STANDARDIZED PROCEDURE
CHEST TUBE PLACEMENT (Adult)

These procedures are intended to describe procedures performed by Nurse Practitioners and/or Certified Nurse Midwives (depending on the clinical privileges granted to the individual practitioner) at UC San Diego Health.

I. Definition

Chest tube insertion is a common therapeutic procedure used to provide evacuation of abnormal collections of air or fluid from the pleural space. Tube thoracostomy may be indicated for pleural effusions associated with malignancy, infection, or hemothorax in the post-surgical setting. In these situations, drainage is imperative to allow for lung re-expansion.

II. Background Information

Setting: The setting (inpatient vs outpatient) and population (adults vs pediatrics) for the Advanced Health Practitioner (AHP) is determined by the approval of the privileges requested on the AHP Privilege Request Form. This particular procedure is for adults only.

Supervision

The necessity of the procedure will be determined by the AHP in verbal collaboration with the attending physician or his/her designee.

Direct supervision is necessary until competency is determined and the minimum number of procedures is successfully completed, as provided for in the procedure. After that time, the attending physician or his/her designee must be available.

Designee is defined as another attending physician who works directly with the supervising physician and is authorized to oversee the procedures being done by the AHP.

Indications

1. Pneumothorax (especially if it is large or progressive, or if the patient is symptomatic).
2. Tension pneumothorax.
3. Penetrating chest trauma.
4. Hemothorax.
5. Chylothorax
6. Empyema.
7. Drainage of pleural effusions.
8. Prevention of hydrothorax after cardiothoracic surgery.
9. Bronchopleural fistula

Precautions/Contraindications

1. Anticoagulation of a bleeding dyscrasia.
2. Systemic anticoagulation.
3. Small, stable pneumothorax (may spontaneously resolve).
4. Empyema caused by acid-fast organisms.

5. Loculated fluid accumulations.

The AHP will notify the physician immediately under the following circumstances:

1. Patient decompensation or intolerance to the procedure
2. Outcome of the procedure other than expected

III. Materials

1. Fentanyl or other pain medication
2. 1% Lidocaine with Epinephrine, 10 ml syringe with 25 gauge needle
3. ChloraPrep
4. Sterile gloves, masks, and hat (gown optional)
5. Sterile tray to include:
    - 4 x 4's
    - 2 x 2's
    - Drapes
    - Curved mosquito hemostat
    - Curved Kelly clamp
    - Scissors
    - Needle holder
6. Sterile thoracotomy tube, Available sizes are 28 F, 32 F, or 36 F. Choose the tube best suited for the patient, or use a sterile 8.5 Fuhrman pigtail catheter if a pigtail catheter is indicated.
7. Scalpel
8. 4-0 silk suture on cutting needle
9. Petroleum-soaked gauze
10. Underwater sealed drainage system or a "Heimlich" valve.

IV. Chest Tube Insertion

A. Pre-treatment evaluation

1. Monitor the patient's cardiorespiratory status & oxygen saturations throughout the procedure.
2. Premedicate patient for pain control. Assess need for further medication throughout the procedure.
3. Position the patient supine with the affected side slightly elevated and the arm on the affected side restrained superiorly (over the head) or anteriorly.

B. Set up (if applicable)

Gather necessary supplies

C. Patient Preparation

1. Perform time out with all appropriate steps.
2. Don cap, mask, sterile gloves, and if there is time, a sterile gown.

D. Procedure

Chest Tube Insertion – Standard Method

1. Identify the insertion site, which is usually the fourth or fifth intercostal space in the mid-to-anterior axillary line (just lateral to the nipple in males), immediately behind the lateral edge of the pectoralis major muscle. Direct the tube as high and anteriorly as possible for a pneumothorax. For a hemothorax, the tube is usually inserted at the level of the nipple and directed posteriorly and laterally. Elevate the head of the bed 30 to 60 degrees, and place (and restrain) the arm on the affected side over the patient's head. Do not direct the tube toward the mediastinum because contralateral pneumothorax may result. The diaphragm, liver, or spleen can be lacerated if the patient is not properly positioned or the tube is inserted too low.

2. Assemble the suction-drain system according to manufacturer's recommendations. Connect the suction system to a wall suction outlet. Adjust the suction as needed until a small, steady stream of bubbles is produced in the water column.

3. Prep the skin with povidone-iodine or Chlorhexidine solution and allow to dry. Drape the site with fenestrated sheet. Using the 10 ml syringe and 25 gauge needle, raise a skin wheal at the incision area (in the interspace one rib below the interspace chosen for the pleural insertion) with 1% solution of Lidocaine with Epinephrine.

4. Liberally infiltrate the subcutaneous tissue and intercostal muscles, including the tissue above the middle aspect of the inferior rib to the interspace where pleural entry will occur and down to the parietal pleura. Using the anesthetic needle and syringe, aspirate the pleural cavity, and check for the presence of fluid or air. If none is obtained, change the insertion site. Be careful to keep away from the inferior border of the rib to avoid the intercostal vessels.

5. Make a 2 to 3 cm transverse incision through the skin and the subcutaneous tissues overlying the interspace. Extend the incision by blunt dissection with a Kelly clamp through the fascia toward the superior aspect of the rib above. After the superior border of the rib is reached, close and turn the Kelly clamp, and push it through the parietal pleura with steady, firm, and even pressure. Open the clamp widely, close it, and then withdraw it. Be careful to prevent the tip of the clamp from penetrating the lung, especially if no chest radiograph was obtained or if the x-ray film does not clearly show that the lung is retracted from the chest wall.

6. Insert an index finger to verify that the pleural space, not the potential space between the pleura and chest wall, has been entered. Check for unanticipated findings, such as pleural adhesions, masses, or the diaphragm.

7. Grasp the chest tube so that the tip of the tube protrudes beyond the jaws of the clamp, and advance it through the hole into the pleural space using your finger as a guide. Direct the tip of the tube posteriorly for fluid drainage or anteriorly and superiorly for pneumothorax evacuation. Advance it until the last side hole is 2.5 to 5 cm (1 to 2 inches) inside the chest wall. Attach the tube to the previously assembled suction-drainage system. The chest tube should be inserted with the proximal hole at least 2 cm beyond the rib margin. Position of the chest tube

with all drainage holes in the pleural space should be assessed by palpation. Confirm the correct location of the chest tube by the visualization of condensation within the tube with respiration or by drained pleural fluid seen within the tube. Ask the patient to cough, and observe whether bubbles form at the water-seal level. If the tube has not been properly inserted in the pleural space, no fluid will drain, and the level in the water column will not vary with respiration.

8. Suture the tube in place with 1-0 or 2-0 silk or other nonabsorbent sutures. The two sutures are tied so as to pull the soft tissues snugly around the tube and provide an airtight seal. Tie the first suture across the incision, and then wind both suture ends around the tube, starting at the bottom and working toward the top. Tie the ends of the suture very tightly around the tube, and cut the ends.

9. Place a second suture in a horizontal mattress or purse-string stitch around the tube at the skin incision site. Pull the ends of this suture together, and tie a surgeon's knot to close the skin around the tube. Wind the loose ends tightly around the tube, and finish the suture with a bow knot. The bow can be later undone and used to close the skin when the tube is removed. Alternatively, some choose to only use the purse-string to secure the chest tube. This usually involves wrapping the suture around the tube several more times than in the other method to ensure that the tube does not slip from location.

10. Place petroleum gauze around the tube where it meets the skin. Make a straight cut into the center of two additional 4 X 4 inch sterile gauze pads, and place them around the tube from opposite directions. Tape the gauze and tube in place, and tape together the tubing connections. Obtain postero-anterior and lateral chest radiographs to check the position of the chest tube and the amount of residual air or fluid as soon as possible after the tube is inserted.

11. Use serial chest auscultation, chest radiographs, volume of blood loss, and amount of air leakage to assess the functioning of the chest tube. If a chest tube becomes blocked, it usually may be replaced through the same incision. Chest tubes are generally removed when there has been air or fluid drainage of < 100 ml in 24 hours for more than 24 hours.

Percutaneous Chest Tube Insertion – Pigtail insertion

The pigtail catheter is a percutaneous chest tube used for drainage of pleural effusions or pneumothorax. It is easier, less invasive, and a reliable alternative to the standard chest tube. The pigtail catheter package includes the following: 8.5 French pigtail catheter that is 15 cm long and has a adaptor at the end for connecting to the underwater sealed drainage system, 18 gauge needle, plastic dilator, and J-tip guide wire that is designed to decrease the potential for lung injury. The pigtail has six holes along the shaft that curl to the inside when the catheter is in place. The catheter is placed using the Seldinger technique which is described below.

1. Perform time out with all appropriate steps.
2. Don cap, mask, sterile gloves, and if there is time, a sterile gown.
3. Keeping the pleural tube sterile, measure the approximate length of the tube needed to reach the desired site from the point of the skin entry site. Note the appropriate length.
4. Prep the skin with ChloraPrep. Allow to dry

5. Sterile drapes should be placed on the surface near the patient and to cover the unprepared skin near the incision site.
6. If time permits, infiltrate the skin with 1% Lidocaine, down to the rib and along the proposed insertion path of the tube.
7. Insert the 18 gauge needle with syringe attached into the skin and aspirate for fluid or air to verify placement.
8. Remove the syringe and send for studies if fluid is present. Care must be taken to occlude the lumen when the syringe is removed to prevent air embolus
9. Straighten the J tip of the guide wire and insert into the needle. Advance guide wire about 2-3 cm beyond the tip of the needle. Do not trim the length of the guide wire or withdraw against the needle bevel since it may cause sheering of the wire.
10. With a firm grip, hold the guide wire in place as the needle is withdrawn. (Should there be significant chest wall edema, the puncture site may be enlarged prior to withdrawing the needle. This is done by placing the cutting edge of the scalpel away from the needle and making a small cut)
11. Insert dilator over the guide wire to dilate the subcutaneous tissues. Gently roll the dilator between thumb and forefinger using clockwise/counterclockwise motions to advance the dilator. Maintain a firm grasp on the guide wire during this maneuver.
12. Remove dilator while maintaining the guide wire in stable position.
13. Straighten the pigtail catheter tip and insert over the guide wire using the same twisting motion used during step 11. Advance until all holes are in the chest plus 1-2cm further.
14. Slowly withdraw the guide wire while holding the pigtail firmly in place. As the guide wire is withdrawn the pigtail will curl against the chest wall and be parallel with the lung.
15. The pigtail is then immediately connected to underwater sealed drainage or to a one-way “Heimlich” valve to evacuate the pleural space.
16. Suture the chest tube securely to the skin.
17. Dress insertion site as in the above procedure with petroleum-soaked gauze.

E. Follow-up treatment

1. The position of the chest tube and resolution of the intrapleural air or liquid is checked by x-ray (AP and cross table lateral). Tube should be pulled back if it crosses the mediastium.

F. Termination of treatment

The chest tube will be discontinued in the event that it is no longer needed, or thought to be occluded.

G. Potential Complications:

- Injury to the heart, great vessels, or lung
- Diaphragmatic perforation
- Subdiaphragmatic placement of the tube
- Open or tension pneumothorax
- Subcutaneous emphysema
- Unexplained or persistent air leakage

- Hemorrhage (especially from intercostal artery injury)
- Recurrent pneumothorax
- Empyema
- Lung parenchyma perforation
- Subcutaneous placement
- Cardiogenic shock (from chest tube compression of the right ventricle)
- Infection

There continues to be controversy concerning the need for prophylactic antibiotics in patients requiring a chest tube. Most trials show no benefit, although some have shown a reduction in infection in patients with penetrating chest trauma.

V. Documentation

A. Written record: Documentation of procedure in chart by AHP:

Documentation is in the electronic medical record

1. Documentation of the pretreatment evaluation and any abnormal physical findings.
2. Record the time out, indication for the procedure, procedure, type and size of tube used, method used, EBL, the outcome, how the patient tolerated the procedure, medications (drug, dose, route, & time) given, complications, and the plan in the note, as well as any teaching and discharge instructions.

B. All abnormal findings are reviewed with Attending or supervising physician

VI. Competency Assessment

A. Initial Competence

1. The AHP will observe the procedure in its entirety at least three times. Under the direct supervision of the attending physician the AHP will perform chest tube insertion successfully three times and will be evaluated for competence and technical skill.
2. The AHP will demonstrate knowledge of the following:
    - Medical indication and contraindications of chest tube insertion.
    - Risks and benefits of the procedure
    - Related anatomy and physiology
    - Consent process (if pplicable)
    - Steps in performing the procedure
    - Documentation of the procedure
    - Ability to interpret results and implications in management.
3. The AHP will ensure the completion of competency sign off documents and send them directly to the medical staff office.

B. Continued proficiency

1. The AHP will demonstrate competence by successful completion of the initial competency.

2. Each candidate will be initially proctored and signed off by an attending physician. AHPs must perform this procedure at least three times per year. In cases where this minimum is not met, the AHP must demonstrate skill with this procedure in a simulation or skills lab, or the attending, must again sign off the procedure for the AHP. The AHP will be signed off after demonstrating 100% accuracy in completing the procedure.
3. Demonstration of continued proficiency shall be monitored through the annual evaluation.
4. A clinical practice outcomes log is to be submitted with each renewal of credentials.

It will include the number of procedures performed per year and any adverse outcomes. If an adverse outcome occurred, a copy of the procedure note will be submitted.

VII. RESPONSIBILITY

Please contact the Advanced Practice Council if you need help. The administrative assistant for the Chief Nursing Officer can direct you. Call; 619-543-3438.

VIII. HISTORY OF POLICY

Revised by the Committee of Interdisciplinary Practices: 2/26/2014, 9/28/2016

Reviewed by the Medical Staff Credentials Committee: 3/5/2014, 10/6/2016

Approved by the Medical Staff Executive Committee: 3/20/2014, 10/7/2016