



## Tube Thoracostomy (Chest Tube) Removal in Traumatic Patients: What Do We Know? What Can We Do?

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### ABSTRACT

Chest tube (CT) or tube thoracostomy placement is often indicated following traumatic injuries. Premature movement of the chest tube leads to increased hospital complications and costs for patients. Placement of a chest tube is indicated in drainage of blood, bile, pus, drain air, and other fluids. Although there is a general agreement for the placement of a chest tube, there is little consensus on the subsequent management. Chest tube removal in trauma patients increases morbidity and hospital expense if not done at the right time. A review of relevant literature showed that the best answers to some questions about time and decision-making have been long sought. Issues discussed in this manuscript include chest tube removal conditions, the need for chest radiography before and after chest tubere moval, the need to clamp the chest tube prior to removal, and drainage rate and acceptability prior to removal.

**Keywords:** Tube Thoracostomy Removal; Chest Tube; CT; Traumatic patients.

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### Introduction

Tube thoracotomy is often indicated for pneumothorax, hemothorax, or plural effusion following a traumatic injury. Chest tube management should be individualized according to whether the patient is mechanically ventilated and whether or not the patient has had pulmonary

resection. This guideline is designed to decrease pain and discomfort in trauma patients, reduce tube thoracostomy removal complications, decrease average length of hospital stay and hospital costs, reduce hospital patient and staff traffic, reduce the radiation dose for patients who are exposed, reduce the likelihood of medical staff errors, and help staff in decision-making.

### *Complications of Chest tube Placement*

Inserting a chest tube could be lifesaving, but the most significant complication that arises afterward is recurrent pneumothorax [1], which results in increased length of hospital stay, patient morbidity, and economical liability. Therefore, the optimal method of chest tube removal should be determined. Important factors in determining chest tube complications include urgency in placement, location of chest tube placement, and level of staff experience.

### **Questions to be Addressed**

*First question: What criteria should patients with tube thoracostomy meet to be a candidate for tube removal?*

There is no double-blind clinical trial or meta-analysis regarding characteristics necessary for a tube thoracostomy removal, but almost all experts agree with those found in references books and hospital guidelines and listed below:

- Stable clinical condition
- Wide-open lung in X-ray of the tube thoracostomy
- Discharge of less than 200 cc in twenty-four hours
- No air leak

As regards the history of air leak, there is no direct evidence relating decision to remove the tube thoracostomy, but almost all references and hospital guidelines have focused on and confirmed the necessity of having no air leak from the tube thoracostomy for at least twenty-four hours before removing the tube [2-4]. According to some experts, it is necessary for at least 48 hours to have passed, especially in patients receiving artificial respiration. Studies have shown that the incidence of conditions requiring placement of a chest tube will rise when it is inserted before 48 hours of stability in patients with respiratory conditions [5,6].

*Second question: Is chest radiography necessary before deciding to remove the chest tube?*

All resources confirmed the necessity of ensuring the openness of the lungs before chest tube removal. Many thoracic surgeons request an x-ray after chest tube insertion to ensure tube thoracostomy patency and lungs; if respiratory conditions and an examination of the individual had good results, the chest X-ray would not be repeated before removing the tube [7,8]. A number of authoritative guidelines also dictate getting a chest X-ray, but have limited it to the unreliability of the absence of open lungs, saying: Open the lung with the absence of negative pressure on the chest tube in cases where the patient's level of consciousness is not appropriate, or when the patient has significant air leakage after the initial picture of the tube thoracostomy [9-13].

*Third question: Is it necessary to clamp the chest tube prior to removal?*

Studies in this area can be divided into three parts, all of which belong to level III:

- a. Viewpoints of thoracic surgeons of thoracostomy and lung resections in patients with a chest tube,
- b. Studies of patient management or spontaneous pneumothorax, and
- c. Studies of trauma injury management.

More studies belong to the first two groups [1,14-16]. These studies have shown that if the lung is wide open, there is no air leak and respiratory conditions are acceptable, which do not contribute to the decision to remove the tube thoracostomy. In traumatic patients, however, there is much evidence of level III, and there are more guidelines for hospitals among which there is no consensus [17,18]. According to the ideas and comments of experts, if the patient is receiving artificial respiration, has had a history of severe air leak, or has slight air leakage, clamping is recommended prior to removing the chest tube [19].

*Recommendations* Note that the clamp does not impose a fee or radiation to the patients or the system. In the vast majority of trauma victims, thoracostomies were not performed and the status of the visceral and peripheral areas of the lung injury was not known. Therefore, clamping six hours before removing the tube and clinically monitoring the patient is recommended. In the case of high-risk patients, including patients under ventilation, with a history of excessive air leakage, and patients with a decreased level of consciousness or further unreliable examination, radiography before removing the tube and at least 6 hours after clamping it is recommended.

*Forth question: How much fluid drainage from the tube thoracostomy in twenty-four hours is acceptable? Is it different with regard to the type of drainage (serous, anginos fluid, blood, or pus)?*

No high-level study has been performed on this issue, and there is only type III evidence in this field. However, after thoracoscopic lung resections, daily drainage up to even 400 cc is acceptable for removing the chest tube, because there is damage to the chest wall, lungs, and pleural. It seems that the numerical majority of pulmonologists agree on a daily discharge of 200 cc, especially if the exact extent of the lesion is unknown [19-21]. The liquid output is also important, but if it is not pus-like, the patient's condition should be treated as an empyema.

### *Recommendation*

When the amount of daily tube drainage is less than 200cc and is not pus-like, the chest tube can be removed. Pusy drainage from the chest tube requires empyema management.

*Fifth question: Does the primary reason for chest tube insertion have any effect on decision-making*

*about clamping the tube before removal?*

No study or opinion was found regarding this point, and the primary reason for chest tube insertion seems to have no importance in deciding upon tube removal. Observation of the mentioned rules is adequate for decision-making.

*Sixth question: Is it necessary to have radiography after removing the chest tube?*

In many centers, a routine chest radiograph is taken after chest tube removal. Studies have shown that in cases of reinsertion of a chest tube after removal, all patients were completely symptomatic. The chest radiography of asymptomatic patients who were indicative pneumothorax has been administered without leaving a chest tube [22-24].

*Recommendation*

Although no useful studies have shown that radiography is necessary after tube thoracostomy removal [22-24], it is recommended for some patients: patients who are receiving artificial respiration and chest tubes are removed, patients who have no access to surgical services and have tube thoracostomy removal, and patients with a decreased level of consciousness or unreliable tests. The proposed time for radiography is at least 3 hours after tube removal.

*Seventh question: Can we remove the chest tube of patients who are under mechanical respiration?*

A significant number of experts believe that keeping a chest tube in patients under mechanical ventilation until they are interrupted is best [25-31], but most studies have shown that long-term indwelling of a chest tube could increase a patient's chances of empyema and related respiratory complications resulting from pain [32,33]. Therefore, some centers determine special conditions for chest tube removal in these patients. In a study done in this center, it was shown that doctors would remove a chest tube a minimum of 5-7 days after its insertion in patients who were under mechanical respiration and had met the conditions for chest tube removal [34-41]. The complication rate of the chest tube control group showed no difference after removing the ventilator

from patients.

*Recommendation*

When a patient is under artificial respiration and meets the conditions for removal of the chest tube, the tube can be removed 5-7 days after insertion while fully observing precautions. In other words, the tube will be removable after a chest X-ray is taken and an open chest is ensured.

**Discussion**

It is necessary to have no tube air leak for at least 24 hours before removing the chest tube [2,4]. In patients with respiratory conditions, chest tube placement will rise when inserted 48 hours of stability [5,6]. Some studies have shown to do x-rays after chest tube insertion [7,8]. Chest tube clamping is recommended prior to removal if the patient receiving artificial respiration and has a history of severe air leak [19]. Clamping is not imposing radiation to the patients and is recommended to clamp six hours before removing the chest tube.

In regards of fluid drainage from the tube thoracostomy, daily drainage up to 400cc is acceptable for removing the chest tube [9-21]. When the amount of daily drainage is less than 200cc, chest tube can be removed.

It is recommended to do radiography after tube thoracostomy for the patients who are receiving artificial respiration and have no access to surgical services, although there is no study showing that the radiography is necessary [22-24].

The number of experts believes that keeping a chest tube is the best in the patients who are under mechanical respiration [25-31]. We believe that the tube can be removed 5-7 days after chest x-rays and tube insertion.

Therefore, we recommend clamping patients between 6 to 24 hours before removing the chest tube. In such cases, 6 hours for alert patients and 24 hours for unconscious patients are recommended. Moreover, after removal of the chest tube, X-rays must be taken within 3 hours to confirm patency.

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