

Chest Tube Placement (Thoracostomy) and Pleurodesis

Thoracostomy involves the insertion of a thin plastic tube into the space between the lungs and the chest wall. The tube may be attached to a suction device to remove excess fluid or air. Or, it may be used in a procedure called pleurodesis in which medication is delivered into the space to decrease the likelihood that fluid will accumulate.

Thoracostomy may be performed to treat pneumothorax, also known as collapsed lung.

Your doctor will instruct you on how to prepare, including any changes to your medication schedule. Tell your doctor if there's a possibility you are pregnant and discuss any recent illnesses, medical conditions, allergies and medications you're taking, including herbal supplements and aspirin. You may be advised to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or blood thinners several days prior to your procedure. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.



What is chest tube placement (thoracostomy) and pleurodesis?

Thoracostomy is a minimally invasive procedure in which a thin plastic tube is inserted into the pleural space — the area between the chest wall and lungs — and may be attached to a suction device to remove excess fluid or air. A chest tube may also be used to deliver medications into the pleural space.

Imaging techniques such as computed tomography (CT), fluoroscopy and ultrasound (US) may be used to help guide the interventional radiologist's instruments while placing the chest tube.

Two thin membranes line the pleural space — one wraps around the lungs and another lines the inner wall of the chest. The space between these two membranes is usually filled with a small amount of lubricating fluid that helps the lungs move within the chest cavity during breathing.

Certain conditions and diseases may cause excess air, blood or extra fluid to collect in the pleural space. This may compress or collapse the lung, making it difficult to breathe. A chest tube helps remove the excess fluid or air and allows the lung to expand, making breathing easier.

Your doctor may decide that you require long-term fluid drainage. If this is the case, you will receive a tunneled pleural drainage catheter.

A tunneled pleural drainage catheter is a thin plastic chest tube that is placed into the pleural space by tunneling it (placing it) under the skin of your chest. This catheter is a treatment option for removing continual accumulations of fluid within the pleural space due to conditions such as infections, metastatic cancers, liver disease or advanced congestive heart failure. It is tunneled under your skin for long-term use (weeks to months) in removing pleural fluid.

The advantage of this catheter is that it avoids the need for repeating the pleural tap procedure to remove the re-accumulating pleural fluid. This catheter also provides a simple way for draining the pleural fluid at home on a regular, often daily, basis.

Pleurodesis

In some instances, your doctor may determine that in order to decrease the likelihood of fluid accumulation, a special procedure called pleurodesis is necessary.

Pleurodesis is a procedure in which a medication is injected into the pleural space in order to minimize the amount of fluid that can collect there. Unlike temporary procedures such as thoracentesis (<http://www.radiologyinfo.org/en/info/thoracentesis>), pleurodesis is generally a long-term, even permanent solution to prevent the accumulation of pleural fluid.

What are some common uses of the procedure?

Physicians perform a thoracostomy to treat conditions including:

- pneumothorax (collapsed lung), a collection of air in the pleural space that causes the lung to collapse. Spontaneous pneumothorax occurs in the absence of disease or injury. Complicated pneumothorax may occur during heart or lung surgery or as a result of a traumatic injury (such as a gunshot or stab wound) to the chest. The condition may develop as a result of lung diseases, such as:
 - trauma/chest injury
 - cystic fibrosis
 - chronic obstructive pulmonary disease (COPD)
 - lung cancer
 - asthma
 - ventilator-related air leak, which occurs when a mechanical ventilator pushes air into the lungs and part of the lung collapses.
- empyema, an infection within the pleural space
- hemothorax, excess blood in the pleural space caused by a chest injury, tumor or other bleeding problems
- pleural effusion, excess fluid in the pleural space, caused by:
 - heart failure
 - infection: pneumonia, tuberculosis or viral infection such as HIV
 - lung tumor
 - lymphatic fluid (chylothorax)

Pleurodesis is performed to prevent the recurrent collection of pleural fluid following thoracentesis.

How should I prepare?

The preparation for placement of a chest tube and tunneled pleural drainage catheter is similar.

Tell your doctor about all the medications you take, including herbal supplements. List any allergies, especially to local anesthetic, general anesthesia or to contrast materials. Your doctor may tell you to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or blood thinners before your procedure.

Tell your doctor about recent illnesses or other medical conditions.

You will receive specific instructions on how to prepare, including any changes that need to be made to your regular medication schedule.

You will be given a gown to wear during the procedure.

Women should always inform their physician and x-ray technologist if there is any possibility that they are pregnant. Many imaging tests are not performed during pregnancy so as not to expose the fetus to radiation. If an x-ray is necessary, precautions will be taken to minimize radiation exposure to the baby. *See the Safety page (<http://www.radiologyinfo.org/en/info/safety-radiation>) for more information about pregnancy and x-rays.*

What does the equipment look like?

Chest tube placement may be performed with the guidance of computed tomography (CT), *ultrasound* (<http://www.radiologyinfo.org/en/info/genus>) or fluoroscopy. X-rays may be taken following the procedure to check the placement of the chest tube.

The chest tube is similar to a catheter. The size of the tube placed varies depending on the reason for the procedure.

The tunneled pleural drainage catheter is similar to a kind of chest tube. To allow regular drainage of pleural fluid at home, a disposable bottle collection system is provided with the catheter.

A catheter is a long, thin plastic tube that is considerably smaller than a "pencil lead", or approximately 1/8 inch in diameter.

The CT scanner is typically a large, donut-shaped machine with a short tunnel in the center. You will lie on a narrow examination table that slides in and out of this short tunnel. Rotating around you, the x-ray tube and electronic x-ray detectors are located opposite each other in a ring, called a gantry. The computer workstation that processes the imaging information is located in a separate control room. This is where the technologist operates the scanner and monitors your exam in direct visual contact. The technologist will be able to hear and talk to you using a speaker and microphone.

Ultrasound scanners consist of a computer console, video display screen and an attached transducer. The transducer is a small hand-held device that resembles a microphone. Some exams may use different transducers (with different capabilities) during a single exam. The transducer sends out inaudible, high-frequency sound waves into the body and then listens for the returning echoes. The principles are similar to sonar used by boats and submarines.

The technologist applies a small amount of gel to the area under examination and places the transducer there. The gel allows sound waves to travel back and forth between the transducer and the area under examination. The ultrasound image is immediately visible on a video display screen that looks like a computer monitor. The computer creates the image based on the loudness (amplitude), pitch (frequency) and time it takes for the ultrasound signal to return to the transducer. It also takes into account what type of body structure and/or tissue the sound is traveling through.

A portable x-ray machine is a compact apparatus that can be taken to the patient in a hospital bed or the emergency room. The x-ray tube is connected to a flexible arm that is extended over the patient while an x-ray film holder or image recording plate is placed beneath the patient.

Other equipment that may be used during the procedure includes an intravenous line (IV), ultrasound machine and devices that monitor your heart beat and blood pressure.

How does the procedure work?

Different parts of the body absorb the x-rays in varying degrees. Dense bone absorbs much of the radiation while soft tissue, such as muscle, fat and organs, allow more of the x-rays to pass through them. As a result, bones appear white on the x-ray, soft tissue shows up in shades of gray and air appears black.

Ultrasound imaging is based on the same principles involved in the sonar used by bats, ships and fishermen. When a sound wave strikes an object, it bounces back, or echoes. By measuring these echo waves, it is possible to determine how far away the object is as well as the object's size, shape and consistency. This includes whether the object is solid or filled with fluid.

In medicine, ultrasound is used to detect changes in the appearance of organs, tissues, and vessels and to detect abnormal masses, such as tumors.

In an ultrasound exam, a transducer both sends the sound waves and records the echoing waves. When the transducer is pressed against the skin, it sends small pulses of inaudible, high-frequency sound waves into the body. As the sound waves bounce off internal organs, fluids and tissues, the sensitive receiver in the transducer records tiny changes in the sound's pitch and direction. These signature waves are instantly measured and displayed by a computer, which in turn creates a real-time picture on the monitor. One or more frames of the moving pictures are typically captured as still images. Short video loops of the images may also be saved.

In many ways, a CT scan works like other x-ray exams. Different body parts absorb x-rays in different amounts. This difference allows the doctor to distinguish body parts from one another on an x-ray or CT image.

In a conventional x-ray exam, a small amount of radiation is directed through the part of the body being examined. A special electronic image recording plate captures the image. Bones appear white on the x-ray. Soft tissue, such as the heart or liver, shows up in shades of gray. Air appears black.

With CT scanning, several x-ray beams and electronic x-ray detectors rotate around you. These measure the amount of radiation being absorbed throughout your body. Sometimes, the exam table will move during the scan, so that the x-ray beam follows a spiral path. A special computer program processes this large volume of data to create two-dimensional cross-sectional images of your body. These images are then displayed on a monitor. CT imaging is sometimes compared to looking into a loaf of bread by cutting the loaf into thin slices. When the image slices are reassembled by computer software, the result is a very detailed multidimensional view of the body's interior.

Refinements in detector technology allow nearly all CT scanners to obtain multiple slices in a single rotation. These scanners, called multi-slice or multidetector CT, allow thinner slices to be obtained in a shorter amount of time. This results in more detail and additional view capabilities.

Modern CT scanners can scan through large sections of the body in just a few seconds, and even faster in small children. Such speed is beneficial for all patients. It's especially beneficial for children, the elderly and critically ill – anyone who finds it difficult to stay still, even for the brief time necessary to obtain images.

X-rays are a form of radiation like light or radio waves. X-rays pass through most objects, including the body. Once it is carefully aimed at the part of the body being examined, an x-ray machine produces a small burst of radiation that passes through the body, recording an image on photographic film or a special detector.

How is the procedure performed?

You may be given medications to help prevent nausea and pain, and antibiotics to help prevent infection.

You will be positioned on the procedure table.

You may be connected to monitors that track your heart rate, blood pressure, oxygen level and pulse.

A nurse or technologist will insert an intravenous (IV) line into a vein in your hand or arm to administer a sedative. This procedure may use moderate sedation. It does not require a breathing tube. However, some patients may require general anesthesia.

Your physician will numb the area with a local anesthetic. This may briefly burn or sting before the area becomes numb.

The area of your body where the catheter is to be inserted will be sterilized and covered with a surgical drape.

A very small skin incision is made at the site.

Using image-guidance, a catheter (a long, thin, hollow plastic tube) is inserted through the skin to the treatment site.

An x-ray will be taken to check the placement of the tube. The chest tube is kept in place with a suture or adhesive tape. A drainage system may be attached. The tube remains in place until x-rays show that the excess fluid or air has been drained from the chest and the lung is fully expanded. This procedure is usually completed within 30 minutes.

As fluid or air is removed, you will be asked to take deep breaths to help expand your lungs. Your lung capacity may also be tested using a spirometer, a device that measures how much and how fast you breathe air in and out.

You may stay in the hospital until the chest tube is removed or you may return home with a portable drainage system and the chest tube in place.

When the chest tube is no longer needed, your physician will loosen the suture or tape, you will take a deep breath and the tube will be removed. The area may be sutured and a special bandage applied. Another x-ray will be taken to make sure that excess fluid or air have not reaccumulated in the pleural space.

Pleurodesis:

A pleurodesis procedure is usually performed through a chest tube placed at the time of the thoracentesis.

A medication such as doxycycline is injected into the pleural space, which triggers an inflammatory reaction on the pleural membrane that lines the outside of the lung and the inside of the chest wall. This causes the membranes to stick together, eliminating or reducing the space where excess fluid can collect.

What will I experience during and after the procedure?

You will feel a slight pinch when the needle is inserted into your vein for the IV line and when the local anesthetic is injected. Most of the sensation is at the skin incision site. This is numbed using local anesthetic. You may feel pressure when the catheter is inserted into the vein or artery. However, you will not feel serious discomfort.

If the procedure is done with sedation, the intravenous (IV) sedative will make you feel relaxed, sleepy and comfortable for the procedure. You may or may not remain awake, depending on how deeply you are sedated.

You may feel slight pressure when the catheter is inserted, but no serious discomfort.

If you return home with the chest tube in place, you will be given instructions on how to care for the tube and drainage system.

- You may be given antibiotics and pain medication.
- You should change positions often while lying down, and exercise if possible.
- Keep the skin around where the chest tube is inserted clean and dry.
- Take regular deep breaths followed by a cough.
- Maintain the drainage system as instructed, keeping it below chest level.

If you return home with a tunneled pleural drainage catheter, you or your care nurse will be instructed on how to care for the tube and the drainage system.

- You must take sterile precautions during regular use of the catheter to reduce the chances of infection.
- Do not reuse the drainage bags.
- Do not drain more from the chest at one time than your doctor recommends. Your doctor will recommend draining a specific amount depending on your size.
- You should change the dressing over the catheter at least once a week or each time the clear dressing becomes moist.

You should call your physician if you observe the tubing to be bent or twisted or if the connection to the drainage system becomes loose. Also call your doctor if you have:

- a fever
- pain, swelling or redness in the area where the tube is inserted
- chest pain or trouble breathing

Pleurodesis

Some patients may experience chest pain during and after the introduction of the medication. You will be given pain medicine for this.

After the pleurodesis, the chest tube is left in place until it is no longer needed, and removed in the same way.

Who interprets the results and how do I get them?

The interventional radiologist or physician treating you will determine the results of the procedure and will send a report to your referring physician, who will share the results with you.

Your interventional radiologist may recommend a follow-up visit.

This visit may include a physical check-up, imaging exam(s) and blood tests. During your follow-up visit, tell your doctor about any side effects or changes you have noticed.

What are the benefits vs. risks?

Benefits

- No surgical incision is necessary—only a small nick in the skin that does not need stitches.
- No radiation remains in a patient's body after an x-ray examination.
- X-rays usually have no side effects in the typical diagnostic range for this exam.
- X-ray equipment is relatively inexpensive and widely available in emergency rooms, physician offices, ambulatory care centers, nursing homes and other locations, making it convenient for both patients and physicians.
- Because x-ray imaging is fast and easy, it is particularly useful in emergency diagnosis and treatment.

Risks

- Any procedure where the skin is penetrated carries a risk of infection. The chance of infection requiring antibiotic treatment appears to be less than one in 1,000.
- There is always a slight chance of cancer from excessive exposure to radiation. However, the benefit of an accurate diagnosis far outweighs the risk.
- Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant. *See the Safety in X-ray, Interventional Radiology and Nuclear Medicine Procedures (<http://www.radiologyinfo.org/en/info/safety-radiation>) page for more information about pregnancy and x-rays.*
- Complications that may result from a thoracostomy include:
 - pneumothorax (collapsed lung)
 - accidental injury to the chest wall, arteries, veins or lung parenchyma
 - blood clots
 - dislodging of the tube

A Word About Minimizing Radiation Exposure

Special care is taken during x-ray examinations to use the lowest radiation dose possible while producing the best images for evaluation. National and international radiology protection organizations continually review and update the technique standards used by radiology professionals.

Modern x-ray systems have very controlled x-ray beams and dose control methods to minimize stray (scatter) radiation. This ensures that those parts of a patient's body not being imaged receive minimal radiation exposure.

What are the limitations of thoracostomy?

To help facilitate complete drainage, some patients may be given special medications, called fibrinolytics and DNases, which are injected through the chest tube. These medications make the fluid in the pleural space less viscous (thick) and facilitate improved drainage through the chest tube. However, not all patients are eligible for these medications.

If thoracostomy fails to drain fluid effectively, other procedures such as video-assisted thoracoscopic drainage and/or decortication may be needed.

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