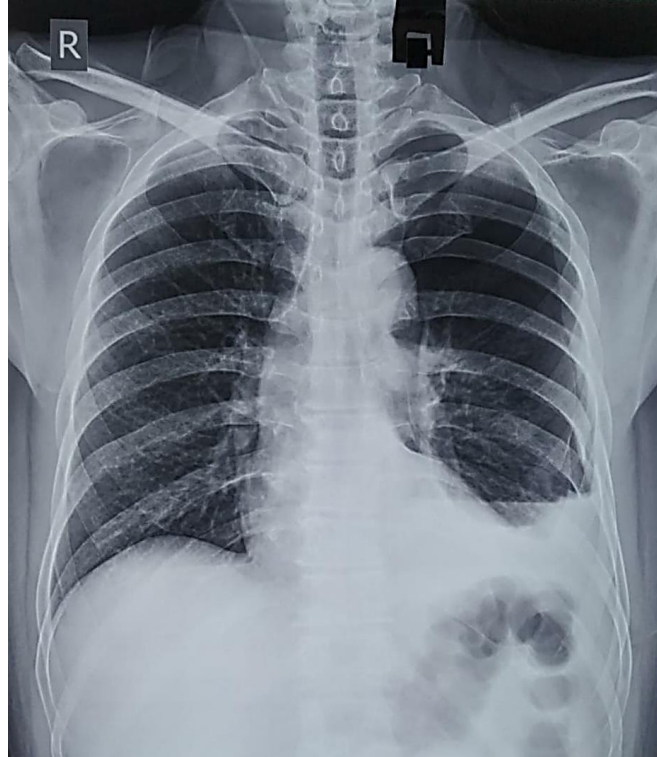


Case Brief

A 50-year-old male presents to the ER with shortness of breath after blunt trauma to the chest due to physical assault. BP is 110/70 mmHg.

On examination, the base is dull to percussion and the apex is hyper-resonant. On auscultation breath sounds are reduced on the left side.

Chest x-ray reveals the following.



A.) What is the definitive operative management in this patient?

Discuss in detail regarding the steps of surgery and briefly mention the complications of surgery.

B.) What would be the post-operative management of this patient?

The pre-op chest x-ray shows left sided pneumothorax with pleural effusion – possibly hemopneumothorax considering trauma.

Hence a tube thoracostomy is necessary immediately.



Skin preparation and marking.



Local anesthesia.



Skin incision.



Blunt dissection down to the intercostal muscle.



Palpation of the selected intercostal space and the superior margin of its inferior rib.



A closed and locked Kelly clamp is used to enter the chest wall into the pleural cavity. Make sure to guide the clamp over the upper margin of the rib.



Once the Kelly clamp enters the pleural cavity, the clamp should be opened to further enlarge the opening.



A finger is used to palpate the tract and feel for adhesions before insertion of the chest tube.



The proximal end of the chest tube is held with a Kelly clamp that is used to guide the chest tube through the tract. The distal end of the chest tube should always be clamped until it is connected to the drainage device.



Connection of the chest tube to a drainage system.



A 0 or 1-0 silk or nylon suture is used to secure the chest tube to the skin.



Apply petrolatum (eg, Vaseline) gauze over the skin incision.



Apply support gauze dressing around the chest tube and secure it to the chest wall with 4-in adhesive tape.

- 1.** Position the patient.
- 2.** Clearly mark the site of chest tube insertion (right or left).

Identify the fifth intercostal and the midaxillary line. The skin incision is made in between the midaxillary and anterior axillary lines over a rib that is below the intercostal level selected for chest tube insertion. A surgical marker can be used to better delineate the anatomy.
- 3.** Shave excessive hair and apply a preparatory solution to a wide area of the chest wall as shown below.
- 4.** Wear sterile gloves, gown, hair cover, and goggles or face shield, and apply sterile drapes to the area.

Administer analgesia. Administer a systemic analgesic (unless contraindicated). Use the 25-ga needle to inject 5 mL of the local anesthetic solution into the skin overlying the initial skin incision, as shown in the image below. Redirect the needle to the expected course of the chest tube (following the upper border of the rib below the fifth intercostal space), and inject approximately 10 mL of the anesthetic solution into the periosteum (if bone is encountered), intercostal muscle, and the pleura. Aspiration of air, blood, pus, or a combination thereof into the syringe confirms that the needle entered the pleural cavity.
- 5.** Use the No. 11 or 10 blade to make a skin incision approximately 4 cm long overlying the rib that is below the desired intercostal level of entry.

The skin incision should be in the same direction as the rib itself. Use a hemostat or a medium Kelly clamp to bluntly dissect a tract in the subcutaneous tissue by intermittently advancing the closed instrument and opening it, as shown. Palpate the tract with a finger as shown, and make sure that the tract ends at the upper border of the rib above the skin incision. Insertion of the chest tube as close as possible to the upper border of the rib will minimize the risks of injury to the nerve and blood vessels that follow the lower border of each rib. Adding more local anesthetic to the intercostal muscles and pleura at this time is recommended.
- 6.** Use a closed large Kelly clamp to pass through the intercostal muscles and parietal pleura and enter into the pleural space, as shown.

This maneuver requires some force and twisting motion of the tip of the closed Kelly clamp. This motion should be done in a controlled manner so the instrument does not enter too far into the chest, which could injure the lung or diaphragm. Upon entry into the pleural space, a rush of air or fluid should occur.
- 7.** The Kelly clamp should be opened (while still inside the pleural space) and then withdrawn so that its jaws enlarge the dissected tract through all layers of the chest wall as shown. This facilitates passage of the chest tube when it is inserted.

Use a sterile, gloved finger to appreciate the size of the tract and to feel for lung tissue and possible adhesions, as shown in the image below. Rotate the finger 360° to appreciate the presence of dense adhesions that cannot be broken and require placement of the chest tube in a different site, preferably under fluoroscopy (ie, by interventional radiology). Measure the length between the skin incision and the apex of the lung to estimate how far the chest tube should be inserted. If desired, place a clamp over the tube to mark the estimated length. Some prefer to clamp the tube at a distal point, memorizing the estimated length.
- 8.** Grasp the proximal (fenestrated) end of the chest tube with the large Kelly clamp and introduce it through the tract and into the thoracic cavity as shown.

Release the Kelly clamp and continue to advance the chest tube posteriorly and superiorly. Make sure that all of the fenestrated holes in the chest tube are inside the thoracic cavity.
- 9.** Connect the chest tube to the drainage device as shown (some prefer to cut the distal end of the chest tube to facilitate its connection to the drainage device tubing). Release the cross clamp that is on the chest tube only after the chest tube is connected to the drainage device.
- 10.** Before securing the tube with stitches, look for a respiration-related swing in the fluid level of the water seal device to confirm correct intrathoracic placement.

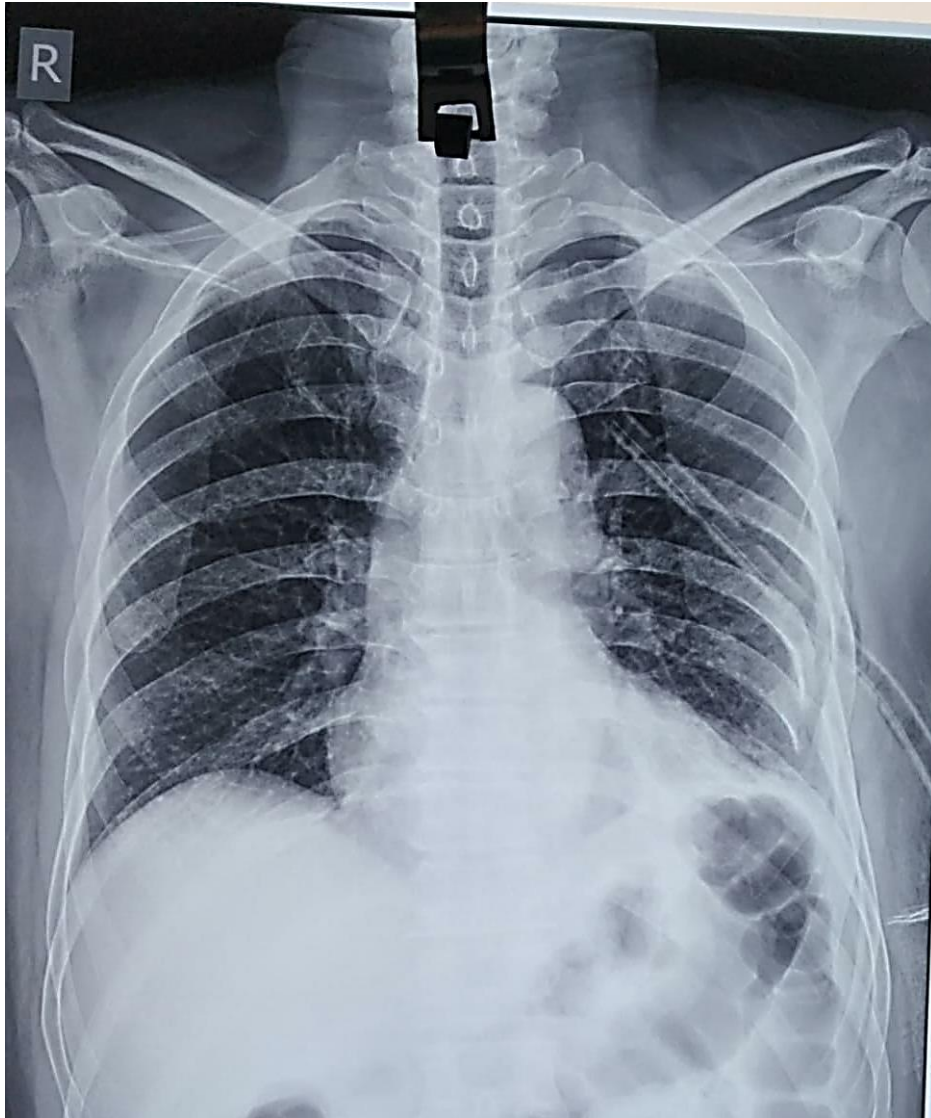
Secure the chest tube to the skin using 0 or 1-0 silk or nylon stitches, as depicted.
For securing sutures, two separate through-and-through, simple, interrupted stitches on each side of the chest tube are recommended. This technique ensures tight closure of the skin incision and prevents routine patient movements from dislodging the chest tube. Each stitch should be tightly tied to the skin, then wrapped tightly around the chest tube several times to cause slight indentation, and then tied again.
- 11.** Sealing suture: A central vertical mattress stitch with ends left long and knotted together can be placed to allow for sealing of the tract once the chest tube is removed.

Place petrolatum (Vaseline) gauze over the skin incision as shown.
- 12.** Create an occlusive dressing to place over the chest tube by turning regular gauze squares (4 x 4 in) into Y-shaped fenestrated gauze squares and using 4-in adhesive tape to secure them to the chest wall, as shown below.

13. Make sure to provide enough padding between the chest tube and the chest wall. Strap the emerging chest tube on to the lower trunk with a "mesentry" fold of adhesive tape, as this avoids kinking of the tube as it passes through the chest wall. It also helps reduce wound site pain and discomfort for the patient. All connections are then taped in their long axis to avoid disconnections.

Obtain a chest radiograph, like the one below, to ensure correct placement of the chest tube.

Post-Operative Care of patient



POST OPERATIVE CHEST X-RAY : Note the direction of Chest Tube in the patient. The pneumothorax is targeted to be relieved first and hence direction of tube is towards the apex. Fenestrations in the tube allows the hemothorax to be drained out very quickly

A chest drain must be securely held in place with a suture, which will also prevent any air leakage around the tube.

Underwater drainage is established immediately after the drain is in the pleural cavity. Air is expelled with each breath and bubbles through the water. No air can be drawn back into the pleural space, and there is no danger of the fluid in the bottle being drawn back if the bottle remains below chest level.

Low-pressure suction can be added for more efficient drainage, **but it is important to remember that a negative suction apparatus that fails, is in essence, the same as a clamped chest drain, with the danger of a tension pneumothorax, in the presence of a continuing air leak.**

When to remove the chest drain?

A chest drain should not be removed until it has achieved the purpose for which it was inserted.

The lung must be fully inflated, no air should have bubbled for at least 24 hours and any fluid still draining must be non-purulent.

Drain removal is performed under the protection of a sustained Valsalva maneuver (**ask the patient to forcefully expire against a closed airway**) to prevent the entrance of air into the chest before the skin suture is tied.

A post-removal chest X-ray is then taken to exclude this.

Complications

Minor complications of thoracostomy tube placement such as unresolved/re-accumulation of pneumothorax or misplacement of the tube (too deep/kinked) are common and approach approximately 30%

Improper placement is a possible complication; various placements and resolutions are as follows:

- Horizontal (over the diaphragm) - Acceptable for hemothorax; should be repositioned for pneumothorax
- Subcutaneous - Must be repositioned
- Placed too far into the chest (against the apical pleura) - Should be retracted
- Placed into the abdominal space - Should be removed

Bleeding may occur, and resolution is as follows:

- Local - Usually responds to direct pressure
- Hemothorax (lung vs intercostal artery injury) - Might require thoracotomy if it does not resolve spontaneously
- Hemoperitoneum (liver or spleen injury) requires emergent laparotomy.

Organ penetration usually requires surgical repair. Specific organs may include the following:

- Stomach, colon, or diaphragm - Occurs as a result of unrecognized diaphragmatic hernia
- Lung - Occurs as a result of pleural adhesions or use of a thoracostomy tube trocar
- Liver or spleen – See hemoperitoneum above

Tube dislodgement is a possible complication

Empyema may occur. Chest tube (foreign object) could introduce bacteria into the pleural space.

Retained pneumothorax or hemothorax might require insertion of a second chest tube.

Re-expansion pulmonary edema is a rare and potentially fatal complication that can occur after treatment of pneumothorax or a pleural effusion. It is more common in patient with diabetes and in patients with tension or larger-size pneumothoraces and in patients with large pleural effusions. The development of re-expansion pulmonary edema likely correlates with the amount of negative intrathoracic pressure, which, in turn, is related to the rate of fluid removal. The onset of cough and chest tightness is an important warning sign to end the procedure. Most experts recommend removal of 1-1.5 L at any one time. Supportive treatment is often sufficient.