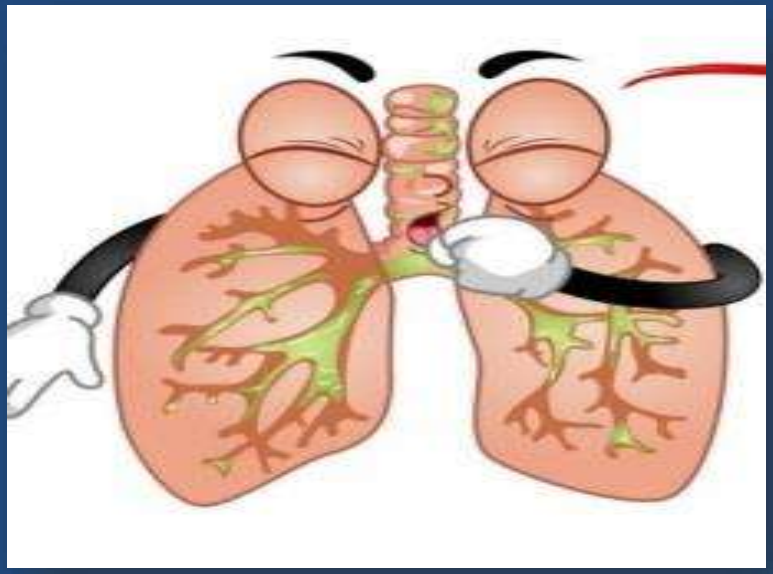
BREATHING EXERCISES, SECRETION CLEARING TECHNIQUES AND AIDS



Dr. HINA VAISH (PT)

AIRWAY CLEARANCE TECHNIQUE

- Postural drainage
- Percussion
- Vibration/shaking
- Manual hyperinflation
- Active cycle of breathing technique
- Autogenic drainage
- Positive expiratory pressure
- High frequency chest compression
- Exercises for airway clearance

Why it is important to remove secretions??????

- Enhance gas exchange
- Improved ventilation-perfusion matching
- Reduce the work of breathing.
- Normalization of the functional residual capacity.

Postural Drainage (Bronchial Drainage)

- Passive technique
- Patient is positioned in gravity assisted position that allow broncho-pulmonary tree to be drained

Indications of postural drainage

- To Prevent accumulation of secretions in patients who are at risk for pulmonary complications. This may include:

✓ Patients with pulmonary diseases that are associated with increased production or viscosity of mucus, such as chronic bronchitis and cystic fibrosis.

✓ Patients who are on prolonged bed rest.

- To Remove secretions already accumulated in the lungs of

✓ Patients with acute or chronic lung disease, such as pneumonia, Atelectasis, acute lung infections, and COPD.

✓ Patients who are generally very weak or are elderly.

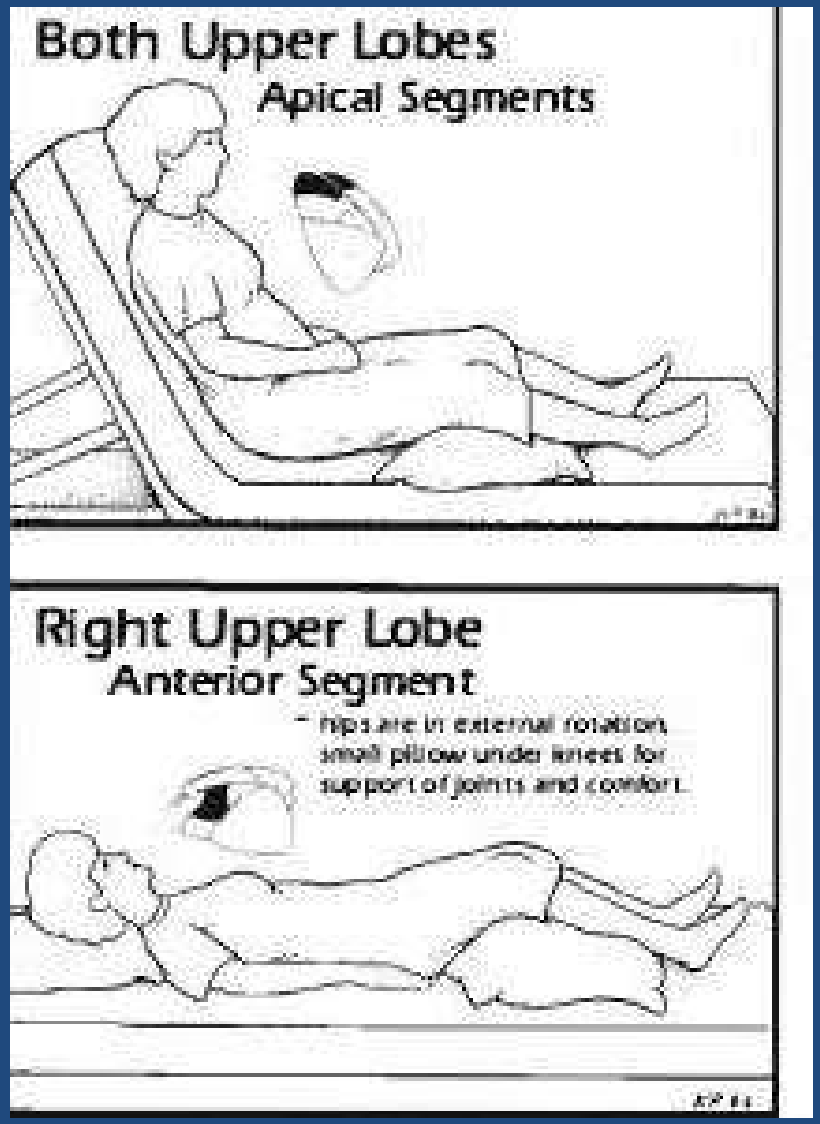
✓ Post surgical patients who have received general anesthesia and who may have painful incisions that restrict deep breathing and coughing postoperatively.

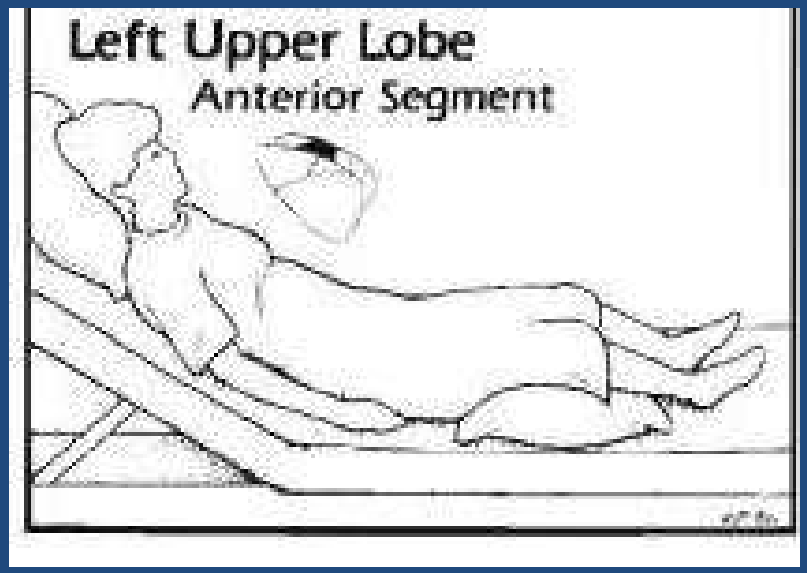
✓ Any patient who is on a ventilator if they are stable enough to tolerate the treatment.

ASSESMENT

- Excessive sputum production
- Effectiveness of cough
- History of pulmonary problems treated successfully with PDT (eg, bronchiectasis, cystic fibrosis, lung abscess)
- Decreased breath sounds or Crackles or rhonchi suggesting Secretions in the airway
- Change in vital signs
- Abnormal chest x-ray consistent with atelectasis, mucus plugging, or infiltrates
- Deterioration in arterial blood gas
- Values of oxygen saturation

Postural Drainage Positions





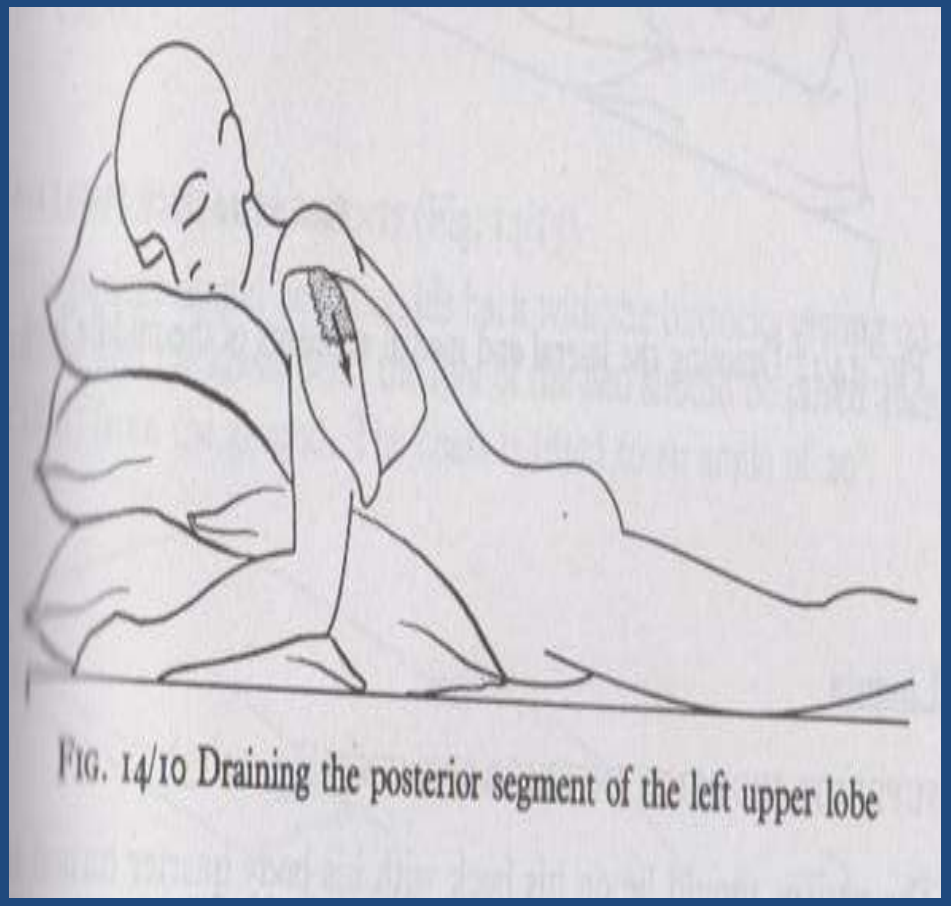
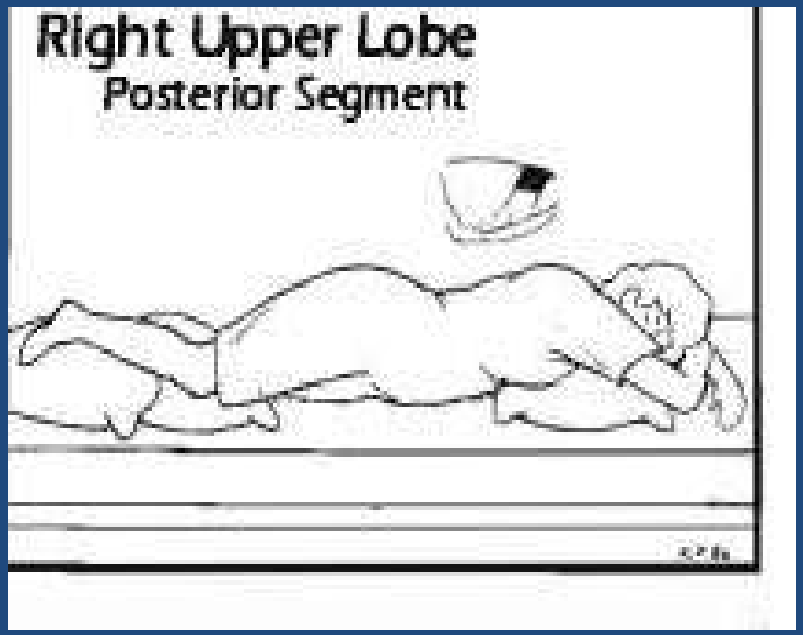
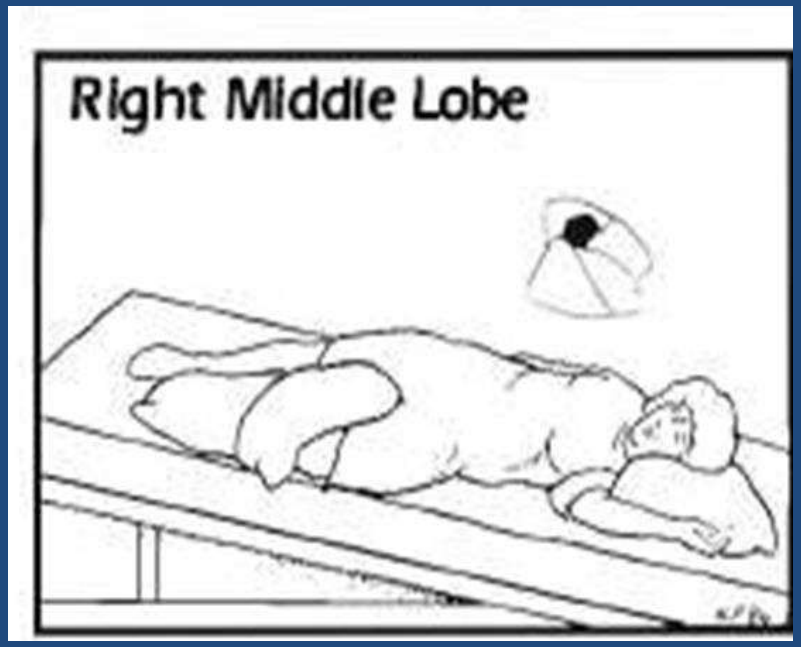


FIG. 14/10 Draining the posterior segment of the left upper lobe


Right Upper Lobe
Posterior Segment



15°.

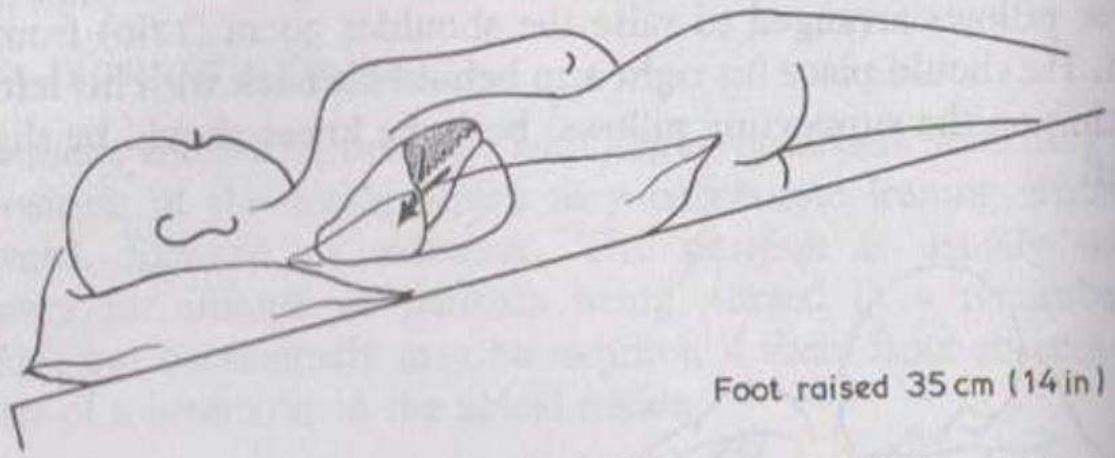


FIG. 14/12 Draining the lateral and medial segments of the middle lobe

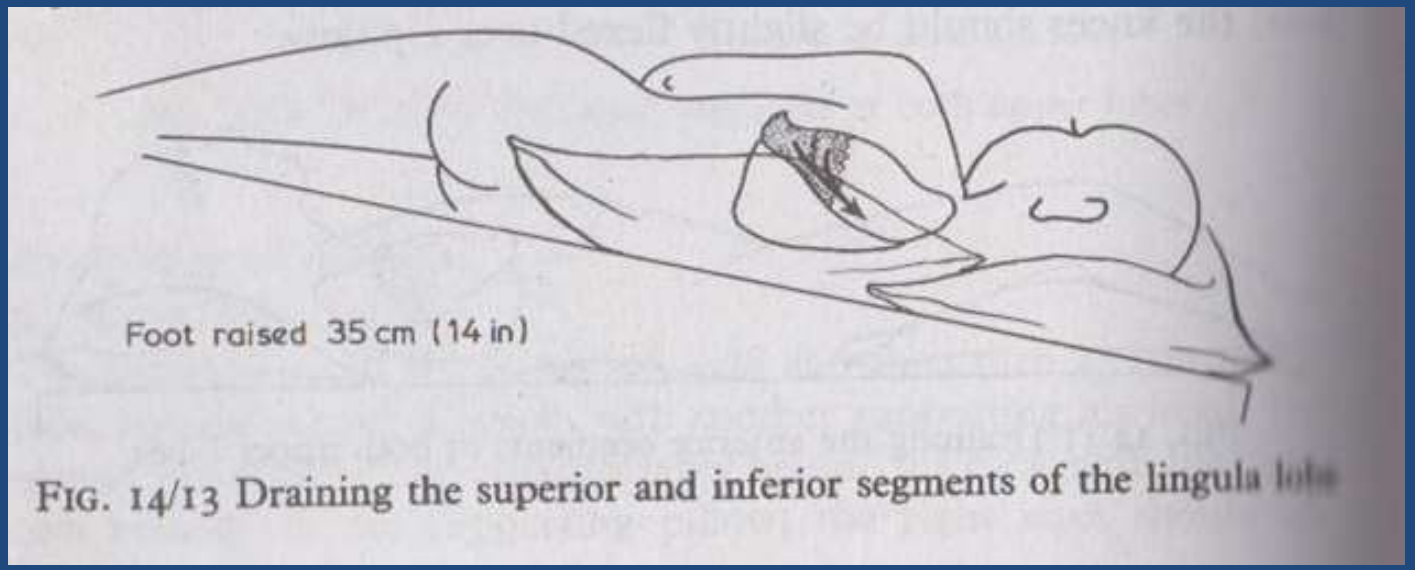
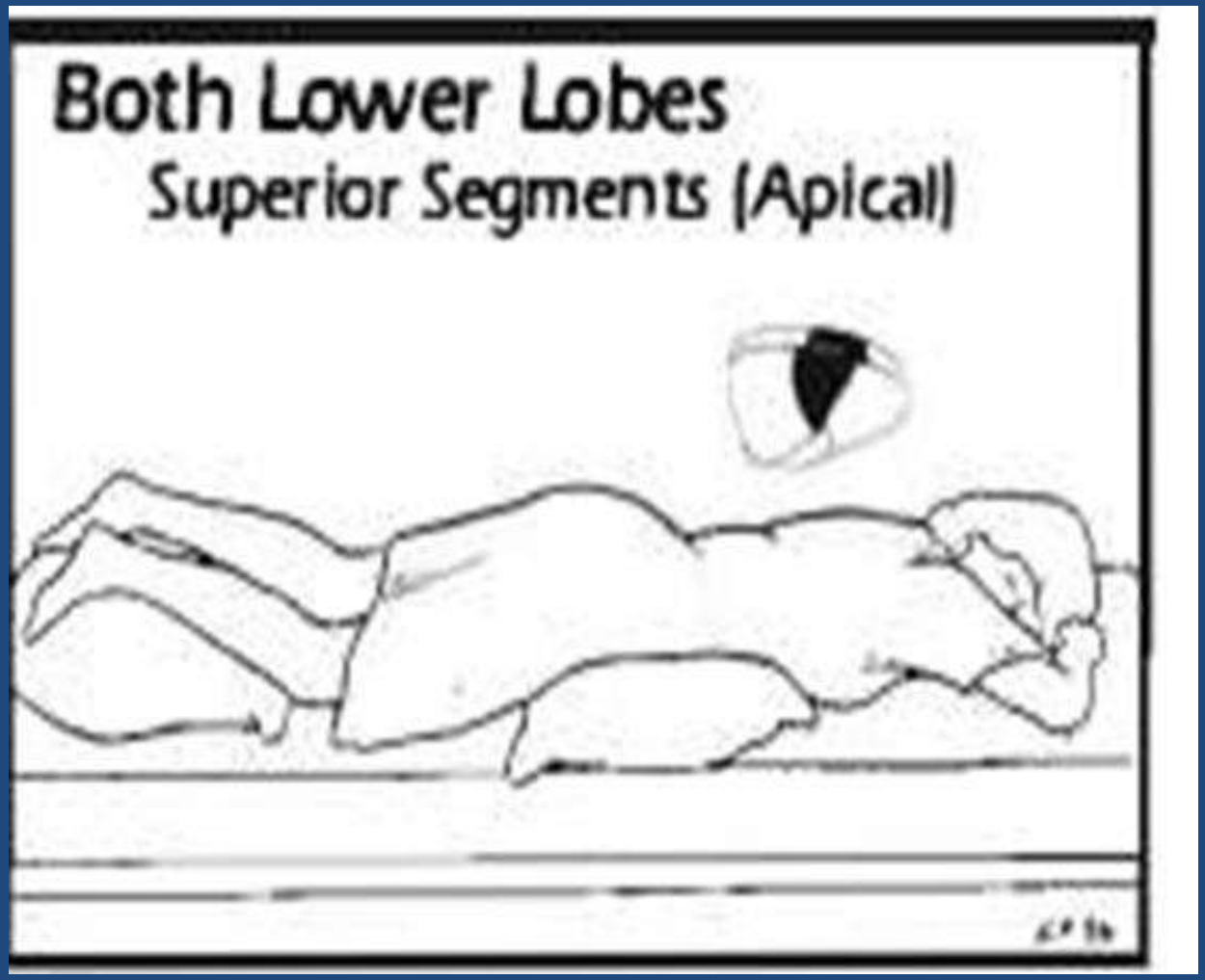
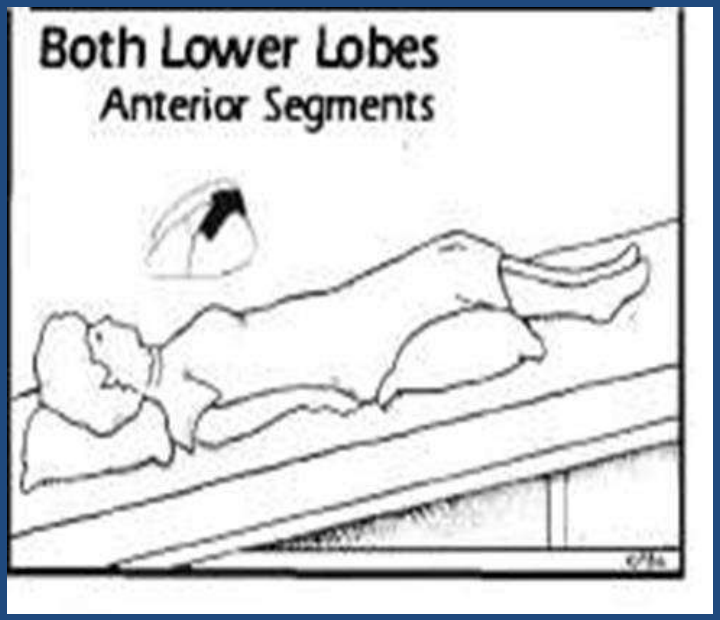


FIG. 14/13 Draining the superior and inferior segments of the lingula lobe


Both Lower Lobes
Superior Segments (Apical)



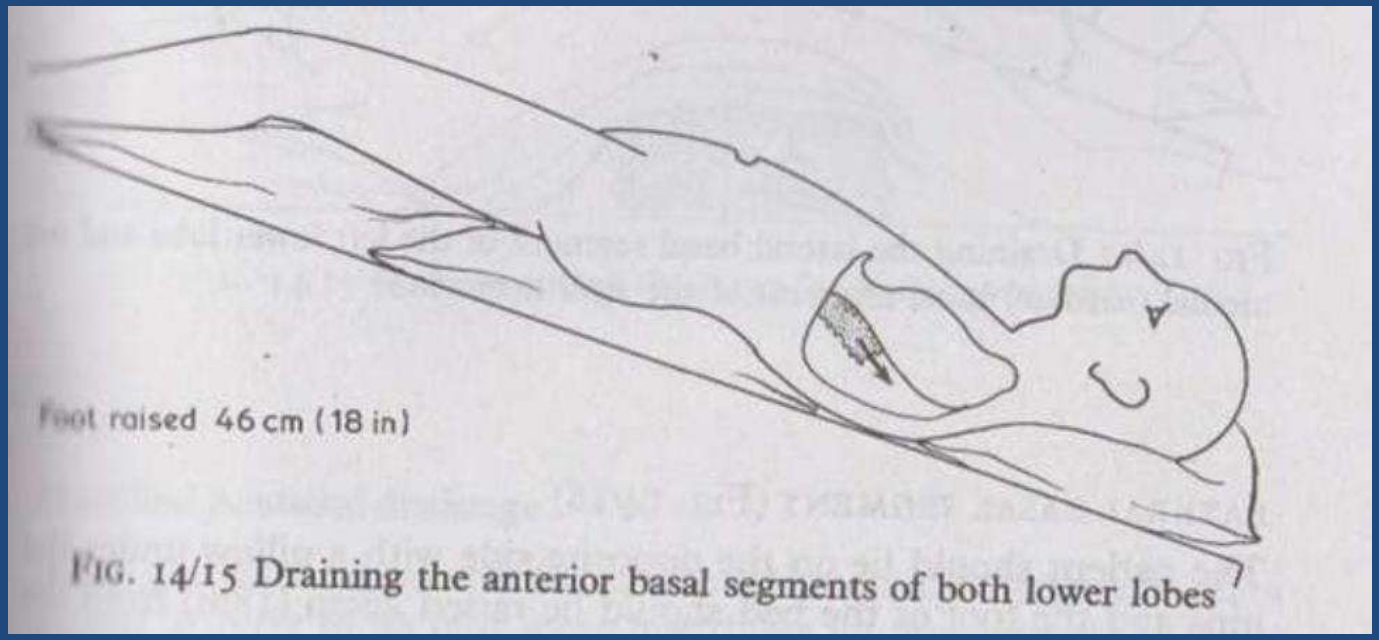
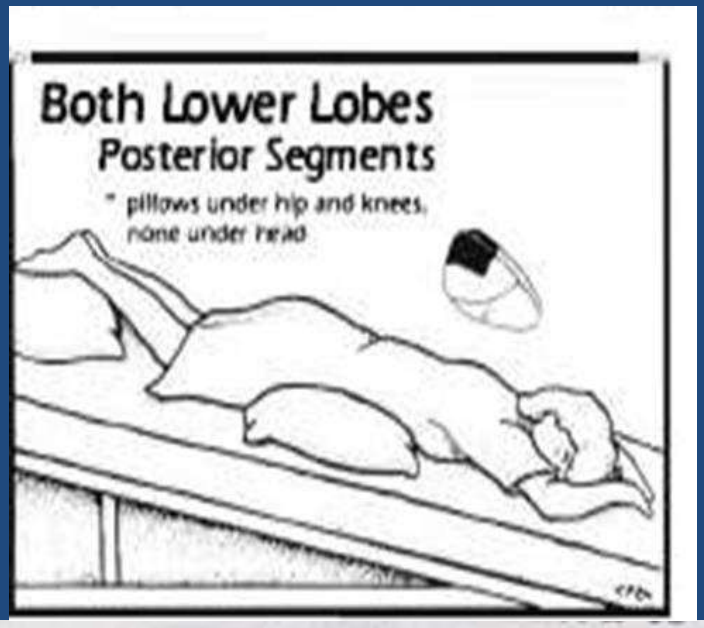


FIG. 14/15 Draining the anterior basal segments of both lower lobes



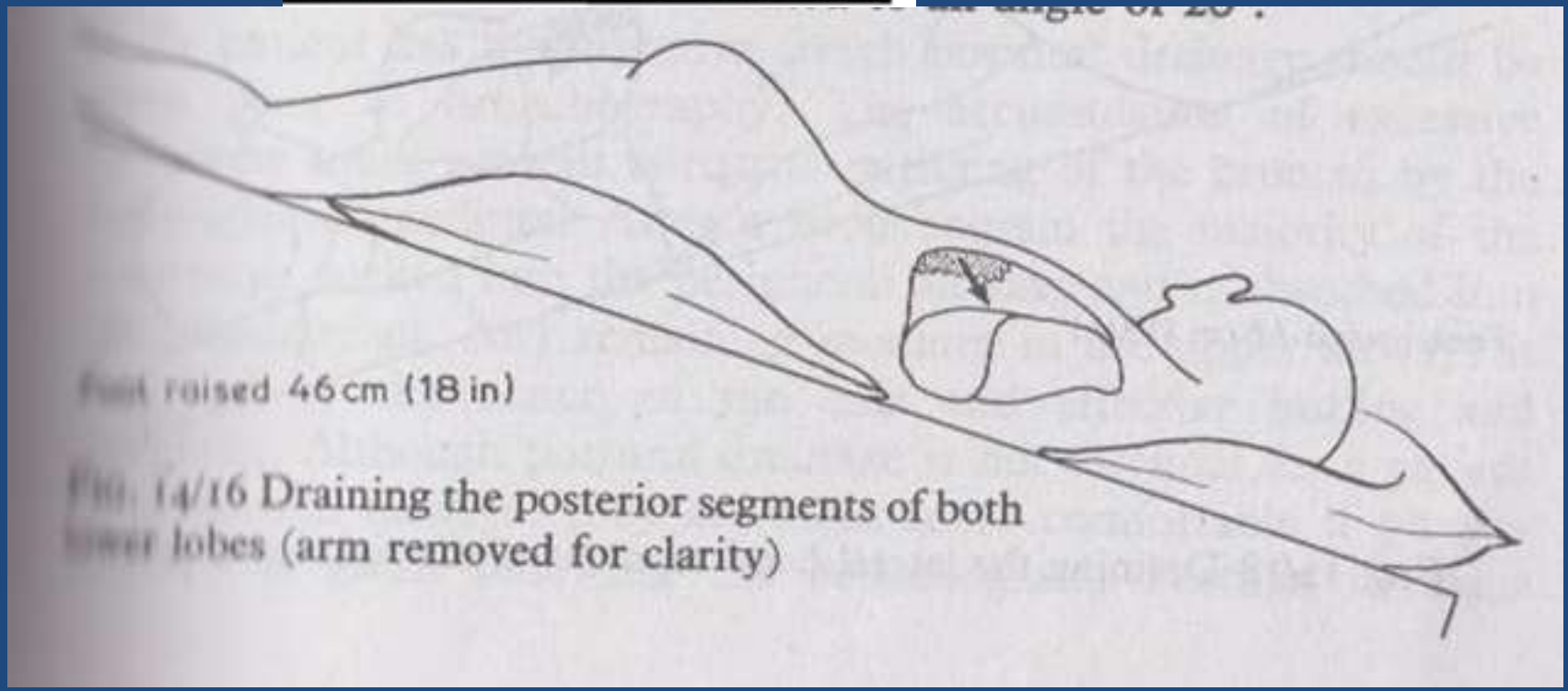
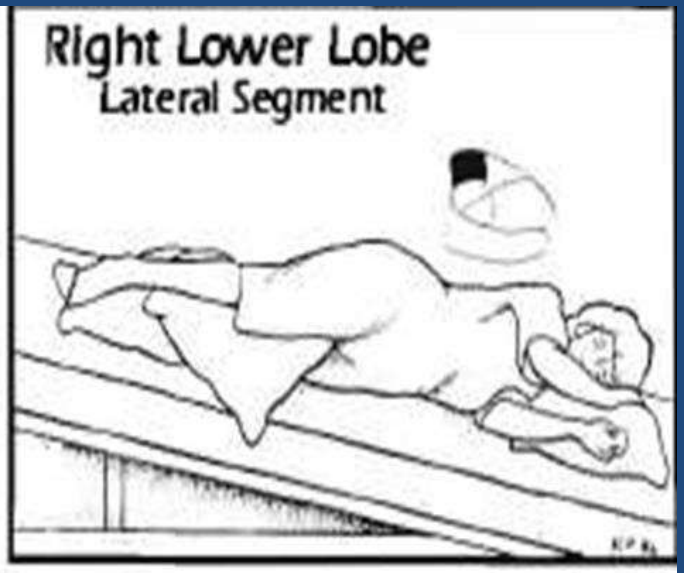
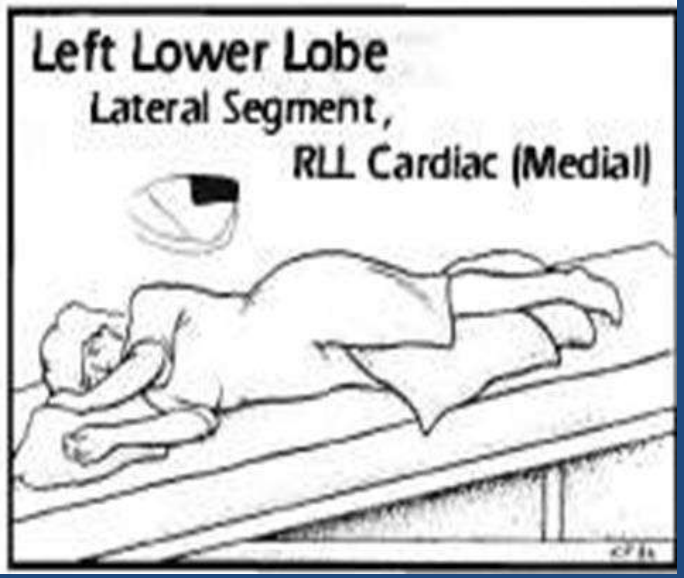


Fig. 14/16 Draining the posterior segments of both lower lobes (arm removed for clarity)





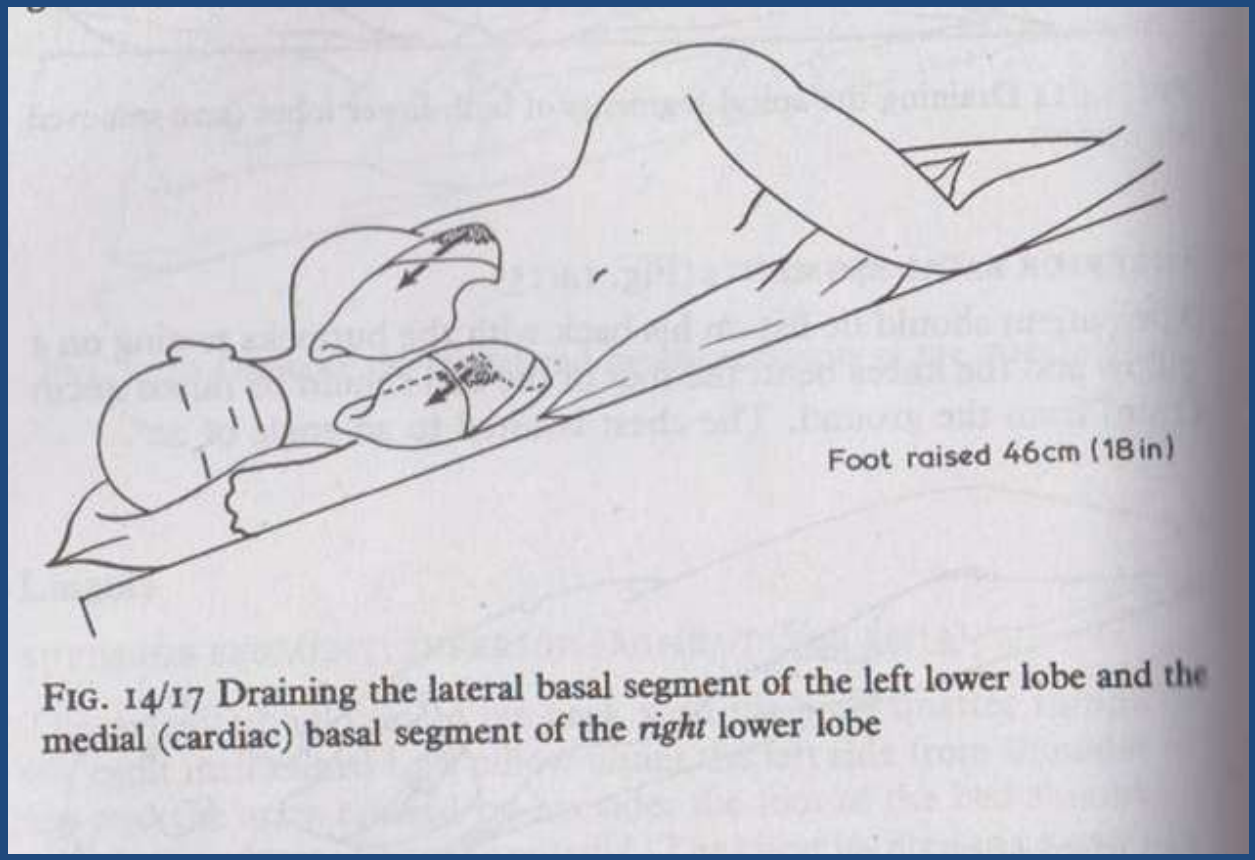
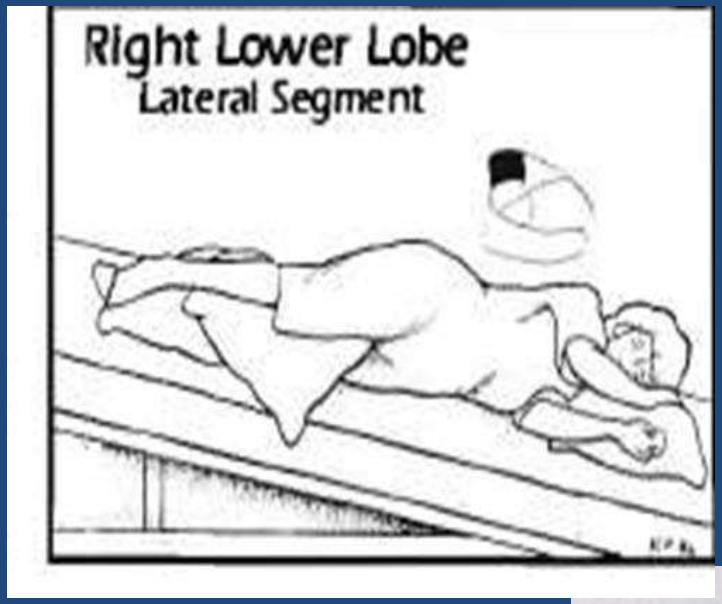


FIG. 14/17 Draining the lateral basal segment of the left lower lobe and the medial (cardiac) basal segment of the *right* lower lobe



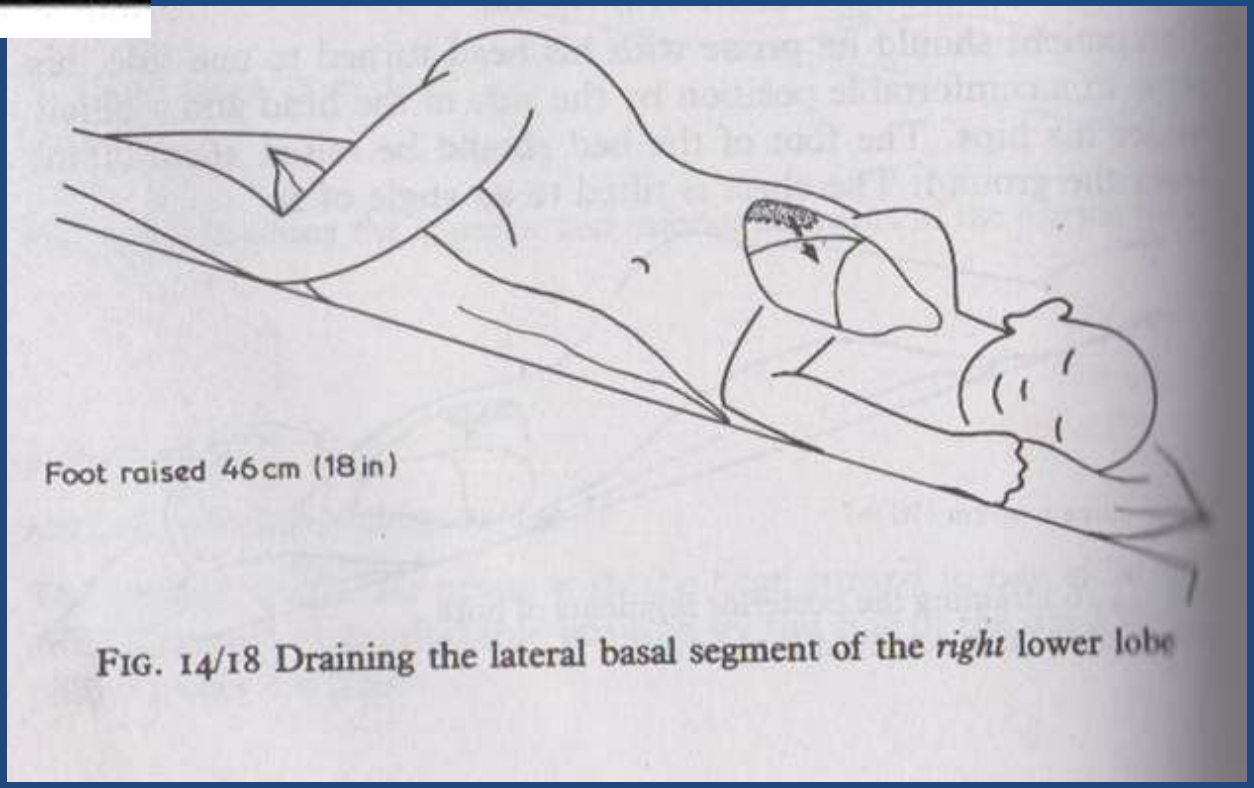


FIG. 14/18 Draining the lateral basal segment of the *right* lower lobe

Contraindications for Postural Drainage

All positions contraindicated for the following

- ICP > 20mmHG
- Head and neck injury until stabilized
- Active hemorrhage with hemodynamic instability
- Recent Spinal Surgery (laminectomy) or acute spinal surgery
- Active haemoptysis
- Empyema
- Bronchopleural fistula
- Pulmonary oedema associated with CHF
- Large pleural effusions
- Pulmonary embolism
- Aged, confused or anxious patients
- Rib fracture with or without flail chest
- Surgical wound or healing tissues

Trelendenberg position is contraindicated for the following

- Patient in whom increased ICP is to avoided (eg, neurosurgery, aneurysms, eye surgery)
- Uncontrolled Hypertension
- Distended abdomen
- Esophageal surgery
- Recent gross haemoptysis related to recent lung carcinoma
- Uncontrolled airway at risk for aspiration
- Reverse Trendelenburg is contraindicated in the presence of hypotension

INDICATION FOR EXTERNAL MANIPULATION

- Sputum volume or consistency suggesting a need for additional manipulation

Contraindications to External manipulation of thorax

In addition to contraindication to postural drainage

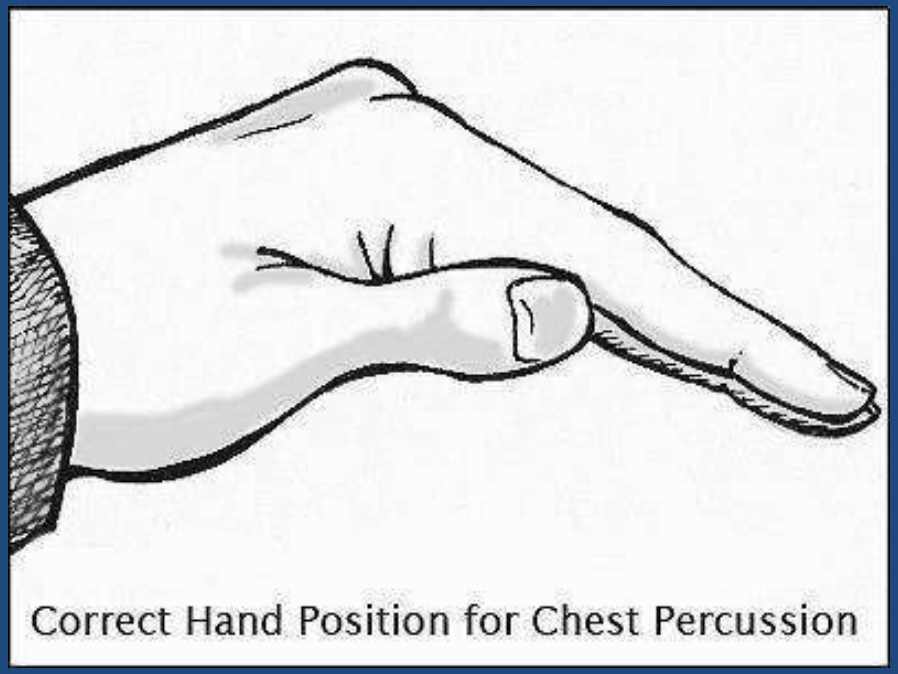
- Osteoporosis
- Coagulopathy
- Osteomyelitis of ribs
- Complaint of chest wall pain
- Bronchospasm
- Suspected pulmonary tuberculosis
- Recently placed pacemaker
- Burns, open wounds and skin infections of thorax
- Recent skin grafts or flaps on the thorax
- Recent epidural spinal infusion or spinal anaesthesia
- Subcutaneous emphysema
- Lung contusion

Percussion (Chest clapping)

- Rhythmical force is applied with cupped hands to the patients thorax over the involved lung segments with the aim of dislodging or loosening secretions.
- The technique is performed with patient in postural drainage position
- The effectiveness of mechanical versus manual percussion has been studied and they are equally beneficial. (Maxwell and Redmond 1979)
- Performed during both inspiratory & expiratory phase of breathing.

- Aim – dislodging or loosening bronchial secretions from airways.
- Mechanism – transmission of wave of energy through chest wall to lungs – wave loosens secretions from bronchial wall – moves them proximally – removal of secretions.
- Pediatrics – use padded rubber nipple, pediatric face mask, padded medicine cups, bell of stethoscope, thenar & hypothenar surface of hand
- Use towel or patient's gown to cover skin.

- Sound of percussion should be hollow.
- Even & steady rhythm – 100 – 480 times/min.
- Force should be equal B/L & to the patient's comfort.
- Should not be done on bony prominences, breast tissue – discomfort & reduce effectiveness of treatment.
- Not tolerated by many post-operatively without adequate pain control.



Correct Hand Position for Chest Percussion

Contraindication to percussion

- Over #
- Osteoporotic bone
- Spinal fusion
- Over tumor area
- Pulmonary embolus
- Condition in which hemorrhage could easily occur (low platelet count ,anticoagulation therapy)
- Patient with unstable angina
- Case of chest wall pain

Vibration

- Sustained co-contraction of upper extremities of a caregiver to produce a vibratory force that is transmitted to the thorax over the involved lung segment.
- Vibration is applied throughout exhalation with mild compression to the chest wall.
- Frequency: 12-20Hz

Position for vibration

Shaking (Rib springing)

- It consists of bouncing maneuver against the thoracic wall in a rhythmic fashion through out the exhalation.
- A concurrent pressure is given to the chest wall compressing the thorax.
- Can be used in PD position
- Frequency 2Hz

Manual hyperinflation

- Use the bag to hyperinflate the lung, then an inspiratory pause followed by quick exhalation.

K Stiller, T Geake, J Taylor, R Grant and B Hall. Acute lobar atelectasis. A comparison of two chest physiotherapy regimens Chest 1990;98;1336-1340

Indications

- To aid removal of secretions
- To aid reinflation of atelectatic segments

Technique

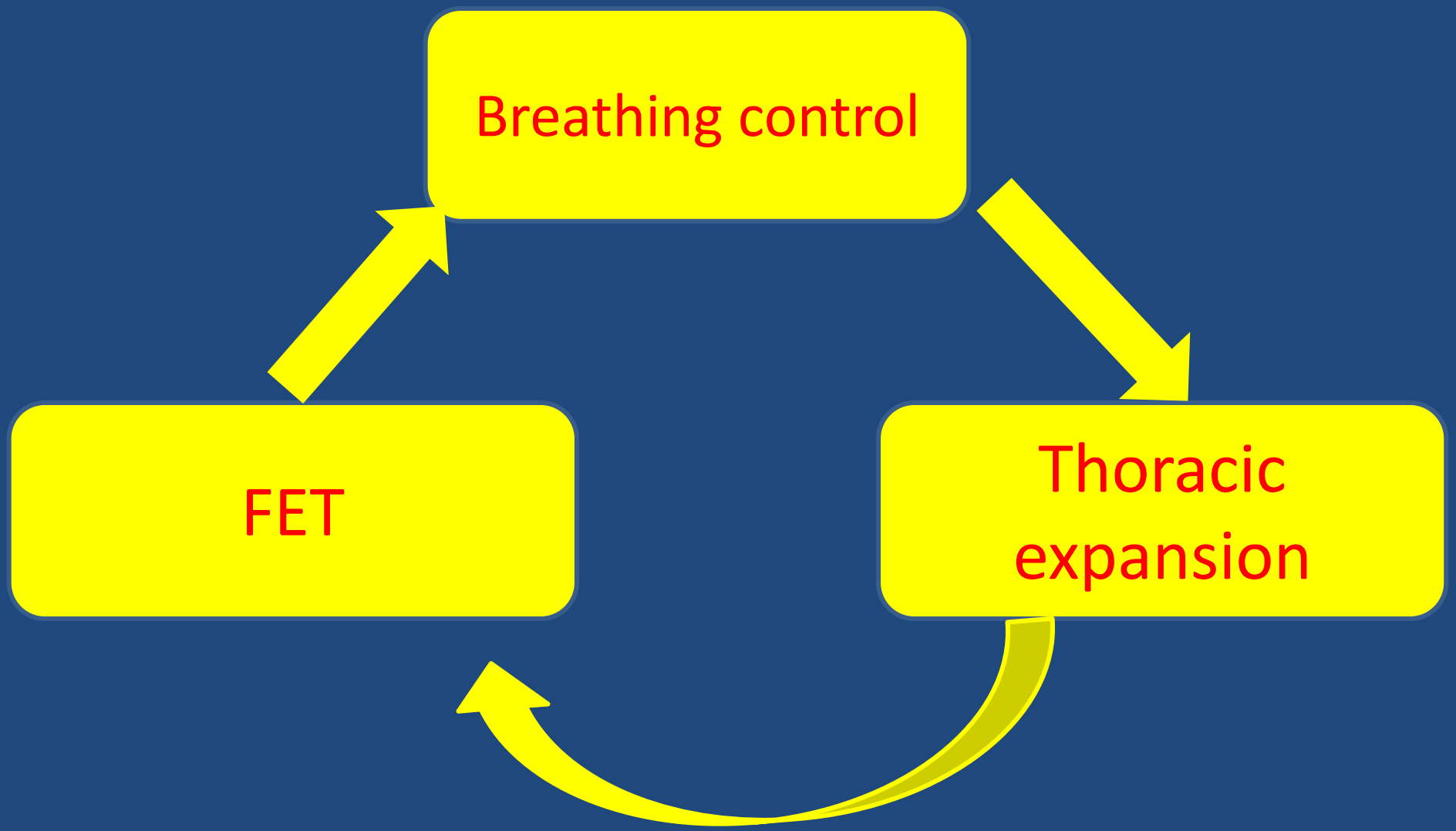
- Slow deep inspiration
- Inspiratory hold (at full inspiration)
- Fast expiratory release

Contraindications

- Undrained Pnuemothorax
- Potential bronchospasm
- Severe bronchospasm
- Gross cardiovascular instability inducing arrhythmias and hypovolaemia
- Unexplained Haemoptysis
- Patient on High PEEP

Manual Hyper inflation

ACBT



AUTOGENIC DRAINAGE

- Autogenic drainage is a technique that utilizes controlled expiratory airflow during tidal breathing to mobilize secretions in the peripheral airways and move them centrally.
- Autogenic drainage consists of the following three phases:

  (1) “unsticking” the mucus in the smaller airways by breathing at low lung volumes

  (2)“Collecting” the mucus from the intermediate-sized airways by breathing at low to middle lung volumes;

  (3) “evacuating” the mucus from the central airways by breathing at middle to high lung volumes.
- The individual then coughs or huffs to expectorate the mucus from the large airways.
- The advantage of autogenic drainage over postural drainage is that it can be performed in the seated position without the assistance of a caregiver.

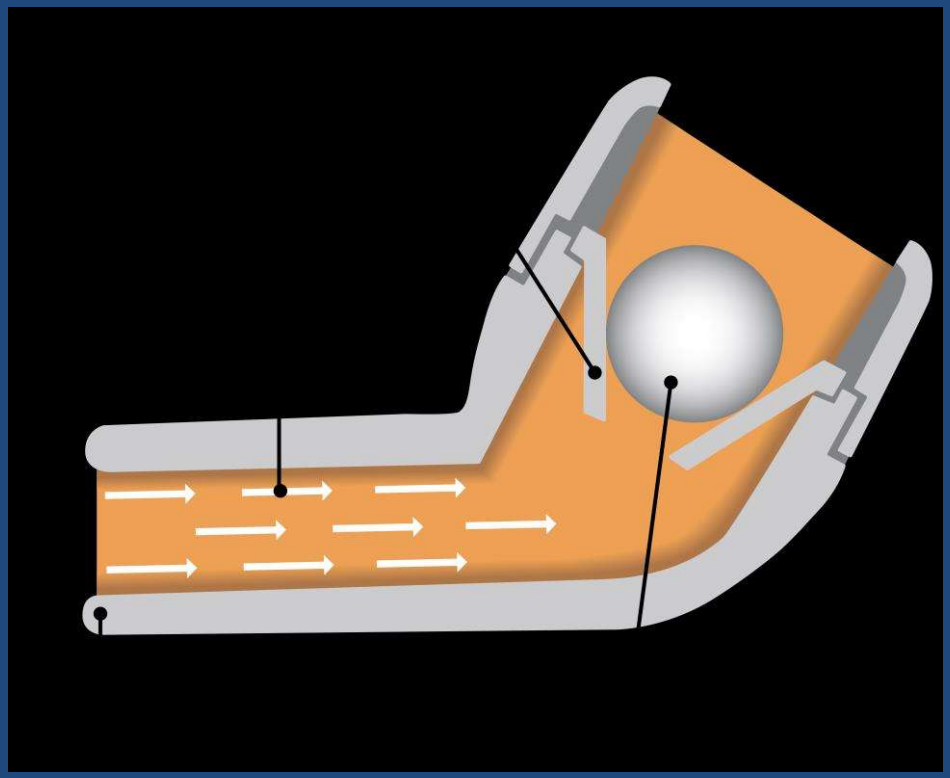
Devices

- *PEP*
- The administration of PEP from 5 to 20 cm H2O delivered by facemask is believed to improve mucus clearance by either increasing gas pressure behind secretions through collateral ventilation or by preventing airway collapse during expiration

- *Oscillatory Devices (Flutter, Intrapulmonary Percussive Ventilation, High-Frequency Chest Wall Oscillation)*
- High-frequency oscillations can be applied either through the mouth or chest wall causing the airways to vibrate, thereby mobilizing pulmonary secretions. These devices can be used with the patient seated or supine.
- The “flutter” device (Varioraw SARL; Scandipharm Inc; Birmingham, AL) is a plastic pipe with a mouthpiece at one
- Within the device, a high-density stainless steel ballend and a perforated cover at the other end to the chest wall has been referred to as either *high-frequency chest compression* or *high-frequency chest wall oscillation*.

OSCILLATORY DEVICES

Flutter



Acapella

HFCC

COUGHING

- Forceful expiration against closed glottis (Linder 1993)

- Stages
- Adequate Inspiration
- Glottal Clossure
- Building up of Intrathoracic and intra abdominal prsssure
- Glottal opening and expulsion

FET

- The forced expiratory technique (also called *huffing*) was introduced as an alternative to cough. This maneuver consists of one or two forced expirations without closure of the glottis starting from mid-lung to low lung volume, followed by relaxed breathing.
- Because the intrapulmonary pressures during FET are lower than with those with cough, the FET may lead to less airway compression and better sputum clearance.

- Huffing and coughing (splinted)

Manually assisted coughing

Paradoxical outward motion of the abdomen during cough may occur in individuals with neuromuscular weakness or structural defects of the abdominal wall, and this paradoxical motion contributes to cough inefficiency. Reducing this paradox either by manually compressing the lower thorax and abdomen or by binding the abdomen should theoretically improve cough efficiency.

Manually assisted coughing

Costrophrenic assist

Heimlich manuever

Suctioning

- Suctioning is the mechanical aspiration of pulmonary secretions from a patient

Indications

- Inability to cough effectively
- Sputum plugging
- To assess tube patency

Bonde et al, 2002.Sputum retention after lung operation:Prospective randomised trial shows superiority of mini tracheostomy in high risk patients. Annals of Thoracic Surgery74:196-203

Contraindication

- Frank haemoptysis
- Severe brochospasm
- Undrained pneumothorax
- Compromised cardiovascular system

Precautions

- The suction catheter used must be less than half the diameter of endotracheal tube.
- The vacuum pressure should be as low as possible. (-60 to -
- 150mmHg)
- Suction should never be routine, only when there is an Indication
- Hyperventilate and hyper-oxygenate the patient before suctioning

Hazards of Suctioning

- Mucosal trauma
- Cardiac arrhythmias
- Hypoxia
- Raised intracranial pressure

Routes

- Nasal and oral suction
- Endotracheal suction
- Tracheostomy suction

Pressures Used in suctioning

- Adult -100 to -120 mm Hg
- Child - 80 to -100 mm Hg
- Infant -60 to -80 mm Hg

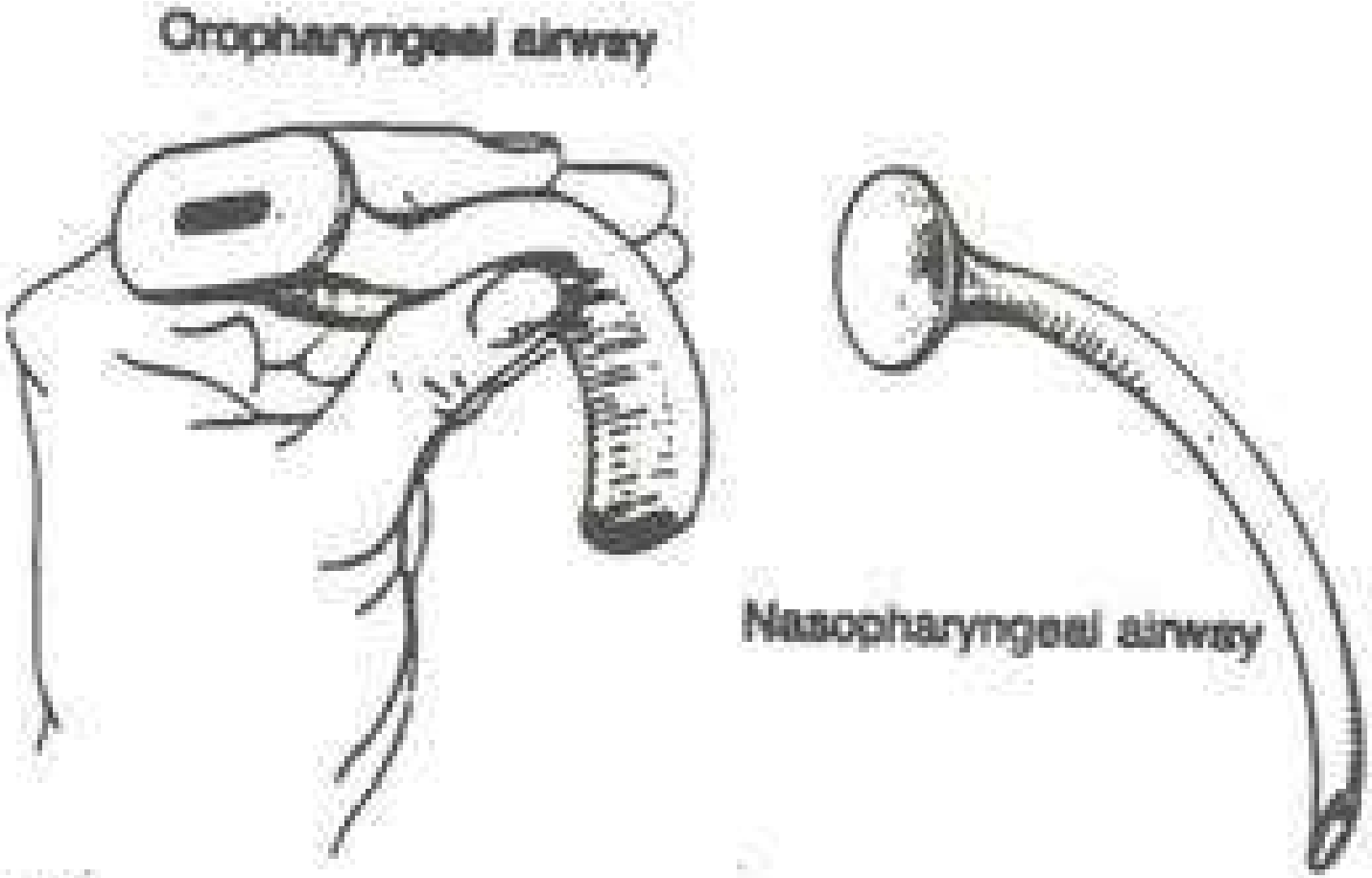
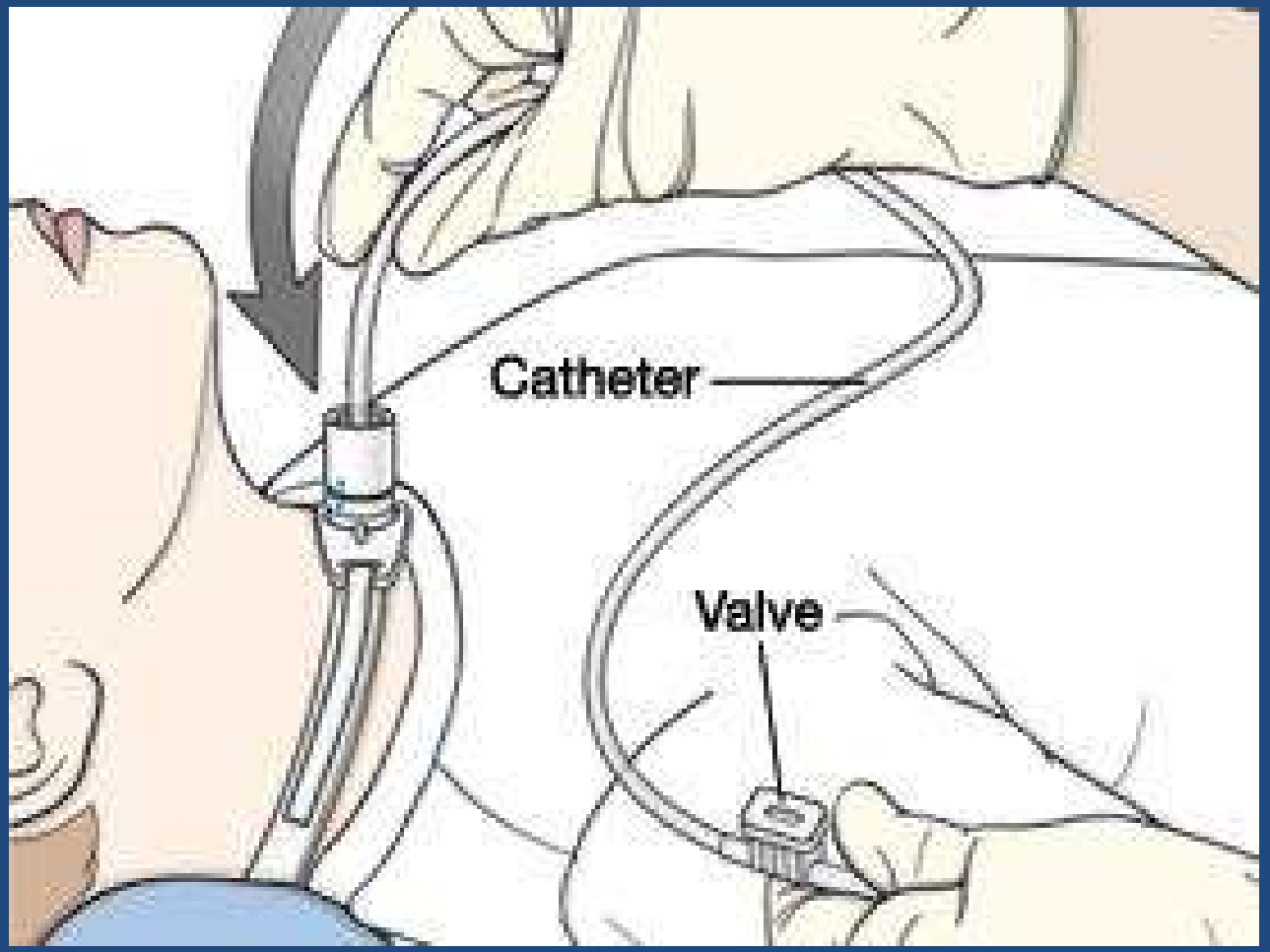


Figure 1


1600
1500
1400
1300
1100
1000

Endotracheal suctioning



Tracheostomy suctioning

TECHNIQUE TO FACILIATE VENTILATION PATTERN

- Body positioning
- Breathing technique
- Mobilizing the thorax
- Facilitating the accessory muscles of respiration

Positioning

- Physiological Effects of Positioning
- Optimizes oxygen transport by improving V/Q mismatch
- Increases lung volumes
- Reduces the work of breathing
- Minimizes the work of heart
- Enhances mucociliary clearance (postural drainage)

- **Positioning.**
  - Body positioning is a potent therapeutic intervention that promotes oxygen transport and gas exchange in two ways:one froM the physiological benefit accrued from specific position themselves and other from physiological benefit accrued from changing from one position to another.
  - **For unilateral lung pathology: Sidelying position with good lung down**
  - **For bilateral lung pathology: Right sidelying position**

Benedetti F, Amanzio M, Casadio C, et al:Control of postoperative pain by transcutaneous electrical nerve stimulation after thoracic operations :Journal of Cardiothoracic and Vascular Anesthesia. 12; 4:August 1998, 492
Dean E. Effect of Body Position on Pulmonary Function .Physical Therapy May 1985; 65: 5 613-618

DIAPHRAGMATIC FACILITATION TECHNIQES

- Relaxing
- Repatterning
- Sniffing
- Diaphragmatic scoop

Breathing Exercises

- Breathing Control
- Treatment should start with breathing control
- It is a normal tidal breathing to promote relaxation & prevent hyperventilation
- While teaching expiration should be controlled but not forceful

DIAPHRAGMATIC BREATHING

- For relaxation & coordinated breathing pattern
- Greater tidal volume is achieved with Diaphragmatic breathing and improve overall ventilation

Pursed Lip Breathing

- Benefits- increase tidal volume, decrease RR, decrease PaCO2 level, increase PaO2

- Procedure
- Have a patient assume a comfortable position and relax as much as possible
- Explain to the patient that expiration must be relaxed and that contraction of the abdominal must be avoided.
- Place your hand over the patients abdominal muscle to detect any contraction of abdominals
- Patient to breathe in slowly and deeply and then patient loosely purse the lips and exhale.

Glossopharyngeal Breathing

- Glossopharyngeal breathing is a means of increasing a patients inspiratory capacity when there is severe muscle weakness of inspiratory muscle

procedure

- Mouth open to draw in air
- then mouth is closed and tongue pushes the air back and traps in pharynx
- The air is then forced into lungs when glottis is opened
- This increase the depth of the inspiration and patient vital capacity
- Contradiction for this technique is tmj disorder

SEGMENTAL BREATHING