

Errors and Complications in Chest Tube Placement



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KEYWORDS

• Chest drainage • Placement • Lung • Pleura • Diaphragm • Errors • Complications

KEY POINTS

- Despite many benefits, drain placement is not always a harmless procedure, and potential significant morbidity and mortality may exist.
- According to the guidelines, to reduce the risk of injury of the underlying vascular structures, the drain should be inserted within the so-called “safe triangle,” defined as the thoracic area between the anterior edge of the latissimus dorsi muscle, the lateral edge of the pectoralis major muscle, and a line superior to the horizontal level of the nipple with the apex below the axilla.
- Care should be taken when a drain must be placed in a patient with a previous thoracic/cardiac surgery, or in whom a pleurodesis has been previously achieved.
- Potentially, all the intrathoracic organs (especially the lung, the diaphragm, the heart, the great vessels, and the esophagus) may be at risk of possible injury during the chest drain insertion.
- The trocar technique, especially when performed in an emergency setting, is burdened by a high risk of possible complications.

INTRODUCTION

Chest drain placement is one of the most common surgical procedures performed in routine clinical practice. It can be done at the patient bedside, in the operating room, and in the emergency department, sometimes in life-threatening conditions (**Box 1**). The procedure is usually performed by thoracic surgeons, but, oftentimes, also by emergency physicians, intensivists, pulmonologists, interventional radiologists, and nonphysician advanced practitioners, in the emergency setting.^{1,2} The thoracic drain evacuates air, blood, and fluids retained in the pleural cavity, monitors possible thoracic bleeding, prevents tension pneumothorax, enhances the lung reexpansion improving respiratory function and facilitates the

postoperative recovery in patients submitted to thoracic/cardiac operations.

Despite the many benefits, chest tube insertion is not always a harmless procedure, and potential significant morbidity and mortality may exist. Collop and colleagues³ reported a 3% early (generally drainage misplacement and pneumothorax) and 8% late complication rate (tube dislodgement and kinking, infection). Incorrect tube insertion also may have disastrous consequences: perforation of the right or left ventricle, of the main pulmonary artery, or the esophagus has in fact been described.

The aim of this article was to highlight the correct chest tube placement procedure and to focus on errors and clinical complications following its incorrect insertion into the chest.

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Box 1**Clinical indications to chest tube insertion****Pneumothorax**

- In any ventilated patient
- Tension pneumothorax
- Persistent/recurrent pneumothorax
- Secondary large pneumothorax (especially in patients 50 years or older)

Chest trauma

- Penetrating trauma

Severe blunt trauma

- Hemopneumothorax

Malignant pleural effusions (\pm pleurodesis)**Chylothorax**

Pleural empyema and complicated parapneumonic effusions

Bronchopleural fistula**Postsurgery**

- Thoracic surgery
- Cardiac surgery
- Esophageal surgery

STANDARD SURGICAL TECHNIQUES FOR CHEST DRAIN PLACEMENT

The standard technique to correctly insert a chest drain is extensively described by the British Thoracic Surgery (BTS) guidelines.⁴ Before proceeding to any invasive procedure, an exhaustive individual consent form, which explains the advantages and the possible complications of the surgical procedure, should be obtained from the patient and documented in the patient medical record.

The preferred patient's position should be supine, on the bed, slightly rotated, with the arm placed behind the head, to better expose the axillary area.

The drain should be inserted within the so-called "safe triangle," defined as the thoracic area between the latissimus dorsi muscle anterior edge, the pectoralis major muscle lateral edge, and a line superior to the horizontal level of the nipple with the apex below the axilla (**Fig. 1**). This area reduces the risk of injuring underlying vascular structures, such as the internal mammary artery, as well as to damage muscles or the breast, resulting also in a comfortable position for the patient.

In case of anterior or apical pneumothorax, a tube could be placed in the second intercostal space, in the mid clavicular line; however, this



Fig. 1. The "safe triangle": where to correctly place a chest drain.

position may be dangerous and uncomfortable for the patient.

Particular care should be taken to drain pleural effusions or pneumothorax in a patient who previously underwent lung/cardiac surgery or pleurodesis (**Fig. 2**). These situations usually require exhaustive imaging studies. The diaphragm is in fact raised, as consequence of the former operation, and it could be injured during the tube placement; the lung also may present several dense adhesions and the risk of bleeding is therefore increased.

A different and lower tube position is required to drain fluid collection, especially loculated ones, as generally is observed as a consequence of a pleural empyema. Care should be taken to avoid diaphragm damage during the placement, or tube misplacement in the abdomen.

If a resident or a young physician places the tube, and the scheduled insertion should be outside the "triangle of safety," the procedure should be discussed with a senior surgeon. Both the National Patient Safety Agency (NPSA)⁵ and BTS⁴ guidelines recommend ultrasound guidance to insert a chest tube to drain fluid. Therefore, correct training in thoracic ultrasonography is required for the medical staff (senior and young physicians) involved in emergencies and in the care of patients with thoracic diseases.

Chest tubes are usually divided into *large bore* (≥ 20 F) and *small bore* (≤ 20 F) according to their size. French (F) is a standardized unit of measurement that was proposed by the French surgical instrument maker Joseph-Frederic-Benoit Charrière in 1860; F refers to the outer diameter of a cylindrical tube and is equivalent to 0.333 mm. The internal diameter (bore), which may vary according to the manufacturer and the length of the tube, is the

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