
- Fremitus = Vibrations.
- It is the palpable vibration of the vocal cords felt at the chest wall by the examiner's hand, when the patient says 44 in Arabic or 99 in English.
- Compare between right and left sides.
- At midclavicular, midaxillary lines and back in upper, middle and lower chest.

1. Causes of increased T.V.F.:

- Consolidation.
- Cavitation. Cavity must be big, superficial, and around it an area of consolidation.
- Collapse with patent main bronchus.

2. Causes of decreased T.V.F.:

- Thick chest wall.
- Pleural effusion or pleural fibrosis.
- Pneumothorax.
- Emphysema.

Palpable rhonchi or pleural rub

Palpable rhonchi as in bronchitis.

Palpable pleural rub as in pleurisy.

Classification of the percussion notes

1) Resonance:

- Normal resonance: It is the normal sound of the lung, not very loud but could be heard easily, and have a long duration, shown as a low-pitched sound.
- Hyperresonance: Lower and longer than the resonance, very loud and very easy to be heard. In emphysema.
- Tympanic resonance: The pitch is higher than resonance, the duration is moderate, intensity is moderately loud, e.g. percussion on a stomach filled with gas produces such a sound.

2) Dullness

- Slight dullness: Opposite to resonance, duration is not so long, pitch and intensity are both of medium degree, senses of vibration beneath the pleximeter finger is not so obvious, but sense of resistance is increased. Over scapula or minor consolidation.
- Dullness: over heart, liver and massive consolidation.
- Flatness: It refers to the lacking of resonance, very similar to the sound of knocking a water-filled container. It is also considered as the extreme dullness.

Auscultation of the chest

Auscultation

Auscultation of the chest is used to identify lung sounds by using the Stethoscope. Stethoscope has two heads, the bell and the diaphragm. The bell is used to detect low pitched sounds, and applied loosely to the skin. While the diaphragm is better used to detect higher pitched sounds, and applied firmly to the skin.

Auscultation should be performed in a quiet environment. The patient is asked to breath in and out through the mouth. The examiner should first concentrate on the length of inspiration and then on expiration. Also, the examination should proceed from side to side and from top to bottom, one side is compared with the other.

Auscultation of the anterior chest is performed in the supraclavicular fossae, axilla, and anterior chest intercostal spaces. On the other hand, Auscultation of the posterior chest is performed in the supra scapular areas, Para spinal between scapulae.

Types of breath sounds:

Vesicular breath sound (normal): It has the following Characters:

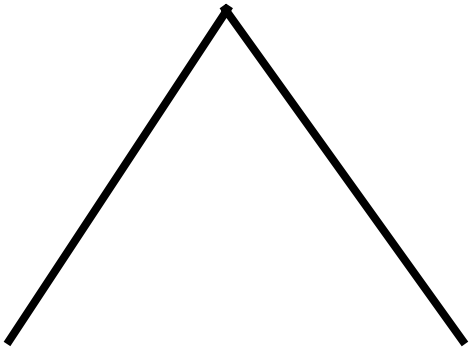
- Low pitched, soft, breezy sound rustling in character.
- Inspiration: expiration = 3:1.
- No pause (gap) between inspiration & expiration.
- Best heard over the axilla and infrascapular.
- Weak in women and obese

Bronchial breath sound:

- High pitched sound hollow in character.
- Expiration may be as long as inspiration.
- There is gap between inspiration & expiration.
- Best heard over the trachea and parasternal.

Bronchovesicular breath sounds:

Combination of bronchial breathing in inspiratory phase and vesicular breathing in expiratory phase. Near main stem bronchi, in 1st and 2nd intercostal spaces interscapular.



- It may be heard in:
  - Pulmonary fibrosis.
  - Patchy consolidation.
  - Pulmonary infiltration.

Tracheal breath sounds:

Loud, harsh, very high pitched over trachea.

Adventitious sounds

Crackles (rales):

Discontinuous nonmusical lung sounds due to sudden opening of partially collapsed or secretion in small airways. Crepitations are mainly inspiratory.

Types of Crackles:

1. Fine Crackles: Resembled by crackling of salt on a heated dish or pressing on hair.
2. Medium sized Crackles.
3. Coarse Crackles: resembled by water gurgling from a bottle.

Rhonchi:

Continuous musical lung sounds due to fluttering of the airway wall due to rapid airflow through narrowed airways. Rhonchi are mainly expiratory.

Types of Rhonchi:

- Sibilant Rhonchi (wheezes):

High pitched - due to obstruction of small bronchioles. Not cleared by cough. Occurs when there is airflow limitation, as may be produced by bronchospasm, airway edema or collapse, or intraluminal obstruction by neoplasm or secretions.

End-expiratory in mild COPD. Whole expiration in significant COPD. Expiratory and inspiratory in severe COPD.

- Sonorous Rhonchi:

Low pitched - due to obstruction of large bronchi.

- Pleural Rub:

A scratching sound heard due to friction between the two pleural surfaces against each other.

Characters:

- Leathery sound.
- Heard during inspiration and expiration.
- Localized over area affected by pleurisy.
    - Increased by deep inspiration and pressure of stethoscope.
    - Decreased on stoppage of breathing or absentby effusion.
- Stop respiration: If not changed → pericardial.
- Disappear → Pleural.

- Decrease → Both.

Diaphragmatic excursion

● This technique helps to measure the amount of displacement of thoracic diaphragm during breathing. It is performed commonly from sitting position with using a stool. If it is difficult to the patient it can be applied from side lying position over the left side of the body so it will be easy to measure from the right side to decrease the effect of the heart at the left side.

● While the patient is in sitting relax position and wearing light clothes the therapist percusses against the back of the chest in the intercostal spaces below the posterior angle of the scapula, until sounds change from resonant to dull (lungs are resonant, solid organs should be dull). Therapist marks this level with marker to determine the average level of the diaphragm during quite breathing.

● First asking the patient to take a deep breath as much as he can and holds it while the therapist percusses down till, finding the sound changes from resonant to dull to put a mark at that level to representing the maximum displacement of the diaphragm during full inspiration.

● Then asking the patient to exhale as much as he can then hold during this act the therapist will start to percusses from the mark of average level that he did it before and continue upward till finding that sounds of dullness starts to be resonant and make another mark to represent maximum level of diaphragm with full expiration.

● Normal Diaphragmatic excursion in quite breathing is 1–3 cm, and with deep breathing 3–5 cm. This measures the displacement of the diaphragm during its contraction.

Lung auscultation points and sounds you will learn the following:

- The basics about lung auscultation
- Anterior lung auscultation points
- Posterior lung auscultation points
- Normal lung sounds
- Abnormal breath sounds

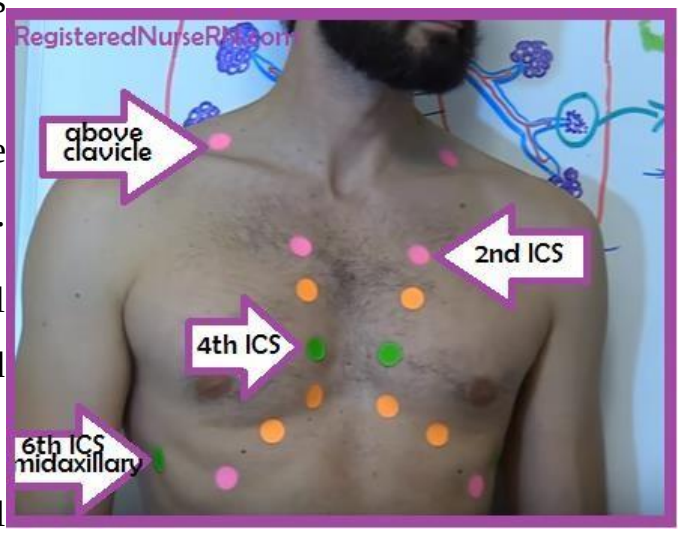
How to auscultate lung sounds

- Listen to both the anterior and posterior sides of the chest
- Start at the top and work your way to the bottom of the chest while comparing sides (watch the video for the technique)
- When listening note the following:
    - A full inspiration and expiration cycle
    - The inspiration and expiration sound's pitch, quality,
    - duration, and if it is normal sounding
    - Ask yourself is there anything "weird" heard along with the inspiration and expiration. For example, are you hearing crackles or wheezes?
- Have the patient sitting up with arms resting on lap. When listening to the posterior side of the chest the arms need to definitely be in the lap so the scapulae are separated.
- Use the diaphragm of the stethoscope to auscultate at various locations (see images below)

- Have patient breathe in and out through mouth slowly while listening. Allow the patient to set the pace to prevent hyperventilating , especially patients with breathing disorders like COPD.

Anterior Lung Auscultation Points:

Start at: the apex of the lung which is right above the clavicle



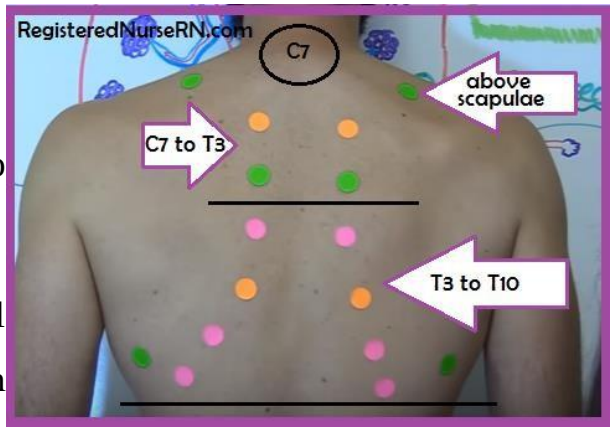
Then move to the 2nd intercostal space to assess the right and left upper lobes.

At the 4th intercostal space, you will be assessing the right middle lobe and the left upper lobe.

Then midaxillary at the 6th intercostal space you will be assessing the right and left lower lobes.

Note: within these landmarks move your stethoscope around to assess other areas as well.

Posterior Lung Auscultation Points:



Start right above the scapulae to listen to the apex of the lungs.

Then find C7 (which is the vertebral prominence) and go to T3…in between

the shoulder blades and spine. This will assess the right and left upper lobes.

Then from T3 to T10 you will be able to assess the right and left lower lobes.

Again, move your stethoscope around to assess various areas while comparing sides.

Bronchial:

Found where? auscultated over anterior chest and heard over

tracheal area

Characteristics:

- sound will have a high pitch and be loud
- inspiration will be slightly SHORTER than expiration

Bronchovesicular:

Found where? auscultated anteriorly and posteriorly and heard over the bronchi

- anteriorly: 1st and 2nd intercostal space near the sternum
- posteriorly: between the scapulae

Characteristics:

- sound will have a medium pitch
- inspiration and expiration will be EQUAL

Vesicular:

Found where? auscultated anteriorly and posteriorly and heard over peripheral lung fields

Characteristics:

- sound will be soft with a low pitch
- inspiration will be slightly GREATER than expiration

What are Abnormal Lung Sounds?

- Discontinuous Lung Sounds:

These are extra sounds heard LESS than 0.2 seconds during a full respiration cycle.

1. Coarse Crackles:

Crackles are also known as: rales

- Auscultated during inspiration and can extend into expiration as well
- Low-pitched, wet bubbling sound
- May be heard in patient with fluid overload, pneumonia etc.

2. Fine Crackles:

Crackles are also known as: rales

- Auscultated during inspiration (DON'T CLEAR with COUGHING)
- High-pitched, crackling sound that is similar to a fire crackling
- May be heard in patients with edema in the lungs or ARDS (acute respiratory distress syndrome).

3. Pleural Friction Rub:

- Auscultated during inspiration and expiration

- Low-pitched/harsh grating sound
- Patients may have pain when breathing in and out due to inflammation of pleural layers
- May be heard in patients with pleuritis

 Continuous Lung Sounds:

These are extra sounds heard MORE than 0.2 second during a full respiration cycle

1. High Pitched, Polyphonic Wheeze

Also known as: Sibilant Wheeze

- Auscultated mainly in expiration but may be present during inspiration
- Sounds like a high-pitched musical instrument with MORE than one type of sound quality
- May be heard in patients with asthma

2. Low-pitched, Monophonic Wheeze

Also known as: Sonorous Wheeze or Rhonchi

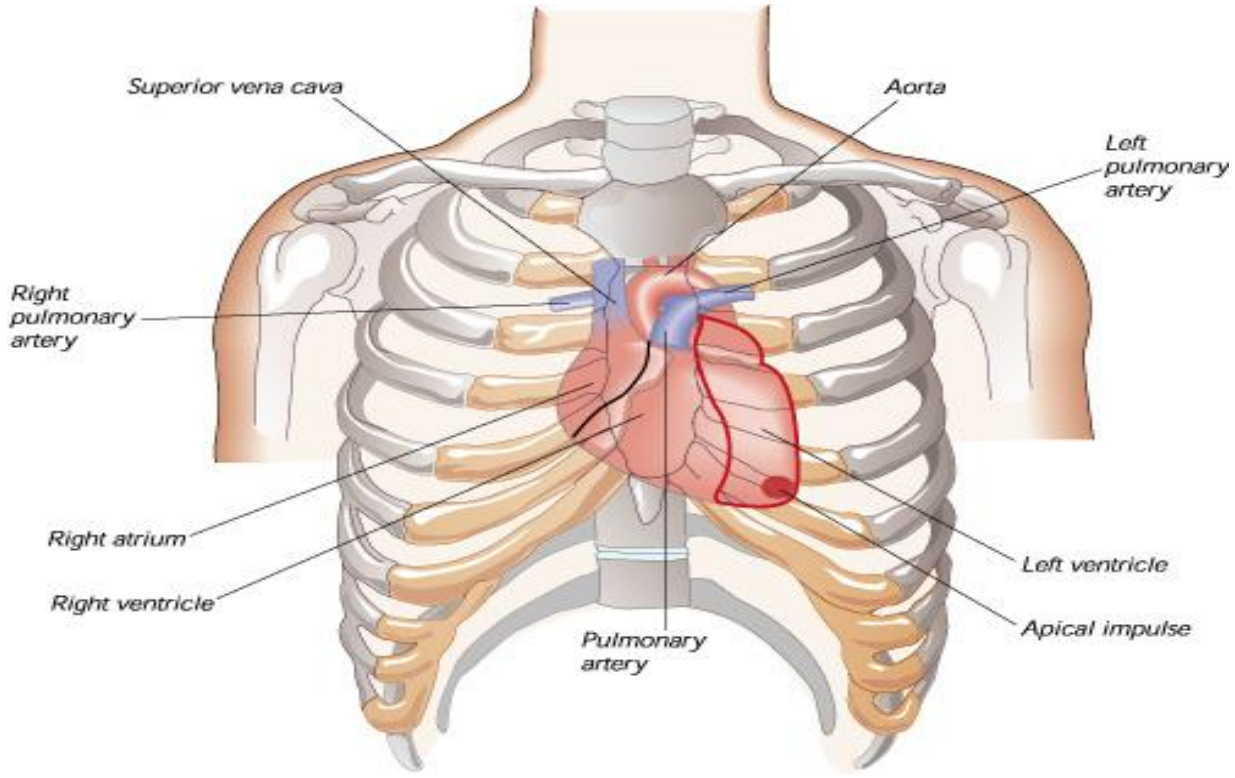
- Auscultated mainly in expiration but may be present at anytime
- Sounds like a low-pitched whistling tune or whine with ONE type of sound quality
- May be heard in patients with COPD or pneumonia etc.

Stridor

- Auscultated during inspiration

- high-pitched whistling or gasping sound with harsh sound quality
- May be seen in children with conditions such as croup or epiglottitis or anyone with an airway obstruction etc.

Cardiac Examination



I – History taking:

1- Personal and social:

- Name.
- Age.
- Sex.
- Residence.
- Occupation (employment).
- Habits (of medical importance, e.g. smoking, diet, physical activity, etc.).
- Socioeconomic status.

2- Past history:

- Previous illness (bilharziasis/tonsillitis).
- Cardiac surgery and hospitalization.
- Acute rheumatic fever.
- Chronic illnesses (HTN, bleeding disorders, hyperlipidemia, D.M, CAD, Congenital disorders).
- Medications.

3- Family history:

- Familial diseases (D.M, HTN, heart diseases, congenital diseases).
- Sudden death in relatives.
- Positive consanguinity.
- Family members with risk factors.

4- Present history (symptoms):

a) Symptoms of pulmonary congestion:

1. **Dyspnea**
    - Exertional
    - Orthopnea
    - PND (paroxysmal nocturnal dyspnea)
    - Acute pulmonary oedema
    - Cheyne-stokes breathing
2. **Exertional cough**
3. **Hemoptysis.**
4. **Recurrent chest infection (winter bronchitis in MS).**

B) Symptoms of systemic congestion:

1. **L.L oedema.**
2. **Ascites.**
3. **GIT congestion (dyspepsia).**
4. **Hepatic congestion (pain and jaundice).**

c) Symptoms of low COP: (HF, stenosis, shock, arrhythmia)

1. **Angina.**
2. **Intermittent claudication.**
3. **Fatigue.**
4. **Oliguria.**
5. **Blurring vision, drowsiness and syncope.**

d) Symptoms of congenital heart diseases:

1. **cyanotic** (cyanosis; central, peripheral).
2. **acyanotic** (winter bronchitis, exertional cyanosis).

e) Palpitation.

f) Chest pain:

(CHD, pericardial effusion/inflammation, pulmonary infarction, aortic aneurysm, cardiac neurosis, etc.)

g) Pressure symptoms :(pericardial effusion, aortic aneurysm)

1. Trachea: **brassy cough**
2. Bronchus: **dyspnea**
3. Esophagus: **dysphagia**

h) Symptoms of Increased Blood pressure:

1. **Headache.**
2. **Blurred vision.**
3. **Tinnitus.**
4. **Epistaxis.**

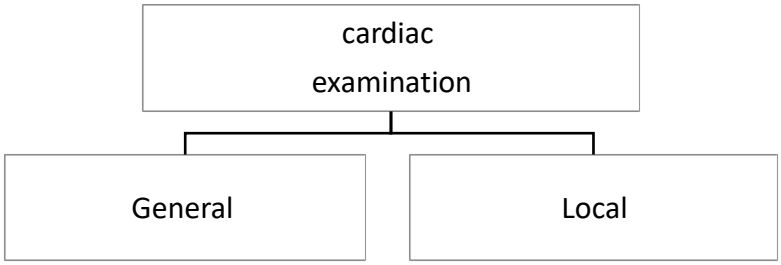
Cardiac history

An awareness of the patient's risk factors enables the therapist to develop realistic goal for the patient's long-term treatment

From the history can determine whether the patient has any of the following major risk factors for heart disease.

- Hypertension.
- Smoking.
- Elevated serum cholesterol or a 'diet high in cholesterol.
- A family history of heart disease.
- Stress.
- Sedentary lifestyle.
- Older age.
- Male gender.
- Obesity.
- Diabetes.

II – Examination:



A) General Examination:

1- Vital signs:

- **Pulse** (rate, rhythm, volume, equality, character, peripheral pulses).
- **B.P** (systolic, diastolic, pulse pressure).
- **Temperature**.
- **Respiration** (rate, rhythm, depth, character).

2-Body built.

Height:

Marfan syndrome: patient characterize with very tall, sternum depression and aortic incontinence.

Dwarf undergrowth: patient characterize with short associated with congenital heart disease.

Weight:

Under weight: especially teenager female after fever and sudden weight loss due to congenital heart diseases or rheumatic heart disease.

Overweight: obese individuals are in very high risk of atherosclerosis.

Body shape:

Triangle body shape: well developed upper part unlike the under developed lower parts usually they have coarctation Aorta.

3-Decubitus.

Orthopnea (long sitting): patient cannot sleep flat, as in Lt. Heart failure.

Squatting: patients with congenital cyanotic heart disease.

Praying: patients with pericarditis and mediastinal syndrome prefer leaning forward.

4-Facies:

-Pallor: all skin became pale and the tongue yellow as in patients with Lt. Heart failure rheumatic heart disease and anemia.

-Jaundice: yellow discoloration off skin as in myocardial infarction and pulmonary infraction.

-Cyanosis: bluish discoloration of skin & mucus membrane.

Cyanosis	Central	Peripheral
Site of examination	tongue and mouth	toes, fingers and earlobes
Cause	hypoxaemia where there is an increase in the amount of haemoglobin not bound to oxygen.	Poor peripheral circulation, especially in cold weather.
Disease	Congenital cyanotic heart disease	Low cardiac output & vascular disease

2- <u>Eyes</u>: (**puffy** eyelids in severe HF, **jaundice**)

3- <u>De Musset sign</u>: (head nodding in aortic regurge).

4- <u>Neck veins</u>: (external jugular vein indicates pressure changes in Rt. atrium)

Congested pulsating in CHF.

Internal jugular vein distention indicates central venous pressure elevation.

<u>Application:</u>

- Patient position: long sitting with head flexed 45 °.
- Identify internal jugular vein distention; estimate how high in cm the top of column is above the angle of Louis.
- Identify the supra-sternal notch.
- Then detect the angle of Louis, which is approximately 4-5 cm below the notch. This is roughly at level of 2nd intercostal space.
- The vertical distance from the top of the column to this angle is add to 5 cm,
- The sum is an estimate of the central venous pressure (CVP). Normal is 9-7 cm.

5- **<u>Carotid artery</u>**: (visible and vigorous pulsation in aortic regurge AR = **Corrigan pulse**).

Carotid artery is adjacent to internal jugular lying medial to it. To differentiate between carotid artery pulse & internal jugular vein (IJV) pulse:

- Find patient radial pulse and use it as reference.
- The carotid pulse coincides with palpated radial artery as a single upstroke timed with systole.
- Search along the projected course of IJV as the top of pressure wave. May be higher, ask patient to increase 45 degree to identify it & direct a pen light across the neck.
  If it is still not clear apply gentle pressure to upper right quadrant of abdomen for 5-10 seconds.

6- **<u>U.L:</u>**

- **Clubbing** fingers (pale / blue).

Loss of the angle between the nail bed and the nail itself.

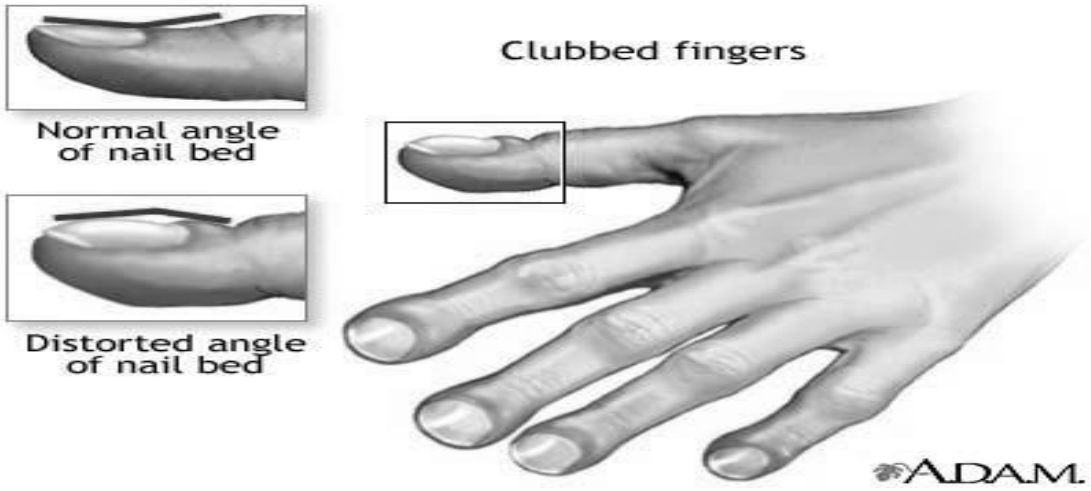
- Toxic (pale): as in patient with endocarditis.
- Hypoxic (blue): as in patient with congenital cyanotic heart disease.

Degrees of Clubbing Fingers:

- First degree: Obliteration of the nail angle.
- Second degree: Parrot-peak appearance.
- Third degree: Drum-stick type.
- Forth degree: Osteoarthropathy.

Unilateral clubbing: Lt Side mostly as in patient with aortic aneurysm.

Bilateral: as in patient with endocarditis.



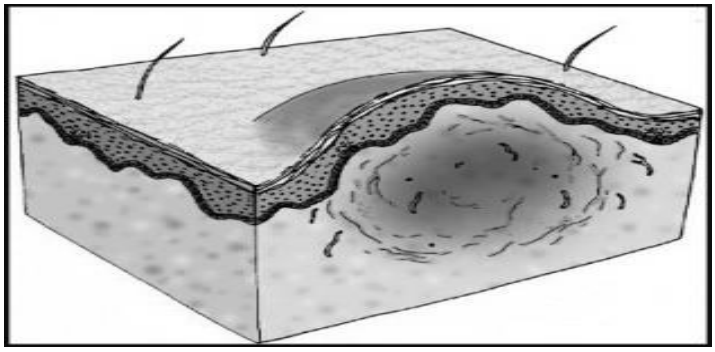
- Capillary pulsation in AR (**Quinke's pulse**).
- **Cyanosis.**
- Subcutaneous **nodules** in rheumatic fever (R.F).

Osler's nodules:

Are painful, red, raised lesions found on the hands and feet, located in small tendon or attached to subcutaneous tissue, associated with endocarditis.

- Subcutaneous nodules:

Located around the extensors of the hand in deeper tissue but it not painful associated with Rheumatic heart disease and heart failure.



10- <u>L.L:</u>

- **Clubbing** toes.
- **Oedema.**

The extremities are inspected for the presence of edema; edema is examined for its level of pitting when moderate pressure applied.

Peripheral edema tests	• Pitting • Circumference • Skin color and texture	
Test sites for petting	• Dorsum of feet • Behind medial malleolus • Pretibial	
Test technique	Press thumb into skin for 5 seconds	
	Grade 1+	2mm deep
	Grade 2+	4mm deep
	Grade 3+	6mm deep

	Grade 4+	8mm deep
Arterial edema	Cool to touch	
Venous edema	Warm to touch	
Bilateral edema	Result of CHF	
Unilateral edema	Local factors of same leg such as: varicose vein or lymphedema	

- **Cyanosis.**

B) Local Examination:

Position:

Patient position: rest with 30 -45 body elevation (semi fowler position).

Therapist position: stand at patient's Rt side.

(I) Inspection:

During inspection of the anterior chest, you should be looking for scars, obvious abnormalities, and the apical impulse. Tangential lighting will help you in visualizing impulses, but do not worry too much if you still cannot see them especially if the patient is particularly obese or muscular.

-Face:

Toxic look: as in endocarditis & rheumatic heart failure.

Malar flush: as in mitral stenosis.

Mongolic feature: Down syndrome patient usually suffer from congenital problems.

-Eye:

Sever hypertension associated with heart disease mostly lead to peripheral hemorrhage in conjunctiva.

- **Chest wall:**

(1) Precordial bulge (2^{nd} to 6^{th} Lt. space):

- Rt. Ventricular enlargement (RVE) since early childhood (Rh HD., congenital HD)
- Pericardial effusion

(2) Skeletal abnormalities (kyphoscoliosis, pectus excavatum)

(3) Dilated chest veins (SVC or IVC obstruction)

(4) Scars of previous operations:

- Median sternotomy (open heart surgery, valve replacement)
- Lateral thoracotomy (inframammary: mitral valvotomy)

- **Apex beat:**

Def.: (the outmost and lowermost visible &palpable pulsation over chest)

Normal site: (Lt. 5^{th} I.C space, just inside MCL)

Abnormalities:

- Absent: pericardial Effusion, weak contraction in MI, dextrocardia

- Upward displacement: pregnancy, Ascites, paralysis of Lt. copula
- Downward displacement: thin persons with long chest, emphysema.
- Inward: congenital dextrocardia, Rt lung fibrosis, Lt pleural effusion
- Outward: RVE or LVE, Lt. lung fibrosis, Rt. pleural effusion
- Outward &downward: LVE

❖ **Pulsations of different areas:**

- Suprasternal: child, fever, thyrotoxicosis, AR, A. arch aneurysm.
- Rt 2nd space (aortic area, along the Rt. Sternal Border): A. desending aneurysm, HTN.
- Lt 2nd space (pulmonary area, along the Lt. Sternal Border): pulmonary HTN
- Lt parasternal 3rd & 4th spaces: RVE, huge LA.
- Rt parasternal: RAE, A. aneurysm.
- Epigastric: (midline: A abdominal aneurysm, pregnancy), (Rt: liver pulse), (Lt: RVH).

(II) Palpation:

- Confirm pulsations; detect thrills, and palpable sounds.
- Palpation enables you to feel any thrills (large areas of sustained outward motion). These are best felt through the ball of your hand pressed firmly against the patient's chest. Thrills usually are associated with loud murmurs such as aortic stenosis or mitral stenosis.

1- Apex beat:

- Pulsation: arc of 1-2 cm around, small gentle tap and brief.
- Rate (apical) when there is irregularity as in AF.

- Palpable sounds: S3 or S4 (gallop)
- Systolic thrill in mitral regurge (MR).
- Diastolic thrill in mitral stenosis (MS).

2- **Neck (carotid):** thrill in AR.
3- **Lt. Infraclavicular:** thrill in PDA.
4- **Aortic area:** pulsation / systolic thrill in AS.
5- **Pulmonary area:** pulsation / systolic thrill in PS.
6- **Lt parasternal:** pulsation in RVE, ASD, TR, pul.HTN or systolic thrill in VSD.
7- **Rt parasternal:** pulsation in RAE, A.aneurysm.
8- **Epigastric pulsation:** aortic, hepatic, or RVE.
9- **Thrill:**

Palpable vibration over chest wall as buzzing associated with murmurs (without patient speak as we feel it, we have to auscultate to make sure)

Thrill at apex when patient turned to left and hold expiration which may be systolic or diastolic.

Thrill at the base when patient leaned forward and hold expiration which almost systolic.

(III) Percussion:

- To estimate the heart size roughly.
- To detect pericardial effusion.

1- Rt border: normally: no dullness on the Rt side of the sternum.

Dullness: RAE, pericardial effusion, or chest disease.

2- Upper border (base of the heart):

Normally: Aortic & pulmonary areas are resonant.

Dullness: pericardial effusion (changes to resonance if sitting)

3- Waist of the heart (3rd Lt space):

Normally: ½ dullness of normal apex-up to 2 f.

Dullness: obliteration of waist; (LAE, pl. effusion)

4- Lt border (pul. Area + waist + outside apex):

Normally: no dullness outside apex.

Dullness outside apex: pericardial effusion, or chest disease.

5- Bare area (4th & 5th spaces between midline and PSL):

Normally: flat dullness

Increased dullness: RVE & pericardial effusion.

Resonance: emphysema or pneumothorax.

6- Lower 1/3 of the sternum:

Normally: resonant.

Dullness: RVE.

(IV) Auscultation:

Before you begin, there are certain things that you should keep in mind:

a) Try to create a **quiet environment** as much as possible.

b) The patient should be in the **proper position** for auscultation.

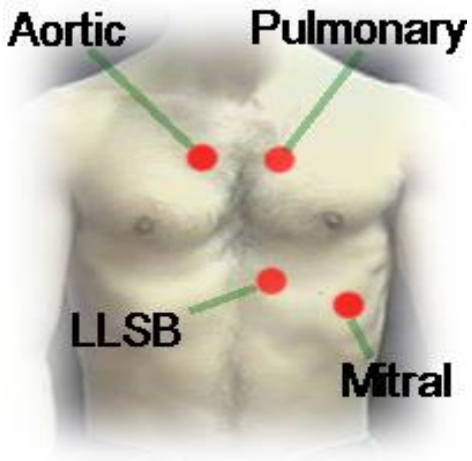
sitting up in bed leaning forward, lying on his/her left side, or supine or at 30-degree elevation on the examining table.

Palpation and cardiac auscultation area'

- *LV area (Mitral-apex)* : apex of the heart at 4th or 5th intercostal space (ICS) along
- *RV area* (tricuspid): 3rd to 5th ICS along the left sternal border (LSB)
- *Pulmonic Area*: 2nd ICS along the LSB
- *Aortic Area*: 2nd ICS along the right sternal border (RSB)

c) Your stethoscope should be touching the patient's **bare skin** whenever possible. You may wish to wet the patient's **chest hair** with a little warm water to decrease the sounds caused by friction of hair against the stethoscope.

d) Always ensure **patient comfort**. Be considerate and **warm** the diaphragm of your stethoscope with your hand before auscultation.



- Listen to the heart sounds with the diaphragm of your stethoscope beginning at the **apex**, in each **ICS** along the **LSB**, and in the **2nd Rt** ICS.

- When auscultating, first concentrate on the **S1** and **S2** sounds, next listen for **S3 and S4** sounds before looking for **murmurs** and other **abnormal heart sounds.**

- The **diaphragm** is most useful for picking up **high-pitched** sounds e.g. S1, S2, aortic or mitral regurgitation, pericardial friction rubs.
- The **bell** is most useful for picking up **low-pitched** sounds e.g. S3, S4, mitral stenosis.
- When using the **bell,** press it **gently** against the skin. Applying more pressure stretches the skin taut and results in the bell functioning like the diaphragm.
- Listen to all the auscultatory areas with the patient in a **supine** position. You may also wish to use other patient positions in order to elicit or accentuate other heart sounds.

Patient Positions and Special Techniques for Auscultation	
Position	**Use**
Supine	general auscultation and most heart sounds
Sitting up and leaning forward and holding exhalation	aortic stenosis, aortic regurgitation, pericardial rubs
Left lateral decubitus	S3, S4, mitral stenosis (using bell of stethoscope)
Vasalva manoeuver	increases intensity of mitral valve prolapse and hypertrophic cardiomyopathy, decreases intensity of aortic stenosis

1st heart sound (S1): (lub)

High pitch sound

Cause: Closure of A-V valves (M & T),

Timing: At the onset of systole

Site: Best heard over apex (mitral) an also at tricuspid

These 2 events are separated usually by less than 30msec and because this is below normal hearing resolution threshold, the sound is single

Increased (accentuated)	**Decreased** (muffled)
MS & TS	MR & TR
Hyperdynamic circulation	Decreased contractility (HF, MI)
HTN and tachycardia	Hypotension and bradycardia
Very thin persons	Obese persons
Children	

2nd heart sound (S2): (Dub)

Low pitch sound

Cause: Closure of semilunar valves (A & P)

Timing: At the onset of diastole.

Site: pulmonary and aortic areas

- Aortic: single (A2)

- Pulmonary: split (A2 followed by P2) during inspiration.

Normally the aortic valve closure proceeds pulmonary valve closure, so S2 is physiologically splitted into tow component A2 & P2.

That split increases with inspiration and decreases with expiration due to delay in Rt. ventricular contraction during inspiration as venous return increased.

Splitting is better heard over pulmonic area during inspiration (as Lt. side louder than Rt.).

During expiration the normal split between the closure of aortic & pulmonic valve narrows and heard as single sound.

Split of sound is present in atrial septal defect

If splitting does not vary with inspiration, it is termed a "fixed split S_2" and is usually due to a septal defect, such as an atrial septal defect (ASD) or ventricular septal defect (VSD). The ASD or VSD creates a left to right shunt that increases the blood flow to the right side of the heart, thereby causing the pulmonary valve to close later than the aortic valve independent of inspiration/expiration. A bundle branch block either LBBB or RBBB, (although RBBB is known to be associated only with S_1 split), will produce continuous splitting but the degree of splitting will still vary with respiration.

When the pulmonary valve closes *before* the aortic valve, this is known as a "paradoxically split S_2

Increased	Decreased
A2 in systemic HTN	A2 in AS & AR
P2 in pulmonary HTN	P2 in PS & PR
Hyperdynamic circulation	Hypotension
Child & thin chest	Emphysema & obesity

3rd heart sound (S3): (ventricular gallop)

- **Low pitch**, **early diastolic** sound shortly after S2 (lup-dup-dup), best heard near to the **apex.**
- **Mechanism:** excessive ventricular vibration due to rapid rush of blood after opening of A-V valves. (rapid filling phase)
- **Causes:**

Physiological: healthy young adult (25-30), athletes, pregnancy

Pathological:

1- Flappy myocardium (LVF), RVF& dilated cardiomyopathy

2- Volume overload: (LV): MR, AR and VSD.

(RV): TR, PR and ASD.

4th heart sound (S4): (atrial gallop)

- **Low pitch**, **late diastolic** sound (**pre-systolic**) before S1 (La-lup-dup), heard at **apex or Lt. sternal edge**.

- **Mechanism:** forcible atrial contraction against ventricular EDP. It is a late diastolic sound reflecting decreased ventricular distensibility, always pathologic.

  - **Causes:**

    1- Tension overload: hypertrophy of; LV (systemic HTN, AS)

    RV (pulm. HTN, PS)

    2- Decreased compliance of ventricles: (MI)

Added Sounds:

1- Systolic clicks:

- Early systolic (ejection), after S1, e.g. Aortic (AS, HTN) or Pulmonary (PS, pulm. HTN)
- Mid and late systolic (mitral prolapse)

2- Opening snap:

- A diastolic sound, after S2.
- Medial to the apex & along LSB in Lt lateral position.
- Due to opening of rigid A-V cusps as in MS or TS.

3- Pericardial rub:

- Superficial leathery continuous sound.
- Over the bare area, with the patient sitting.
- Does not disappear on holding up respiration.

Evaluating Murmurs:

Abnormal turbulent sound caused by:

- Obstruction of blood flow (stenosis).
- Regurgitation of valves.
- Flow from narrow to dilated chambers.
- Rapid flow to bigger chambers of the heart or big vessels

Evaluate the following characteristics:

1. systolic vs. diastolic
2. duration
3. pitch: high, medium, low
4. quality: harsh, rumbling, blowing
5. intensity: e.g. crescendo, decrescendo, crescendo-decrescendo, plateau
6. best heard location
7. areas of radiation: e.g. axilla, carotids
8. grade of murmur (see table below)
9. variation with respiration and/or change of position
10. other associated sounds: S3, S4, ejection click, opening snap

Timing of murmurs:

A) Systolic:

- Pan systolic (MR, TR, VSD)
- Ejection (AS, PS)
- Late systolic (M prolapse)

B) <u>Diastolic:</u>

- Early diastolic (AR, PR)
- Mid & late diastolic (MS, TS)

C) <u>Continuous:</u>

- PDA (2^{nd} ICS)
- Double valve lesion (AS+AR or MS+MR).

Examination of the lower extremities

-Arterial pulses.

-Lower limb edema: Assessment of edema is performed by pressing two fingers into the particular areas for 2 to 3 seconds. If an impression is left once the fingers are removed, then pitting or dependent edema is present. The degree of edema is based on the length of time that the indentation lasts. 1+ is the least; 4+ is the worst.

-Skin color.

-Skin temperature.

Vital signs

Vital signs are critical indicators of a person's health and current medical status. Vital signs reflect whether specific body systems are functioning appropriately or not. Also, provide the first indication of harmful physiological changes or disturbances in the body.

There are four traditional vital signs, also known as cardinal signs (temperature, pulse rate, respiratory rate and blood pressure. Two additional measures, pain level and oxygen saturation, were more recently added to these.

Recording baseline measurements of vital signs during initial patient contact is important for comparison with future measurements. Knowledge of normal range of vital signs is also important for patient evaluation and direction of interventions.

Temperature

Body temperature is regulated within a narrow physiological range but may increase significantly in response to infection and increased physical activity.

Many other factors such as circadian rhythm, Clothing, age, gender, menstrual cycle, pregnancy, emotion and injury may influence core body temperature.

Body temperature is regulated primarily by the hypothalamus, which acts like a thermostat, keeping core body temperature near a set point of approximately 37 degree.

Core body temperature may shift excessively downward, resulting in hypothermia or upward resulting in hyperthermia.

Methods for Measuring Temperature

Body temperature may be measured with various types of thermometers and at various sites.

Thermometer types include:

●Mercury in glass thermometer:

It consists of a sealed glass tube calibrated in degrees centigrade. Mercury in glass thermometer generally has one of three different tips (slim for oral or axillary use, short rounded tip, and the pear shaped for rectal use.

●Tympanic membrane thermometer:

*It uses an otoscope like probe that is inserted into the external auditory canal.

*It is minimally invasive, record temperature in approximately three seconds. Also, have no direct contact with mucus membrane.

●**Electronic thermometers**:

It is relatively easy to use, portable, and can be used to measure oral, axillary and rectal temperature. There is disposable probe cover needs to be in place to operate, which helps reduce the risk of cross contamination.

●**Disposable (single use) thermometers:**

It consists of plastic strip with a matrix of dots, which arranged to correspond with temperature registered in degrees centigrade.

Disposable thermometers have the advantages of being sterile, unbreakable and decreasing the risk of cross infection.

It is better choice, when treating patients under isolation or with communicable diseases.

●**Oral measurement with mercury in glass thermometer**

-Patient should be resting comfortably.

-Don disposable gloves.

-Read the level of mercury at eye level before using it.

-Place the thermometer gently under the patient's tongue.

-The thermometer remains in place for three minutes.

-Remove the thermometer and record the patient's temperature.

Oral

- Glass, paper, or electronic thermometer
- Normal /37° C

Axillary

- Glass or electronic thermometer
- Normal /36.5° C

Rectal

- Glass or electronic thermometer
- Normal /37.5° C

Aural (in the ear)

- Electronic thermometer
- Normal /37.5° C

Pulse Rate

Quality and regularity of the peripheral pulse may give information about cardiovascular function.

Pulse has characteristics of rhythm and strength in addition to rate. Rhythm reflects the regularity of heart beat and strength reflects the volume of blood ejected.

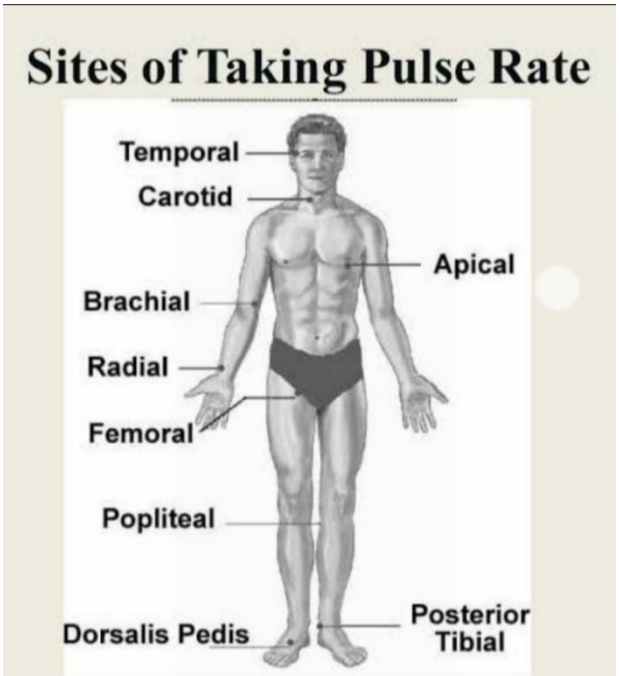
Documentation should include the heart rate, strength and rhythm, for example, a pulse may be reported as 60 bpm, strong and regular, or as 70 bpm, weak and irregular.

Pulse may be assessed peripherally at sites where an artery is close to the skin. Also, similar procedures should be used for all sites.

The ratio of respiratory rate to pulse rate is 1:4. The respiratory rate in newborn is about 44 per minute, and decreases gradually upon growing up.

Assessment of pulse from different sites:

- Temporal
- Carotid artery.
- Brachial artery.
- Radial artery.
- Femoral artery.
- Popliteal artery.
- Dorsalis pedis artery.
- Posterior tibial artery.



Ranges of the pulse rate measurement:

*__*Normal resting pulse*__ rate ranges from 60-100 bpm.

*__*Tachycardia*__ or rapid pulse rate is defined as a pulse greater than 100 bpm at rest.

*__*Bradycardia*__ or a slow pulse rate is defined as a heart rate of less than 60 bpm at rest.

Respiratory Rate

It is the number of breaths or the number of times a cycle of inspiration and expiration is completed per minute.

Clinician should try to assess the rate and regularity of breathing as well as the depth of breathing to determine if an adequate volume of air is being exchanged.

Ranges of the respiratory rate: -

Respiratory rate is higher in the newborn (30-60 breaths per minute) than in the adult (14-18 breaths per minute), and slightly higher in adult women than men.

- ***Tachypnea*** means rapid respiratory rate faster than 20 breaths per minute.
- ***Bradypnea,*** means respiratory rate slower than 10 breaths per minute.

Blood pressure

It is the pressure exerted by the blood on the arterial walls.

Systolic blood pressure represents the peak ventricular contractile force pushing the blood through the vascular system. While diastolic pressure represents the minimum pressure in the arteries between heart beats.

Blood pressure is generally measured noninvasively using a sphygmomanometer and a stethoscope.

A sphygmomanometer with an aneroid dial and a stethoscope are the most popular devices, because these devices are economical, simple to use, and easy to handle and provide accurate results quickly while avoiding the hazards associated with mercury.

How to measure arterial blood pressure:

- Positioning of the therapist and patient is critical to obtain accurate results.
- Initial measurement should be taken in both upper arms.
- Patient's arm is supported at the level of the heart.
- Select the appropriate cuff size, the elbow should be slightly bent, and the lower border of the cuff should be placed approximately 1 inch above the antecubital fossa in adults.
- Expose upper arm and apply the cuff directly to the skin.

- Ear pieces of the stethoscope should be directed forward, place the diaphragm of the stethoscope over the brachial artery in the antecubital fossa, and inflate the cuff about 30 mmHg above the point where the pulse disappeared.
- Gradually deflate the cuff while listening for the pulse with the stethoscope, and remove the cuff.
- Record your findings.
- Normal ranges in adult is less than 120/80 mmHg. Hypertension is defined as a blood pressure with either the systolic or the diastolic blood pressure being at or above the cut-off 140/90 mmHg.

Factors affecting blood pressure:

- Patient age, race and gender.
- Physical exertion.
- Changing patient position and diurnal variations.
- Medication usage.
- Fever and environmental temperature.

THERAPEUTIC TECHNIQUES

Objectives:

By the end of this lab the student will be able to:

- Underline the scientific background that is required for applying different therapeutic techniques.
- Identify the importance of the different therapeutic techniques.
- List the advantage and disadvantage of each therapeutic technique.
- Demonstrate the good way of applying the different therapeutic techniques.

BREATHING EXERCISES

There is a co-ordination between the activity of the respiratory muscles and the changes of chest wall configuration which increase the respiratory muscle activity when a person changes his position.

Indications for breathing exercises:

- Chronic obstructive lung diseases as asthma and bronchitis.
- Pneumonia.
- Atelectasis.
- Pulmonary embolism.
- Acute respiratory distress.
- Pain in thoracic area because of surgery and trauma.
- Bronchospasm.

- High spinal cord injury.
- Acute and chronic progressive myopathic or neuropathic diseases.
- Severe orthopedic deformities as scoliosis.

Precautions:

When teaching breathing exercise, be aware of the following precautions:

- Never allow a patient to force expiration but expiration should be passive and relaxed as the forced expiration lead to bronchospasm.
- Do not allow the patient to initiate inspiration with the action of accessory muscles and upper chest wall and the patient should be relatively quite during respiration.
- Allow the patient to practice deep breathing for only three or four inspirations and expirations at the time available to avoid hyper ventilation.

Aims of breathing exercises:

- Promoting a normal relaxed pattern of breathing.
- Teaching controlled breathing with a minimum amount of effort.
- Assisting in removal of secretions.
- Aiding in re-expansion of lung tissue.
- Mobilizing the thoracic cage.

Practice: Advice the patient to carry out each breathing exercise for 18-24 times in a 6 group with a short rest in between each group to avoid hyperventilation and should be repeated for 2-5 times per day according to the patient's condition.

Types of breathing exercise

Nose breathing exercise

Technique:

- Patient in half-lying position with knees slightly flexed.
- Vibration is applied on muscles on both sides of nose.
- Feel the passage of air at the tip of nose or smell any thing not irritant to the patient.
- Close one nasal opening by the tip of the thumb and ask the patient to take deep inspiration then close the other one and repeat the process.
- Massage is applied to relax muscles surrounding nose.

Localized breathing exercise

Types:

- Apical breathing exercise.
- Sternal breathing exercise.
- Upper costal breathing exercise.
- Middle costal breathing exercise.
- Lower costal breathing exercise.

- Unilateral lower thoracic breathing exercise.
- Posterior lower thoracic breathing exercise.

Position of patient:

Half lying with knees flexed, sitting position or long sitting according to patient comfort.

Apical breathing exercise:

This is useful when there is restriction in upper chest movement or incomplete expansion of lung in an apical region.

Technique:

1. Therapist put his hands at apical region of the lung.
2. Turn the patient head to the other side.
3. Ask patient to take deep inspiration and push my hand out-hold-expire slowly.
4. Therapist hands give pressure at the end of expiration and may apply resistance after initiation of inspiration according to patient's need.
5. Shoulder should be relaxed.

***Sternal breathing exercise*:**

Technique:

1. Therapist hand placed over sternum.
2. Same as apical.
3. Same as apical.
4. Same as apical.
5. Same as apical.

***Upper costal breathing exercise*:**

Technique:

1. Therapist put his hand for guidance, assistance and resistance just under the axilla with his knuckles parallel to anterior axillary line at the level from first to fourth inter costal spaces.
2. Same as apical.
3. Same as apical.
4. Same as apical.
5. Same as apical.

***<u>Middle costal breathing exercise</u>*:**

Technique:

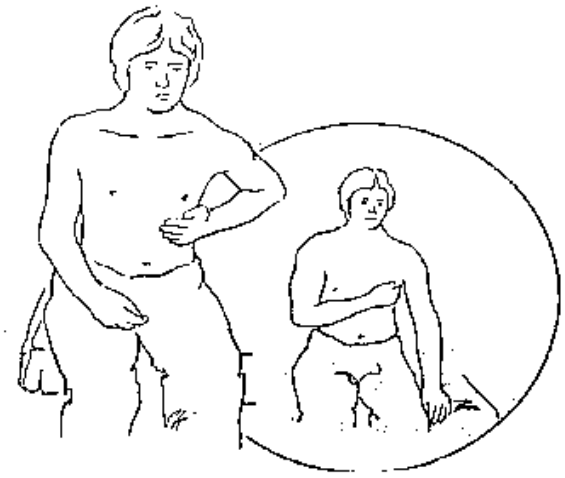
1. Therapist put his hand at the level of 4, 5 and 6 inter costal spaces bilaterally.
2. Same as apical.
3. Same as apical.
4. Same as apical.
5. Same as apical.

***<u>Lower costal breathing</u>*:**

Technique:

1. Therapist placing his hands over 7, 8 and 9 inter costal spaces bilaterally with two thumbs directed towards xiphoid process.
2. Same as apical.
3. Same as apical.
4. Same as apical.
5. Same as apical.
6. It is also facilitate diaphragmatic movement.

***<u>Unilateral lower thoracic breathing exercise</u>*:**



Technique:

1. Therapist places his hand well round to the side in the mid axillary line over 7, 8 and 9 inter costal spaces.
2. Same as apical.
3. Same as apical.
4. Same as apical.
5. Same as apical.

***<u>Posterior lower thoracic breathing exercise</u>*:**

Technique:

1. Therapist places his hands over the posterior aspect of lower ribs just below the inferior angle.

2. It may apply unilateral or bilateral.
3. Same as apical.
4. Same as apical.
5. Same as apical.
6. Same as apical.

Diaphragmatic breathing exercise

Position of patient: Half lying with back support head turned to the opposite side and abdominal muscles relaxed.

Technique:

For slow diaphragmatic:

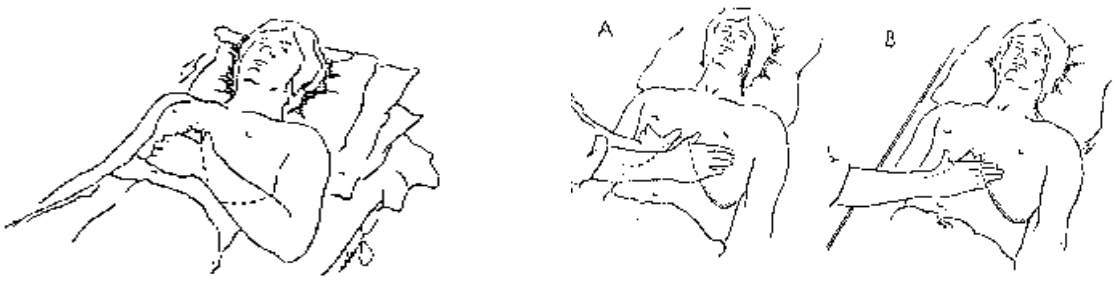
1. Therapist put his dominant hand at the level of xiphoid process fisted or fanned, vertical or transverse and other hand over sternum for guidance.
2. Ask the patient to take deep inspiration then expire slowly with avoidance of abdominal contraction and giving vibration at the end of expiration.

For deep diaphragmatic:

1. Therapist hands places same as slow diaphragmatic.
2. Ask the patient to take deep inspiration, hold then expire slowly without trick movement of the abdomen with applying resistance during inspiration and vibration at the end of expiration.

For mechanical resistive diaphragmatic:

Same as deep diaphragmatic but using mechanical resistance as sand bags.



Glossopharyngeal Breathing (GPB)

It is a substituted method of increasing the volume of air that is brought into the lungs for cases as Patient with inter costal muscle paralysis or weakness.

Patient with loss of abdominal muscles can use GPB to improve the force of coughing. GPB helps to increase lung volume by as much as 1000cc.

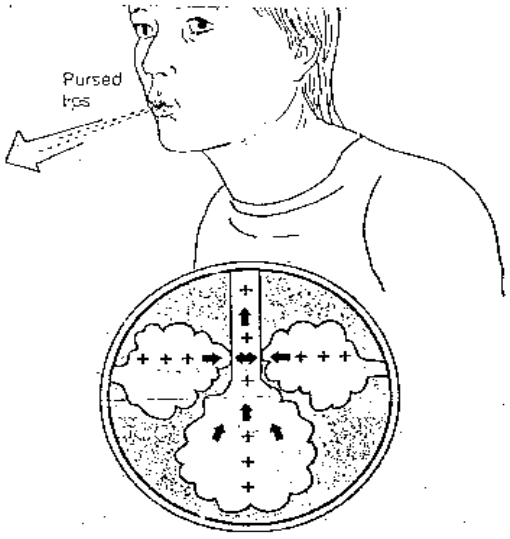
The patient takes in several gulps of air then the mouth is closed and the tongue pushes the air back and traps to in the pharynx. The air is then forced into the lungs when the glottis is opened this will help to increase the depth of inspiration and patient vital capacity.

Pursed lip breathing exercise

Technique:

Patient in crock lying position with turning head to the other side.

For passive pursed lip:



1. Therapist place one hand over sternum for guidance and the other one over the mid Rectus area to detect any abdominal muscle contraction.
2. Ask the patient to inhale slowly and deeply.
3. Instruct the patient to purse the lips before exhalation.
4. Instruct the patient to relax the air out through the pursed lips without abdominal contraction.
5. Direct the patient to stop exhalation when abdominal muscle contraction is detected.

For active pursed lip:

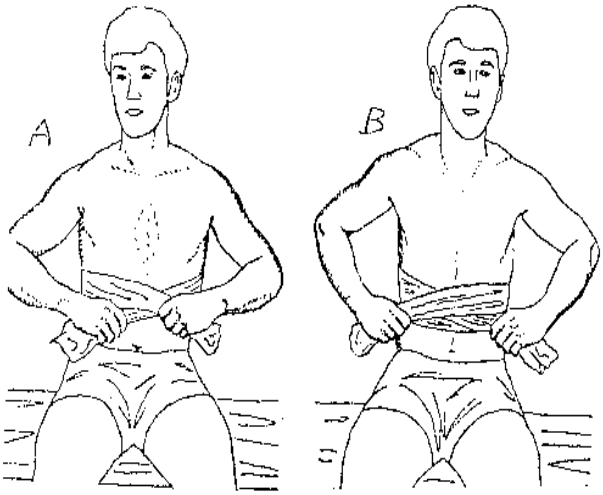
Same as passive with holding between inspiration and expiration with permission of abdominal contraction.

Belt exercise

Exercise done by using belt 2 meters length & 30 cm width.

Disadvantage:

- Trick movements are difficult to be noted.
- Can not be used for small and irregular areas.

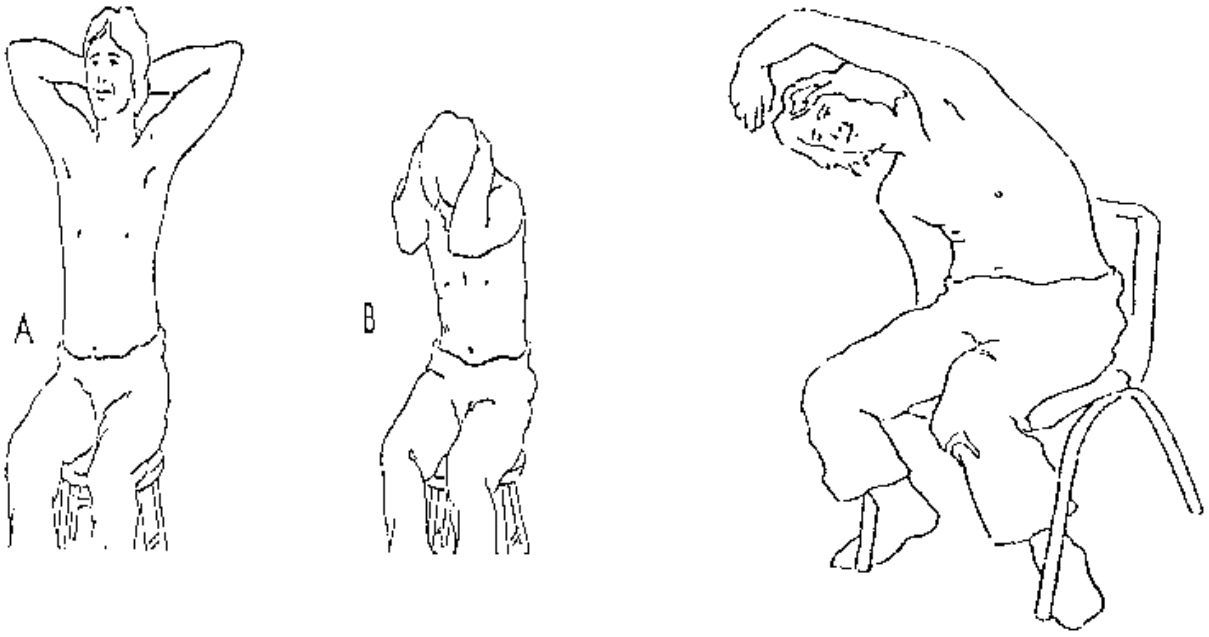


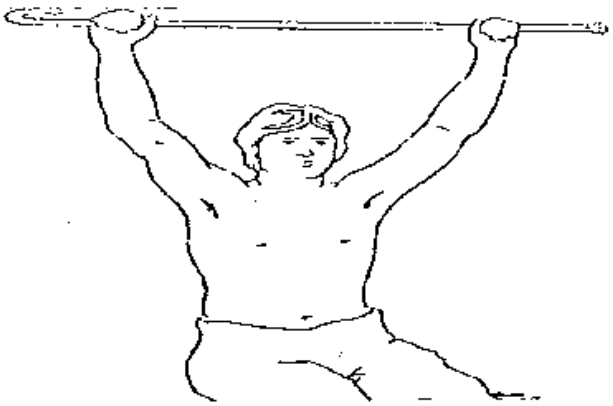
Technique:

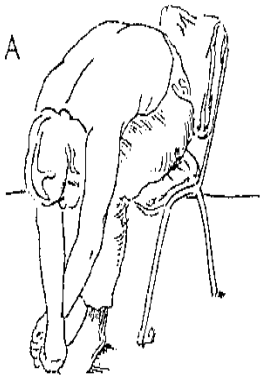
1. Patient in sitting position with belt around chest cage with crossed end.
2. Release the belt during inspiration to assist full inspiration bilateral or unilateral..
3. Assist with pressure along the rib cage during expiration.
4. Asking the patient to push the chest against the belt.

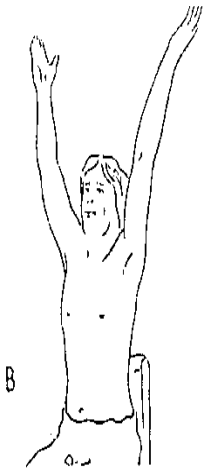
Exercise connected with respiration

- Using upper and lower limbs with respiration as abduction, extension and bending backward with inspiration.
- Adduction, flexion and bending forward with expiration.









Sustained breathing exercise

Aims:

- Improve ventilation of the lung as a whole at the same time.
- Enhance endurance in respiratory muscle.
- Training of elastic recoil of the lungs.

Faults must be avoided during breathing exercise:

- Avoid forced expiration.
- Avoid trick movement of the abdomen.
- Avoid over use of accessory muscle of respiration.

Rib Raising

- Patient is supine lying, and the therapist sits at the side of the plinth.
- Patient crosses his arms to move the scapulae laterally.
- Therapist places his finger pads under the ribs.
- Therapist lifts the ribs angles anteriorly, until anterior chest wall motion observed.
- Therapist holds the ribs up until the surrounding tissues relax.
- Rib raising may be applied once or rhythmically for several cycles.
- When one side of the rib cage is treated completely, the other side is treated.

COUGHING

An effective cough is necessary to eliminate respiratory obstructions and keep the lungs clear. It is important part of treatment of patients with acute or chronic respiratory conditions.

Teaching an effective cough:

1. Evaluate the patient's voluntary or reflective cough.
2. Place the patient in a relaxed and comfortable position for deep breathing and coughing:
   i) Sitting or leaning forward is usually the best.

ii) The patient's neck should be slightly flexed to make coughing more comfortable.

3. Teach the patient deep controlled diaphragmatic breathing.
4. Demonstrate the proper muscle action of coughing (contraction of the abdominal m.s).
5. Have the patient place his hands on his abdomen and do three huffs with expiration to feel the contraction of the abdominal.
6. The patient is asked to take three deep breaths; the first two breaths are exhaled normally while the third breath is coughed firmly.
7. The deep breaths preceding the cough are thought to decrease atelectasis and increase the volume and thus, the effectiveness of the cough.

Splinted cough

If incisional pain from recent surgery is restricting the cough, teach the patients to splint over the incision.

1-The patient's hands, a pillow or other soft cushion held gently but firmly against the incision while coughing makes the process less painful.

2-During the cough, the patient feels the thoracic or abdominal wall pushing out and the patients can give counter pressure with the pillow or his hand.

3-If patients cannot reach the incision, therapists can assist.

Manual assisted cough

1-The best cough is produced while the patient is sitting upright, a position in which the highest cough pressure is attained.

2-If the cough is still not strong while the patients sitting, manual pressure to the rib cage and abdomen can produce greater pressure.

3-Therapist can assist by standing in back of the patient and apply an inward and upward force during expiration, which pushes the diaphragm upwards to cause a more forceful and effective cough.

4-The heal of one hand on the patient's abdomen at the epigastric and other hand on top of the first with interlocking fingers.

5-The patients can participate by self-assisted cough, while he is in a sitting position he crosses his arms across his abdomen and after a deep inspiration he pushes inward and upward on the abdomen with his wrist or forearm and simultaneously leans forward as he attempt to cough

Tracheal trickle

It may be used with infants or disoriented patients who cannot cooperate in the treatment. This is uncomfortable maneuver used to facilitate reflex cough.

1-The therapist places two fingers at the sternal notch and applies a circular motion with pressure downward into the trachea to facilitate a reflexive cough

2- Never allow the patients to suck air in by gasping because it increases the work of breathing and the patients fatigued easily.

3- It tends to increase turbulence and resistance in the airways and may lead to increase bronchospasm.

4- It may push mucus or foreign object into air passages.

5-Aviod forceful coughing with patients who have a history of CVA or aneurysm, therefore, these patients huff several times to clear airways.

6-Be sure that the patient's coughs while in a somewhat erect posture.

Huffing

1-It is similar in concept and effect to coughing with one major difference that the mouth is kept open and keeping the glottis from closing.

2-Air is forcefully exhaled as in coughing but less effort from the patients.

3- The technique is generally felt to be less stressful to the patients and more effective in clearing the air ways than constant forced coughing.

POSTURAL DRAINAGE (PD)

Postural drainage (PD) is a mean of clearing the air ways from secretions by placing the patient in various positions, so that gravity will assist in the flow of secretions. The positions are based on the anatomy of the tracheobronchial tree and are designed to drain specific areas of the lungs. Secretions are moved from affected bronchioles to larger bronchi & trachea where it can be coughed or suctioned out.

Equipment required for PD:

For hospitalized patient, there are a variety of beds those operated manually or electricly to position the patient. Pillows or bedrolls to support body parts or relive pressure areas.

Goals of PD

- Prevent accumulation of secretions in patients at risk for pulmonary complication:
  - Diseases associated with increased mucus production such as chronic bronchi and cystic fibrosis.
  - Patient conditions required prolonged bed rest.
  - Post surgical patients received general anesthesia, patients who have painful incisions that restrict deep breathing and coughing
  - Any patient who is on a ventilator, and he is stable enough to tolerate treatment.

- Remove secretions already accumulated in the lungs such as in cases of COPD very frail elderly & artificial airways.

Preparation for PD

- Nebulized bronchodilators before PD may facilitate the mobilization of sputum.
- An adequate intake of hot fluids (as allowed) decreases viscosity of the secretions, allowing easier mobilization.
- In the ICU, it is important to be familiar with the multiple lines, tubes, and other devices attached to the patient.
- Make sure there are enough personnel to position the patient with little stress to both patient & staff as possible.
- Have suctioning equipment ready to remove secretions from an artificial airway or patient's nasal cavity after treatment. Have tissues or a specimen cup available for patient with an adequate cough to expectorate secretions.
- Loose tight or bulky clothing – the patient may wear a light weight shirt or gown.
- Explain the treatment procedures to the patient.
- Never administer PD directly after meal.
- Choose times of a day that will be of benefit to patient:
    - A patient's cough tends to be very productive in the early morning due to accumulated secretions from the night before.
    - PD in the early evening will clear the lungs prior to sleep and help patient rest more easily.

- Frequency of the treatment will depend on the pathology of the patient's condition:-
  - Thick copious mucus: from 2 to 4 times per day until lungs are clear.
  - Maintenance: From 1 to 2 times per day to prevent further accumulation of secretions

Treatment Sequence

- After determining the lobe of the lung to be treated, put the patient in the appropriate position.
- If PD is used exclusively, each position should be maintained for 5to 10 minutes, if tolerated, or longer when focusing on a specific lobe. Coordinating PD positioning with nursing care for skin pressure relief. If PD is used in conjunction with another technique, the time in each position may be decreased.
- A patient who requires close monitoring should not be left unattended in a Trendelenburg position, but this may be appropriate if a patient is alert and position himself.
- The patient should be encouraged to take deep and cough after each position if possible.
- Secretions may not be mobilized immediately after the treatment, but this may occur up to one hour later.
- Total duration of any treatment should not exceed 40 to 45 minutes, as procedure is quite fatiguing to patient.
- Assess the effectiveness of the treatment, and note the smell, type, color, consistency and amount of secretions produced. Auscultate over the segments

that were drained and note changes in breath sounds. Check the symmetry of chest wall expansion.

- Discontinue PD if chest x-ray is relatively clear, Patient is a febrile for 24 to 48 hours.
- Percussion, vibration and shaking may be used in conjunction with PD positioning.

Contraindications to PD:-

- Large amount of blood in sputum (severe hemoptysis).
- Untreated acute conditions such as congestive heart failure sever pulmonary edema, large pleural effusion, and pneumothorax.
- Cardiovascular instability in cases of cardiac arrhythmia, severe hypertension or hypertension, and recent myocardial infarction.
- Recent neurosurgeries such as, head down positioning may cause increased intracranial pressure.

Modified PD: Some patients who require PD cannot assume or tolerate the positions of PD:

- Patients with congestive heart failure may develop shortness of breath caused by lying flat.
- Post neurosurgery patients may not be allowed to assume a head down position.
- Patients with cardio thoracic surgeries may have chest tubes and monitoring wires the limit PD positions. This compromise is better than not administering PD at all.

Home program of PD

- PD should be carried at regular interval at home, patient need to be shown how to position themselves using inexpensive aids such as pillows over hard wedges or stacks of newspapers.
- A child may be positioned on an ironing board .A family members should be instructed in positioning and percussion to assist the patient. Guidelines and precautions should be followed.

Percussion

Percussion is performed with the aim of loosening retained secretions from the airways, so they removed by suctioning or expectoration. It is performed during both the inspiratory and expiratory phases of breathing

Percussion is used in postural drainage positions for increased effectiveness.

Equipment Required For Percussion

- The only equipment required for manual percussion is care givers cupped hands to deliver force to mobilize secretions.
- For the adult and older pediatric population, electric or pneumatic precursors that simulate percussion.
- Several devices may be used to provide percussion to infants such as the bell of a stethoscope.

Preparation for percussion:-

- Place the patient in appropriate PD positions.
- Place a thin towel or hospital gown over patient's skin.
- Adjust the level of the bed so that the caregiver may use proper body mechanics during the treatment.

Advantages of percussion:

Addition of percussion to PD treatment may enhance secretion clearance and shorten the treatment. Patients, especially young children and infants, often find the rhythm soothing and relaxed.

Disadvantages of percussion:

- Over fractures, spinal fusion or osteoporotic bone.
- Over tumor area.
- If the patient has a pulmonary embolus.
- In patients with conditions in which hemorrhage could easily occurs.
- Percussion is not well tolerated by many patients post operatively without adequate pain control.

Treatment with percussion:

- Position the hand in the shape of a cup with the fingers and thumb adducted .It is important to maintain this cupped position of the hands throughout the treatment, while letting the wrists, arms, and shoulders stay relaxed.

- The sound of percussion should be a hollow, if erythema occurs with percussion; it is usually a result of slapping.
- The force applied to the chest wall from each hand should be equal.
- If the size of an infant dose not allows use of full hand, percussion may be done manually by three fingers, with the middle finger tended.
- Percussion does not performed over bony prominences of the patient, or over breast tissues. This will produce discomfort and diminish the effectiveness of treatment.
- A patient may be taught to perform one–handed self percussion to those areas that can be reached comfortably.

Vibration

- It involves a gentle, and high frequency force. It is performed by contracting all the muscles in the caregiver's upper extremities to cause a vibration.
- For manual techniques, it is performed by caregiver's hands. Mechanical vibrators are available, and are useful for self treatment by a patient.
- Place the patient in appropriate PD position; use a hospital gown over the patient's skin, and proper body position for a caregiver. The hands may be placed side by side, or one over the other. The hands may be placed side by side, or one over the other.
- The patient is instructed to take deep inspiration; a gentle but steady co-contraction of the upper extremities is performed to vibrate the chest wall.
- If a patient has limited chest wall movement, vibration will probably be better tolerated than shaking.

Shaking

- It is more vigorous, for moving Secretions from the lung periphery to the larger airways.
- At the peak of inspiration, apply a slow, rhythmic bouncing pressure to the chest wall until the end of expiration.
- If the patient has a rapid respiratory rate, it may be necessary to apply vibration or shaking every other exhalation.

Postural Drainage Techniques

Positions are based on the anatomy of the lungs and the tracheobronchial tree.

UPPER LOBES:

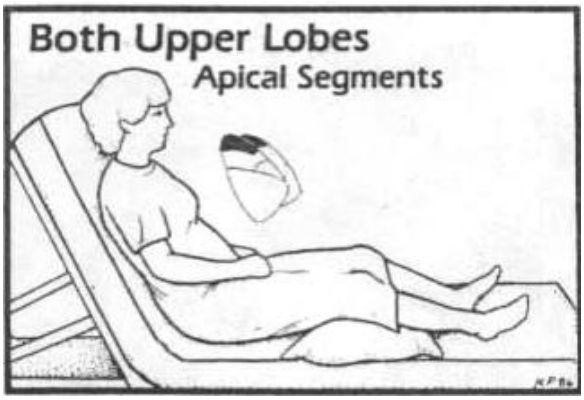
Right and left lungs, upper lobes were divided into, apical, anterior and posterior segments.

Apical segment:

Patient position**:** Patient sits in upright position.

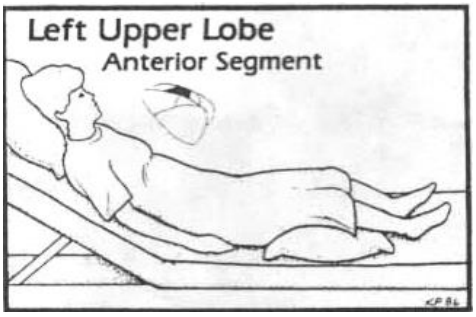
Percussion site**:** Vibration, percussion or shaking is applied directly under the clavicle

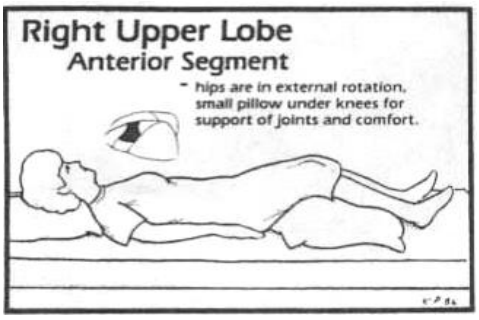
Anterior segment:



Patient position**:** Patient sits with slight leaning backwards, or patient in supine lying position.

Percussion site**:** Vibration, percussion or shaking is applied directly over the nipple or just above the breast.

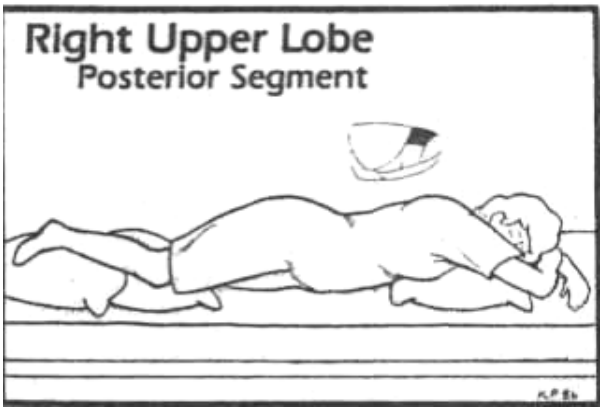




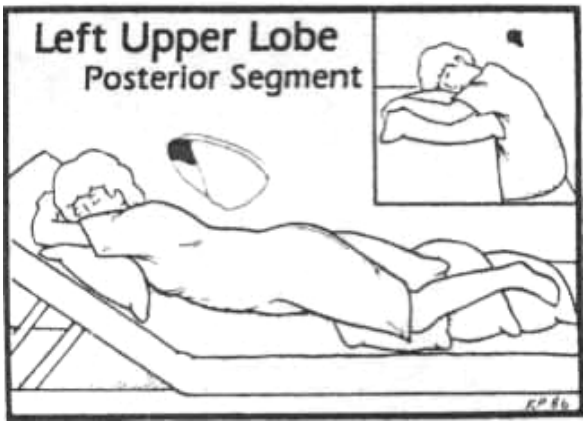
Posterior segment:

Patient position**:** patient in prone lying position, or patient sitting with slightly leaning forward.

Percussion site**:** Vibration, percussion or shaking is applied directly above the scapulae .The therapist's fingers curve over the top of the shoulder.

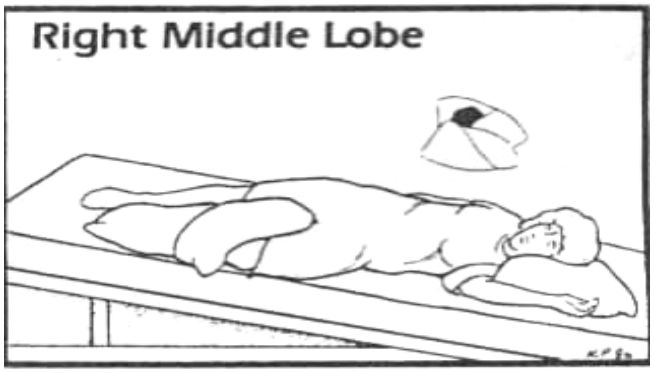


MIDDLE LOBE:



Middle lobe is divided in the right lung into medial and lateral segments, but in the left lung the middle lobe is represented by lingua which is divided into superior and inferior lingual.

Medial segment of the right lung:



Patient position: Patient lies side lying on left side, supported with pillows behind his back, patient leaning backward 45 degrees, and the treatment bed must be raised about 14 inches from its lower end.

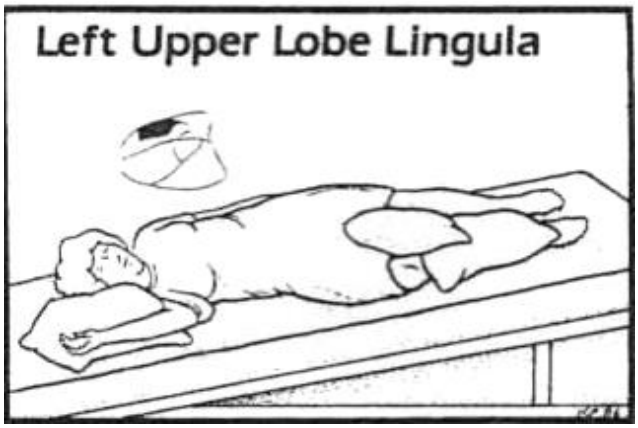
Percussion site: Vibration, percussion or shaking is applied directly under the right breast.

Lateral segment of the right lung:

Patient position**:** Patient lies side lying on the left side, supported with pillows anteriorly, with leaning forward 45 degrees, and the treatment bed must be raised about 14 inches from its lower end.

Percussion site: Vibration, percussion or shaking is applied directly under the right breast.

Superior lingula of the left lung:



Patient position**:** Patient lies side lying on the right side, supported with pillows anteriorly, with leaning forward 45 degrees, and the treatment bed must be raised about 14 inches from its lower end.

Percussion site**:** Vibration, percussion or shaking is applied directly under the left breast.

Inferior lingula of the left lung:

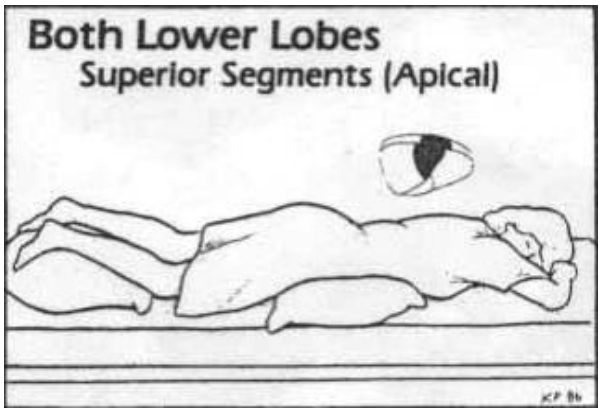
Patient position: Patient lies side lying on right side, supported with pillows behind his back, patient leaning backward 45 degrees, and the treatment bed must be raised about 14 inches from its lower end.

Percussion site: Vibration, percussion or shaking is applied directly under the left breast.

LOWER LOBE:

Lower lobe in the right lung is divided into five segments include apical ,anterior ,posterior ,medial, and lateral .But the left lung is divided into four segments include apical ,anterior, posterior, and lateral.

Apical segments of right and left lungs:

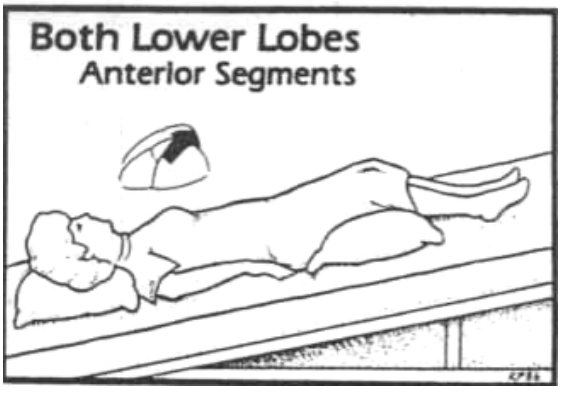


Patient position: Patient lies prone position, pillow under his abdomen to flatten his back.

Percussion site: Vibration, percussion or shaking is applied directly below the scapulae.

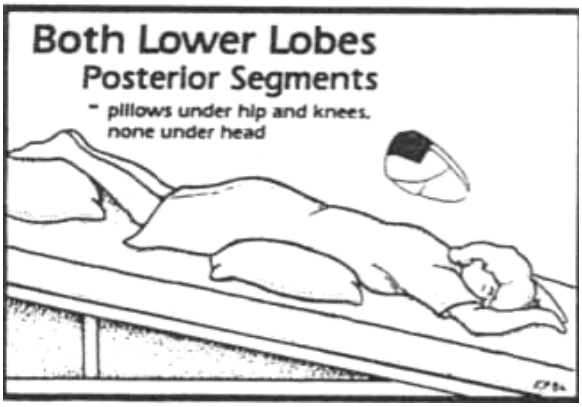
Anterior segments of the right and left lungs:

Patient position: patient in supine lying position, with pillows under his knees. Treatment bed is raised 18 inch from the lower end.



Percussion site**:** Vibration, percussion or shaking is applied directly over the lower portion of the ribs.

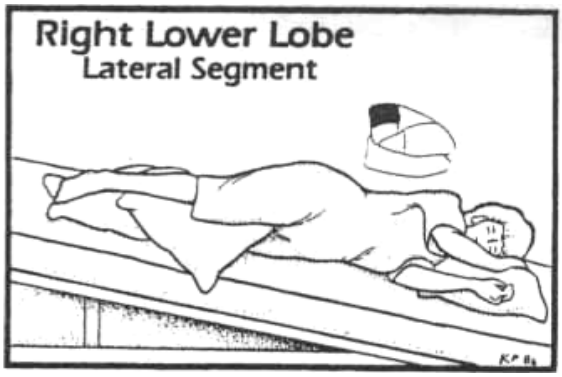
♦Posterior segments of the right and left lungs:



Patient position**:** patient in prone lying position, with raising the treatment bed 18 inch from the lower end.

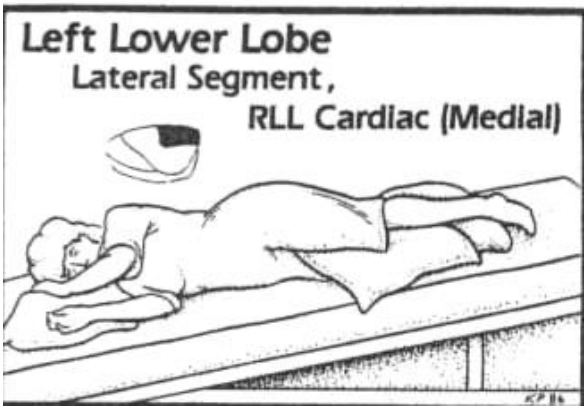
Percussion site**:** Vibration, percussion or shaking is applied directly over the lower portion of the ribs.

Lateral segments of the right lung and left lungs:



Patient position: Patient lies side lying on the opposite side to be drained, supported with pillows anteriorly, with leaning forward 45 degrees, and the treatment bed must be raised about 18 inches from its lower end.

Percussion site: Vibration, percussion or shaking is applied directly under the lateral aspect of the rib cage of the drained segment.



Medial segment of the right lung (lower lobe):

Patient position: Patient lies side lying on right side, supported with pillows behind his back, patient leaning backward 45 degrees, and the treatment bed must be raised about 18 inches from its lower end.

Percussion site**:** Vibration, percussion or shaking is applied directly over the lateral aspect of the right rib cage.

STRETCHING EXERCISES

It is a therapeutic modality designed to elongate a pathological shortened soft tissue structure to increase flexibility, elasticity and of soft tissue leading to increase range of motion. Stretching is a method of treatment for respiratory diseases which used for correction of bad or maintenance of good posture.

Frequency and time of application:

3-5 times for 10 min or according to tolerance of the patient.

Procedures for applying stretching:

Prior to the initiation of stretching:

- Explain the goals of stretching to the patient.
- Position the patient in a comfortable and stable position that will allow the best plane of motion in which the stretching procedure can be done.
- Explain the procedure to the patient and be certain that he understands.
- Free the area to be stretched from any restrictive clothing.
- Employ relaxation techniques prior to stretching.

During applying stretch:

- Instruct the patient to avoid ballistic stretching.

- Do not attempt to gain full range in one or two treatment sessions. Increasing flexibility is a slow and gradual process.
- In the stretched position, the patient should experience a sense of pulling or tightness of the structures being stretched, but not painful

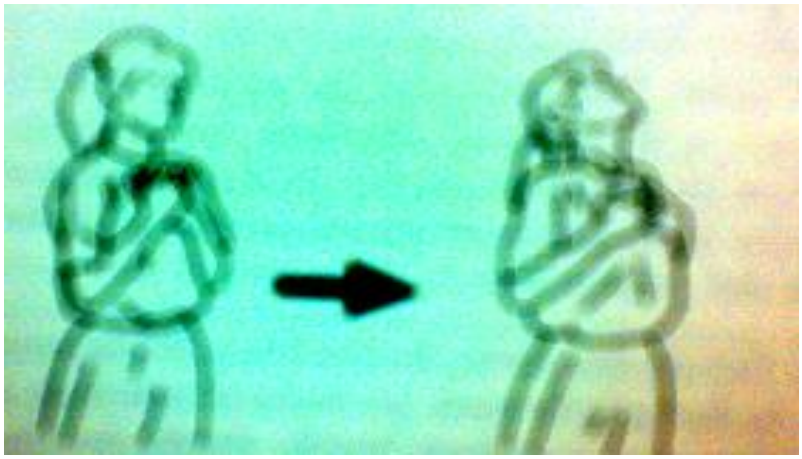
Ways of instructing the patient:

- Perform each pattern five times in sequential order, and then repeat pattern 1 again, this constitute one session.
- Perform one session each in the morning, afternoon, and evening for a total of these three sessions per day.
- If any pattern causes pain, simply by pass that pattern, and perform only the patterns that feel comfortable.

Different ways of stretching chest wall

***Stretching upper chest-wall and neck muscles**:*

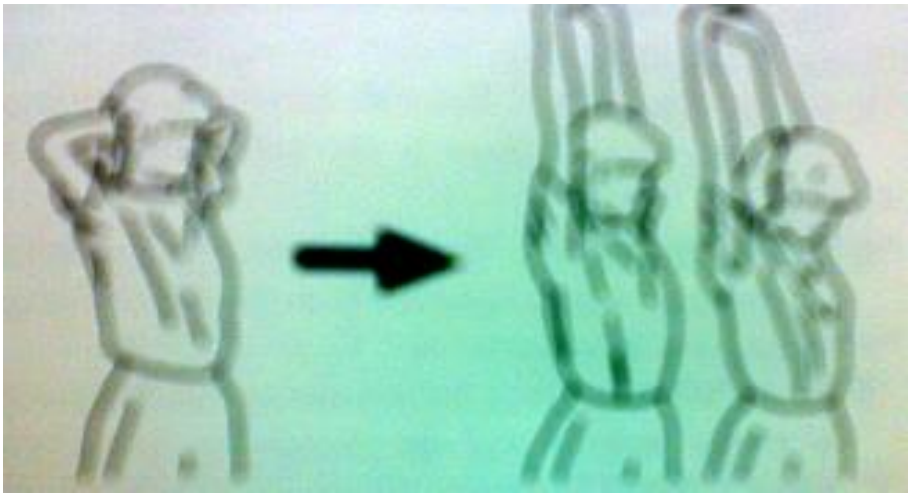
- Patient places his palms on the upper chest and stretch downward without leaning backward.



- Then patient pull the elbows back and the chest down, inhaling deeply, then exhale and relax.
-

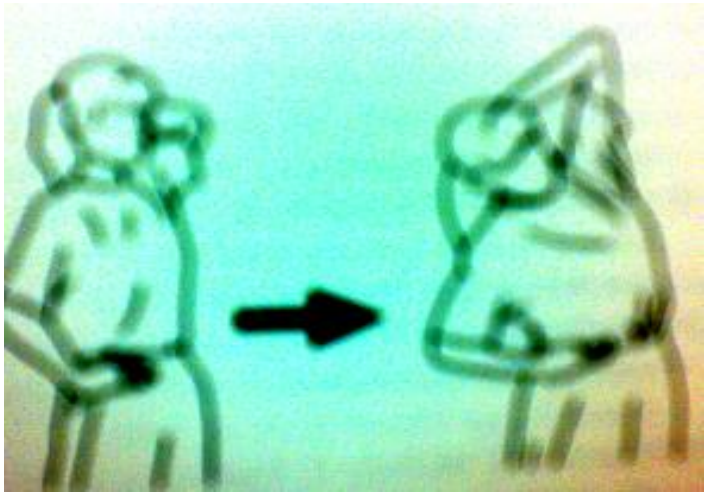
Stretching lower chest wall:

- Patient places both hands on the back of his head.
- After the patient taking a deep breath, turn his palms upward and stretch the arms, breathing out slowly.



Stretching upper torso of the body:

- Patient holds one hand behind the head.
- While exhaling slowly, patient twist and stretch the upper torso to one side of the body, then raising the elbow as high as possible.



***Phalanx stretch position*:**

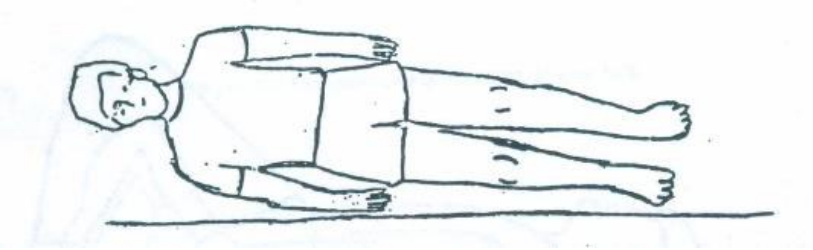
It is for stretching of lateral aspect of chest wall and can be applied from supine, prone, sitting and standing position.

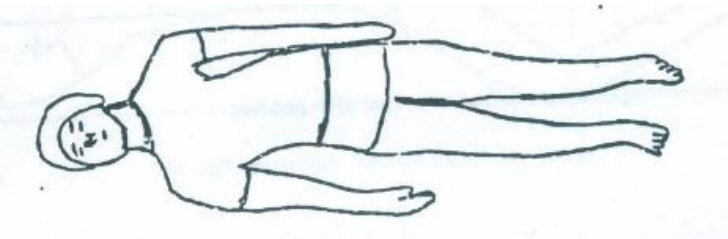
Position of patient**:** supine lying.

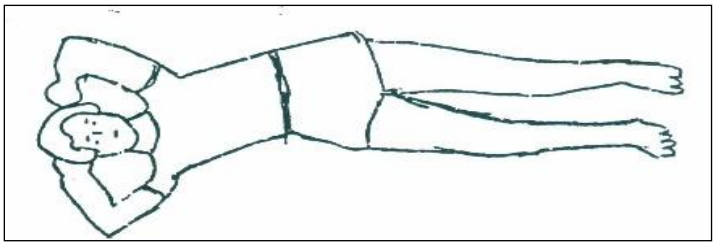
Technique**:** For stretching left side turn trunk to right side.

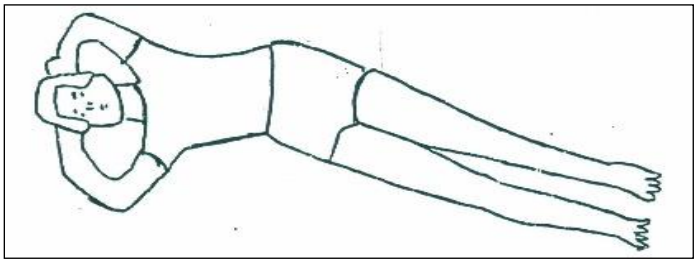
Progression***:***

- Extend the upper limb towards knee on the same side "unaffected".
- Turn the head to the unaffected side.
- Elevate the upper limb over head.
- Cross lower limb towards unaffected side.









***Wring stretch position*:**

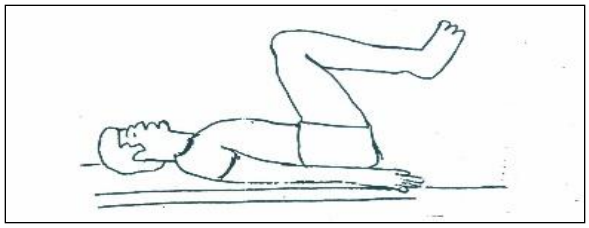
It is for stretching posterior aspect of chest wall due to squeeze action, can be applied from supine lying, sitting and standing position.

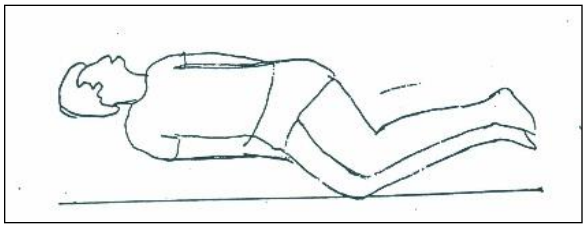
Position of patient**:** Supine lying with lower limbs at 90° hip flexion and 90° knee flexion.

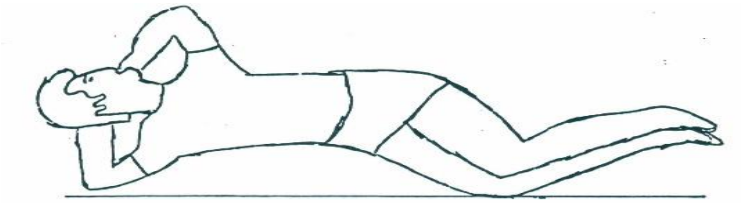
Technique**:** The patient rotates lower limbs to one side with squeezing the trunk. The therapist stabilizes the pelvis and may apply stretch on the chest wall. Upper limb alternates the movement of rotation with lower limb for stretching upper part of the trunk.

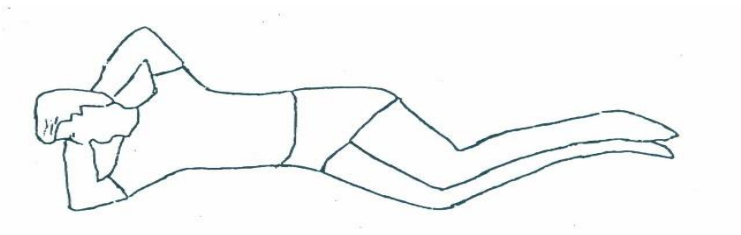
Progression**:**

- The patient puts his hands over head.
- The patient turns his head to the side of rotated lower limb.









***Hip shoulder stretch position*:**

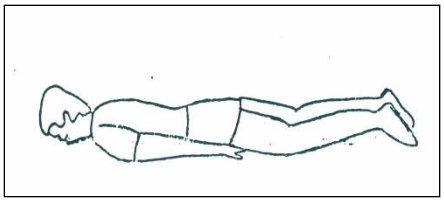
It is for stretching anterior aspect of chest wall as in cases of Kyphosis. It can be applied from prone lying, side lying and standing position.

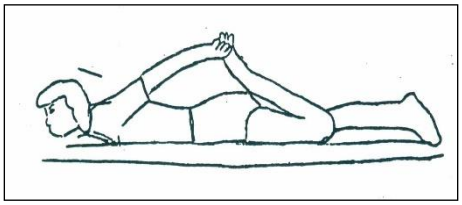
Position of patient: prone lying position.

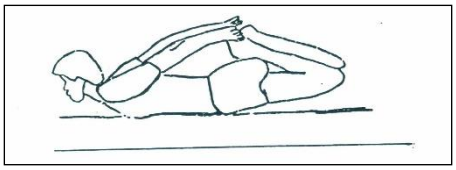
Technique: the patient holds his ankle by his hand of the affected side.

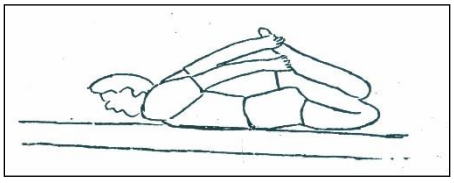
Progression**:**

- The patient holds both ankles by both hands.
- The patient elevates his head and trunk upward









CHEST SELF-MOBILIZATION

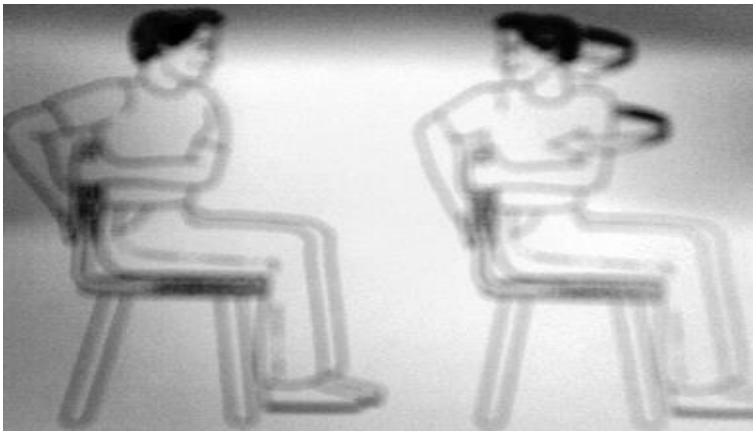
Self mobilization can be performed over the back of a chair, four –point kneel and patient leaning against a wall .Home mobilization exercise will be necessary if the respiratory condition is chronic and long term musculoskeletal dysfunction.

Passive Stretching anterior shoulder muscles & mobilization of thoracic extension.

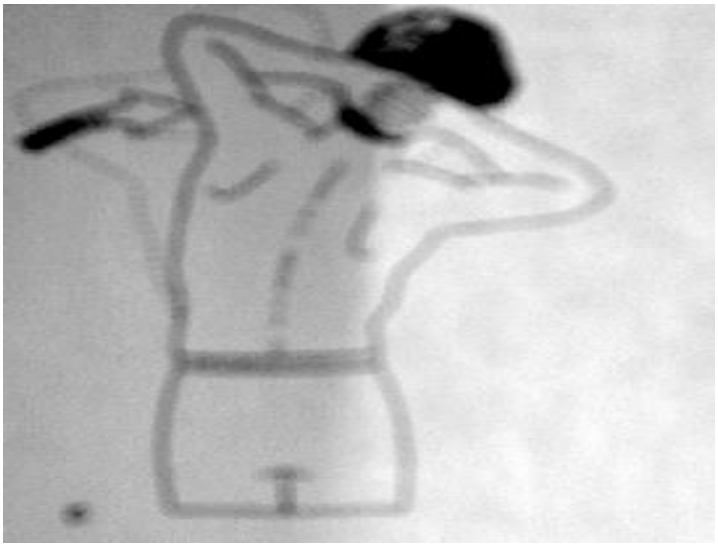
Active assisted stretching for thoracic spine extension

Active assisted stretching

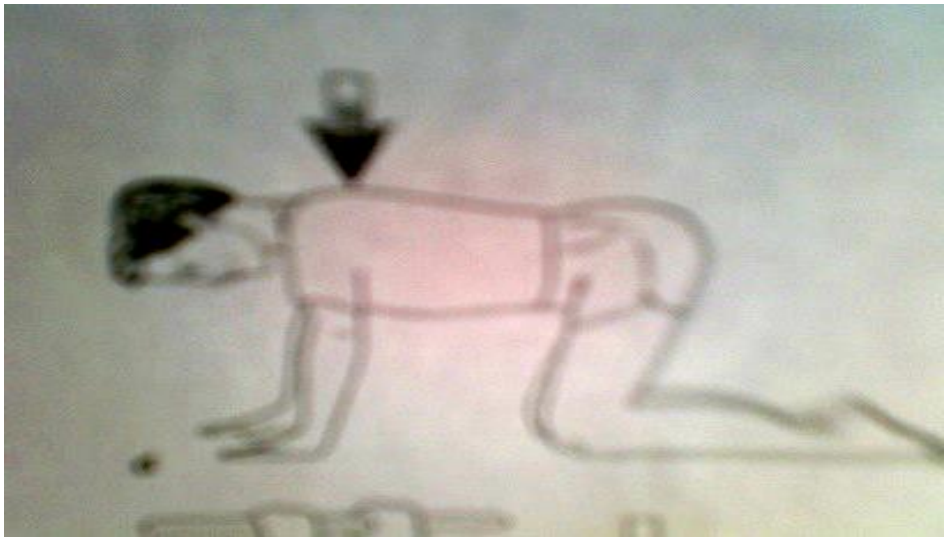
(Rotation of cervical & thoracic spine)



Active exercise for thoracic spine lateral flexion and stretching of the intercostal muscles



Active mobilization for mid thoracic extension



SKIN TRACTION

Definition:

It is a specific manual technique over skin of intercostal spaces to break down adhesions in this area.

N.B.:

Techniques must be applied not painful within patient tolerance and must be not over stretched.

Time of application:

From 10 to 15 minutes.

Frequency:

From 3 to 4 frequencies/minute

Technique:

Position of patient:

Side lying, supine, and prone lying which are a comfortable position for the patient.

Position of therapist:

Stands near to treated area at same level of adhesion area.

Grasp:

We use thumb and middle finger to pick up skin, open, compress, and relax over intercostal spaces obliquely.

N.B.: Hyperaemia should appears at middle area between therapist's fingers at a star shape.

Circulatory exercises

Guidelines of circulatory exercises:

▪Start from distal joints and then to proximal joints.

▪It must be done in rhythm of slow-fast-slow.

▪It must be done in full range of motion.

▪It can be done for both upper and lower limbs.

Circulatory exercises for lower limbs:

▪***Position of patient:***

Supine lying – long sitting with ankle outside of the bed.

▪***Position of the therapist***:

Stride standing beside the bed.

Command:

-Flexion &extension of the toes in one foot, then in other, then both together and finally alternating.

-Abduction of the toes in the same manner.

-All movement of ankle joint (dorsi &planter flexion, eversion &inversion, circumduction, or figure of eight in & out).

-Knee flexion &extension (N.B in case of upper & lower abdominal surgery we use static exercise for quadriceps muscle).

-Hip flexion & extension, abduction & adduction, internal & external rotation.

Circulatory exercises for upper limbs:

▪***Position of patient:***

Supine lying position or long sitting position with ankle outside of the bed.

▪***Position of the therapist:***

Stride standing beside the bed.

Command:

-Flexion &extension of the fingers.

-Abduction & adduction of fingers.

-Wrist flexion & extension, radial & ulnar deviation of the wrist.

-Elbow flexion & extension pronation & supination.

-Shoulder girdle flexion & extension, abduction & adduction, internal & external rotation.

Student activities

Course title: P.T for Cardiothoracic Diseases and its Surgeries. level : Third

Academic year: 2024/2025 - First semester

Student name: …….. ID #:……Lab section #:…….

1. **Attendance**

Lectures														
Practical sections														

2. **Quizzes :**

Quiz 1	**Quiz 2**	**Quiz 3**	**Quiz 4**	**Quiz 5**	**Quiz 6**	**Quiz 7**	**Quiz 8**	**Quiz 9**	**Quiz 10**
Student average mark									

2. Practical assignment:

……..

3. Teamwork research assignment

…….

Student total mark	

Lab section demonstrator **lecturer of the course**

…… **…….**