

Complications and Pitfalls of Tube Thoracostomy at a Tertiary Care Hospital

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A B S T R A C T

Background: A significant number of patients are treated by doctors in the emergency room due to the rising incidence of catastrophic chest injuries. For the treatment of pneumothorax, hemothorax, and hemopneumothorax resulting from chest trauma, a tube thoracostomy is a vital life-saving procedure.

Objective: To outline potential issues with Thoracostomy tube insertion and typical pitfalls in managing the underwater seal system.

Methodology: This retrospective study was carried out at General / Thoracic Surgery Department of Hayatabad Medical Complex Peshawar between July 2020 and December 2021. Total 300 patients were included in this study. Complications related to the thoracostomy tube insertion and mistakes practiced by the medical staff regarding the management of thoracostomy tube and its system were documented and analyzed.

Results: There were 22 (7.3%) complications were related to tube insertion, 13 (4.3%) iatrogenic lung injuries occurred during the insertion process, followed by diaphragmatic injury 4 (1.3%), intercostal vessel injury 3 (1%) & liver injury 2 (0.7%) respectively. There were total 118 (39.3%) pitfalls were observed, amongst which the most common was clamping the chest tube 29 (9.7%), followed by intrathoracic malposition 22 (7.3%), loose fixation 18 (6%), improper handling of suction system 15 (5%), vent covering 12 (4%), improper filling of the bottle 9 (3%), subcutaneous position 7 (2.3%), improper insertion site 6 (2%) respectively.

Conclusion: The trocar was the cause of all chest tube insertion-related issues. It is common to make mistakes when working with the tube and its system. All surgeons, especially general surgery residents and paramedical staff should complete specialised training in chest tube management and care.

Keywords: Thoracostomy Tube; Complications; Pitfalls

Introduction

A significant number of patients are treated by doctors in the emergency room due to the rising incidence of catastrophic chest injuries. For the treatment of pneumothorax, hemothorax, and hemopneumothorax resulting from chest trauma, a tube thoracostomy is a vital life-saving procedure.^{1,2} The fundamental goal in chest trauma is to maintain lung ventilation so that body tissues are properly oxygenated. This cannot be done without chest decompression, which lowers intra-pleural pressure and allows the lungs to fully expand.³ For the treatment of chest injuries, a number of therapeutic alternatives including clinical observation, thoraco-centesis, tube thoracostomy, and open thoracotomy have been documented in the literature.^{4,5} The most effective of them, with a 30% complication risk, is chest tube decompression. Despite the enormity of its clinical utility, this procedure carries considerably significant preventable morbidity.^{6,7} In general, they are categorized as insertional, positional or infectious. Although several risk factors contribute to this tube-related complications like size of tube, technique and approach of insertion, experience of operator and prehospital tube placement, level of experience is one of the important factors in the development of these complications.^{8,9}

Hewitt was the first to use a completely closed intercostal drainage system in 1876, but it wasn't until World War II that tube thoracostomy became typical in the treatment of injured patients.¹⁰ Doctors with almost all surgical specialties, intensivists, and emergency physicians are required to perform this life-saving procedure.¹¹

In this study, we documented all potential complications and mistakes associated with tube thoracostomy and care of its system at Hayatabad Medical Complex Peshawar.

Objective

To outline potential issues with Thoracostomy tube insertion and typical pitfalls in managing the underwater seal system.

Methodology

This retrospective observational study was conducted at General/Thoracic Surgery Department of Hayatabad Medical Complex Peshawar from July 2020 to December 2021. Total 300 patients were included in this study. All of these patients underwent a drainage procedure of the pleural cavity using a thoracostomy chest tube.

The procedure was performed by different physicians with different specialties including thoracic surgeons, general

surgeons & general surgery residents. Chest tubes that were inserted at the cardiac center were excluded. Tubes were inserted either with or without trocars. The site of insertion was the lateral chest wall in the vast majority of the patients ranging from the third to the seventh intercostal space and from the posterior to anterior axillary line. The tubes were connected to a chest bottle with under water seal system or to negative suction system.

Chest X-ray was performed post insertion, for daily follow up and post removal of the tube. Chest CT scan done, if needed. The chest tubes and its drainage system were followed up daily by the thoracic surgery team till the date of its removal. Any complication related to the insertion of the chest tube and any mistake during the care and management of the tube and its system were recorded. Statistical analysis was done using SPSS 27.0. The continuous variables were expressed as the mean $\pm$ SD, and categorical variables were expressed as percentages.

Results

Total 300 patients were included. Age ranged from 20 to 60 years, with a mean of 40 years. There were 185 (61.7%) males and 115 (38.3%) females.

In operating theatre 170 (56.7%) thoracostomy tubes were inserted after thoroscopic / open surgery, 90 (29.2%) were inserted in the intensive care unit and surgical wards, while 40 (13.3%) were inserted in the emergency department (Figure 1).

The most common indication of thoracostomy tube insertion was post thoracotomy or thoroscopic surgery 160 (53.3%), following Trauma 60 (20%), pleural effusion 40 (13.3%), empyema 13 (4.3%), pneumothorax 12 (4%), post cardiac surgery injuries 9(3%) & malignant pleural effusion 6 (2%) respectively (Table 1).

There were 22 (7.3%) complications were related to tube insertion, 13 (4.3%) iatrogenic lung injuries occurred during the insertion process, followed by diaphragmatic injury 4 (1.3%), intercostal vessel injury 3 (1%) & liver injury 2 (0.7%) respectively (Figure 2).

There were total 118 (39.3%) pitfalls were observed, amongst which the most common was clamping the chest tube 29 (9.7%), followed by intrathoracic mal position 22 (7.3%), loose fixation 18 (6%), improper handling of suction system 15 (5%), vent covering 12 (4%), improper filling of the bottle 9 (3%), subcutaneous position 7 (2.3%), improper insertion site 6 (2%) respectively (Table 2).

Discussion

The invasive technique of a chest tube thoracostomy

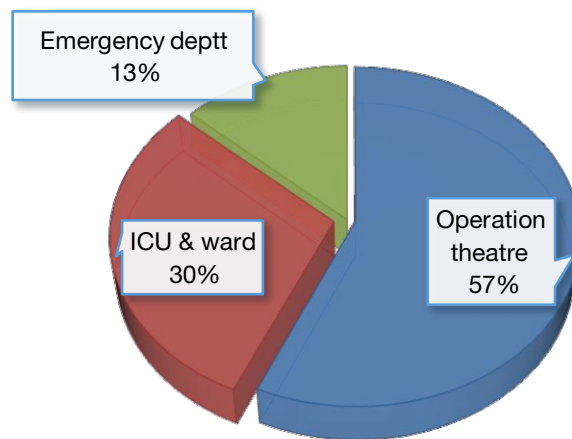


Figure 1. Tube insertion at OT, ICU & Emergency

frequently leads to difficulties from insufficient tube thoracostomy drainage. Early complications can include intra-abdominal malposition, kinking, clogging, dislodging, injury to an intercostal artery, vein, or nerve; lung perforation; perforation of the right atrium or right or left ventricle; stenosis of the subclavian artery; injury to the inferior vena cava; Horner's syndrome; and inferior vena cava injury.¹² Injuries to the heart, oesophagus, mediastinum, induction of a contralateral pneumothorax, injuries to the phrenic nerve, and an arterio-venous fistula are some other risks that have been documented.^{13,14}

In our study, there were no complications associated with inserting intraoperative chest tubes in the theatre following thoracotomy since they were all placed and positioned under vision. Similar to the findings of Dural K et al & S.F Monaghan et al, who concluded that all chest tube-related problems happened when an immediate

intervention in the emergency room or intensive care unit was required.^{15,16} When employing the open approach for the insertion, there were no difficulties in our research; however, all of the issues were connected to the insertion of the chest tube using trocars. Since this might happen when junior doctors are ill-trained, this observation should raise the alarm.

Emergency chest tube placement resulted in lung injury most frequently,¹⁷ as seen in our results. Tang A reported that intercostal artery laceration as the most observed complication related to the insertion.¹⁸ Although, Fulbrook et al considered mal positioning of the tube ranking first in the complications rate.¹⁹ We preferred to classify mal-positioning as part of the pitfalls. Our results showed clamping the chest tube during the transport of patients from one department to other was the commonest pitfall observed. Doing this maneuver may put the patients in

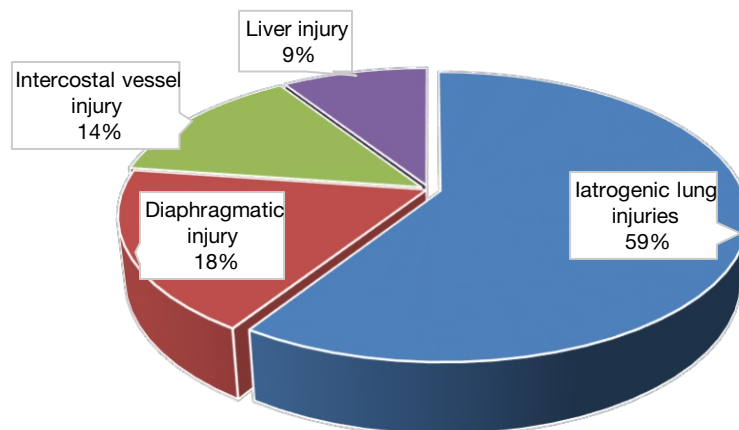


Figure 2. Complications of thoracostomy tube insertion (n=22)

Table 1. Indications of tube insertion

Indication	Frequency	Percentage
Post thoracotomy	160	53.3%
Trauma	60	20.0%
Pleural effusion	40	13.3%
Empyema	13	4.3%
Pneumothorax	12	4.0%
Post cardiac surgery	9	3.0%
Malignant pleural effusion	6	2.0%

danger of accumulating air in the pleural cavity and possible tension pneumothorax. This practice was done mostly by the nurses and the residents. Lehwaldt et al, in a study about nurse's knowledge of the chest drains care, warned about this common pitfall by the paramedical staff.²⁰

Inadequate knowledge of the suction system that is connected to the chest bottle was being practiced by both residents and nurses. We noticed a dangerous pitfall of connecting the chest bottle to the thoracostomy tube without filling the bottle with saline, which resulted in a tension pneumothorax immediately and cardiac arrest,

although the patient was resuscitated and survived and this has been highlighted earlier.

Conclusion

Majority of the complications resulted from insertion of a chest tube with trocar. Thus, using chest tubes with trocars should be avoided by the in-experienced consultants. Mistakes in dealing with the thoracostomy tube and its system are commonly being practiced, mainly by the residents and the nurses, due to inadequate knowledge and poor experience.

Table 2. Pitfalls of thoracostomy tube insertion (n=118)

Pitfall	Frequency	Percentage
Clamping chest tube	29	9.7%
Intrathoracic mal position	22	7.3%
Loose fixation	18	6%
Improper handling of suction system	15	5.0%
Vent covering	12	4.0%
Improper filling of bottle	9	3.0%
Subcutaneous position	7	2.3%
Improper insertion site	6	2.0%

References

1. Ellis H. The applied anatomy of chest drain insertion. *Br J Hosp Med*. 2007;68(Sup3):M44-5.
2. Remerand F, Luce V, Badachi Y, Lu Q, Bouhemad B, Rouby JJ. Incidence of chest tube malposition in the critically ill: a prospective computed tomography study. *J Amer Soc Anesthesiol*. 2007;106(6): 1112-9.
3. Sohara. Reexpansion pulmonary edema. *Ann Thorac Cardiovasc Surg*. 2008,14(4), 205-9.
4. Sundaramurthy SR, Moshinsky RA, Smith JA. Non-operative management of tube thoracostomy induced pulmonary artery injury. *Interact Cardiovasc Thorac Surg*. 2009;9(4):759-60.
5. Kao CL, Lu MS, Chang JP. Successful management of pulmonary artery perforation after chest tube insertion. *J Trauma Acute Care Surg*. 2007;62(6): 1533.
6. Fry W, Paape K. Shield's text book of general thoracic surgery, 6th ed. Chapter 56:794-805.
7. Ball C, Lord J, Laupland K, Gmora S, Mulloy RH, Ng AK, et al. Chest tube complications: How well are we training our residents? *Can J Surg*. 2007; 50:450-58.
8. Edwin F. eComment: management options of tube thoracostomy-induced pulmonary artery injury. *Interact Cardiovasc Thorac Surg*. 2009;9(4):760-1.
9. Gulati MS, Wafula J, Aggarwal S. Chilaiditi's sign possibly associated with malposition of chest tube placement. *J. Postgrad. Med*. 2008;54(2):138.
10. Huber-Wagner S, Korner M, Ehrh A, Kay MV, Pfeifer KJ, Mutschler W. Emergency chest tube placement in trauma care-Which approach is preferable? *Resuscitation*. 2007;72:226-33.
11. Dominguez Fernandez E, Neudeck F, Piotrowski J. Perforation of the heart wall— a rare complication after thoracic drainage treatment. *Chirurg*. 1995; 66(9):920-2.
12. Rashid MA, Wikstrom T, Ortenwall P. Mediastinal perforation and contralateral hemothorax by a chest tube. *Thorac Cardiovasc Surg*. 1998;46(6):375-6.
13. Cox PA, Keshishian JM, Blades BB. Traumatic arteriovenous fistula of the chest wall and lung Secondary to insertion of an intercostal catheter. *J Thorac Cardiovasc Surg*. 1967;54(1):109-12.
14. Andrabi S, Andrabi SI, Mansha M, Ahmed M. An iatrogenic complication of closed tube thoracostomy for penetrating chest trauma. *N Z Med J*. 2007; 120(1264):U2784.
15. Dural K, Gulbahar G, Kocer B, Sakinci U. A novel and safe technique in closed tube thoracostomy. *J Cardiothorac Surg*. 2010;5(1):1-4.
16. Monaghan SF, Swan KG. Tube thoracostomy: the struggle to the "standard of care". *Ann Thorac Surg*. 2008;86(6):2019-22.
17. Hutton I, Kenealy H, Wong C. Using simulation models to teach junior doctors how to insert chest tubes: a brief and effective teaching module. *Intern Med J*. 2008;.[Epub ahead of print].
18. Tang A, Velissaris T, Weeden D. An evidence-based approach to drainage of the pleural cavity: evaluation of best practice. *J Eval Clin Prac* 2002;8: 333-40.
19. Fulbrook P. Developing best practice in critical care nursing: knowledge, evidence and practice. *Nur Crit Care* 2003;8:96-102.
20. Lehwaldt D, Timmins F. Nurses' knowledge of chest drain care: an exploratory descriptive survey. *Nur Crit Care* 2005;10:192-200.