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Department of surgical diseases No. 2

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DISEASES OF LUNGS AND PLEURA

Textbook for students of 4 courses medical faculty of faculty surgery

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This teaching guide covers main issues about etiology, pathogenesis, clinical features, laboratory and instrumental diagnostics and complications of Diseases of lungs and pleura.

Teaching guide “Diseases of lungs and pleura” is made for “Faculty surgery” discipline in accordance with requirements of FSES HE, and is intended for students from medical universities and faculties, studying for specialty 31.05.01 General medicine.

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CONTENTS

PULMONARY INJURIES.....	4
PNEUMOTHORAX.....	5
HEMOTHORAX.....	7
INTERCOSTAL CHEST TUBE (ICT) INSERT.....	9
SURGICAL EMPHYSEMA.....	12
EMPYEMA.....	15
BRONCHOPLEURAL FISTULA.....	17

PULMONARY INJURIES
CONTUSION OF THE LUNG

- Deceleration injuries or crush trauma often produces extensive parenchymal damage. Haemorrhage and interstitial oedema result in obliteration of alveolar spaces and consolidation of large areas of pulmonary tissue.

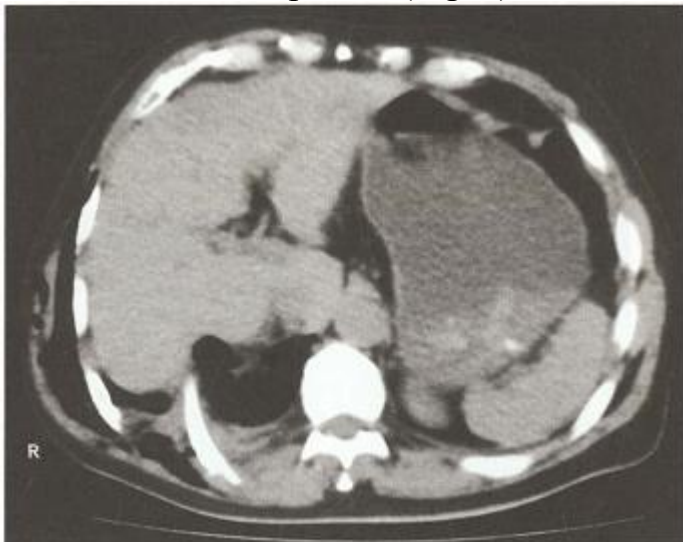
- Contusion of the lung can be unilateral or bilateral. The contusion can be in the form of a small area of damage with oedema and extravasation of the blood, or it may be widespread damage. Haemoptysis and excessive tracheobronchial secretions give the clue to the diagnosis.

PULMONARY INJURIES

- Contusion
- Pneumothorax/haemothorax
- Laceration
- Chest wall injuries

- Chest X-ray: Early patchy consolidation. It must be differentiated from adult respiratory distress syndrome (ARDS).

- CT scan is more specific (Fig. 1).



CT scan showing rib fracture and lung injury Fig. 1

Treatment

- Fluid restriction, pulmonary care
- Chest physiotherapy
- Steroids and rarely ventilation

Usually self-limiting, if there are no other severe injuries.

Complications

- Pneumonia
- Atelectasis
- Respiratory failure
- ARDS

PNEUMOTHORAX

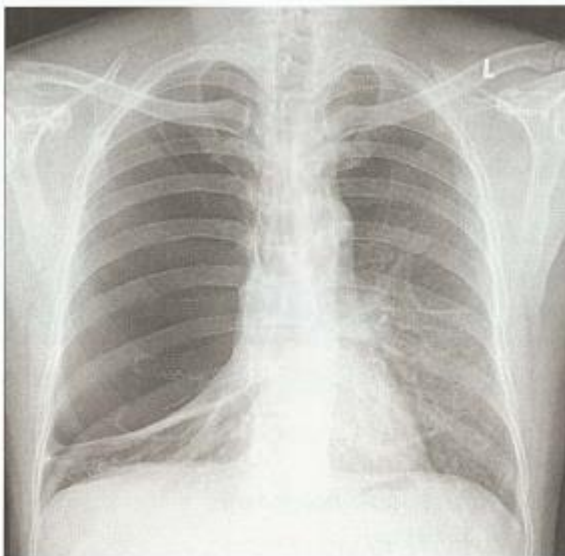
- Pneumothorax is the most common cause of respiratory insufficiency following chest trauma.
- Usually if there is a rib fracture and evidence of subcutaneous emphysema, pneumothorax is certainly present (Fig. 2).



Pneumothorax right lung

Fig. 2

- Pneumothorax can be closed (simple), open and tension.
- Small simple pneumothorax does not need any treatment.
- A repeat chest X-ray after 12-24 hours is essential to confirm that it is not progressing.
- It can be confused for a large bullae (Fig. 3).



Large bullae

Fig. 3

- Small pneumothorax can be missed easily.
- Bilateral pneumothorax is an emergency.
- Late pneumothorax can also occur.

- Open chest wound will produce complete collapse of lung and paradoxical shift of the mediastinum with each respiration (mediastinal flutter) causing hypoventilation and reduced cardiac output.
- Treatment is by closure of the wound, intercostal tube drainage (ICD) and surgery.

TENSION PNEUMOTHORAX

TENSION PNEUMOTHORAX: CLINICAL FEATURES

- Tachypnoea
- Tachycardia
- Tympanic note on percussion
- Total absence of breath sounds
- Tracheal shift

Observe 5 Ts

TENSION PNEUMOTHORAX

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graph TD
    A[Injury to the lung] --> B[Valvular air leak]
    B --> C[Lung collapse]
    C --> D[Mediastinal shift to opposite side]
    D --> E[Increased intrapleural pressure]
    E --> F[Decreased venous return]
    F --> G[Decreased ventilation]
    G --> H[Hypoxia and cardiac arrest]
  
```

TENSION PNEUMOTHORAX

- Diagnosis immediately
- Do not wait for CXR
- Thoracocentesis in 2nd intercostal space, midclavicular line.
- Then, follow with intercostal chest tube insertion.

- Injury to the lung results in continuous valvular air leak. The accumulating air collapses the lung on the same side and pushes the mediastinum to opposite side. As a result of this tension, the intrapleural pressure increases, till it is above atmospheric pressure at the time of expiration. This reduces the venous return to the heart as well as compromises the ventilation.
- Tension pneumothorax is an emergency which should be treated urgently with needle thoracocentesis in the second intercostal space in the midclavicular line to release the tension. Thoracocentesis converts tension pneumothorax to simple pneumothorax.

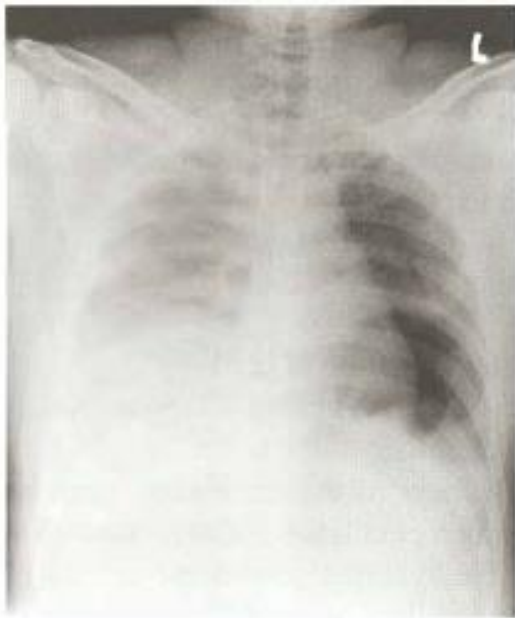
- This should be followed by urgent ICD insertion and connected to underwater seal.
- Do not wait for chest X-ray.

Tension gastrothorax

This occurs due to herniation of dilated and obstructed stomach into the mediastinum due to diaphragmatic tear resulting in haemodynamic compromise. It should be treated by reducing the hernial contents and repair of diaphragmatic tear.

HAEMOTHORAX

- May be missed in chest X-rays in the supine position.
- Results from injury to internal mammary artery, intercostal artery and vascular lung adhesions.
- Classical signs are reduced-chest expansion, dullness to percussion and absent breath sounds on affected side.
- Treated by intercostal chest tube insertion (Figs 4 and 5).



Right haemothorax

Fig. 4



Bilateral haemothorax—detected early and treated with ICT on the right

Fig. 5

- If bleeding continues or features of shock develop, thoracotomy has to be considered.
- The bleeding may be delayed or may recur after several days.

Indications for thoracotomy

- Initial volume of blood loss is not as important as the amount of ongoing bleeding.
- Drainage is more than 1000 ml or 100 ml each hour for 4 hours.
- If clotted haemothorax is suspected (opacity persisting on chest X-ray even after ICT).

Complications

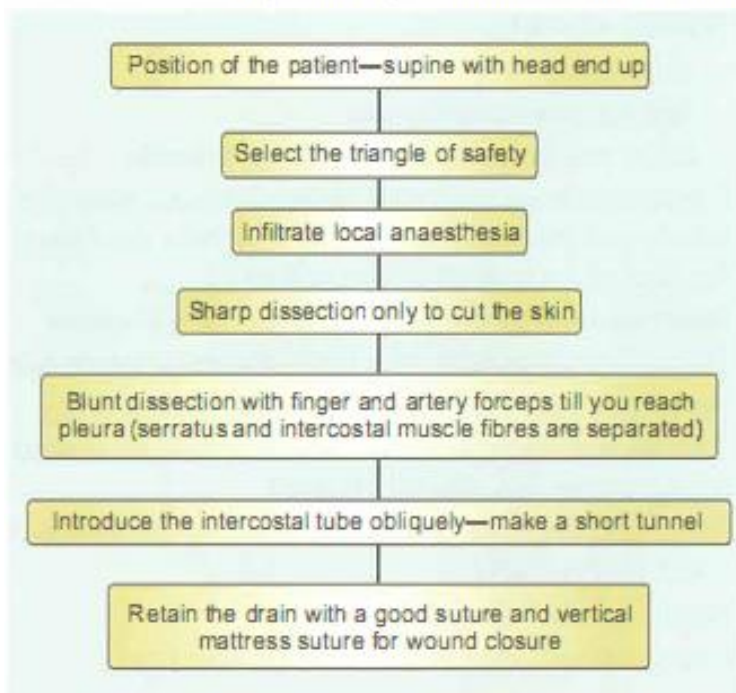
Failure to adequately drain a haemothorax initially results in residual clotted haemothorax and empyema or late fibro-thorax.

INTERCOSTAL CHEST TUBE (ICT) INSERTION (CLOSED TUBE THORACOSTOMY)

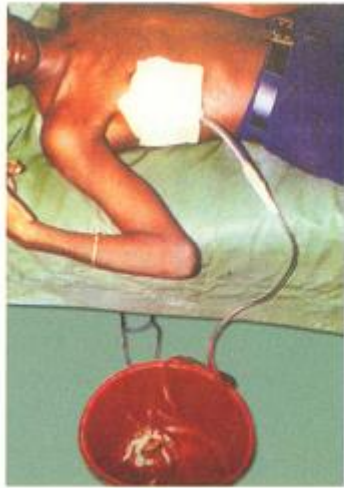
TEN COMMANDMENTS OF PRECAUTIONS WHILE USING ICT-ICD

1. Should select triangle of safety
2. Should direct the tube towards apex in cases of haemothorax and pneumothorax
3. Should direct the tube towards base in empyema
4. Should confirm that all the holes are inside
5. Should be connected to under water seal
6. Should observe for movement of the fluid column with respiration
7. Should take an X-ray after the insertion of the tube
8. Should avoid kinking of the tube
9. Should not clamp the ICD if there is air leak
10. Should be always lower than patient level in the supine position. Otherwise, contents of the bottle will enter the pleural space

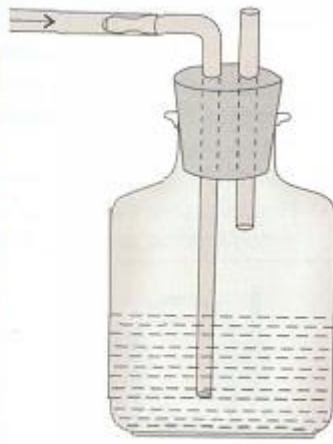
Important steps of intercostal tube insertion



- Second intercostal space-anteriorly midclavicular line is ideal or pneumothorax and sixth space in the midaxillary line or haemothorax.
- Triangle of safety:
 - Above the level of nipples
 - Anterior to midaxillary line
 - Below and lateral to pectoralis major muscle
- Can be introduced from sixth intercostal space midaxillary line or pneumothorax also but the chest tube should reach the apex of the lung (Fig 6).



Intercostal tube (ICT)
connected to underwater seal



Underwater
seal (diagrammatic)

Fig. 6

- Infiltrate local anaesthetics up to the parietal pleura
 - 2-3 cm incision parallel to the ribs-deepened, suture taken
 - Insert the chest tube with trocar into the pleural cavity
 - Then the trocar is removed and the chest tube is connected to underwater seal.
- The ICT is fixed
- Intercostal drainage can also be done by connecting to 2 bottles (Fig. 7)



ICD with 2 bottles

Fig. 7

- Removal of ICT

ICT—REMOVAL

- Chest X-ray—lung fully expanded and drainage should be less than 100 ml for two days and no air leak. Patient should not be on a ventilator
- Clamp the tube for 24 hours
- Removal after 24 hours of clamping, provided the patient is comfortable and lung remains fully expanded.

LUNG LACERATION

- Minor laceration: Haemopneumothorax. Usually inter costal chest tube is enough.
- Major laceration: Haemopneumothorax
-Introduce intercostal chest tube

-Continuous air leak or bleeding through JCT and lung not expanding.
Requires thoracotomy and repair on resection of lobe.

SHOCK LUNG

Definition

- Alveolar collapse due to shock as a result of oedema, impaired perfusion, and reduction in alveolar space resulting in respiratory failure is called shock lung.
- It is also called Acute Respiratory Distress Syndrome (ARDS).

Causes

- Major chest trauma with multiple rib fractures and lung contusion
- Septic shock and septicaemia
- Disseminated intravascular coagulation
- Massive blood transfusion
- Major burns
- Cardiopulmonary bypass (also called 'Pump lung')
- Acute pancreatitis
- Aspiration of gastric contents

Pathogenesis

- Diffuse inflammation of the lung
- Extensive intravascular coagulation due to micro-thromboembolism
- Focal disorders of the circulation, primarily because of sluggish microcirculation due to leukostasis, sludge, leading to extensive hyaline thromboses
- Increased capillary permeability due to damaged capillaries
- Diffuse alveolar damage, decreased production of surfactant by type II pneumocytes leading to bilateral extensive lobar atelectasis
- Net result is pulmonary consolidation, decrease in the lung compliance, poor gas exchange leading to stiff lung.

Investigations

- Arterial blood gas analysis
- Chest X-ray
- CT scan

Treatment

- Ventilatory support (intermittent positive pressure ventilation)
- Antibiotics-broad spectrum
- Low to moderate doses of steroids may help in early ARDS, in patients requiring high doses of vasopressors to maintain blood pressure.
- Intensive care-supportive therapy can be remembered as

FASTHUG

F-Feeding (usually enteral)

A-Analgesia

S-Sedation once a day and check neurological status

T-Thromboembolism prophylaxis

H-Head-end elevation (20-30°)

U-Ulcer (gastric) prophylaxis, and

G-Glucose (blood) control

SURGICAL EMPHYSEMA

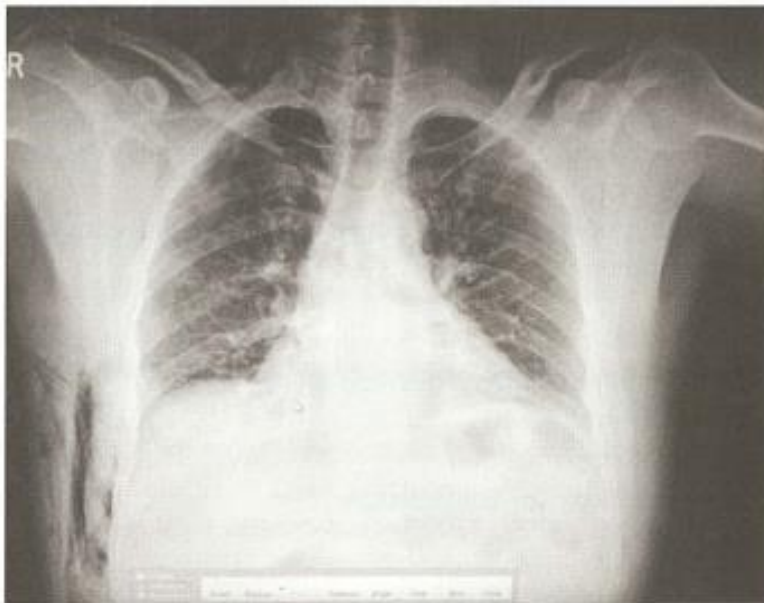
Types

1. Localised

2. Extensive from the eyelids to the scrotum, quite alarming in appearance.

Indicates lung injury.

X-ray chest may show pneumothorax or air in the sub-cutaneous plane (Fig. 8).



Chest X-ray showing 10th rib fracture with surgical emphysema on the right side

Fig. 8

Treatment

- Localised: Not extending, no pneumothorax-observation
- Pneumothorax-ICT
- Extensive: ICT to be introduced on the side where it is maximum.
- ICT may be required on both sides
- Two ICT, one apical and the other, basal, may need to be introduced if there is continuous air leak.

- The emphysema usually subsides within a week. Multiple incisions and expelling the air from the subcutaneous space manually are not required but may be carried out for cosmetic purposes or if patient has respiratory distress.

SURGICAL EMPHYSEMA

- Air in the subcutaneous tissue
- Palpable crepitus
- Sometimes, can be gross
- Disfigurement is more than symptoms and signs
- Rib stabbing the lung
- Rupture of bronchus—mediastinal emphysema

PENETRATING THORACIC WOUNDS

Stab wounds

They depend on type of weapon, length and direction of the stab.

PENETRATING WOUNDS

- Represents mainly stab and gunshot wounds
- Immediately pack the wound
- Intercostal chest tube
- Thoracotomy mandatory

Projectile wounds

- Relatively low velocity revolver bullets may perforate one or two lobes of the lung with a little damage and only drainage of the pleural space is required. High velocity perforating wounds cause more damage to the tissue, adjacent to the tract. If the damage is extensive, lobectomy or pneumonectomy has to be considered.
- Bomb fragments, because of irregular shape, commonly carry with them pieces of ribs and are associated not only with severe haemorrhage and air leak from the torn pulmonary vessels and bronchus but also with haemorrhage from irregular entry and exit wounds. Urgent thoracotomy is necessary.

Treatment

Emergency thoracotomy is a life-saving procedure in the trauma centre.

Thoracotomy for polytrauma has a poor prognosis than for isolated thoracic injuries.

Indications

- Decompression of cardiac tamponade
- Control of bleeding, allow for internal cardiac massage
- Clamping of descending thoracic aorta for exsanguinous bleeding in the abdomen.

Surgery

Anterolateral thoracotomy through 5th intercostal space, entered in 1-2 minutes.

MEDIASTINAL EMPHYSEMA

- The emphysema is mainly suprasternal.

- On auscultation, pericardial crunching sounds synchronous with the heart beat, are heard.
- If there is hemodynamic instability, bilateral intrapleura JCT has to be introduced as a precaution against tension pneumothorax.
- Rule out esophageal and tracheal injury.

Principles of managing chest injuries

1. Pulmonary physiotherapy: Most important in all chest injury patients.
2. Aspiration of secretions: Tracheal aspiration, nasotracheal suction, aspiration of oral cavity and pharynx.
3. Relieving pain: Oral narcotics, parenteral narcotics, thoracic epidural analgesia, intercostal nerve block.
4. Physiotherapy assistance
 - Encourage coughing
 - Chest percussion and vibration
 - Deep inspiratory efforts
 - Humidification of air, nebulisation
 - Early mobilisation
5. Treatment of pneumothorax or haemothorax: Insertion of intercostal chest tube.
6. Treatment of shock: First of all, the causes of shock in chest injuries has to be determined by thorough assessment of the patient. Once the cause is found out, depending upon the nature of the problem, the patient is treated in an intensive care unit.

CAUSES OF SHOCK

- Tension pneumothorax
- Massive haemothorax
- Cardiac tamponade
- Myocardial contusion
- Air embolism
- Ruptured diaphragm
- Injury to the great vessels

7. FAST (focussed abdominal sonography in trauma) ultrasound: Focussed assessment with ultrasonography for trauma and rapid assessment for ruling out fluid collection in the abdomen, chest and pericardium.
8. Surgery: Depending upon the severity and location, surgery is done.
9. Treatment of complications

COMPLICATIONS

- Empyema
- Bronchopleural fistula
- Bronchial stenosis
- Chylothorax
- Clotted haemothorax
- ARDS
- Atelectasis

- Thromboembolism
- Tracheostomy complications

- Prolonged ICU complications.

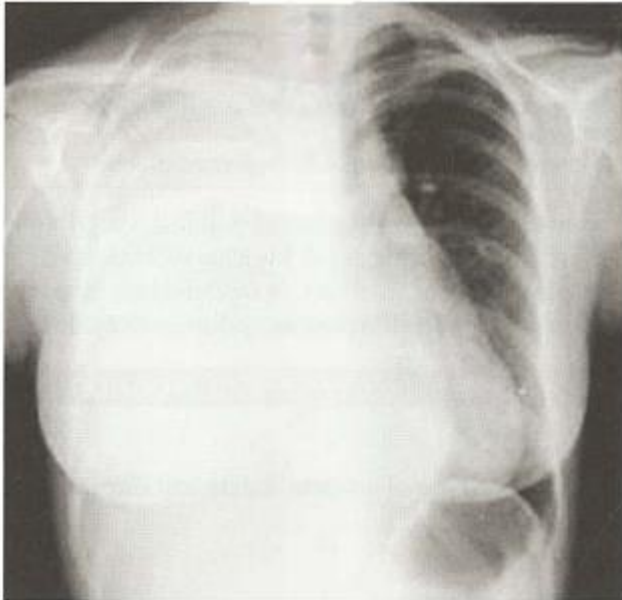
EMPYEMA

Definition

Collection of the pus in the pleural space is called empyema.

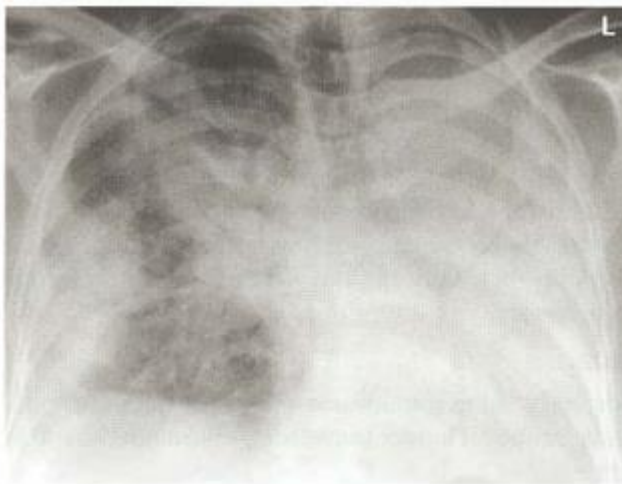
Aetiopathogenesis

- It is the end stage result of pleural effusion and infection. A few examples are-following haemothorax, lung abscess, pneumonia. In India, tuberculosis is an important cause of empyema (Figs 11 and 12)



Effusion

Fig. 11



Consolidation

Fig. 12

- Oesophageal perforations-iatrogenic or spontaneous also result in empyema.
- Rupture of subphrenic abscess, rupture of hydatid cyst, rupture of amoebic liver abscess also can result in empyema.

- The classical events which follow empyema following pneumonia are exudative phase with pleural effusion, followed by thickening of fluid-fibropurulent stage and when the lung is covered by thick cortex, it is called organising phase.

Diagnosis

- History of fever diagnosed as pneumonia or tuberculosis
- Pain in the chest, difficulty in breathing
- Tenderness over the chest
- Toxic features in acute empyema specially in children
- Presence of thick pus with thick cortex of fibrin and coagulum over the lung.

Investigations

- Chest X-ray may show collapse of the lung, tracheal deviation, evidence of pneumonia or tuberculosis.
- Aspiration of pleural fluid and analysis-exudative in cases of pneumonia. Send for bacterial culture.
- CT scan may show split pleura sign. Tuberculous spine can be diagnosed as a cause of empyema

Surgical management of pleural effusions and empyema

- Video Assisted Thoracoscopic Surgery (VATS): With 34 ports, video assisted procedures have become very popular. Minimal incision, less pain and recovery is fast. Drainage, pleural biopsy, talc pleurodesis, debridement of empyema, intercostal tube drainage (ICD) can all be done.
- Rib resections, and drainage through a window-Eloisier's method.
- Decortication: More radical procedure involves thoracotomy, debridement, excision of thick cortex or the covering of the lung, so that lung will expand. This is done by posterolateral thoracotomy.

Complications

- Toxicity, septic shock, multiorgan failure in untreated cases
- Damage to the lungs-lobectomy, pneumonectomy

Empyema necessitans: It is a type of empyema which presents as a swelling in the subcutaneous plane with communication to the pleural space/cavity. It is a tense, tender, fluctuant swelling with local rise of temperature. Intercostal bulge is also seen. On asking the patient to cough, expansile impulse is felt. Otherwise, management is similar to that of empyema such as drainage, treating the cause, ATT in tuberculosis and antibiotics in pyogenic infections.

BRONCHOPLEURAL FISTULA

Definition

It is a fistulous communication between the pleural space and the lung.

Causes

- Following pneumonectomy or an infection.
- It may occur when large airways are in communication with the pleural space following a large pneumothorax.

Pathogenesis

- There will be a large empty space left behind following pneumonectomy. This space will be filled with air. Over a period of time air is absorbed. The gaping of bronchial stump occurs resulting in bronchopleural fistula.
- Invariably the fluid which accumulates later will be infected-purulent.

Clinical features

- History and clinical features suggestive of empyema
- History of lung surgery
- Persistent air leak in the intercostal drain
- Pus in the ICD

Treatment is extremely difficult and disappointing

- Propped up/sitting position and turn to the disease side so as to get a dependent drainage
- Intercostal drain connected to under water seal
- Pleurocutaneous window drainage can be done
- Specific treatment includes control of infection, treat the primary cause, suturing, etc.

1. Fracture of the following rib is a marker of severe trauma:

- A. First
- B. Fourth
- C. Eighth
- D. Tenth

2. Treatment of posterior lail segment is:

- A. Strapping
- B. Open reduction and fixation
- C. No treatment is required
- D. External fixator application

3. Posterior lail segment does not require treatment because:

- A. Scapula supports the flail segment
- B. It does not cause complications
- C. It heals by itself
- D. It has no physiological implications

4. 'Internal pneumatic fixation' for flail chest is the term used for:

- A. Insertion of a balloon into the chest
- B. Internal fixation with screws
- C. Endotracheal intubation and positive pressure ventilation

- D. Valsalva manoeuvre
5. Tension pneumothorax should immediately be treated with:
- A. Intercostal tube insertion
 - B. Needle thoracostomy
 - C. Thoracotomy
 - D. Thoracoscopic drainage
6. Features of tension pneumothorax include all of the following except:
- A. Tachypnoea
 - B. Hypotension
 - C. Dull note on percussion
 - D. Tachycardia
7. Indications for thoracotomy in haemothorax include all of the following except:
- A. Drainage more than 1000 ml
 - B. Drainage of more than 100 ml/hour or 4 hours
 - C. If clotted, haemothorax is suspected
 - D. Coagulation abnormalities
8. The intercostal drain can be removed in all of the following situations except:
- A. Lung is fully expanded
 - B. Drainage < 100 ml
 - C. No air leak
 - D. The patient is on a ventilator
9. The following is diagnostic of surgical emphysema:
- A. The lungs are emphysematous
 - B. Always follows surgery
 - C. Palpable crepitus
 - D. Infiltrates on chest X-ray
10. The following is true about mediastinal emphysema except:
- A. The emphysema is mainly suprasternal
 - B. Mediastinal drain needs to be inserted
 - C. Pericardial crunching sounds can be heard on auscultation
 - D. Esophageal and tracheal injury need to be ruled out

ANSWERS:

1-A 2-C 3-A 4-C 5-B 6-C 7-D 8-D 9-C 10-B

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