Thoracic Emergencies

26

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Contents

Objectives

- Recognize patients requiring a needle thoracocentesis or an emergency chest tube insertion
- Perform safe thora(co)centesis or chest tube insertion
- Recognize when a patient needs an emergency pericardiocentesis
- Perform a subxiphoid pericardial window

Every general surgeon should be able to manage the following non-trauma chest emergencies:

- Tension pneumothorax
- Pleural effusions (compressive or empyema)
- Cardiac tamponade

26.1 Pneumothorax

26.1.1 Tension Pneumothorax

26.1.1.1 Causes

- Pneumothorax may occur spontaneously in non-trauma patient without apparent chronic lung disease (primary). This is usually subsequent to ruptures of small pulmonary blebs.

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- Pneumothorax may also occur in patients with chronic lung disease ("secondary"); e.g., emphysema, tumors. In that case, the rupture involves bullae or diseased pulmonary parenchyma.

26.1.1.2 Diagnosis

- Main symptoms:
  - Chest pain and shortness of breath
  - High-pitched sounds on percussion
- Chest X-ray: confirmation of pneumothorax and determination of volume
- Tension pneumothorax (one-way air leak)
  - Rare
  - May lead to respiratory distress, oxygen deprivation, tachycardia, hypotension, tracheal deviation, and cardiac arrest
    Specifically when there is preexisting impaired lung function

26.1.1.3 Indications

- When symptoms are severe, urgent insertion of chest tube is needed.
  - Initial management by needle decompression is easy and allows to gain time.

26.2 Liquid Pleural Effusions

26.2.1 Types of Effusion and Causes

- Blood: primary spontaneous hemothorax (can occur in patients under anticoagulant treatment).
- Pus: thoracic empyema (or pyothorax) can be responsible for poor clinical status and respiratory failure.
- Serous liquid: secondary to pulmonary infection, pulmonary embolism, cancers, etc.

26.2.2 Diagnosis

- Relies on symptoms (dyspnea, chest pain), chest percussion, chest X-ray, and CT scan.
  - Symptomatology depends on the volume of the collection.
- Pleurocentesis can identify the nature of the aspirate (blood, pus, serous liquid, transudate, exudate, etc.)

26.2.3 Indications

- Most pleural effusions can be managed initially by medical physician's referral to thoracic or cardiovascular surgeon and may be necessary according to the type and nature of the pathology.
- Two circumstances require urgent treatment:
  1. Respiratory failure (dyspnea, cyanosis, hypoxemia, etc.); insert a chest tube promptly
     - Pleurocentesis can improve the clinical status of the patient before the chest tube is inserted.
  2. Purulent collections found on pleurocentesis or empyema
     (a) Definitions:
        i. Empyema means pus in a natural cavity.
        ii. Thoracic empyema means pus in the pleural cavity.
     (b) Diagnosis can be
        i. Frank pus is found
        ii. Or demonstration of organisms by direct examination or culture
        iii. And/or biochemical criteria such as pH <7.2, WBC >15,000, LDH >1,000 IU/ML, and glucose <400 mg/l
- Chest tube thoracotomy with IV antibiotics
  - Thoracocentesis constitutes the first step of the treatment.
    May be sufficient (success rate is 70 %)
  - Should be followed by drainage thoracostomy
    To allow complete evacuation of accumulated pus
  - In case of failure (multiloculated effusion) and according to the stage of the empyema, surgery is necessary.
    To clean the pleural cavity
    To perform decortication as needed (Fowler-Delorme procedure)
    - Can be performed via VATS or thoracotomy
    - Referral to specialized centers and/or surgeon preferable

26.2.4 Thoracentesis (Also Called Thoracocentesis or Pleurocentesis) and Chest Tube Insertion

26.2.4.1 Thoracocentesis or Pleurocentesis (Pleural Tap)

- Equipment:
  - 20 cc syringe
  - Intramuscular (IM) needle
  - Xylocaine
  - 20 gauge catheter or better, a Veress needle
    Longer and reaches the pleural collection easily when the chest wall is thick.
    Retractable tip limits the risk of lung puncture.
- Puncture site
  - Pneumothorax best exsufflated in second costal interspace, just anterior to the midclavicular line.
  - In obese patients with thick chest wall, lateral approach in the fourth costal interspace anterior to the midaxillary line is preferred.
  - Fluid collection best treated by a posterior approach, just in the middle of area of matted percussion with patient sitting upright on the bedside and leaning forward on a table and arms over a pillow.
- Procedure
  - Anesthetize the chest wall from the skin to rib cage.
  - Infiltrate periosteum along the top edge of the selected rib.
  - Maintain continuous aspiration on the syringe when entering the pleural space.
    *Aspiration of air or pleural liquid confirms the correct position of the needle.
- Safety measures
  - Pleurocentesis safe at the upper edge of the rib since the interspace vessels are at distance.
  - It is critical that the patient holds his/her breath to avoid piercing the lung.

26.2.4.2 Chest Tube Insertion

- Equipment:
  - A straight drain (silicone or PVC) is generally used.
    Drains can be inserted with or without trocar and different devices exist.
    - The Joly-type trocar
      - Made of a sharp and large needle inserted in the drain lumen.
      - The whole device acts as a trocar and is inserted in the pleural space.
      - Is dangerous as the tip of the trocar is sharp and an uncontrolled push may puncture the lung, therefore the use of this device should be avoided.
    - The Monod-type trocar
      - Trocar sheath contains a blunt needle allowing the insertion of the device safely deep inside the pleura (devices with sharp needle should be avoided).
  - Some specific medical devices can be placed under ultrasound control by the Seldinger technique (Pleurocath®, Pigtail catheters).
  - The size of the tube remains empiric.
    Current trend is to use smaller guidewire-inserted drains, but randomized studies are required to confirm safety and efficacy.
    Classical tube sizes are 20 F or 24 F for pneumothorax and 28 F or 32 F for empyema.
- Site of drainage:
  - Typically inserted in the third or fourth interspace on the midaxillary line.
  - When collection is not dependent, a CT or ultrasound scan can help locate the optimal site of drainage.
- Procedure:
  - Patient supine, arms in abduction
  - Table prepared for the sterile equipment.
  - Drains, trocars, connecting tubes, and water seal packs are checked, prepared, and should be ready to be connected before the skin incision.
  - Landmarks and anesthesia:
    Identical to those for pleurocentesis
    Adapt length of needle to chest wall thickness (long needle needed for obese)

Beware of absence of dependence of pleural effusion due to pleural adhesions
- Withdrawal of blood mixed with air means lung puncture.
  - Change to another site

– Drain introduction
1.5–2 cm skin and subcutaneous fat incision parallel to upper edge of selected rib
Create channel through muscles with blunt forceps (Kocher or Roberts) until reaching the elastic and firm consistence of the pleura
- This step may be slightly uncomfortable for the patient despite the local anesthesia.

Push closed forceps a few millimeters more in a firm but controlled manner, then open to enlarge the pleural opening and the muscular chest wall track
Retrieve forceps retrieved
Enlarge channel, clear potential adhesions, and control sudden issue of fluid with gloved finger
Insert trocar (Monod) or tube perpendicularly then guided posteriorly and upward
Retrieve blunt shaft
Clamp the proximal end of thoracotomy tube
Advance tube into pleural space to the desired length (10–15 cm)
Remove trocar sheath, maintaining drain in place
Connect drain to water seal container before releasing clamp and applying controlled depression (20 cm water)
Fix drain to skin with a mattress "U" stitch (as effective as a purse-string stitch and will make a more cosmetic scar)
- Add stay stitch to close the skin for the drain removal.
- Extra stitches will ensure fluid or air tightness if necessary.
- Have an assistant carefully maintain the drain in place while stitching it to the skin and connecting to the water seal container.
- Follow-up: chest X-ray and CT scan are systematically performed.
- Pitfalls and difficulties:
  - Abutting on the cage rib and insertion of tube out of the chest cavity or between the pleura and the rib cage make progression laborious and painful.
    Many types of visceral injuries have been reported (lung, heart, liver, etc.).
  - Aspiration of liquid or air in the pleural space during local anesthesia.
  - Adequate length of skin incision guarantees for a safe and appropriate placement of the chest drain.

26.3 Pericardial Effusion and Cardiac Tamponade

26.3.1 Causes

- May be seen in association with cancer, infections (viral or bacterial), or various inflammatory conditions.
- Neoplastic and bacterial pericarditis are the most common causes of cardiac tamponade.

26.3.2 Diagnosis

- Development may be progressive and asymptomatic despite a large volume.
- Rapid development is poorly tolerated (even for small volumes) and can lead to tamponade.
  - Cardiac tamponade is suspected on signs like pulsus paradoxus, tachycardia, venous pressure elevation, hypotension, diminished heart sounds, low voltage ECG.
  - The chest X-ray can show an enlarged pericardial sac.
  - But diagnosis relies on echocardiogram.

26.3.3 Indications for Emergency Pericardial Drainage

- Not all pericardial collections require emergency drainage.
- Cardiac tamponade requires urgent treatment.
  - Pericardiocentesis grounded on echocardiogram (even in the absence of clinical tamponade)

And especially with signs of right ventricular diastolic collapse and/or right atrial collapse

- Optimal treatment of symptomatic pericardial effusions remains controversial.
  - Different procedures may be used.

Percutaneous pericardiocentesis:

- Blind pericardiocentesis carries a risk of myocardial injury.
  - Should be reserved for patients with life-threatening hemodynamic instability and absence of echography
  - Best performed under ultrasound or electrocardiography
  - Requires presence of trained and expert personnel
    - Cardiologist or a surgeon knowledgeable in echocardiography

    Needle site entry can be subxiphoid or transthoracic.
  - Advantage: avoids general anesthesia
  - Drawback: is associated with an increased recurrence rate (60 % according to some authors) and does not allow visualization and biopsy of the pericardium

The subxiphoid approach

- The most common approach
  - Insert 18 gauge catheter attached to 20 ml syringe through skin incision made a few millimeters inferior and to the left of the xiphoid process
  - Direct needle to posterior aspect of left shoulder, at approximately 30° angle

    Goal: enter the pericardium underlying the right ventricle
  - Flashback of pericardial fluid in the syringe means the needle has entered the pericardial sac.
- After pericardiocentesis, a drain may be inserted into the pericardial sac using a guidewire and a dilator as needed.

26.3.4 Pericardial Drainage (or Pericardiostomy)

- Allows
  - Placement of a larger tube
  - To break loculations with a finger or a suction device
  - Pericardial biopsy (useful to guide further treatment)
- Associated with lower recurrence rate
- Can be done via a subxiphoid (local anesthesia if necessary) or transthoracic approach (anterior thoracotomy or VATS)
- Aim: evacuate the collection, improve heart function, and sometimes ensure the diagnosis with pericardial biopsies and lab tests on the aspirate

26.3.4.1 Patient Position and Operative Setup

- Skin preparation and draping can be performed with patient sitting (semi-Fowler position), arms hanging, and when declivity is not well tolerated.
  - Operating field runs from the abdomen to the neck allowing a sternotomy if necessary.
  - Operator stands on the right with assistant opposite.
  - Surgical equipment:

    Langenbeck-type retractors.

    Toothed clamps (Bengolea or Kelly).

    Scissors.

    Dissecting forceps.

    N°11 scalpel blade on a long handle.

    A Veress needle will be of help to perform pericardiocentesis.

    Sternotomy instruments should be available in the room.
  - Anesthetic induction is a critical phase with a risk of sudden cardiac arrest specifically during intubation: all should be ready to intervene rapidly if necessary (clear leadership and calm and effective communication between the anesthetist team and the OR nurses are paramount.
  - In some circumstances, pericardiocentesis under local anesthesia is the first step allowing to optimize patient hemodynamics and safer anesthetic induction.

26.3.4.2 Procedure

- 6–8 cm incision centered on the xiphoid appendix, involving the lower part of the sternum and the upper part of the linea alba.

- Open linea alba.
- Blunt finger dissection keeping close contact with posterior aspect of xiphoid process, cephalad then to the left and laterally until reaching the yellowish pericardial fat covering the underlying grayish pericardial sac.
  - Place Langenbeck-type retractors placed under the sternum and the ribs to lift rib cage.
  - If recognition unclear, progressive, careful palpation (searching for heart beats) or cautious pericardial puncture (Veress needle).
  - Muscular insertions may be coagulated.
  - Depending on the patient anatomy, appendix may have to be resected (by electrocautery, scissors, or gouge forceps) when access to the pericardium is impaired.
- Inform anesthesiologist when opening the pericardial sac as patient hemodynamics may change dramatically.
- Grasp pericardial sac between two forceps, creating a fold which is incised with the tip of the scissors or the scalpel.
- Retrieval of liquid for culture, cytology, and chemistry.
- Create wide pericardial window (2 × 2 cm) to:
  - Aspirate all pericardial contents (false membranes and pockets of fluid may occur in infected pericarditis)
  - Explore the sac (nodules, vegetations, etc.)
  - Inspect external aspect of the heart
  - Insert silicone pericardial drain (20–24 French gauge)
- Retrieve sufficient specimen for histology.
- Leave pericardium open.
- Drain exits through a counter incision at either lateral aspect of the initial incision and connected to a dependent non-aspirating collector.
- Close linea alba and skin.
- Of note: opening the peritoneum is of no consequence.
- Postoperative prescriptions include:
  - Chest X-ray or an ultrasound scan
    Residual collection is frequent and should not worry the surgeon nor the patient.
  - Removal of drain on day 2 (some authors advocate day 4 or 5 in case of neoplastic pericardial effusion)

Nota Bene

- Both echocardiography-guided pericardiocentesis or pericardial open drainage are best dealt within a thoracic or a cardiovascular environment.
- When specialized surgeon is not available, pericardial drainage must be performed by a general surgeon.
- Secondary evacuation of a patient with cardiac tamponade is very dangerous with high risk of en route death.
- If the echography-guided pericardiocentesis is impossible, or not efficient, or if the surgeon is more comfortable with a surgical approach, the most common and simple procedure is the subxiphoid pericardial window.

Pitfalls

- Needle thoracocentesis: needle is too short = use Veress needle
- Chest tube: pleural adhesions, puncture of the lung = change site, use ultrasound
- Empyema: thoracocentesis alone is not enough
- Pericardial effusion and tamponade: failing to evacuate patient to a specialized center
- Not performing surgical open drainage in absence of expertise in echocardiography
- Insufficient exposure in subxiphoid pericardial window: routine resection of the xiphoid appendix

26.4 Summary

Non-trauma thoracic emergencies are pneumothorax or pleural effusion with impaired breathing, thoracic empyema, and pericardial effusions with cardiac tamponade. Tension pneumothorax or pneumothorax with respiratory failure (underlying lung disease) requires urgent drainage sometimes after needle thoracocentesis. Pleural effusions can contain blood (spontaneous hemothorax), serous fluid, or pus (empy-

ema). Urgent drainage is indicated in case of respiratory failure. Chest tube insertion with IV antibiotics constitutes the first step for emergency treatment of thoracic empyema. Non-trauma pericardial effusions are associated with cancer, infections (viral or bacterial), or various inflammatory conditions. Symptomatic pericardial effusions (clinical and/or echocardiographic signs of cardiac tamponade) require urgent pericardial drainage that can be performed either by a percutaneous pericardiocentesis (echocardiography guided) or by a surgical pericardial window: optimal treatment remains controversial, but subxiphoid pericardial window is the most common and most simple procedure for a general surgeon, especially if not knowledgeable in echocardiography.

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