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Mwakio Patterson-Mwakio's Series General Surgery Article-Chest Trauma

Mwakio Patterson

MBChB, Bsc. Anat, HNDRH

Abstract: ***Chest trauma is an important cause or morbidity and mortality, accounting about 10% of trauma hospital admissions and 25-50% of mortality associated with trauma globally. Road traffic accidents {RTA}, Fall, physical assault and burn are the leading causes of chest trauma in Kenya. Chest injury is more common among males in Kenya with RTA being the leading cause in about 52%, fall 22%, assault 13% and burn 6% and overall mortality rate of 3.5% { Tobias otieno et al, 2004}. Chest trauma is broadly classified into mechanical, chemical and thermal. Blunt chest trauma following RTA is associated with High Thoracic Abbreviated Injury Scale {AIS thoracic} Score and Injury Severity score {ISS} and therefore, victims are more susceptable to a higher risk of morbidity and mortality following chest trauma.***

Keywords: Chest trauma, Road traffic accident {RTA}, Mortality, Morbidity, Hemothorax, Pneumothorax, Thoracotomy, Hypoxia, Fail chest

1. Introduction

Broadly chest trauma could be:
a) Mechanical-high or low velocity
b) Chemical
c) Thermal

Mechanical trauma may be further classified as:
1) Penetrating
2) Non-penetrating –Blunt and Crush injuries
3) Inhalational injury
4) Aspiration of foreign body
   - 2 major forces within the chest which lead to injury are the **compression** and **distraction** injuries.
   - **Compression** results in **destruction of vascular structures,** haemorrhage, oedema and impairment of function.
   - **Distraction** injuries usually result in **shearing forces** which destroy the integrity of intrathoracic viscera.

Penetrating injuries
- 61% of chest trauma admissions.
- Result in parenchymal damage related to track of missile or stabbing, implant used and velocity.
- Solid structures as the heart and major great vessels suffer more injuries
- Most lethal complication is haemorrhage
- Often associated with abdominal injury

Non-penetrating injuries
Blunt (acceleration and deceleration injuries)
- Sudden reduction in speed as in RTA. Aortic rapture as a cause of death on spot is not uncommon.
- Care should be taken while dealing with the very young or the elderly.

Crush injuries
- **Occurs where the elastic limit of the chest wall and its limit have been exceeded.** Patients usually have AP deformity
- Majority have flail chests, haemothorax or pneumothorax
- Most has pulmonary contusion. Injuries of the heart, Aorta, liver, spleen, kidney are common
- In **"Traumatic asphyxia"** syndrome-constrictive forces are applied in wide area for as little as 2-5 minutes
- Crush injuries have high mortality.

Clinical presentation

History
- History of chest trauma
- Pain on breathing especially inspiration
- Guarding of injury
- Haemoptysis

Physical exam
- Cyanosis, pale, cold skin
- Tachypnea and tachycardia
- Chest exam-Below

Pathophysiology in chest injury
1) Hypoxia –Reduced air exchange
2) Acidosis –Anaerobic respiration
3) Low Cardiac Output-Hypovolemia and cardiogenic shock

Casualty Management
1) Primary survey
2) Secondary survey
3) Investigation
4) Transfer to ward or theatre

Primary Survey

1) The majority of chest injuries are confined to the thoracic cage.
2) These consist of rib fractures with underlying pulmonary contusion, hemothorax, or pneumothorax.
3) Can be treated effectively simply by chest drain insertion and fluid restriction
4) Early deaths caused by in chest injuries are usually caused by**: Conditions that would impair breathing**
   - Airway obstruction
   - Open pneumothorax

- Massive hemothorax
- Tension pneumothorax
- Flail chest
- Cardiac tamponade

Later deaths are due to
1) Respiratory failure
2) Sepsis
3) Unrecognized injuries

The basis for successful management of thoracic trauma is effective cardio pulmonary resuscitation followed by early detection and treatment of life-threatening injuries.

Initial Management-Primary Survey
1st is A, B, C, D of resuscitation plus vital signs

1) Airway and cervical spine
Maintain cervical spine immobilization in all unconscious or symptomatic (neck pain or tenderness) patients.
- Inspect mouth remove debris by sweeping through
- Chin lift/jaw thrust (tongue is attached to the jaw) and always airway in tongue falling back. To perform a *chin lift*, place two fingers under the mandible and gently lift upward to bring the chin anterior. During this maneuver, be careful not to hyperextend the neck. Care should be given to neck stabilization, if appropriate. The *jaw thrust* is performed by manually elevating the angles of the mandible to obtain the same effect.
- Secure airway by Guedel airway/oropharyngeal airway. Insert the oral airway into the mouth behind the tongue**; it is usually inserted upside down until the palate is encountered and is then rotated 180 degrees.**
- Intubations; keep the neck immobilized in neutral position. Use sedation and short acting neuromuscular blockade if necessary. If not possible to intubate:
- Tracheostomy
- Cricothyrotomy

2) Breathing: Oxygenation and ventilation.
Check for the six conditions that would impair breathing.

a) Inspect (LOOK)
Inspection of respiratory rate and evidence of respiratory distress is essential. Are any of the following present?
- Use of accessory muscles, flaring of alae nasae
- Cyanosis-lips
- Chest movements (chest excursions)
- Penetrating injury in the chest or Sucking chest wounds
- Presence of flail chest

b) Palpate (FEEL)
- Tracheal shift
- Broken ribs (Use compression-lateral to lateral/ anteroposterior)
- Subcutaneous emphysema.
- Chest expansion

c) Percusion
Percussion is useful for diagnosis of **hemothorax (dull)** and **pneumothorax (hype resonant)**

d) Auscultate (LISTEN)
- Pneumothorax/hemothorax (**decreased breath sounds on site of injury)**
- Detection of abnormal sounds in the chest.

Immediate intervention
1) Tension pneumothorax-put through a needle then chest tube insertion
2) Massive pneumothorax-chest tubes insertion
3) Sucking wounds-strap the open wound then chest tube insertion.
4) Flail chest-positive pressure ventilation
5) Cardiac tamponade

Resuscitation action
- Insert an intercostal drainage tube as a matter of priority, and before chest X-ray if respiratory distress exists, to drain the chest pleura of air and blood
- When indications for intubation exist but the trachea cannot be intubated, consider using a laryngeal mask airway or direct access via a cricothyroidotomy.
- If available, maintain the patient on oxygen until complete stabilization is achieved
- If a you suspect a tension pneumothorax, introduce a large-bore needle into the pleural cavity through the second intercostal space, mid clavicular line, to decompress the tension and allow time for the placement of an intercostal tube
- If intubation in one or two attempts is not possible, a cricothyroidotomy should be considered a priority

3) Circulation and arrest of bleeding.
"Shock" is defined as inadequate organ perfusion and tissue oxygenation. In the trauma patient, it is most often due to hemorrhage and hypovolemia.

The diagnosis of shock is based on clinical findings:
- Hypotension
- Hypothermia
- Tachycardia
- Tachypnoea
- Pallor
- Cool extremities
- Decreased capillary refill
- Decreased urine production

Hemorrhagic (hypovolemic)
- Shock is due to acute loss of blood or fluids. The amount of blood loss after trauma is often poorly assessed and in blunt trauma is usually underestimated. Remember:
- Large volumes of blood may be hidden in the abdominal and pleural cavity.
- **Femoral shaft fracture** may lose up to 1.0-1.5 liters of blood
- **Pelvic fracture often loses in excess of 2 liters of blood.**

Cardiogenic shock
Cardiogenic shock is due to **inadequate heart function**. This may result from
- Myocardial contusion (bruising)
- Cardiac tamponade

- Tension pneumothorax (preventing blood returning to heart)
- Penetrating wound of the heart
- Myocardial infarction.

Assessment of the jugular venous pressure is essential in these circumstances and an ECG should be recorded, if available.

Neurogenic shock
Is due to the loss of sympathetic tone, usually resulting from spinal cord injury. The classical presentation is hypotension without reflex tachycardia or skin vasoconstriction.

Septic shock
Is rare in the early phase of trauma, but is a common cause of late death (via multi-organ failure) in the weeks following injury. It is most commonly seen in penetrating abdominal injury and burns patients.

Resuscitation
- First priority is to **stop any obvious bleeding by Sub fascial gauze pack placement and Manual compression on the proximal artery.** Carefully applied compressive dressing of the entire injured limb can be done. Then
- **Vascular access 2 large bore size 16 on the 2-basilic veins**
- **Fluids**: infuse 0.9% NaCl initially 2L to run as fact as possible through 2 large bore IV lines in the antecubital fossa then re-assess
- **Resuscitate to goal of mean arterial pressure (MAP) >90 mmHg** to maintain a presumptive cerebral perfusion pressure (CPP) >60 mmHg
- **Urinary catheter insertion and monitor the input and output chart** at least 30-50 ml/hour or 0.5/kg/hour of urine flow
- Monitor by **vital signs**, pallor, sweating, anxiety, skin warmth clammy, input and output
- **Blood transfusion** must be considered when the patient has persistent hemodynamic instability despite fluid (colloid/crystalloid) infusion.

If type specific or cross matched blood is not available, use group O negative packed red blood cells. Transfusion should, however, be seriously considered if the hemoglobin level is less than 7 g/dl and the patient is still bleeding.

4) Neurological dysfunction
Establish preliminary level of consciousness by AVPU
A –Awake, **V-V**erbal response, **P-P**ainful response
U –Unresponsive and any focal neurologic deficits.

5) Exposure and environmental modification
Cover patient in case of shock and shivering

2. Anatomical Classification of Chest Injuries

A. Skin and Subcutaneous tissue
Cuts and bruises
Superficial cuts-surgical toilet and suturing, analgesia and tetanus toxoid

B. RIBS
Usually fracture. Types of rib fracture include**:**
1) Simple fracture
2) Compound fracture
3) Multiple fractures-many ribs or rib plus sternal fracture. May or may not cause Flail chest
4) Flail chest

a) Simple fractures
Main management is to provide **analgesia, reduce pain and allow ventilatory movements.**
Analgesia may be systemic or local

b) Systemic analgesia
- Paracetamol
- NSAIDS
- Opioids
- Combination

c) Local analgesia
- Intercostal block usually administered as a mixture of short acting (Xylocaine or Procaine) and long acting (Bupivacaine) local anesthetic plus a steroid
- Inject the intercostals space involved plus two above and two below because of the overlap of the sensory innervation
- Usually is cumbersome to do this for a single fracture, more reasonable for multiple rib fractures.
- Injection is done below the rib and along the medial border of the scapula.

Risks
- Bleeding
- Penetration of pleura-pneumothorax and hemothorax

C. Multiple fractures
- Firm strapping of the thorax in a hemi-thorax fashion.
- May give systemic analgesia or local analgesia as above. Firm strapping not done in older patients because may interfere with respiration.

D. Flail chest/ segment
- **A portion of the chest wall becomes isolated by multiple fractures** moves in and out with inspiration and expiration with severe reduction in ventilatory efficiency.
- Is dangerous because of the paradoxical movement of the flail segment to the rest of the ribs cage and thus the area of the lung under it is not ventilated and may collapse.
- Atelectasis, hypercapnia, hypoxia, accumulation of secretions, and ineffective cough occur.

Management options
Less severe cases, intercostal nerve block or continuous epidural analgesia may be adequate treatment otherwise

I) Hemi-thorax strapping
Pack with gauze and Strap 3-4 ribs in hemi thorax fashion

II) Positive pressure ventilation
Sedate patient and do the positive pressure ventilation

III) Tracheostomy

This reduces the work of breathing by reduction of dead space and thus reduces the paradoxical movement of the flail segment. Give humidified oxygen.

IV) Thoracotomy and ORIF

Drill two holes in each rib and hold using wire

E. PLEURA

Pleural injuries also involve lung parenchyma

Hemothorax

Classified according to the amount of blood:

1) Minimal, 350 mL
2) Moderate, 350-1500 mL;
3) Massive, 1500 mL or more.
   - Rate of bleeding after evacuation of the hemothorax even more important. If air is also present, the condition is called hemopneumothorax
   - Hemothorax should be suspected with penetrating or severe blunt thoracic injury.
   - **Clinically-Reduced chest movements, dullness to percussion and decreased breath sounds**
   - **CXR** (upright or semi upright,) should be promptly obtained.
   - **Tube thoracostomy** using one or two large-bore pleural catheters should be performed promptly
   - In 85% of cases, tube thoracostomy and circulatory support are the only treatment required.
   - If bleeding is persistent, as noted by continued output from the chest tubes, it is more likely to be from a systemic (e. g., intercostal) rather than a pulmonary artery.

In most cases, the chest wall is the source of hemorrhage, but the lung, heart, pericardium, and great vessels account for 15-25%.

Indication for thoracotomy

1) Initial drainage of fluid>1500L and still draining.
2) Drainage rate >250ml /hr for 3 or more hours.

Pneumothorax

Types

1) Open pneumothorax
2) Closed
3) Tension
   - **Lacerations of the lung or chest wall following penetrating or blunt chest trauma.** Prompt **occlusive dressing** should be done for open pneumothorax before tube insertion.
   - **Hyperinflation** (e. g., blast injuries, diving accidents) can also rupture the lungs.
   - After penetrating injury, 80% of patients with pneumothorax also have blood in the pleural cavity.
   - **Tension pneumothorax develops when a flap-valve leak allows air to enter the pleural space but prevents its escape; intrapleural pressure rises causing total collapse of the lung and a shift of the mediastinal viscera to the opposite side.**
   - It must be relieved immediately to avoid interference with ventilation in the opposite lung and impairment of cardiac function.
   - For any impaled or penetrating objects still on the chest should left in situ until the patient is in theatre.
   - Bandage and stabilize the object to avoid further injury.
   - If large open pneumothorax exists, tape the dressing on three sides: A totally occlusive dressing can result in a tension pneumothorax

Spontaneous-primary pneumothorax

- The only abnormality is superficial blebs at the apex of one or more lobes, typically the upper lobes, which either leak spontaneously or are triggered by an otherwise unremarkable event such as exertion.
- It is more common in males, occurs predominantly in the ‘teens or twenties may be bilateral and may be familial.
- Primary pneumothorax affects mainly tall, thin boys and men between the ages of 10 and 30 years.
- It is thought to occur from rupture of subpleural apical blebs in response to high negative intrapleural pressures. Family history and cigarette smoking may also be important factors.

Spontaneous-secondary pneumothorax

- Any lung disease that breaches the pleura may cause a pneumothorax so probably every possible lung disease will, at one time or another, cause a pneumothorax.
- Secondary pneumothorax occurs as a complication of COPD, asthma, cystic fibrosis, tuberculosis, pneumocystis pneumonia, menstruation (catamenial pneumothorax), and a wide variety of interstitial lung diseases including sarcoidosis, lymphangioleiomyomatosis, Langerhans cell histiocytosis, and tuberous sclerosis.
- The most common causes are obstructive airways disease in any form and bullous emphysema iatrogenic.
- This is commonly seen in general hospital practice as a result of insertion of central lines for central venous pressure monitoring, intravenous feeding or cardiac pacing.

Indications for thoracotomy

1) Cardiac tamponade
2) Initial drain through the chest tube>1.5 L and continuing
3) Hourly drain **>250ml/hr.**
4) Electro cardiac dissociation
5) Intraabdominal bleeding in excess indicating a thoraco-abdominal injury
6) Persistent pneumothorax even with adequate drainage suggesting injury to trachea or bronchi. Confirmed by bronchoscopy
7) Diaphragmatic injury
8) Large Chest wall defects
9) High velocity injuries
10) Impacted objects on the chest in situ
11) Trans mediastinal injury
12) Delayed indications-Clotted hemithorax, Lung abscess or fistula formation.
13) Failure of resuscitation measures

Trachea and Bronchus:

- **Blunt tracheobronchial injuries are often due to compression of the airway between the sternum and the vertebral column in decelerating injury**
- Patients present with
- **Pneumothorax or hemopneumothorax**
- **Subcutaneous emphysema**
- **Cervicofacial emphysema**
- **Pneumo mediastinum**
- **Hemoptysis.**
- Suspected with massive air leak or when the lung does not readily re-expand after chest tube placement
- **In penetrating injuries of the trachea or main bronchi, there is usually massive hemorrhage and hemoptysis.**
- **Systemic air embolism** resulting in cardiopulmonary arrest may occur if a broncho venous fistula is present.
- Diagnosis may require **tracheobronchoscopy**.
- Primary repair is indicated for tracheobronchial lacerations.

Lung Injury

- Pulmonary **contusion** due to blunt or penetrating injuries.
- Alveolar rupture with fluid transudation and extravasation of blood are early findings. These enter alveolar spaces and bronchi and produce localized airway obstruction and atelectasis.
- Increased mucous secretions and overzealous intravenous fluid therapy may combine to produce copious secretions (wet lung) and further atelectasis.
- Blood oxygenation and pH drop and PCO_2 rises.
- Treatment is often delayed because clinical and x-ray findings may not appear until 12-24 hours after injury.
- The clinical findings are **loose, copious, blood-tinged secretions, chest pain, restlessness, apprehensiveness, and labored respirations. Eventually, dyspnea, cyanosis, tachypnea, and tachycardia develop**.
- **X-ray changes consist of patchy parenchymal opacification or diffuse linear peribranchial densities that may progress to diffuse opacification ("white-out").**
- Mechanical ventilatory support permits adequate alveolar ventilation with oxygen.
- Most lung lacerations are caused by penetrating injuries, and hemopneumothorax is usually present.
- Tube thoracostomy is indicated to evacuate pleural air or blood and to monitor continuing leak

Heart and Pericardium

- **The injury varies from localized contusion to cardiac rupture.**
- Early clinical findings include **friction rubs, chest pain, tachycardia, murmurs, dysrhythmias, or signs of low cardiac output.**
- ECGs show nonspecific ST and T wave changes. Serial tracings should be obtained, since abnormalities s may not appear for 24 hours.
- Hemopericardium may occur without tamponade and can be treated by **pericardiocentesis**.
- **Tamponade in blunt cardiac trauma is often due to myocardial rupture or coronary artery laceration.**
- **Cardiac Tamponade produces**
- **Distended neck veins**
- **Muffled heart sounds**
- **Shock**
- **Cyanosis.**
- **Immediate thoracotomy and control of the injury are indicated.**
- **Treatment of injuries to the valves, papillary muscles, and septum must be individualized; when tolerated, delayed repair is usually recommended**.
- Pericardial lacerations from stab wounds tend to seal and cause tamponade, whereas gunshot wounds leave a sufficient pericardial opening for drainage.
- Gunshot wounds produce more extensive myocardial damage multiple perforations, and massive bleeding into the pleural space.
- Hemothorax, shock, and exsanguination occur in nearly all cases of cardiac gunshot wounds.
- Treatment of penetrating cardiac injuries has gradually changed from initial management by pericardiocentesis to **prompt thoracotomy and pericardial decompression.**
- Pericardiocentesis is reserved for selected cases when the diagnosis is uncertain or in preparation for thoracotomy. The myocardial laceration is closed with sutures

Diaphragm

- **Penetrating** injuries of the diaphragm outnumber **blunt** diaphragmatic injuries by at least **4: 1.**
- Wounds of the diaphragm must not be overlooked, because they **rarely heal spontaneously** and because **herniation of abdominal viscera into the chest can occur either immediately or years after the injuries.**
- **More common on the left hemi diaphragm** as the right is protected by the liver.

Presentation

- Abdominal tenderness
- Dyspnea
- Shoulder pain
- Unilateral breath sounds
- CXR it is entirely normal in about 20% of cases. The most common finding is **ipsilateral hemothorax.**
- **Once the diagnosis is made, immediate thoracotomy and the diaphragm sutured with heavy nonabsorbable sutures**.
- **In delayed diagnosis, when repair can not be done without tension Marlex mesh or a pericardial flap are employed.**
- Because pulmonary complications are frequent; diaphragmatic injury should be approached through the abdomen when there is no other injury requiring thoracotomy.

Esophagus:

-Esophagus is well protected, and perforation from external penetrating trauma is relatively infrequent. Blunt injuries are very rare.

Symptom of esophageal perforation is chest pain; fever develops within hours in most patients.

- Regurgitation of blood
- Hoarseness
- Dysphagia
- Respiratory distress may also be present.

Physical findings include

1) Shock
2) Pneumothorax and pneumomediastinum
3) Local tenderness
4) Subcutaneous emphysema,
5) **Hamman's sign (i. e., pericardial or mediastinal "crunch" synchronous with cardiac sounds)**
6) Leukocytosis occurs soon after injury.
   Gastrografin swallow for possible esophageal injury (e. g., pneumomediastinum)
   - **A nasogastric tube** should be passed to evacuate gastric contents. **If recognized within 24-48 hours of injury, the esophageal perforation should be closed and pleural drainage instituted with large-bore catheters.**
   - Illness and death are due to pneumothorax or mediastinal and pleural infection.

Thoracic Duct:

- **Chylothorax and chylopericardium** are rare complications of trauma but, when they occur, are difficult to manage.
- Penetrating injuries of the neck, thorax, or upper abdomen can injure the thoracic duct or its major tributaries.
- The occurrence of chylothorax after a trivial injury should lead one to suspect underlying cancer.
- **Chest tube drainage should be instituted if the effusion recurs.**
- **Intravenous hyperalimentation with no oral intake may be effective in persistent leaks.**
- **Three or 4 weeks of conservative treatment usually are curative.**
- If daily chyle loss exceeds 1500 mL for 5 successive days or persists after 2-3 weeks of conservative treatment, the thoracic duct should be **ligated** via a right thoracotomy.

The sternum

- These fractures are usually **transverse** and may overlap, causing agonizing pain.
- **Internal fixation** is required to correct deformity and relieve the discomfort of instability.
- **This is performed by making an incision in the xiphisternum and passing a Steinmann pin up through the medulla of both sternum fragments from underneath.**

B. Secondary Survey

This is a second examination from the head to the toe while still monitoring the vital signs.

If any aspects of the A, B, C, D, E deteriorates re-evaluate the patient for stabilization

C. Investigations

Basic Trauma investigation

1) CXR
2) Pelvic X-ray
3) C-spine x-ray
4) Skull x-ray

Other investigations as required for chest injury

1) Arterial blood gases
2) ECG
3) Tracheobronchoscopy for tracheobronchial injuries
4) Aortography
5) Trans esophageal ECHO
6) MRI and CT-scan

What to check for in CXR

1) Pneumothorax
2) Hemothorax
3) Subcutaneous emphysema
4) Pneumo-mediastinum
5) Widening of mediastinum
6) Fractures-ribs, clavicle, sternum.
7) Pneumo or hemopericardium
8) Lung contusions
9) Aspiration

Underwater Seal Drainage (U. W. S. D)

Indications

1) Fluid in the pleural space
2) Greater than 20 % pneumothorax
3) Tension pneumothorax

Components of UWSD system

1) Chest tube
2) Bottle for fluid collection
3) Connecting tubes
4) Sealing fluid
5) 5.-/+Suction mechanism

Types of collecting Bottles

1) Single Tubor Edwards Bottle system
2) Separate Reservoir and Seal
3) Three bottle system with controlled suction
4) Commercial system

Characteristics of good chest tube

1) Be transparent
2) Be flexible
3) Radio-opaque line in tube
4) Last tube hole goes through the radio-opaque line.
5) Must be graduated

Principles of under water seal drainage

1) Drainage of fluid influenced by gravity.
2) Drainage of air influenced by the pressure difference of the chest cavity and the UWSD system.
3) The return of air/fluid is prevented by the under-water seal.
4) The rate of fluid drainage is influenced level of seal under water.

Insertion of a chest tube

- Explain to the patient his condition and the need to have a chest tube inserted
- Collect materials needed

UWSD system, sterilized drapes, Scalpel, Local anesthetic, antiseptics, curved artery forceps, surgical gloves

3. Procedure

1) Have patient lie lateral position with the side with pathology facing upwards.
2) Expose the whole chest wall and identify the intercostal space of insertion.
   Usually in the 4th intercostal space just above the 5th rib in triangle of safety (bordered anteriorly by anterior axillary line, posteriorly by mid axillary line and inferiorly by the upper border of fifth rib.
3) Clean the area with antiseptic and drape the patient leaving the identified intercostals space.
4) Infiltrate the skin, muscle and pleura with 1% lidocaine at the appropriate intercostal space.
   Aspirate fluid from the chest cavity to confirm your diagnosis
5) Using a sterile scalpel **a small transverse incision just above the rib to avoid damaging the vessels under the lower part of the rib**
6) Using a pair of large, curved artery forceps, do blunt dissection penetrating the pleura and enlarging the opening.
7) Using the same forceps to grasp the chest tube at its tip (**clamped distally)** and introduce it into the chest.
8) **Advance the chest tube Posteriorly into the costovertebral angle. (hemothorax) or towards the apex for pneumothorax.**
9) **Close the incision with interrupted skin sutures, using one stitch to anchor the tube**.
   Leave an additional suture untied adjacent to the tube for closing the wound after the tube is removed.
10) Apply dressing around the chest tube.
11) **Remove the clamp and connect the tube to the underwater-seal drainage system and mark the initial level of fluid in the drainage bottle.**
12) **Do a check x-ray to know the position of the chest tube**

Management of chest tube in situ

1) Monitor the **vital signs** of the patient with his respiratory pattern.
2) Observe the UWSD system for the initial level, the nature of the drainage, the movement of the water seal up and down with respiration, the volume of initial drainage.
3) Observe for bubbling of air-continuous air bubbles in both expiration and inspiration may be sign of deep chest tube into the airway or the presence of bronchopleural fistula
4) Secure the UWSD system in clearly lit area and protect it –in ward using a stool to avoid accidents.
5) Always keep the UWSD system at a level below the patient to facilitate drainage of fluid by gravity
6) Chest drains should never be clamped except when changing drain bottles, whenever the chest drain bottle has to lifted above the level of the patient's chest
7) Educate patient on the need to keep the chest tube secure and avoid turning or movements that would kink or dislodge the chest tube
8) Continuously monitor the amount and nature of drainage->1.5L of hemothorax and continuing or >200ml/hr for more than 3hrs are indications for thoracotomy.
9) **Change the bottle every 24 hours noting the nature and volume of drainage which is noted as part of the output in the 24hr input/output chart.**
10) Establish original level of fluid in drainage bottle before reconnecting as this provides a baseline for future measurements. The fluid level should be clearly marked on the bottle either in the area provided or using a strip of tape
11) **Use of prophylactic antibiotics especially in penetrating chest injuries-contaminated wounds.**
12) **Also give analgesics as appropriate.**
13) Inspect the wound at point of chest tube insertion for exudates, discharges or signs infection and change dressing every 3 days.
14) **Palpate area of chest wall around the chest tube for any crepitation-subcutaneous emphysema.**
15) Do regular respiratory examination for any features of distress, chest expansion, air entry bilaterally.
16) Do regular CXR to monitor the drainage of the hemothorax or pneumothorax and thus chest expansion
17) Encourage the patient to sit upright, take deep breaths and slight coughs to encourage drainage of fluid or gases from the pleural space. Chest physiotherapy is equally important

When to remove the chest tube

When it has done its work of draining the hemothorax or pneumothorax.

This is assessed both

a) Clinically by respiratory examination
b) Radiologically by taking CXR
c) Drainage from the chest tube 50-100ml/24 hrs

Removal of chest tube

1) Remove the dressing and clean the area with antiseptic.
2) Remove the suture securing the chest tube and ask the patient to deeply breath in and do Valsalva maneuver.
3) Remove the chest tube while the assistant ties the purse string stitch around the chest opening.

Complications of chest tubes

There is no organ in the thoracic or abdominal cavity that has not been pierced by a chest drain. "

Acute complications (Poor technique)

1) Hemothorax, usually from laceration of intercostal vessel (may require thoracotomy)
2) Lung laceration (pleural adhesions not broken down)
3) Diaphragm / Abdominal cavity penetration (placed too low)
4) Stomach / colon injury (diaphragmatic hernia not recognized)

5) Tube placed subcutaneously (not in thoracic cavity)
6) Tube placed too far (pain)
7) Tube falls out (not secured)

Late complications

1) Blocked tube (clot, lung)
2) Retained hemothorax
3) Empyema or sepsis
4) Pneumothorax after removal (poor technique)

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