



# Chest Tube Insertion

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## ABSTRACT

Chest tube insertion (also called tube thoracostomy) is one of the commonest procedures done in the emergency room by surgical residents. Proper placement of tube in the pleural space is essential to drain air, fluid, and/or blood adequately to decompress the lung and help it reexpand, which can be life-saving in some situations like tension pneumothorax. So surgical and emergency room residents must know the correct technique of chest tube insertion and connect it to underwater seal bag or bottle, with proper aseptic precautions. They must also be familiar with complications that can result from faulty technique of tube insertion, so that those complications can be avoided.

**Keywords:** Chest trauma, Thoracic drainage system, Thoracostomy, Tube insertion.

**How to cite this article:** Karbhase J, Kadam PS. Chest Tube Insertion. MGM J Med Sci 2018;5(1):31-32.

**Source of support:** MGMIHS

**Conflict of interest:** None

## INTRODUCTION

Hippocrates was the first to describe pleural space drainage via metal tubes to drain empyema.<sup>1</sup> The first mention of tube thoracostomy is found in Wolfram von Eschenbach's Parzival, written between 1210 and 1220 AD in which he has described a knight with chest injury who was managed by chest tube made from tree bark and inserted through the wound into the chest to save his life.<sup>2</sup> First description of rubber tube (India gum rubber) insertion was done by Playfair.<sup>3</sup> Subsequently, many types of tubes were introduced. Sherwood Medical introduced chest tubes made of plastic material in 1961.<sup>4</sup>

Chest tube insertion is usually carried out in the emergency department. The ninth edition of Advanced Trauma Life Support: Students Course Manual<sup>4</sup> published by the American College of Surgeons describes the procedure in detail with 12 clearly defined steps.

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## INDICATIONS FOR TUBE THORACOSTOMY

Following are the indications for chest tube insertion:<sup>6</sup>

- Spontaneous pneumothorax (large, symptomatic, or in presence of underlying lung disease)
- Tension pneumothorax
- Penetrating chest injuries
- Hemopneumothorax in acute trauma
- Patient in extremis with evidence of thoracic trauma
- Complicated para-pneumonic effusions (empyema)
- For carrying out chemical pleurodesis in intractable pleural effusions, usually malignant
- Chylothorax
- After thoracic surgery

Primary survey in a chest trauma patient tells us in the first few minutes whether immediate life-threatening chest injury exists or not. The causes of death in chest trauma are hypoxia, hypercarbia, and acidosis.<sup>4,5</sup> So the initial treatment of patient with thoracic injuries is to prevent these by maintaining clear airway, by adequate resuscitation, and by inserting chest tube. Air hunger, respiratory distress, tachycardia, tachypnea, hypotension, tracheal deviation, unilateral chest elevation, absence of breath sounds, absence of respiratory movements, paradoxical chest wall movement, distension of neck veins, and cyanosis are some of the clinical features of severe chest trauma. X-ray chest is the only basic investigation that needs to be done before inserting a chest tube.

The ideal place for placement of chest tube is fifth intercostal space in the mid-axillary line in most situations. This area is commonly known as the "safe triangle," bordered by the anterior border of latissimus dorsi, the lateral border of the pectoralis major, a line superior to the horizontal level of the nipple, and apex below the axilla. The tubes are made up of clear plastic (polyethylene) in various internal diameters for different age groups. They have distance markers, multiple holes for drainage, and a radiopaque line over the entire length.<sup>6</sup>

## CHEST TUBE INSERTION

After careful skin preparation, draping, and administration of local anesthesia, a short skin incision is made over the correct interspace. The incision is deepened into the intercostal muscles, and the pleural cavity is entered with a blunt-tipped clamp. When any doubt exists about the status of the pleural space at the site of puncture, the wound is

enlarged bluntly to admit a finger. Finger is swept around in the adjacent pleural space to confirm entry and to break down any adhesions. Chest tube tip is grasped in a clamp and inserted into the pleural cavity. The tip is directed upward to the apex in case of pneumothorax or downward if only fluid is present for adequate drainage. Size 28F to 32F tubes are adequate for most situations. Tube size 36F may be used for hemothorax and empyema, because smaller sized tubes may get blocked. For drainage of simple pneumothorax, many surgeons prefer smaller tubes (16F–20F). The tube is connected to a water-seal drainage system. Suction is added, if necessary, to expand the lung, e.g., in a patient with lot of air leak (as in bronchopleural fistula). Chest X-ray is taken to confirm correct tube placement.

## THORACIC DRAINAGE SYSTEM

Thoracic drainage system was first introduced by Lilienthal.<sup>7,8</sup> He used it in a case of bronchiectasis after lung resection surgery. The underwater seal acts like a valve, allowing air from pleural cavity to exit into the bottle but not vice versa. Single bottle (or bag) (Fig. 1) water-seal drainage system is most commonly used. It has two rigid tubes, one long and another short. Long tube is connected to the chest tube with another length of tubing, and its inside end must, at all times, remain submerged under water (sterile saline) at least for 2 cm, so that the water seal remains functional. Inner end of the shorter tube does not dip under water and its outer end remains open to the air to let the air drained from the pleural cavity to escape. It should never be closed, otherwise high pressure may be generated inside the bottle or the bag, which will force collected fluid in the bottle back into chest. Amount of fluid/blood/pus drained is measured and recorded. Bottle should be emptied at least once every day and filled with fresh sterile saline, and while doing so the chest tube must be clamped to prevent access of air into the chest.



**Fig. 1:** Water-seal drainage bag

## COMPLICATIONS

Tube thoracotomy can cause inadvertent injury to adjacent organs. Lung may get lacerated causing hemo-pneumothorax. Continuing bleeding and air leak due to lung laceration may necessitate urgent thoracotomy to repair the damage. Badly lacerated lobe may have to be excised. Damage to diaphragm can occur if the drain placement is too low. Damage to liver can also occur by chest tubes penetrating across raised domes of diaphragm. Hemo-peritoneum and shock will occur requiring urgent laparotomy. Cardiac penetration has been reported with trocars being pushed into left chest without adequate control. (Trocar-based chest tubes are generally avoided these days.) Injury to intercostal vessels can lead to bleeding. Rapid drainage of massive fluid from pleural cavity can lead to shortness of breath, clinical instability, and postexpansion pulmonary edema.<sup>9</sup> So, massive pleural collections should be drained slowly by partially clamping the chest tube and letting the collapsed lung to reexpand slowly.

## REMOVAL OF CHEST TUBE

Chest tube is removed when no more fluid is draining any longer, air leak has stopped, and the lung has reexpanded fully. Tube should be pulled out at the end of expiration (at which time the pleural pressure is least negative) to avoid air being sucked into the pleural cavity during removal. Wound is sealed with an occlusive dressing. If an untied suture has been placed earlier at the time of chest tube insertion, it is tied to secure the wound fully and then covered with occlusive dressing.

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