Surgery for 4Th stage

The Chest

Index

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Part:1 Surgery

Chest Trauma & Chest Tube

((Chest Trauma))

#Mechanism of trauma of the chest

- **Penetrating trauma**
  - causes:
    1. Bullet injury (the tract is straight) (may result in shock wave and cavitation)
    2. Shell injury (the tract is zigzag like)
    3. Stab wound
  - penetrating trauma (has inlet only) perforating trauma (has inlet and outlet)
  - Penetrating trauma → may lead to laceration of the lung, pneumothorax, hemothorax, heart injury.
- **Blunt trauma**
  - Crushing chest wall between two blunt objects
  - Causes:
    1. RTA (Road Traffic Accident)
    2. FFH (Fall From Height)
    3. Blunt object trauma
  - Blunt trauma → may lead to Ecchymosis, bruising, rib fracture, flail chest, pneumothorax, hemothorax.
- **Blast trauma**
  - It is due to expulsion of a bomb, which lead to formation of intense positive wave followed by negative wave collectively known as ~**Shock Wave**~ which may result in an injury to the micro-structures in the lungs as alveoli and capillaries.
  - May lead to:
    1. Interstitial hemorrhage
    2. Intra alveolar hemorrhage
    3. Diffuse capillary hemorrhage
    4. lung edema
    5. ARDS (acute respiratory distress syndrome)
    6. Pneumothorax and hemothorax

#Components of chest trauma

- Chest wall (skin – subcutaneous tissue – intercostal muscles – neurovascular bundle – ribs) ➔ may lead to open pneumothorax or fracture of the ribs.
- Parietal and visceral pleura ➔ may lead to pneumothorax, hemothorax, empyema.
- The lung ➔ may lead to laceration of the lung, pneumothorax, hemothorax, collapse, respiratory distress, hemoptysis.
- The heart and great vessels ➔ may lead to massive bleeding, massive cardiac tamponade, constrictive pericarditis, ventricular aneurysm, VSD, ASD, valve injury.
- Thoracic duct ➔ may lead to chylothorax (milky color) which need surgery and conservative management (bed rest + no fatty meal + total parenteral nutrition TPN).
- Esophagus ➔ may lead to mediastinitis and sepsis.
- Trachea and bronchus ➔ may lead to tracheal laceration, rapture of the trachea, rapture of the bronchus, pneumothorax, emphysema, hemoptysis, obstruction.
- Diaphragm ➔ may lead to herniation of abdominal content into the chest and it is diagnosed by barium meal.
- Spinal cord ➔ may lead to injury in the spinal cord.

#Effects of chest Trauma

- Chest trauma may effects:
  1-Breathing
  2-Blood flow
- Thoracic inlet includes structure that pass into the chest medial to the clavicle
- Thoracic outlet includes structures that pass out of the chest superlateral to the clavicle.
- Trauma to the chest could cause:
  - Insult without fracture ➔ Manage by: Analgesia, breathing, high flow O2 (ABO).
  - Fracture of ribs ➔If only one or two ribs treat conservatively (ABO).
  - Flail chest ➔ mostly treated conservatively but may need chest tube or mechanical ventilation in severe cases, with/without surgical intervention.
  - Loss of part of the chest wall ➔ needs surgical intervention.
  - Lung injury:
    a. Contusion: hazy area on CXR
    b. Direct injury: damage to tissues that may cause bleeding.
  - Cardiac injury ➔ especially if the trauma associated with fractured sternum (indicated severity of trauma); could be assessed by;
    1-Trponin I and CK-MB monitoring
    2-ECG, suspect:
    a-BBB (bundle branch block) b-1st degree heart block c-tachyarrhythmia.
    Most commonly associated with tamponade

#General principles in treatment of chest trauma

- Resuscitation from shock ➔ restoration of blood volume and relief of pain
- Restoration of normal cardiopulmonary function:
  - Relief of upper airway obstruction (remove forging body + lateral position + tracheostomy)
  - Decompression of pleural cavity (drainage by chest tube)
  - Relief pericardial tamponade
  - Stabilization of chest movement (in flail chest injury)
- Prevention of infection

#Management of Chest Trauma in general

- ABC
- Blood tests, blood gases, blood group and matching and preparing 2 pints of blood.
- CXR (chest X-ray)
- ECG and Echo (Esophageal echo is the best investigation to reveal cardiac injury).
- Endoscopy: to check for esophageal perforation, also you can use water soluble contrast which can be swallowed + fluoroscopy.
- Bronchoscopy: to look for bleeding or damage to bronchi.

#Patient with chest trauma is treated by

- 85% by chest tube
- 15% by thoracotomy

#Indication of Thoracotomy:

- Initial gush of 1500 cc of blood or 250cc/hr. for the first 3 hours (Suggests continuous bleeding which needs repair)
- Heavy air leak in pneumothorax (suggests bronchial injury)
- Thoracic duct injury
- Late complication like: Empyema, Fibrosis, Lung abscess, Broncho-pleural fistula.
- Esophageal injury
- Tracheal fracture: causes stridor, managed by thoracotomy and repair.
- Great vessel injury or cardiac injury
  - Most pt. with aortic injury don't reach ER (95%) only 5% reach with high risk of death during surgical intervention.
  - If aortic injury is small causing an aneurysm its presentation will be late and managed by elective thoracotomy and repair.

((Chest Tube))

#General information

- It is closed drain.
- To isolate the atmospheric pressure from the pleural pressure the tube should be placed in an **underwater seal** of about 200-300 cc of normal saline, so the air can`t return back into the pleural cavity.
- We do under water seal and not emptying the pleura directly and completely to avoid rapid lung expansion.
- In aspiration and insertion of chest tube ➔ we should insert in the upper border of the rib to avoid injury to neurovascular bundle.

#Indications

- Complex pneumothorax
- Pneumothorax on positive-pressure ventilation
- Hemothorax
- Large plural Effusion
- Empyema
- Chylothorax

#Contraindications

- Bleeding diathesis
- Coagulopathy

#Site of insertion

- It is inserted in the **Triangle of safety** which has the following boundaries:
  1. Anteriorly → posterior border of pectoralis major muscle.
  2. Posteriorly → anterior border of latissimus dorssi.
  3. Inferiorly (base) → the 5^{th} intercostal space.
  4. Superiorly (apex) → the base of axilla.
- A line is made in the triangle at the mid-axillary line and the tube is inserted at the level of this line in the 4^{th} or 5^{th} intercostal space.

#We should know the followings:

- Contents of the tube and bottle.
- Amount of the contents.
- If the chest tube is functioning or not**:**
  - Swinging movement of fluid in the tube, if not ask the patient to cough**.**
  - Air bubbles**.**

#when we should remove chest tube?

A-In pneumothorax

1. If there is no air bubbles or air leak.
2. If there is no swinging movement.
-
- Clump the tube for 24 hr. and do X-ray, if the lung expanded open the clump and ask pt. to cough if there are air bubbles leave the tube , if not, remove it.

B-In hemothorax or chylothorax or pyothorax

- No discharge for 24-48 hr.

C-In effusion

- If there is Small amount of fluid we can remove the tube (large amount → not remove it).
- Depend on the fluid collection in the bottle and the X-ray.
- Normal plural fluid is 50-100 cc.

#Complications

- bleeding
- Organ perforation
- Intercostal neuralgia
- Tube blockage
- Subcutaneous emphysema
- Re-expansion pulmonary edema
- Local infection and empyema

>> For more information see the following videos <<

http://www.muhadharaty.com/lecture/1677

http://www.muhadharaty.com/lecture/1678

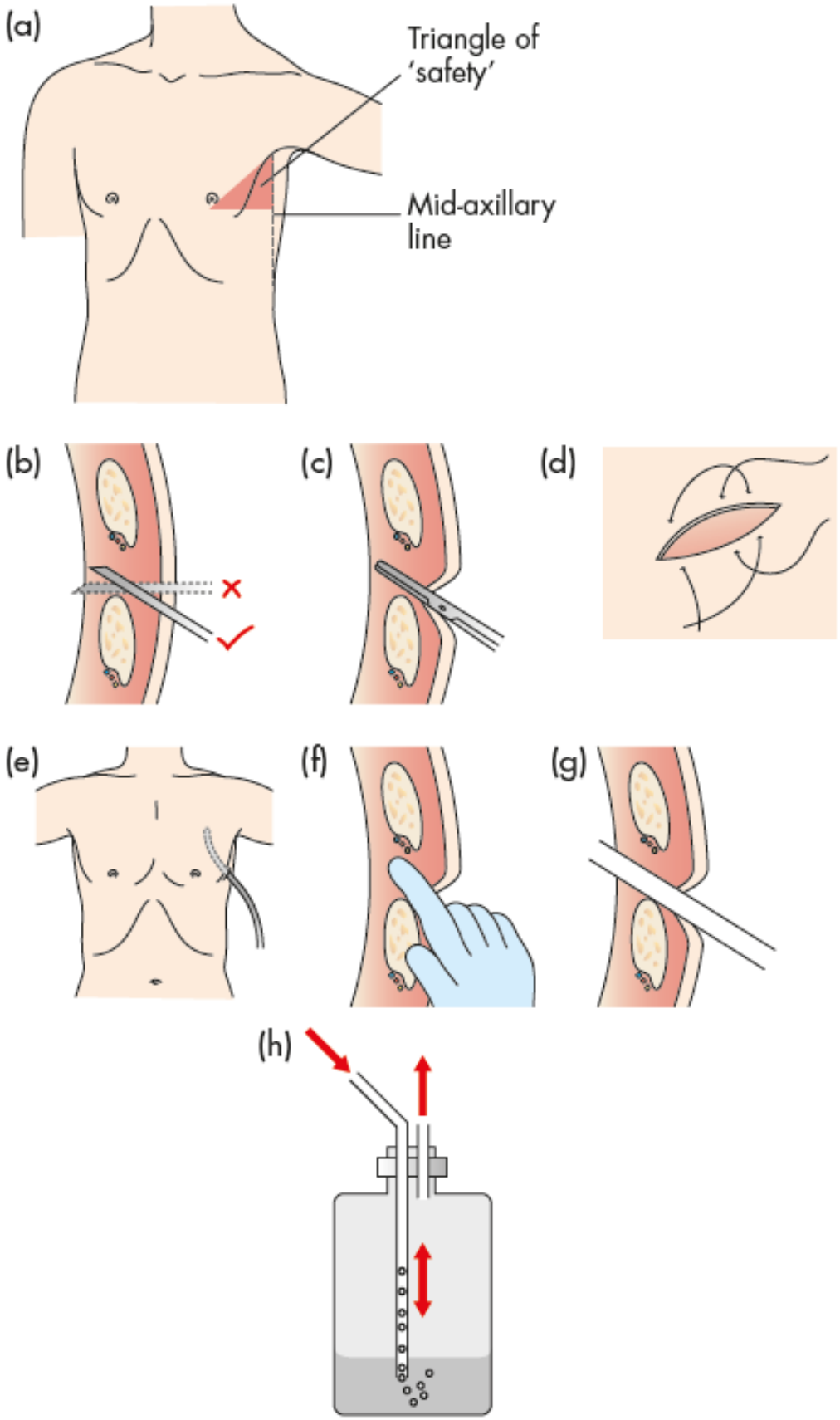


Figure 55.7 Insertion of chest drain: (a) triangle of safety; (b) penetration of the skin, muscle and pleura; (c) blunt dissection of the parietal pleura; (d) suture placement; (e) gauging the distance of insertion; (f) digital examination along the tract into the pleural space; (g) withdrawal of central trochar and positioning of drain; (h) underwater seal chest drain bottle.

Part:2 Surgery

Death in Chest Trauma

Causes of early death in patient with chest trauma:

- Upper airway obstruction
- Massive hemothorax
- Tension pneumothorax
- Open pneumothorax
- Flail chest injury
- Pericardial tamponade

Note:
Simple pneumothorax:

- Simple symptoms or may be asymptomatic
- Mostly occurs in patient with Marfan`s syndrome
- Normal vital sign

(1) Upper airway obstruction

#Causes

- Direct injury leads to edema, hematoma or blood clots obstructing the airways.
- Foreign body aspiration
- Secretions in unconscious patients
- Tongue swallowing
- External compression

#Management

- Position: left lateral position with traction of the angle of mandible anteriorly
- Sucking: any forging body or secretion by the sucker
- High flow O2
- Endotracheal tube: placement from the mouth
- Tracheostomy with use of endotracheal tube: when approach from the mouth is not possible due to fascial trauma or other causes.
- Laryngoscope: sometimes used to open the upper airway.

(2) Massive hemothorax

When 1000-2000ml (or 1.25-1.5 L in other reference) of blood is collected in the pleural cavity initially ➔ It is called massive hemothorax.

#Causes

- Laceration of the lung

- Injury of great blood vessels
- Injury to intercostal artery
- Injury to bronchial artery

#Management

- Give blood + I.V fluid.
- Put the chest tube.
- Do Thoracotomy ➔ done if there is continuous bleeding of 300 cc of blood in 3-4 hours, thoracotomy will stop the bleeding.

Note: 85% of all chest trauma ➔ need chest tube only.

15% of all chest trauma ➔ may need thoracotomy.

(3) Tension pneumothorax

Presence of air under tension (high pressure) in the plural cavity due to one way valve mechanism. It lead to lung collapse and pressure on the other lung and mediastinal structures and push them. It comprise inferior and superior vena cava (lead to shock) and pressure on right and left atrium (lead to hypotension).

#Causes

- Trauma
- Disease or (spontaneous)
  - Tuberuclous
  - Non-Tuberculous:
    a. Rupture of emphysematous bullae (diameter= 2 cm or more)
    b. Rupture of emphysematous bleb
    c. Rupture of solitary lung cyst
    d. Honeycomb lung or cystic lung
    e. Idiopathic in young smoker patient
    f. In patient with Marfan's syndrome (usually simple pneumothorax that progress to tension)

#Diagnosis:

- History:
  - The patient present with severe sudden dyspnea
  - Sometimes chest pain
  - Healthy young patient
  - Previous attack

- Clinical examination:
  - Hyper-resonant on percussion.
  - Asymmetrical chest movement.
  - Tracheal deviation and mediastinal shifting toward opposite side.
  - Vocal fremitus (tactile fremitus) is decreased or absent.
  - Absence of breath sounds.
  - Hypotension or shock (CVP is 10-15mmHg) and engorged neck veins due to compression of large vessels that impair venous return.
- Do Needle aspiration

#Management

- Needle puncture or needle decompression (wide bore needle): in the 2nd intercostal space at the level of mid-clavicular line, converting it into open pneumothorax allowing air to escape into atmosphere thus temporarily relief the tension pneumothorax.
- Chest tube: with underwater seal is done after needle decompression.
- Thoracotomy: according to indication.

(4) Open pneumothorax

Associated with external trauma (Sucking wound)➔ the air enter through the defect in the chest wall during inspiration and go out with expiration. Patient presented with dyspnea.

#Management

- Closure of the wound by either suturing or gauze
- Chest tube

(5) Flail chest injury

- Characterized by paradoxical movement of segment of the chest with respiration:
- In inspiration → the lung go in (collapse)
- In expiration → the lung go out (expansion)

#Cause:

Blunt or penetrating trauma lead to Fracture of ribs:
1-Multiple (more than 3 ribs)
2-Successive
3-Fracture at least in two sites in each rib

#Management

- Rest and immobilization (no movement of the chest).

- Intubation may be needed with high flow oxygen.
- Fixation of the segment by :
  - Plaster
  - Traction
  - Suturing the ribs by using steel wire
  - Thoracotomy
- Chest tube
- Mechanical ventilation (IPPV) in severe cases (anesthesia + endotracheal tube).

#Flail chest may be accompanied by

- Interruption in respiration, leads to respiratory compromise.
- Lung contusion.
- Disease in the lung, mediastinum, pneumothorax, hemothorax.

(6) Pericardial tamponade

- It is characterized by presence of blood in the pericardium.
- Acute form of pericardial effusion clinically characterized by **Becks triad**:
  - Hypotension
  - Engorged neck veins (elevated JVP)
  - Muffled heart sounds
- To improve the diagnosis → do CXR Echo study of the heart

#Cause:

- Trauma.
- Infection mainly in Iraq due to TB, or other causes as uremia or hypoproteinemia.
- Disease (pericarditis, bacterial, inflammatory, malignant, TB) with presence of fluid in all of these diseases.

#Amount of blood:

- Acute tamponade ➔ 100 cc of blood
- Chronic tamponade ➔ 700-1000 cc of blood (chronic tamponade occur in pericarditis due to TB, renal failure, liver failure, heart failure, tumor)

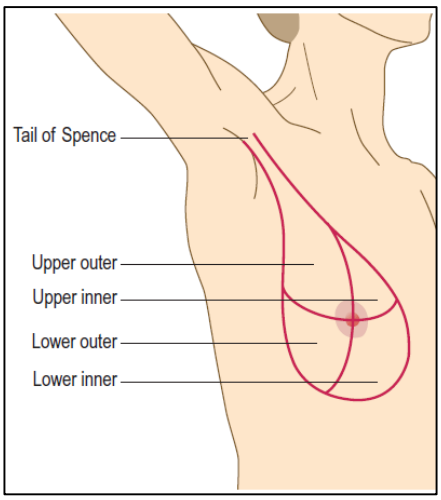
#Management

- Pericardiocentesis with echo guidance. (using needle or catheter for few days)
- Thoracotomy if bleeding is continuous or if recur**.**
- In chronic case: do aspiration + continuous catheter in the pericardium → take blood for investigations (culture + chemical)

Part:3 Surgery

The Breast

#General information



- The breasts are modified sweat glands.
- Composed from lobes → lobules → lactiferous duct
- Pigmented skin covers the areola and the nipple, which is erectile tissue.
- The openings of the lactiferous ducts are on the apex of the nipple.
- The nipple is in the fourth intercostal space in the mid-clavicular line, but accessory breast/nipple tissue may develop anywhere down the nipple line (axilla to groin).
- The adult breast is divided into the nipple, the areola and four quadrants, upper and lower, inner and outer, with an axillary tail projecting from the upper outer quadrant.
- upper lateral quadrant → the most quadrant that affect by malignancy
- 99% of breast cancer occur in female and only 1% in male (more aggressive in male)
- The breast is bounded by the clavicle superiorly, the lateral border of the latissimus muscle laterally, the sternum medially, and the infra-mammary fold inferiorly.
- Conservative breast surgery → radiotherapy + removal of the breast.
- If there is metastases to the spine there will be tenderness and pain on raising the leg and absent knee jerk due to damaging effects on the nerves.

#Lymph nodes

- Lymph drainage of the breast:
  - 70% to the axillary LN
  - 20% to the supraclavicular LN or along the internal mammary vessels
  - 10% to the abdominal LN
- Axillary L.N divided into five groups:
  - Anterior (Pectoral)
  - Posterior (Subscapular)
  - lateral
  - Medical (Sub-clavicular)
  - Central (intermediate)
- Surgical levels of axillary L.N:
  - Level I → bottom level, below the lower edge of the pectoralis minor muscle
  - Level II → lies underneath/posterior the pectoralis minor muscle
  - Level III → above/medial the pectoralis minor muscle

- When there is breast cancer and axillary L.N affected ➔ means metastatic and systemic disease.
- Sentinel L.N (first L.N adjacent to the cancer) ➔ to see if there is metastases make injection of methylene blue or radioactive substance then take biopsy and examine it.

#History

- **Questions**:
  - How long have symptoms been present?
  - What changes have occurred?
  - Is there any relationship to the menstrual cycle?
  - Does anything make it better or worse?
- **Age**:
  - young patient (15-25 years) → fibro-adenoma
  - middle age (25-40 years) → ANDI (Aberrations in the normal development and involution) due to hormonal changes like prolactin and sex hormones
  - old age (more than 40 years) → cancer of the breast
- **Questions of lump** (Cause - first symptoms - onset - duration - associated symptoms – progression - multiplicity)
- **Presentation**: discharge – lump – skin changes
- **History of trauma**: lead to fat necrosis which appears as a mass
- **History of breast surgery and biopsy**
- **Family history**: 5-10% of breast cancer run in family
- **Risks** that increase the probability of breast cancer occurrence:
  - Number of menstruation (increased number →more risk)
  - Nulliparous (more risk)
  - Unmarried (more risk)
  - Lactation (protective)
- **Drug history**: estrogen – progesterone
- **Obesity**: increase the level of estrogen
- **Sex related hereditary diseases**
- **Menstrual history:** Menarche, menopause, changes during the menstrual cycle, pregnancies, lactation.
- **Social history**: smoking – alcohol – diet (fat, animal meat, low fiber, pickles)

#We should examine the following for complete breast exam:

- Both breasts
- The axilla
- The supraclavicular LN
- The abdomen for a-Hepatomegaly b-Ascites

- Do PR to check Douglas pouch for metastasis
- Examine the spine for tenderness
- Do knee jerk and straight leg raising test

#Breast clinical examination

1. Settings:

- Position: The patient must be undressed to the waist, resting comfortably at 45 degree. Ask her to rest her hands on her thighs to relax the pectoral muscles. Other positions: supine or setting 90 degree
- Explain what to do to the patient
- Always examine the patient with nurse or relatives
- Clean your hand – good light – humidity – temperature

2. Inspection:

- Face the patient and look at the breasts for: asymmetry, local swelling, dilated veins skin changes (lump, ulcer, puckering, peau d'orange, scar, fungation), nipple changes (discoloration, discharge, destruction, depression, deviation, displacement, duplication)
- Nipple discharge: one or two breast, single or multiple duct, type of discharge (serous, blood, mixed)
- Ask the patient to press her hands firmly on her hips to contract the pectoral muscles and inspect again for invisible lumps.
- Ask her to raise her arms above her head and then lean forward to expose the whole breast and exacerbate skin dimpling.
- Elevate the breast with your hand to uncover dimpling overlying a tumor which may not be obvious on inspection.
- Examine the arm

3. Palpation:

- Ask her to lie with her head on one pillow and her hand under her head on the side to be examined.
- Hold your hand flat to her skin and palpate the breast tissue, using the palmar surface of your fingers to compress the breast tissue firmly against her chest wall.
- Begin with the symptomless side, or you can examine both sides simultaneously.
- View the breast as a clock face. Examine each 'hour of the clock' from the outside towards the nipple, including under the nipple. Examine all the breast tissue.
- Compare the texture of one breast with the other.
- Define the characteristics of any mass:

- Characteristics: site, size, shape, surface, edge, pain, temperature (raised in inflammation)
- Content: Fibro-adenoma (rubbery) Cyst or glactocele (soft) Cancer (hard)
- Levels of the mass: attach to the muscle or skin (pinch the skin out), mobility, tethering (mass sometimes fixed and sometimes mobile or mass move separately from the skin)
- TNM staging (from lecture)

- Relations to structures beneath the breast is tested by holding the mass between your thumb and forefinger with the patient's hands on her hips. Ask her to push her hands against her hips (contract pectoralis muscle) and then push the examiners shoulder (contract serratus anterior). If the lesion is less mobile, it is either fixed or tethered.
- **Examine the axillary tail** between your fingers and thumb as it extends towards the axilla.
- **Palpate the nipple** by holding it gently between your index finger and thumb. If the patient complains of discharge, try to express it by massaging the breast towards the nipple & gently pressing the nipple to uncover any discharge. Note the color and consistency of any discharge, along with the number and position of the affected ducts. Test any nipple discharge for blood using urine-testing sticks.

4. **Examine the supraclavicular fossa,** looking for any visual abnormality.
5. **Palpate the regional lymph nodes (axillary and neck)**
6. **Examination of axilla**: right axilla examine by left hand and vice versa (we shi=ould make relaxation of the patient hand)
7. **Examine site of malignancy**: back (spine tenderness) abdomen (hepatomegaly – ascites)
8. **Do P.R examination**: for krukenberg tumor
9. **Back examination**: metastasis of breast cancer to venous plexus

#Triple assessment of the mass

1- History and Examination
2- Radiology
   - Ultrasound: mass, cyst, abnormality
   - Mammography: it is X-ray, see soft tissue of the breast, do to 35 years old patient or older, if done to young patient it will make more dense tissue (less soft tissue), it has lateral view and medial oblique view, it used to see if there is malignancy in the breast
3- Biopsy: incisional biopsy, excisional biopsy, fine needle aspiration, whole organ biopsy
4- Extra: MRI, CBC, Others

#Notes

- Clinical presentation of breast symptoms:
  1. Painful lump (Abscess (postpartum or lactational, cyst, periductal mastitis (duct ectasia), fibroadenosis, very rarely Ca)
  2. Painless lump (Carcinoma, cyst, fibro-adenoma, fibroadenosis)
  3. Pain without lump (mastalgia) cyclical or non-cyclical breast pain, very rarely carcinoma.
- Causes of Inversion or retraction:
  1. Cancer slit like inversion of the nipple
  2. Genetic
  3. Puberty
  4. Fungal infection
- Retraction: circumference (benign or congenital) slit like retraction (cancer)
- MOST common cause of nipple discharge is lactation
- Discharge could be either:
  1. Milky or serous (normal)
  2. Bloody or pinkish in papilloma (most common cause) or carcinoma.
  3. Purulent due to infection
  4. Greenish, brownish or black in duct ectasia.
- Question-Difference between fixity and tethering?
  1. Fixity: When a lesion is fixed to the skin, it has spread into the skin and cannot be moved or separated from it.
  2. Tethering: A tethered lesion is one which is more deeply situated and distorts the fibrous septa (the ligaments of Astley Cooper) that separate the lobules of breast tissue. This puckers the skin, but the lesion remains separate from it and can be moved independently.

>> For more information see the following video <<

http://www.muhadharaty.com/lecture/1679

Part:4 Surgery

Vascular Trauma

#General information

- Vascular trauma → trauma to the arteries or veins
- Consequence → ischemia or bleeding
- Bleeding:
  - Arterial: jetting + bright color
  - Venous: continuous + dark color
  - Concealed: internal → in the cavities like pleura, peritoneum, pericardium
  - Revealed: external
- Unrecognized and untreated bleeding → lead to loss of organ (death) or gangrene
- Ischemia:
  - Convert aerobic respiration to anaerobic lead to metabolic disturbances lead to inflammatory response (SIRS)
  - Signs of ischemia (5Ps) Pain – Pale – Paralysis – Paresthesia – Pulseless
  - Acute ischemic limb is due to trauma, thrombus, embolus
  - Chronic ischemia is due to ischemic disease like atherosclerosis lead to some symptoms like claudication
- Unrecognized and untreated ischemia → lead to limb lose, stroke, bowel necrosis, multiple organ failure
- Clot (outside the vessel) Thrombus (inside the vessel)
- Source of embolus:
  - Heart (in atrial myxoma, septic embolus from infected endocarditis)
  - Fat embolus
  - Air embolus
  - Tumor
- Virchow's triad:
  - Endothelial dysfunction or damage
  - Stasis
  - Hypercoagulability
- Venous injury, leading to bleeding and thrombosis.

#Mechanism of vascular trauma

1- Laceration:

- As bullet or shell or stab wound.

- Could be complete or partial cutting of the vessel.
  - Partial: more bleed, less spasm, more dangerous, lead to retraction (increase bleeding) // partial cut lead to expanding pulsating hematoma.
  - Complete: less bleed, more spasm, less dangerous, contraction, spasm of both end of the artery reduce bleeding or thrombus reduce bleeding or retraction reduce bleeding
- Partial cut produce more profuse bleeding than complete cut (Why?):
  Because when there is complete cut, the proximal and distal ends of the vessel undergo vasospasm and retraction in addition to compression from surrounding tissues, while in partial cut the retraction of the vessel will increase the cut opening and thus increases the bleeding. In addition bleeding into the surrounding tissues will lead to formation of hematoma which it is pulsatile in partial cut (due to communication with vessel lumen) and usually not pulsatile in complete cut.

2-Blunt:

- As crush injury
- Lead to thrombosis → ischemia → acute ischemia of the limb.
- A blunt trauma to the artery cause injury to the intima that can end in:
  - Exposure of the sub-endothelial collagen lead to activation of clotting mechanism and thrombosis that lead to obstruction of blood flow lead to ischemia of the distal tissues.
  - The intima itself my flap and act as a valve in the artery, obstructing blood flow.

- Pseudo-aneurysm: it is a pulsatile mass of clot surrounded by membrane or surrounding tissue, it result from arterial hemorrhage within contained hematoma.
- Artero-venous fistula:
  - result from injury to adjacent artery and vein
  - which may lead to subsequent rapture or cardiovascular compromise
  - lead to dilated veins and thick wall veins and increase venous pressure
  - lead to thrill and bruit

#Diagnosis of vascular trauma

1- **Clinical diagnosis:**
   - Hard sign of vascular injury:
     - Pulsatile bleeding
     - Expanding hematoma
     - Absent distal pulses
     - Cold, pale limb
     - Palpable thrill
     - Audible bruit

- Absence of hard sign of vascular injury virtually excludes the presence of vascular trauma.
- Sometimes there is no hard signs but the patient has ischemia ((risk of old age, history of bleeding))
- Presence of hard signs mandates immediate operative intervention ((Time is only **6 hours**, if late lead to irreversible ischemia.
- Signs that mean the limb is not dead yet: capillary refill + movement of the limb.

2- Investigations:

- Doppler US (called duplex Doppler)
- Angiography (done by catheterization)
- CT angiography (less invasive, give I.V contrast)

#Management of vascular trauma

1- Arrest bleeding:

- Pressure: especially venous bleeding.
- Position: depend on the site of bleeding specific positions will reduce bleeding.
- Packing: by using our hands or fingers! Or by using bandages or tourniquet, in areas where bandage or tourniquet can't be used as below the angle of mandible we can use folly's catheter, by inserting it in the wound as deep as possible then inflate its balloon which will provide pressure on the bleeding vessel.
  *** Time limit for tourniquet is 30-45 min, to prevent ischemia, and also we have to write the time of application of the tourniquet so when the pt. reach the hospital or special center, the doctor who will receive him will know the time of its application.

2- I.V line:

- Sample (blood group, cross matching).
- Assessment of vital signs (PR, BP, urine output).
- Volume replacement (give amount of fluid that keep blood pressure between 90 and 100 mmHg to avoid ischemia and hypertension.
- Give normal saline or ringer lactate
- Give blood and clotting factor as necessary are administered to correct hypothermia, acidosis, coagulopathy, restore perfusion
- Not give large amount of fluid to avoid:
  - increase blood pressure
  - dislodgment of clot or thrombus lead to bleeding
  - hemodilution (affect clotting mechanism)
  - hypothermia
  - electrolyte dilution

3- **Surgical treatment:**
   - Vascular clamp: We apply tourniquet proximal to the arterial injury, then we close the proximal and distal ends of the injured artery and stop bleeding, after this we remove the tourniquet to allow blood flow through collateral vessels to the distal tissue.
   - Trimming of the artery.
   - Saphenous vein graft: if there is gap, and we should reverse the direction of saphenous vein because it contain valves, use saphenous vein because it is available without infection and low complications.
   - End to end anastomosis: use **prolyn** (non-absorbable monofilament suture).
   - Not do anastomosis to irreversible ischemia to avoid ischemia perfusion syndrome:
     - Activation of cellular and humeral immunity
     - Collection of toxic material like lactic acid and potassium
     - Lead to cell edema

#Compartment syndrome:

- Ischemia leads to cell membrane dysfunction and thus causes efflux of electrolytes (mainly potassium) from the cells into surrounding tissues, thus increases the osmolarity extracellularly leading to shifting of fluid into the interstitium, which lead to formation of edema which compress the vessels more and causing more ischemia.
- Clinical features:
  - Severe pain
  - Tenderness
  - Weak or no pulse
  - Tense calf area
  - Homan's sign
- Diagnosis:
  - Clinically
  - Probe: to measure the pressure in the compartment (30 mmHg)
- Management:
  - Opening the compartment by fasciotomy if the intracompartment pressure more than 30mmHg, but we do it prophylactically regardless of the pressure inside it.

#Reperfusion Syndrome:

- Ischemia leads to accumulation of the following:
  1-Pottasium (efflux from cells due to membrane dysfunction)
  2-Lactic acid (due to anaerobic metabolism)
  3-Free radicals

- After restoring perfusion the above will enter into the systemic circulation and affects the body tissues and mainly the heart and it may cause:
  1-Cardiac Arrhythmia or Arrest
  2-Metabolic acidosis
- Sometimes it is asymptomatic and these changes will reverse by physiological mechanisms of the body.
- Treatment: Steroids to prevent SIRS, NaHCO3 to prevent acidosis, Ca gluconate to reverse the effect of potassium.

#History of ischemic limb

- History of claudication
  - intermittent pain on waking or exercise for distinct distance (differ from patient to other)
  - Relieved by rest
  - occur in the calf, thigh, buttock, may occur in the arm
  - Leriche's syndrome (claudication in the buttock)
- Color changes (dusky, bluish, reddish, black)
- Pain, Pale, Paresthesia, Paralysis
- Night pain
- previous amputation or loss of limb

#Vascular examination

Steps of assessment of arterial circulation:

1- Inspection

- Check pressure area (heel, medial and lateral malleolus, tips of toes, below calf muscles)
- Check hidden area (popliteal fossa, between toes → see laceration, cracks)
- Skin changes (color, bleeding disorders)
- Wasting and deformities
- Hair destitution and loss
- Gangrene and ulcers
- amputation and loss of toes
- guttering vein (groove)

2- Palpation

- Skin temperature (in ischemia → cold limb, in infection → warm limb)
- Tenderness

- Edema (pitting, non-petting)
- Thrill (in vascular lesion or mass)
- Capillary filling test (more than 2 sec → ischemia, test in the tips of finger nail)
- Burger's angle or vascular angle (patient lie supine and elevate his leg 90 degree then it will become pale if there is ischemia) (The angle increase in severe disease)
- Capillary refilling time (done after burger's test → the limb become purple dusky in color)
- Ulcer examination
- Mass examination
- Amputation → levels of amputation:
  - Toe and head of metatarsal (Ray excision)
  - Trans-metatarsal
  - Through ankle
  - Below knee
  - Through knee
  - Above Knee
  - Head of femur (called disarticulation)
- Palpate peripheral pulses
- **Allen's test**: To determine which artery is not dominant, so we can remove it and put it in the heart if needed.

3- Auscultation

- Listen for bruits
- Measure the blood pressure and index

4- Do investigations

- Random glucose
- Blood urea and nitrogen
- Lipid profile
- Bilirubin level
- Doppler or Duplex

#Examination of arterial pulses

- When examining any pulse, we should know:
  1-Rate
  2-Rhythm
  3-Volume
  4-Character
  5-Consistency of arterial wall
- Lower limb pulses:
  <u>1-Femoral pulse</u>; can be felt in the midinguinal point midway between symphysis

Causes of Radio-femoral delay:

1- Coarctation of aorta

2- Aortic aneurysm

3- Aortic dissection

pubis and anterior superior iliac spine, just below the inguinal ligament.
2-Popliteal pulse; you can fell it by three maneuvers:
a-On supine position either by flexion of knee joint 120 degree and by putting our thumbs of the two hands on the tibial tuberosity and using other fingers palpating deeply in the popliteal fossa. Or by hyperextension of the leg at knee joint and pushing by one hand over the knee and palpating by the other hand.
b-On prone position
c-Sitting position by placing one leg over the other and look for leg movement from pulsation (May be seen in popliteal aneurysm or in normal variant).
(Don't feel sad if u didn't feel the popliteal pulse! Usually it is hard to feel but if its easily felt always suspect popliteal artery aneurysm).
3-Posterior tibial artery; 2cm below the medial malleolus or midway between the heel and medial malleolus,
4-Anterior tibial artery; at the ankle joint, midway between the medial and lateral malleolus.
5-Dorsalis pedis artery; lies lateral the tendon of extensor halluces longus muscle or bet. The 1st and 2nd metatarsal bones.

- Upper limb pulses:
  1-Brachial pulse; you can feel it by asking the pt. to contract his biceps and locate its tendon, the artery lies medial to the tendon.
  2-Radial pulse; lies lateral to tendon of flexor carpi radialis muscle.
  You should remember that examination of pulses is part of vascular examination which includes inspection, palpation, and auscultation.

#Examination of varicose veins

When there is suspected sapheno-femoral varix or perforating varices we can differentiate between them by one of the following tests:

1-Trendelenberg test:

The patient is in supine position and the his/her legs above the level of the heart and pressure us applied at the saphenofemoral junction and then ask the pt. to stand up and inspect if there is :

a-Refilling within 3-5 sec, this is normal

b-Refilling after 20 sec or no filling this indicate incompetent superficial veins

c-If there is rapid filling of the veins this indicate non-competent valves of the communicating branches.

2-Tourniquet test:

Same as above, but the tourniquet is applied instead of the pressure and the same findings are presented to determine whether the incompetency site:

1-above the knee, incompetence in the perforators of the thigh

2-below the knee, incompetence between the short saphenous and popliteal veins.