

CHEST TUBES THORACOSTOMY:REVIEW ARTICLE

Levent ELBEYLİ*

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SUMMARY

Traditionally, tube thoracostomy for pneumothorax or hemothorax has been handled by the thoracic surgeon. Today, because of increased use of invasive procedures by the pulmonologist, those individuals performing such procedures should be component in tube thoracostomy and principles of management. The purpose of this article was to (1) review the historic development of tube thoracostomy; (2) technique of insertion, management; (3) indications and complications associated with the procedure.

Hippocrates was the first to drain empyema with the use cautery and a metal tube(1). This concept remarked in the mid nineteenth century. Although used regularly postthoracotomy in World War II, Closed tube thoracostomy drainage of the pleural space following thoracotomy was first reported by Lilienthal, and wide use of this system for traumatic hemothorax was not employed until the Korean war. Since than tube thoracostomy has become one the primary modalities in treating thoracic disease, especially chest trauma. Recently, the spectrum of diagnostic techniques available to the pulmonary physician and surgeon has expanded greatly. Transbronchial biopsy, transbronchial needle biopsy and thoracoscopy are examples of the wider scope of invasive techniques now employed by the investigators. Percutaneous needle biopsy and thoracoscopy are examples of the wider scope of invasive technique now employed by the radiologist, pulmonologist and surgeon(2,3,4).

The components of closed tube thoracostomy consist of a chest tube, the apparatus to collect the drained material, and the apparatus that control the amount of suction exerted in the pleural of space. Modern chest tube are distinctly different from their earlier counterparts. They are made varying internal diameter, with distance markers, multiple drainage holes, and a radiopaque stripe, whice outlines the proximal drainage hole. This addition permits better determination of appropriate tube position on a post placement chest roentgenogram. The tubes currently in use are minimally thrombogenic, ranging from 8-F to 40-F. They may be straight or angulated, and the may or may not have a trocar. The choose of a pleural drainage system should be determined by the clinical requirements, physiological pirinciples, and physical characteristic of both the system and components. The collecting system and the

* Gaziantep University Faculty of Medicine, Department of Thoracic Surgery, Asst.Prof.

system that controls the amount of suction exerted in the pleural space may be composed of the conventional chest bottles or of the various commercially available apparatus. All drainage systems, simple or complex required a water seal. This seal allows fluid or air to drain without allowing air to be (sucked into) the pleural space. The commonly used, commercially available tube thoracostomy apparatus are composed of three chambers and function on the same principles as the three chest bottles. The chamber that is connected to the chest tube serves as a collecting system; the second chamber, which contains a small amount of saline, acts as a one-way valve, allowing the flow of the medium only from pleural space into the collecting chamber and not in a reverse direction; and the third chamber controls the amount of suction applied to the pleural space(3,5).

Thoracic catheters that are used today to evacuate the pleural space have a blind end. When the end is grasped with a Kelly clamp, there is distortion and an increase in the diameter at the end of the tube, making insertion more difficult. In addition, the blunt end does not provide a leading edge for the ease of insertion. To facilitate passage percutaneously, the tunnel tip thoracic catheter was developed. The tunnel tip thoracic catheter is available in straight and right angled form. The tapered end allows for tube thoracostomy to be performed easily and safely with the manipulation of the right angled thoracic catheter for optimal placement. The site of chest tube insertion should be determined by the status of the material to be drained: Whether it is free in the pleural space or is loculated. As a rule, free fluid or air in the pleural space can and should be drained through a chest tube insertion through the fifth or the sixth intercostal space in the midaxillary line. A Petzer drain can be used through the second intercostal space in the mid clavicular line for pneumothorax(4,6).

For the insertion of the chest tube, the patient is placed supine with the involved side elevated 10-20 degrees from the bed. The chest wall is prepared and draped, and a small transverse skin incision is made at the intercostal space below the selected for insertion of the tube. Using blunt dissection afforded by spreading the scissors or a clamp between the skin and chest wall, a subcutaneous tract is developed up to the level of the selected intercostal space. The intercostal muscles are separated over the edge of the fifth rib with a blunt clamp, and the parietal pleura is gently penetrated. The tip of the finger is then inserted through the skin incision to verify that the entry was made into the pleural space and that the lung is not adherent to the chest wall at the site of the thoracostomy. The big size adults or smaller in children is then inserted through the prepared tract and directed posteriorly in order to reach the most dependent portion of the pleural space. The tube is then connected to a sterile under water seal drainage, graduated bottle, or other systems containing sterile normal saline, and the underwater seal drainage apparatus is connected to 20 cm H₂O of negative pressure. Blind insertion of a chest tube without previous

insertion of the exploring finger should be avoided, and a tube with trocar should never be used(4,7).

INDICATIONS FOR THORACOSTOMY

Indications for insertion of a chest tube are listed below(4,7).

- 1- Spontaneous pneumothorax
- 2- Tension pneumothorax or suspected
- 3- Iatrogenic pneumothorax
- 4- Penetrating chest injuries
- 5- Hemopneumothorax in acute trauma
- 6- Patient in extremes with evidence of thoracic trauma
- 7- Complicated parapneumonic effusions(empyema)
- 8- Pleurodesis for intractable symptomatic effusions, usually malignant
- 9- Chylothorax
- 10- Post thoracic surgery
- 11- Bronchopleural fistula
- 12- After thoracoscopy

Pneumothorax is a common problem in hospitalised patients and in the emergency room. The pneumothorax may be spontaneous, traumatic or iatrogenic(8). Therapeutic alternatives include observation, aspiration, and tube thoracostomy. The standart treatment for an initial spontaneous pneumothorax that is either symptomatic or large is hospitalisation and the insertion of a thoracostomy tube(9). When intervention was deemed necessary, treatment traditionally has been with tube thoracostomy. Smaller tubes have been used as an alternative to large tube thoracostomy in the treatment of pneumothoraces. The use of small calibre chest tubes in the treatment of pneumothoraces was initially by Sargent and Turner(10). They employed a No.9 French catheter in combination with a flutter valve developed by Heimlich. This system was easy to insert and required minimal nursing care after placement. Perlmutter et al reported successful treatment of 95 percent of postlung biopsy pneumothoraces using small calibre catheters(5).

Tube thoracostomy is both diagnostic and therapeutic with acute injuries. Closed tube thoracostomy is a common and very useful procedure in therapy of acute thoracic injury. It is used for a variety of well-established indications and is a common procedure in the emergency department(2).

Whether or not an individual with a parapneumonic effusion tube thoracostomy depends on several different factors. Patients with loculated parapneumonic effusions are more likely require chest tubes, although not all loculated prapneumonic effusions require tube thoracostomy. The smaller pleural effusion, the less likely tube thoracostomy will be necessary. When a patient with a parapneumonic effusion is identified, it is recommended that thoracentesis be

performed immediately. If frank pus is obtained or if the Gram stain of the pleural fluid is positive, tube thoracostomy should be performed without delay. It is also recommended that almost all patients with a pleural fluid glucose value below 40 mg/dl or a pleural fluid pH below 7.00 and the pleural fluid LDH is above 1,000 IU/L, undergo tube thoracostomy (11,12). A number of recent investigations have shown that chest tube drainage followed by instillation of a various agents are effective in preventing the recurrence of malignant effusions. Chest tube drainage alone has been found to be effective in controlling recurrent effusions in approximately 55 % of patients. With recurrence of the effusion after the initial drainage procedure, a chest tube should be inserted and a sclerosing agent instilled(13,14). At the other hand, patients with complicated pleural effusion of frank pus on thoracentesis should undergo immediate insertion of a dependent, closed-chest drainage catheter. If the effusion has not yet loculated, full lung expansion with obliteration of the pleural space will usually be achieved following chest tube insertion. Repeated needle thoracentesis for drainage of complicated parapneumonic effusion is inadequate and should be discouraged(15,16).

When chest tube drainage is needed over a long period, the use of a long-term drainage system is advisable. For example, long-term drainage is indicated in the treatment of malignant pleural effusion for which sclerosing therapy was not successful. Attaching a chest tube to dependent drainage will interfere with the patients mobility, be a great inconvenience, and prolong the patients hospital stay. Velanovich and co. works have used colostomy bags for chest tube drainage system for drainage of malignant effusions that have not responded to sclerosing therapy or for drainage of chronic empyemas. The lung must be sufficiently scarred so that exposure to the atmosphere does not produce a pneumothorax, and the contralateral lung must function sufficiently so that the patients air exchange is not attached to clumsy drainage bottles or plastic containers that, even when placed on intravenous poles, still restrict their movements within the hospital and prevent their discharge(17). They believe that this technique is useful for patients who are in need of pleural drainage but who are well enough to be discharged.

COMPLICATIONS

The morbidity of chest tube placement has been well analysed. Blind insertion of a chest tube without previous insertion of the exploring finger should be avoided, and a tube with a trocar should never be used. The complications of tube thoracostomy include insertion of the tube ectopically, namely, into the lung, stomach, spleen, liver or heart(4). Some have been fatal. Complications are and most of these complications result from inexperience or an inadequate understanding of thoracic anatomy and physiology(2,18,19). Reported complications include laceration of lung parenchyma, significant bleeding,

diaphragmatic injury, injury to intra-abdominal structures, and empyema(2,20). Lung injury associated with chest tube placement is most likely to occur in the setting of pre-existing disease such as 'stiff lungs' or severe pleural adhesions. Choronic bronchopleural fistulas may result. Millican and Co. workers documented four technical complications in the 447 patients who underwent tube thoracostomy for acute thoracic trauma. Two cases of isolated diaphragmatic perforation occurred. In both of these patients the injuries were recognised during laparotomy for abdominal trauma. The spleen and liver are most often damaged. These complications occur because the diaphragm rises to the level of the fourth intercostal space during full expiration(2). On the other hand, placing the tube too high and medially leads to problems with bleeding from the pectoralis muscle, especially in men, and damage to the breast in women. Massive intercostal bleeding, although documented in some series, is a potential but avoidable hazard(2,21). Gerard reported a case in which a chest tube passed through the mediastinum and lodged in the contralateral hemithorax without clinical sequel. Its position was not apparent on chest radiograph but was incidentally detected on CT scan(22).

Drainage of the pleural space with a chest tube is the accepted therapy for severe tension pneumothorax. Unless optimally performed, this procedure can cause perforation of the lung, a potentially serious complication in neonatal period(23,24). Moesinger 12 perforations were noted at autopsy. The incidence of lung perforation following pleural drainage in Moessingers' patients with respiratory distress syndrome (RDS) is high(23). Focal lung infarction may be caused by chest tube suction. This complication can demonstrate radiographically in patients(9,25). Unilateral pulmonary oedema can follow pleural space evacuation. Death have been reported. This complication has been attributed to extreme negative pressure applied to the intrapleural space in the setting of an occluded bronchus or to rapid expansion of a lung which has been collapsed for several days(16,18).

Intrapleural infection after chest tube placement is not infrequent(2). The incidence in acute trauma patients ranges from 1016 percent, with most series reporting less than 3 percent(26,27). Antibiotics may be useful, therefore, as adjuvantive therapy in the tube thoracostomy.

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