Medscape

Tube Thoracostomy Management

Updated: Feb 09, 2022
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Overview

Background

Tube thoracostomy is often used to treat pleural effusion, pneumothorax, hemothorax, hemopneumothorax, and empyema.[1] The use of chest tubes was described as long ago as the time of Hippocrates (c. 460 BCE), when metal tubes were placed to treat empyema.[2, 3] Playfair, treating a child with empyema thoracis in 1873, is credited with being the first physician to use a water-sealed chest drainage system. Chest-tube placement techniques evolved and were perfected during the 1918 flu epidemic and subsequently in the management of combat injuries during World War II.[3]

Physiologically, a potential space exists between the parietal pleura (abutting chest wall) and the visceral pleura (abutting lung parenchyma), which normally contains less than 25 mL of pleural fluid. The presence of excess fluid, air, blood, chyle, or pus in this pleural space results in displacement of pulmonary volume, which disrupts gas exchange. Prompt drainage of this abnormal intrapleural collection is required to restore normal pulmonary mechanics.

In other scenarios, indwelling chest tubes may be placed for postoperative management of patients after lung resections in order to facilitate creation of space for lung reexpansion. Because chest tubes are used to treat patients with both medical and surgical diagnoses, physicians should be familiar with the appropriate management of patients with these drains.

Despite the widespread use of tube thoracostomy, management of patients with chest tubes remains subjective.[4] There remains a need for more high-quality prospective data to guide postplacement management of chest tubes, and management has been driven mainly by anecdotal experience and institutional protocols.[5, 6] Improper management of inserted chest tubes results in premature or delayed removal, both of which may be associated with increased morbidity, hospital stay, and costs.

This article discusses the essential and pragmatic concepts of postplacement management of patients with chest tubes. For details on the technique for chest-tube placement, see Tube Thoracostomy.[7]

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Indications

Indications for chest drains include the following:

- Pneumothorax (spontaneous, tension, iatrogenic, traumatic)
- Pleural collection - Pus (empyema), blood (hemothorax), chyle (chylothorax)
- Malignant effusions (pleurodesis)
- Postoperative
- Thoracotomy
- Video-assisted thoracoscopic surgery (VATS)

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Contraindications

The need for emergency thoracotomy is an absolute contraindication for tube thoracostomy.

Relative contraindications include the following:

- Coagulopathy
- Pulmonary bullae
- Pulmonary, pleural, or thoracic adhesions
- Pulmonary abscess
- Loculated pleural effusion or empyema
- Skin infection at the chest-tube insertion site

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Periprocedural Care

Equipment

In current practice, commercial chest tube kits are readily available. However, in resource-limited settings, the following equipment is necessary for optimally managing patients with chest tubes:

- Chest drainage bottles (see below)
- Adequate length (1.5-2 m) of sterile, transparent, plastic tubing (eg, vinyl or Silastic)
- Appropriate sterile connectors
- Adhesive tape
- Angled clamps (2) for clamping the tube when needed
- Distilled water to fill in the drainage bottle

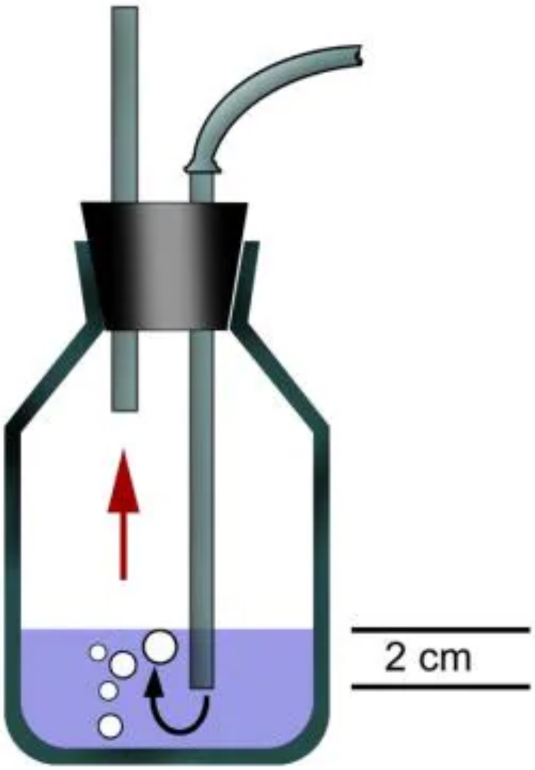
Drainage system

Chest drainage systems work by combining the following three efforts:

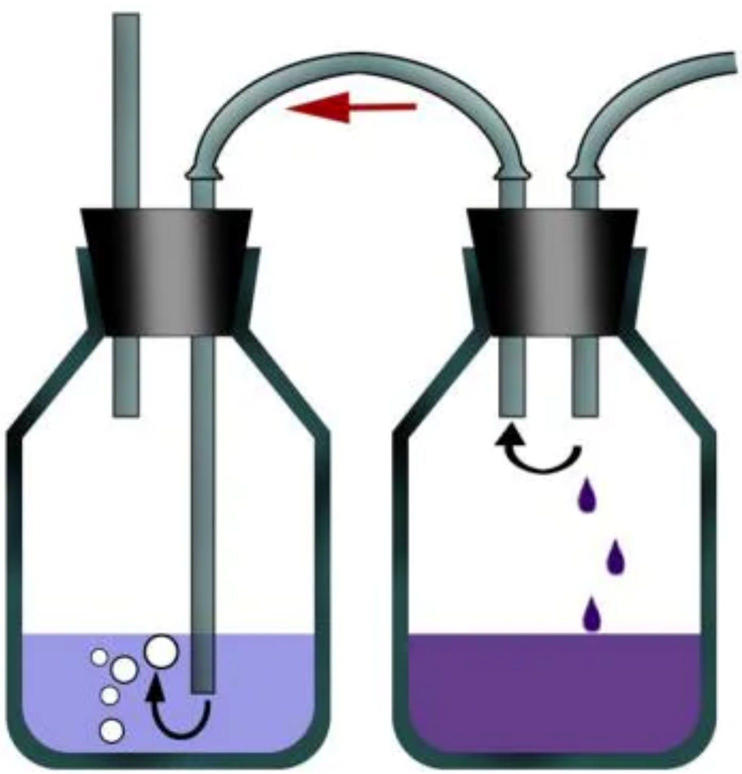
- Expiratory positive pressure from the patient helps push air and fluid out of the chest (eg, cough, Valsalva maneuver)
- Gravity helps fluid drain as long as the chest drainage system is placed below the level of the patient’s chest
- Suction can improve the speed at which air and fluid are pulled from the chest

The typical drainage system consists of three bottles or chambers, as follows:

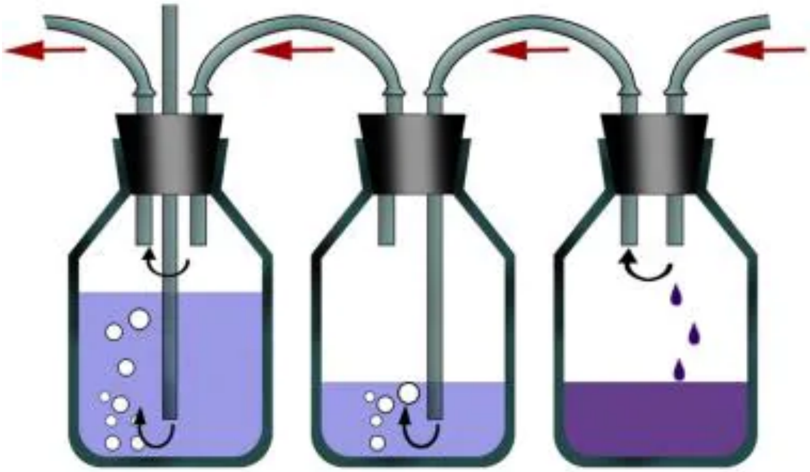
- Underwater seal chamber (see the first image below)
- Trap bottle or reservoir chamber (see the second image below)
- Suction regulator chamber (see the third image below)



The underwater drainage bottle.



The trap bottle.



The suction bottle.

Underwater seal bottle

The underwater seal chamber is the most important element in pleural drainage. It acts as a low-resistance one-way valve for the evacuation of pleural contents. When intrapleural pressure rises (eg, with expiration or coughing), the free contents of the pleural space are forced out through the chest tube and into the underwater seal drainage chamber.[8] Hence, a single-chamber system is optimal only for a pneumothorax. The presence of hemopneumothorax or hydropneumothorax necessitates the use of a three-chamber drainage system.

Reentry of air into the pleural space when intrapleural pressures become negative (eg, with inspiration) is blocked by the underwater seal. The water in this tube is referred to as the "column" of water; its movements reflect the changes in intrathoracic pressure with each inspiration and expiration.

The end of the tube in the underwater seal chamber must remain covered with water at all times. When a broad-based bottle (eg, Tudor-Edwards) and a narrow tube are used, elevation of the water column in the tube lowers the level in the reservoir by only a very small amount, keeping the seal intact. The end of the tube must not be kept too far below the water surface, because the resistance to expulsion of air from the chest is equal to the length of tubing that is under water. The standard recommendation is to keep the tip of the tube 2-3 cm below the water surface.[9, 10]

Trap bottle

When excessive fluid drains from the chest, the level of fluid in the underwater seal is raised. This increases resistance to further outflow of fluid from the chest. To decrease this resistance, a trap chamber is introduced between the chest tube and the underwater seal. The trap chamber collects the fluid draining out of the chest, while the air passes on to the second bottle. This keeps the underwater seal at a constant level.[11]

Suction regulator bottle

A third chamber is introduced to the system to provide suction, which is thought to hasten lung expansion.

The suction regulator chamber has a three-hole stopcock. Short tubes are passed through two of the holes. One short tube connects to the underwater seal bottle’s vent tube, and the other short tube connects to the suction source. An atmospheric vent runs through the third hole, passing below the level of water in this bottle.

When suction is applied, air is drawn down the atmospheric vent in this bottle, equal to the pressure inside the bottle that is decreased by the vacuum. Under stronger vacuum, airflow through the atmospheric vent commences, and air bubbles through the water in the bottle, but the level of suction in the bottle remains the same.

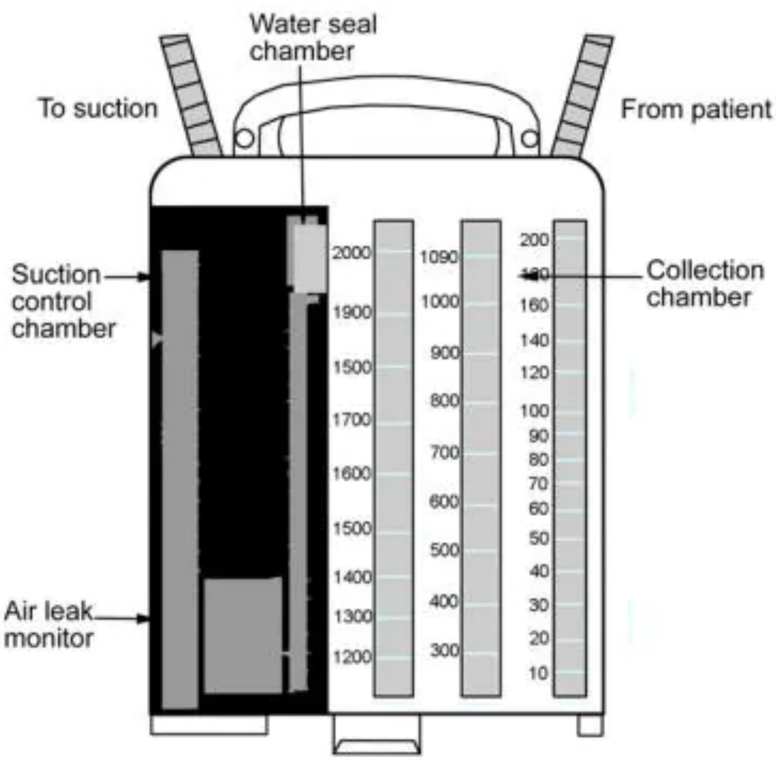
This constant level of low-pressure suction is now transmitted to the underwater seal bottle and then into the pleural cavity, thereby aiding evacuation of contents with a uniform pressure. The maximum force of suction is determined by the depth of the atmospheric vent underwater in the suction regulation bottle.[10]

To obtain a suction of –20 cm H2O, set the tip of the tube 20 cm below the surface of the fluid. Then, increase the vacuum gradually until air bubbles gently and constantly through the atmospheric vent in the water during both phases of respiration. A constant pressure of –20 cm H2O is now transmitted to the underwater seal and on to the chest drain.

The role of suction is now being debated, with some studies favoring the use of suction versus others not favoring the use of suction in patients with chest tubes, for prevention of postoperative air leakage and pneumothorax.[12, 13]

Multifunction chest drainage system

Contemporary chest tube kits contain a three-chamber system incorporated into one multifunction chest drainage system. The multiple bottles and numerous connections of the typical three-bottle system result in a bulky bedside device, which can be prone to accidental disconnections and blockages. In addition, sterility is difficult to maintain. These systems, therefore, have been largely replaced by commercially produced disposable plastic multifunction units (eg, Codman, Pleurovac, and Atrium [see the image below]) that fit into a single box and work on the same principles.



Chest drain multipurpose model Oasis (Atrium Medical Corporation, Hudson, NH).

The kits are designed to incorporate the functions and improve on the safety features of the traditional three-bottle drainage system. They offer patient protection with effective drainage, accurate fluid loss measurement, and assistance in detecting air leaks.

The multifunction systems allow single-catheter or multicatheter drainage and are suitable for both gravity-assisted and suction-assisted drainage. The unit has a latex-free patient tube and a filtered water seal to prevent contamination.

Each multifunction chest drainage system contains the following:

- A collection chamber - Fluids drain directly into this chamber, which is calibrated in milliliters
- The middle chamber (the water seal) - This is a one-way valve, with a U-tube design that can monitor air leaks and changes in intrathoracic pressure
- A suction control chamber - This chamber is also a U-tube, with the narrow arm serving as the atmospheric vent and the large arm as the fluid reservoir; the water level in this chamber, and not the suction regulator, regulates the

amount of suction pressure, and thus, controlling negative pressure is relatively easy [14]

The suction chamber also helps monitor intrathoracic pressure. For gravity drainage without suction, the level of water in the water seal chamber equals the intrathoracic pressure; for suction-assisted drainage, the level of water in the suction control chamber plus the level of water in the water seal chamber equals the intrathoracic pressure.[15]

Dry suction systems

Suction systems in present use are dry suction systems incorporating a dry suction regulator with fully calibrated water seal drainage.[14]

Digital suction systems

Multifunction chest drainage systems with digitally calibrated and regulated suction mechanisms are available.[16, 17, 18] These systems are characterized by the following:

- Ability to regulate the intrapleural pressure by presetting the device for a required length of time or frequency (eg, continuous vs intermittent)
- Ability to quantify air leak precisely, thus reducing interobserver variability and decreasing chest tube duration as well as length of hospital stay [16, 17, 18]
- Ability to store information on the pattern and quantity of drainage over time and to retrieve that information in a graphical or numeric manner [16]

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Patient Preparation

Anesthesia

After chest-tube placement, anesthesia is not required during the management phase. For more information on placement of a chest tube, see Tube Thoracostomy.[7]

At the time of tube removal, in an adult, 5 mL of 1% lidocaine hydrochloride is infiltrated with a 24-gauge needle around the emerging tube at the chest wall. Alternatively, premedication with oral or intravenous (IV) narcotic medication can be considered before chest-tube removal.

Positioning

Patient positioning

Keep the patient in a semirecumbent position (ie, 45-90°). The semi-Fowler position is useful to evacuate air (pneumothorax).[19] The high Fowler position is useful for draining fluid (hemothorax).

Adjust tubing to hang in a straight line from the chest tube to the drainage chamber, avoiding excess length and loops.

Drainage system positioning

Regardless of the type of drainage system used, it should always be placed erect and approximately 100 cm below the level of the patient’s chest. This placement aids gravity drainage of chest contents into the drainage system and prevents reentry of fluid into the chest during inspiration.[8, 20, 21]

Chest-tube site dressing

In the authors' view, major obtrusive dressings around the chest tube are unnecessary and potentially dangerous. They can potentially kink the tube, thereby obstructing the tube and potentially allowing reaccumulation of air or liquid.

The correct taping of the emerging chest tube from the patient is with a "mesentery" fold of adhesive tape that holds the tube to the trunk of the patient. This allows some side-to-side movement of the tube, prevents kinking of the tube as it passes through the chest wall, and is far less painful to the patient than taping the tube directly to the chest wall.

A prospective randomized controlled study by Wood et al compared three dressing types and procedures after chest-tube placement: (1) gauze-and-tape dressing changed daily, (2) gauze-and-tape dressing changed every 3 days, and (3) silicone foam dressing changed every 3 days.[22] Patients with silicone foam dressings reported less pain at the insertion site than did those with gauze-and-tape dressings, and patients with daily dressing changes reported significantly more pain with dressing removal than did those with dressing changes every 3 days. The silicone foam dressing was associated with better skin integrity than the gauze-and-tape dressing.

Multifunction chest drainage system setup

Follow the manufacturer's instructions for adding water to the chambers. This is usually 2 cm in the water seal chamber and 20 cm in the suction control chamber. Connect the 1.5- to 2-m patient tube to the thoracic catheter. Connect the drain to the vacuum.

Slowly increase vacuum pressure until gentle bubbling appears in the suction control chamber. Be sure not to allow too much bubbling in the suction control chamber. Vigorous bubbling is loud and disturbing to most patients, and it causes rapid evaporation in the chamber, which lowers the level of suction.

Technique

Approach Considerations

The following questions are frequently asked in the context of chest-tube management.

What size chest drains should be used?

Use as large a tube that passes comfortably through the intercostal space. As a general rule, in an adult patient, 24-28 French is adequate for draining air, but 32-36 French may be necessary for draining fluid.

Can chest drains be clamped?

A bubbling drain should never be clamped, because the resultant pneumothorax can cause more problems for the patient. A check should be performed to confirm that all connections are secure; once this is done, the patient can be subject to all nursing procedures, movement, and physiotherapy with no clamps on the drain.[23]

When are chest drains clamped?

Drains are clamped only in the following situations:

- When the draining tubes and underwater seal bottle are to be changed
- Just before tube removal, as a trial of clamping for 4-6 hours to confirm that the air leak has stopped
- When it is necessary to reconnect an accidentally disconnected tube that resulted in loss of the underwater seal

If the drain is clamped, it should be unclamped as soon as possible by the same individual who put the clamp on. Clamps are sometimes overlooked when patients are handed over during shift changes of medical personnel. Clamps that are not removed lead to deterioration of the patient's condition.

Can a patient with a chest drain inserted be moved?

Patients with chest drains can be moved around as usual. All connections must be checked for security, and the underwater seal bottle must be kept erect at a level of about 100 cm below the patient's chest.

What suction pressure should be applied?

As a general rule, suction pressures should be between –10 and –20 cm H2O (–2 to –3 kPa). Whereas a suction pressure as high as –25 cm H2O may be needed for massive air leaks, a suction pressure of –5 cm H2O is sufficient to help drain fluid contents out of the chest.

How long should chest drains be left in?

Apposition of the two layers of the pleura is essential to seal air leaks and reduce the drainage. All air leaks eventually stop if the lung can be kept fully expanded constantly. This usually occurs within 1 week, but it may take as long as 4-6 weeks.

If the air leak persists, the case should be reviewed by a thoracic surgeon. If significant discharge is evident but the lung seems to be adherent, conversion to open tube drainage may be needed.

Do alternatives to underwater bottle drainage exist?

Artificially made one-way valve systems may be alternatives to underwater bottle drainage.

The flutter valve (Heimlich) is a one-way system created with a plastic diaphragm, which allows air to escape from the chest and yet maintains expansion of the lung. It is attached to the chest drain and strapped to the patient’s side, affording the patient greater mobility. The flutter valve can be used for pneumothorax only.

The intercostal drainage bag is a plastic bag built around a tube that reaches to its bottom. The bag is filled with fluid to the prescribed level, and this acts as the underwater seal. The tube, which is about 1 m long, is connected to the intercostal tube. As much as 200 mL of drainage can be collected before the contents must be drained and fresh fluid poured in to recreate the underwater seal. The bag can be strapped to the patient's thigh and must always be kept erect. If fluid is draining but air is not leaking, a simple Urosac can be attached to the end of the intercostal tube.[23]

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Management of Chest Tube

Analgesia

Postprocedural pain control is of vital importance in the management of patients with chest tubes. Optimal pain control leads to better patient cooperation for chest exercise and physical therapy. No prospective trials are available in regard to standardizing the pain control regimen for these patients.

Typically, the recommended analgesic options in an alert patient are as follows:

- Opioids (eg, morphine) - Oral, intravenous [IV], or patient-controlled pumps
- Nonsteroidal anti-inflammatory drugs (NSAIDs; eg, ketorolac) - Oral or IV
- Intercostal nerve blocks or epidural analgesia for patients with associated rib fractures or postoperative indwelling chest catheters

At the time of chest tube removal, adequate analgesia should be considered for patient comfort. This can usually be achieved with a single systemic dose of an opioid or an NSAID, infiltration of a local anesthetic (eg, lidocaine) around the chest tube entry site, or both.

Breathing exercises and chest physiotherapy

Breathing exercises and chest physiotherapy are the main keys for achieving quick lung expansion and faster recovery. Incentive spirometry (eg, with the TriFlo incentive spirometer) provides the impetus for expanding the lung quickly. Upper-limb movements, especially at the shoulder, help restore the movements of the chest wall. Steam inhalations and nebulized bronchodilators may also encourage quick lung expansion.

Nursing management

In caring for and maintaining a patient with a chest tube, the following steps are important:

- Keep chest tubes patent
- Note the presence of drainage and fluctuations, and observe the patient's vital signs and level of comfort
- Ensure that the dressing is occlusive, and note whether the chest tube is on negative pressure or is to water seal

Keep the patient in a propped-up position (ie, 45-90°). The semi-Fowler position is useful for evacuating air (pneumothorax).[19] The high Fowler position is useful for draining fluid (hemothorax). Adjust the tubing to hang in a straight line from the chest tube to the drainage chamber, avoiding excess length and loops.

Check that all connections are secure. All joints must be well taped with adhesive. A single layer of tape across the long axis of each joint holds better than layers of circular tape over the joint. This prevents disconnection and the subsequent loss of the negative pressure.

Always ensure the correct position of the underwater seal bottle. The bottle should be erect and at least 100 cm below the level of the patient's chest.

In addition to vital signs, the following items should be monitored routinely:

- Swinging or oscillation of the column of water in the water seal chamber
- Blowing or air bubbling in drainage chamber with quiet respiration and on coughing - Bubbling of air indicates that the lung is still leaking air; the cessation of bubbling during both quiet respiration and coughing indicates that the air leak in the lung may have closed
- Type and quantity of drainage - Inform the practitioner if drainage exceeds 70 mL/hr or if the quality of the drainage changes to frank blood

Never lift the drainage system above the level of the patient's chest; doing so may cause fluid from the system to siphon back into the patient's chest.

Keep two (angled) clamps at the bed side.

Do not clamp a bubbling chest drain.[24] All nursing procedures, patient movement, and physiotherapy are permitted without clamping the drain, with the drainage system kept below the patient's chest level at all times. Clamp tubes only for procedures related to the tube or system (eg, changing, emptying, or reconnecting the tubing or the system).

Avoid kinks in the tubing. Teach the patient to look for kinks and to avoid sitting or lying on the tube(s).

"Milk" the tube(s) regularly to avoid blockage by fibrin plugs or clots. If fibrin plugs form, small doses (1 mg to 1 mL sterile solution dilution) of recombinant tissue plasminogen activator (r-tPA) may be used to restore patency.[25]

Change the connecting tube and drainage system as required, and replace them with sterile equivalents. Wash and disinfect equipment to remove all residue before sterilization.

When connecting two emerging chest tubes to a single drainage unit, use a Y-shaped connector—not a T-shaped connector, which causes kinks in the tubes. Additionally, be sure to equalize the lengths of the emergent tubes before the Y connector; this avoids kinking of unequal lengths of tube.[10]

Suction

Traditionally, all chest tubes have been connected to wall suction after placement; however, firm evidential support for this practice is lacking. The literature on the use of suction is conflicting, with some studies demonstrating early resolution of air leaks with suction and others showing that suction prolongs the resolution of air leakage and hence delays chest-tube removal.[12, 13, 17, 18, 25]

Additionally, only moderate-quality evidence supports the view that suction reduces the incidence of pneumothorax as compared with water seal in the postoperative period.[12, 18] In a systematic review and meta-analysis comparing suction with water seal for tube thoracostomy after traumatic chest injury, suction appeared to have a positive effect on duration of chest-tube treatment, length of hospital stay, and persistent air leakage; however, the available data were limited, and the quality of evidence was (very) low to moderate.[26]

Regardless, the practice of connecting chest tubes to suction, at least during the initial 1-2 days, remains common. Of note, when suction is needed, it should be a constant low-pressure suction to fully remove the pleural contents without causing patient discomfort.

The recommended level of suction is –5 to –20 cm H_2O. (The –20 cm H_2O figure is based on convention, not research.)

Theoretically, suction can improve the speed at which air and fluid are removed from the chest. Greater negative pressure can increase the flow rate out of the chest, but it can also damage lung tissue.

Radiography

Daily chest radiographs are usually obtained to monitor and confirm the expansion of the lung; however, no first-class evidence exists to support this practice. There is evidence to suggest that routine postthoracostomy chest radiography does not significantly change management and that radiographic investigation should be guided by adverse clinical outcomes or procedural factors.[27]

Antibiotics

Antibiotics are not required during the presence of a chest drain for a simple pneumothorax or hydrothorax.

Cefazolin—a first-generation beta-lactam cephalosporin—can be used prophylactically to prevent the development of an empyema when a chest drain is used in thoracic trauma.[28]

Pearls

The underwater seal acts as a one-way valve through which air is expelled and prevented from reentering the pleural space during the next inspiration.

The collection chamber should be kept below the level of the patient's chest at all times to prevent fluid from being siphoned into the pleural space.

The absence of fluid oscillations may indicate obstruction of the drainage system by clots or kinks, loss of subatmospheric pressure, or complete reexpansion of the lung.

Persistent bubbling may indicate a continuing bronchopleural air leak.

Clamping a pleural drain in the presence of a continuing air leak may result in a tension pneumothorax.

The water seal is a window into the pleural space. It reflects the pressure in the pleural space and exhibits bubbling if air is leaving the chest. In the multifunction chest drainage system, a graduated air-leak meter (calibrated from 1 to 5) provides a way to measure the leak and monitor it over time.[15]

Timing and Criteria for Removal of Chest Tube

General recommendations regarding the criteria and timing of chest tube removal exist; however, level 1 studies to guide a uniform chest-tube removal practice are lacking. Several studies have presented institution-based protocols or algorithms to drive chest-tube removal decisions[6] ; however, the reliability of these algorithms has not been validated with prospective randomized controlled trials.

In current practice, chest-tube removal guidelines are individualized on the basis of the institution's or surgeon's preference. Main considerations include the following[6] :

- Initial indication for chest-tube placement
- Whether the patient is mechanically ventilated
- Daily chest-tube output
- Presence of an air leak
- Full expansion of lungs on chest radiographs

The timing of tube removal depends on clinical and radiologic evidence of complete drainage of all abnormal contents of the pleural cavity, as well as complete expansion of the lung.

Minimal drainage should have occurred over the previous 24 hours. Level 1 recommendations state that this should be less than 2 mL/kg/day or less than 200-300 mL over a 24-hour period in adults.[29] Studies have also suggested that removal of chest tubes with 400-450 mL/day of fluids is also safe.[16, 18]

Additionally, no air leak should be present—that is, no bubbling should be seen in the air-leak chamber during forced expiratory maneuvers (eg, Valsalva maneuver) or cough. The swing in the fluid level in the tube in the underwater seal bottle should be minimal, relating to the normal negative pressures in the chest during the phases of respiration. Evaluation for air leak by means of this nonobjective method falls prey to interobserver variability.

Digital drainage systems have the advantage of accurately measuring the presence of air leak and thereby eradicating interobserver variability.[16, 17] These devices are gaining increasing popularity and are the subject of ongoing research on tube thoracostomy management. Additionally, they may play a useful role in younger pediatric patients who are unable to perform forceful expiratory maneuvers or cough on demand; however, this possibility has not yet been well studied.

The values determining safe chest-tube removal in patients who are connected to the newer digital drainage systems are as follows[18] :

- < 50 mL/min in 12 hours *or*
- < 20 mL/min in 8 hours

In adult patients with pneumothorax, a trial period of tube clamping[30] for 6 hours may be performed. A repeat chest radiograph is then obtained. Complete expansion of the lung seen on the repeat chest radiograph confirms that the lung leak has sealed (output < 200 mL/day) and that proper adhesion between the layers of pleura has occurred (no identifiable air leak). The tube may be safely removed at that time.

In the authors' pediatric surgery practice, after a 24- to 48-hour period of wall suction, patients may be placed on a 24-hour period of water seal without suction. After this latter period, if no air leak is present, the chest tube is discontinued and a follow-up chest radiograph obtained to confirm complete lung expansion and rule out a recurrent pneumothorax. A residual pneumothorax smaller than 10% of the original size does not warrant any intervention; however, a larger pneumothorax may suggest persistent or missed air leakage and may necessitate replacement of a chest drainage catheter.

Tube thoracostomy removal is a sterile procedure that requires a practitioner and an assistant. Before removal, the patient should be given a dose of analgesia. In adults, subcutaneous infiltration of 5 mL 1% lidocaine hydrochloride with a 24-gauge needle around the emerging chest drain can increase patient comfort.

Cut loose the securing stitches while the tube is being supported. Free the mattress (sealing) stitch that was inserted and kept long at the time of tube insertion. If this stitch is not in position, consider placing a vertical mattress stitch with a nonabsorbable suture material (eg, silk) across the center of the incision.

Hold the ends of the mattress suture ready to tie a knot. Instruct the patient to hold the breath at either deep inspiration or expiration (the incidence of pneumothorax after tube removal is not different).[31, 32] Gently ease out the tube while simultaneously tying the knot to close the track.

Apply a soft dressing with petrolatum gauze underneath a pad of 4 × 4 gauze pieces. Apply silk or foam tape. If the stitch breaks or cuts through, simply compress the oblique track and apply the occlusive dressing described above.

A chest radiograph is repeated 4 hours after the removal of the tube thoracostomy. The results of this radiograph should confirm that no air has entered the chest and that the lung continues to be fully expanded.

Complications

In a systematic review and meta-analysis of 29 studies that included 4981 tube thoracostomies for traumatic indications, Hernandez et al reported an overall median complication rate of 19%.[33] Complication subtypes included the following:

- Insertional (15.3%)
- Positional (53.1%)
- Removal (16.2%)
- Infectious/immunologic (14.8%)
- Malfunction (0.6%)

Troubleshooting for chest tube management is summarized in Table 1 below.[34, 35]

Table 1. Troubleshooting Chest Drain Management [34, 35] (Open Table in a new window)

Problem	Mechanism	Fix
Column is not oscillating	Blocked tubing	Squeeze, milk, or flush the drainage tubing; restoration of patency is confirmed by a respiration-related swing in the draining tube
Tubes dislodged/disconnected	Dislodged tube	Check connections and reposition under sterile technique; use new entry site if completely dislodged
Leak around the tube	Partial block in the draining system	Remove all blocks from the draining system; if leak persists, place a single nonabsorbable suture to close the leak
Underwater seal bottle/drainage system broken	N/A	Clamp chest tube, replace immediately with a fresh bottle/drainage system, and recreate the underwater seal
Blocked tube due to poor positioning	Tube gets trapped in the major fissure of the lung	Withdraw tube and reinsert at a different location.
Cardiac dysrhythmia	Tube is abutting the mediastinum	Try withdrawing the tube by 1-3 cm; if this is not helpful, remove the old tube and replace at a new entry site
Persistent pneumothorax	Obstructions or leaks in the drainage system	If no leak or obstruction is found, apply suction of up to –20 cm H_2O

Failure of the lung to fully reexpand	• Bronchial plug • Fibrinous peel over the lung	• Fiberoptic bronchoscopy • Decortication
Infection	Rare; reflects breaks in sterility and incorrect management	Antibiotics

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Disclosure: Nothing to disclose.

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Disclosure: Nothing to disclose.

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Disclosure: Nothing to disclose.

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Disclosure: Nothing to disclose.

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