Chest Tube Thoracostomy

INTRODUCTION
A chest tube thoracostomy is commonly done in the ED to evacuate an abnormal accumulation of fluid (blood, empyema) or air from the pleural space under an elective, urgent or emergent basis.

GOALS OF THE PROCEDURE
- Relieve a pneumothorax
- Drain a hemothorax (or hemopneumothorax)
- Drain an empyema

INDICATIONS
- Spontaneous or traumatic pneumothorax (Large size)
- Hemothorax
- Empyema
- Patient with penetrating chest trauma or pneumothorax of any size undergoing positive pressure ventilation or long transport

CONTRAINDICATIONS
- Absolute
- None
- Relative
- Multiple pleural adhesions
- Emphysematous blebs
- Coagulopathy

COMPLICATIONS
- Infection (give Ancef!)
- Laceration of an intercostal vessel
- Pulmonary injury
- Cardiac injury
- Intraabdominal or solid organ tube placement
- Failure of reexpansion of the pneumothorax
- Reexpansion pulmonary edema

ANATOMY
Remember the neurovascular bundle runs below the rib; you’ll enter the pleural space over the rib
“Triangle of Safety” - Ideal site of chest tube insertion
- 4-5th intercostal space from mid-axillary to anterior axillary line

http://www.nataliescasebook.com/img/Case-4/Safe_triangle.png

EQUIPMENT
- Extra Lidocaine 1% with epinephrine (15-20 mL) – if patient awake
- Pleurovac drainage system connected to suction (set up by RN)
- Chest Tube Thoracostomy Tray
  - Sterile drapes
  - Lidocaine 1%, with various needles and syringes
  - Chlorhexidine swab
  - #10 blade scalpel
  - Large Kelly Clamp
  - Small Kelly clamp (or needle driver)
  - 0 or 1-0 silk
  - Forceps
  - Suture scissors
  - Large, curved mayo scissors
  - Petroleum gauze
  - Tape
- Chest Tube (select appropriate size)
  - Pneumothorax ~28 Fr (adult)
  - Hemothorax 32-36 Fr (adult) – larger sizes no longer indicated
  - ETT size x 3 (pediatric)
- Lots of thick silk or foam tape (precut long strips ~8-10 inches)

STEPS
The following steps are for an elective or urgent chest tube. In the case of an emergent chest tube, sterility, position, and anesthesia are less of a priority. Your priority is to relieve the pneumothorax or hemothorax. If the patient has a tension pneumothorax, first needle the chest either at the 2nd intercostal space mid-axillary line or where you’ll be placing your chest tube.

Prepare/Positioning
1. Give Cefazolin (Ancef) 1 gram IV prior to starting (if elective)
2. Position the patient:
   a. Arm abducted/elbow flexed above the head and taped out of the way
   b. Slight reverse Trendelenburg or head of bed elevated 20-30 degrees
      i. Moves intraabdominal contents and diaphragm down
3. Get sterile, prep the chest with chlorhexidine, and set up the chest tube tray
   a. Cut a slit half way through your 4x4 gaze for the chest tube dressing
   b. Cut long pieces of tape (~8-10 inches) for the dressing
   c. Open your petroleum gauze and get your suture ready
   d. Clamp the back end of the chest tube (prevent blood from rushing out)
   e. With the curved Kelly, clamp the front of the chest tube to assist with tube placement
   f. Make sure someone the pleurovac is setup
4. Drape the patient and cut a slit in the drape so you can see the nipple
5. Consider anxiolysis or procedural sedation for the awake patient
   a. Ketamine (0.5-1mg/kg IV) vs Fentanyl vs Versed

Procedure
1. Anesthetize from the skin, rib periosteum and the pleura with generous amounts of Lidocaine 1% with epi (~10-15 mL) along the entire anticipated tract of the tube
   a. The pleura the most painful
2. Incision Site - 4-5th intercostal space anterior to mid axillary line;
   a. Men = nipple level
   b. Female = inframammary fold
   c. To avoid penetrating the abdominal cavity choose a more superior site
   d. Lateral to the edge of the pectoralis major and breast tissue
3. Using a #10 scalpel make a ~3-5 cm transverse incision (ant. to post.) or along the rib cutting through the skin and subcutaneous tissue
4. Bluntly dissect the tissues down to the intercostal muscles and ribs using your finger and a Kelly clamp
5. With the Kelly clamp closed, your finger at the end of the Kelly, pop through the pleura over the top of the rib (avoiding NV bundle) using firm and steady pressure
   a. Having a finger close to the end of the Kelly prevents you from going in too deep and damaging the lung/heart
6. With the tip of the Kelly clamp in the pleural cavity, open the clamp and pull it out; this will create a hole large enough for the tube and your finger
7. Confirm you're in the pleura by placing a finger in the hole, sweeping up and down, feeling the ribs posteriorly and the lung
8. Leave your finger in the pleural cavity and then insert the chest tube either with assistance from the curved Kelly or with your finger as a guide; direct the tube posterior and superior towards the apex
   a. If resistance is met, the tube may not be in the pleural cavity and may be in the subcutaneous tissue, entering the lung fissure, or abutting the mediastinum; if this is case remove it and try to redirect it
9. Place the chest tube deep enough to have the last hole in the pleura
   a. Normal body habitus = ~12 cm at the skin
b. Obese = ~16-20 cm at the skin or more

10. Suture the chest tube in place, wrap the base of the tube at the skin with petroleum gauze, and place your cut 4x4 gauze around the base of the tube

11. Unclamp your chest tube and attach it to the pleurovac attached to suction

12. Place more 4x4 gauze over the chest tube opening and tape down in all directions

13. Tape the chest tube to the pleurovac tube

14. Create a mesentery tape on the distal chest tube and attach it to the body to prevent it from being pulled out

15. Confirm chest tube placement with CXR

VIDEO INSTRUCTION
- https://www.youtube.com/watch?v=L-XSJJYWmeQ (with real patient)
- https://www.youtube.com/watch?v=qyJkh-ghl70#t=397 (with model)

DEEP DIVE

Further Reading

FOAM and Other Videos
- Diku Mandavia
  - Lecture on Chest tube & Heimlich Valve Placement
    - http://vimeo.com/43409822
- EMCrit Blog/Podcast
  - Needle vs Knife II: Needle thoracostomy
    - http://emcrit.org/podcasts/needle-finger-thoracostomy/
  - Managing the Traumatic Arrest
    - http://emcrit.org/podcasts/traumatic-arrest/
  - Finger thoracostomy Lecture
    - https://www.youtube.com/watch?v=NjZiXoUqrFc
- Life in the Fastlane
  - Own the Chest Tube!
  - Chest drain
    - http://lifeinthefastlane.com/education/procedures/chest-drain/
- ALiEM
  - Trick of the Trade: Seldinger Chest Tube Technique using Bougie
  - Managing spontaneous pneumothorax with pigtail tail as outpatient
- Traumaprofessional Blog
  - Pigtail vs Chest Tube
    - http://regionstraumapro.com/post/40765991854
Chest Tube Pearls

- Indication for OR thoracotomy in a hemothorax
  - 1500 mL of blood immediately on chest tube insertion
  - 200 mL/hr of blood after chest tube placement
- Recent literature shows you can effectively drain hemothorax with a smaller size chest tube (28-32 Fr), be nice to your patient
- To estimate proper depth of chest tube insertion:
  - Hold the tube next to chest wall with tip of tube at the level of the clavicle
- To prevent advancing the tube too far:
  - Place a clamp on the tube to mark the maximum depth
- In very obese patients, be sure you have the last hold in the pleural cavity and not the fatty tissue, the depth can be deceiving
- To prevent the tube from entering the fissure:
  - Swirl or rotate the tube away from the chest while inserting (i.e. if inserting on the pt’s left side rotate tube counterclockwise while inserting)
  - Lift the distal end of the chest tube up towards the ceiling while inserting to make it travel posterior instead of into the fissure
- Rotating the tube 360 degrees prevents kinking
- In an obese patient always leave your finger in the pleural cavity so you don’t lose the tract

TUBE SECURING METHODS

Roberts and Hedges’ Clinical Procedures in Emergency Medicine, Chapter 10, p189-211 (Figure 10-24)