

Pattern and Outcome of Chest intubations in a Tertiary Care Hospital

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ABSTRACT

Objective: To assess the outcomes and complications associated with chest tube intubations in patients presenting in a tertiary care hospital.

Study Design: Prospective observational study.

Place and Duration of Study: Department of Thoracic Surgery, Combined Military Hospital, Rawalpindi Pakistan, Aug 2023 to July 2024.

Methodology: Eight Hundred and Fifteen. cases undergoing chest intubation at a tertiary care hospital, were analyzed based on detailing demographic characteristics, comorbidities, indications, outcomes, and associated complications. Data were collected from medical records and analyzed using descriptive statistics to summarize the data and inferential statistics to assess the distribution.

Results: The majority of patients were male (69.2%), with diabetes being the most prevalent comorbidity (21.6%). Blunt trauma (24.5%) and non-traumatic causes (59.8%), such as pneumothorax and pleural effusion, were the leading indications for intubation. Surgical interventions were performed in 20.0% of cases, with prolonged chest drainage required in 24.3%.

Conclusion: Tube thoracostomy is associated with favorable outcomes, as most patients were successfully treated and discharged. In addition, site infections, and prolonged intubation notable incidence of complications. This study highlights the critical need for enhanced management protocols.

Keywords: Outcome Assessment, Post-Operative Complication, Thoracostomy, Thoracic Surgical Procedures.

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INTRODUCTION

Tube thoracostomy, commonly known as chest tube insertion, is a critical and frequently performed invasive procedure in traumatic and non-traumatic thoracic conditions.¹ The optimal site for tube thoracostomy insertion is the "triangle of safety", an anatomical region bordered by the anterior margin of the latissimus dorsi, the lateral edge of the pectoralis major muscle, a line superior to the horizontal level of the nipple, with its apex situated below the axilla.² Tube thoracostomy facilitates the monitoring of thoracic blood loss, removal of blood from the pleural cavity, prevention of tension pneumothorax, and promotes lung re-expansion.^{3,4} Additionally, it aids in removing pathological collections of fluid or air from the pleural space and is a standard treatment for empyema and plays a vital role in postoperative recovery.^{3,5} Both tube thoracostomy and video-assisted thoracoscopic surgery (VATS) are viable treatments for empyema. However, VATS is considered superior due to reduced chest tube drainage duration, shorter fever duration, and a shorter hospital stay.⁶

Although chest tube insertion offers many benefits but may also be associated with risks.^{1,7} The most reported complications associated with chest intubation were tube malposition, infection, and lung injury and may require prompt intervention to prevent further morbidity and mortality. Drainage misplacement and pneumothorax are mostly associated with early complications, whereas the late complications can be accounted for tube dislodgement, kinking, and infection.⁸ Incorrect tube placement can also result in severe consequences including perforation of the right or left ventricle, pulmonary artery, and/or esophagus, with the rate of 20%-40%.^{9,10}

In Pakistan, there is limited data available on the outcomes and complication rates associated with chest intubation in tertiary care hospitals. Therefore, the current study aimed to assess the outcomes and complications associated with chest intubation in tertiary care hospital.

METHODOLOGY

This prospective observational study was conducted at Combined Military Hospital (CMH) Rawalpindi, Pakistan, to evaluate the pattern and outcomes of tube thoracostomy placements. The study included all patients who underwent tube

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thoracostomy between July 2023 and August 2024. The study population comprised patients of all who had undergone tube thoracostomy at CMH Rawalpindi during the study period.

Inclusion Criteria: Patients who undergone tube thoracostomy, either gender were included. In addition, the patients with completed medical records available for review were included.

Exclusion Criteria: Patients were excluded if they had undergone tube thoracostomy at another healthcare facility before being transferred to CMH Rawalpindi, had incomplete medical records or missing data, had a known history of chest wall deformities or previous chest surgeries that could affect result interpretation, had bleeding disorders, or had undergone tube thoracostomy following thoracic or cardiac procedures.

Based on the established criteria, 815 patients were recruited through convenient sampling. Data collection encompassed patient demographics (included age, gender, and relevant medical history), clinical data (comprised the indication for tube thoracostomy placement, the affected side of the chest, pre-procedure vital signs, and relevant laboratory findings), procedural data (details of the tube thoracostomy procedure were recorded, including the size and type of chest tube used, as well as the location of tube placement). In addition, post procedural data were also collected by reviewing complications related to tube thoracostomy placement, the duration of tube placement, and clinical outcomes.

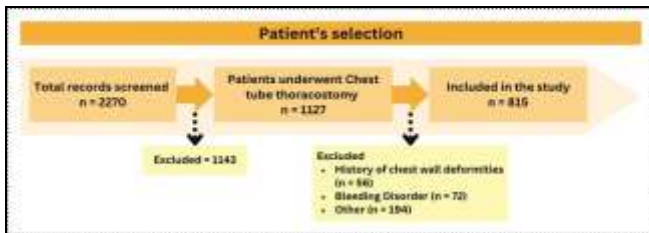


Figure-1: Flow diagram of Patients Selection

Indications for tube placement were categorized into spontaneous pneumothorax, empyema or parapneumonic effusions, pleural effusions, malignancies, and other causes. The settings of chest drainage were classified as trauma (both blunt and penetrating), iatrogenic complications (e.g., complications related to central venous line placement), and non-traumatic or medical causes. Physician specialties involved in the procedure included thoracic surgery, general surgery, emergency medicine, and other relevant fields. Chest tube sizes

were documented in French units (Fr). The placement site was classified into anterior axillary, midaxillary, posterior axillary, anterior midclavicular, and unknown. Complications were categorized into surgical site infections, iatrogenic lung and organ injuries, organ space infections/empyema, accidental dislodgement, tube blockage, re-expansion pulmonary edema, lung expansion failure, and other complications.

The study was reviewed and approved by the ethical committee of CMH Rawalpindi [Serial No.683]. The patient confidentiality was maintained throughout the study. Initially, we drafted a form for data collection based on a discussion with the research team and performed a pilot study. A senior thoracic surgeon in the department further validated the pre-specified form based on our pilot study. The patient data was collected by assigning fictitious number to each patient. The sample size of 220 was calculated using G-power software, with the following input parameters such as effect size =0.3 with level of significance 5%, power of the test 0.95, with degree of freedom.⁵ The data was collected by using a pre-specified Microsoft Excel sheet. The collected data was checked for errors and then imported into Statistical Package for Social Sciences (SPSS, v25) for statistical analysis. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. The frequency and distribution of tube thoracostomy indications and complications were reported. The Chi-square test was used to compare categorical variables, as appropriate. The *p*-value was deemed significant at 0.05 level.

RESULTS

A total of 815 patients were included in the current study. The mean age of the patients was 47 ± 3.03 . Most of the patients were male (69.20%), had diabetes (21.6%), and were non-traumatic (59.75%). Most of the chest intubation were performed Thoracic surgery residents/consultants (40.49%). The details can be seen in Table-I.

The most common intubation site was right side (47.85%) followed by left side (45.15%). The most common position for the intubation was mid-axillary (61.96%) followed by posterior axillary (23.19%). Traumatic pneumothorax (20.49%), followed by primary pneumothorax (18.53%), and hemothorax (16.20%) were common indication for chest intubation in the current study. The detailed information is given in Table-II.

Table-I: Clinico-Demographic Characteristics (n=815)

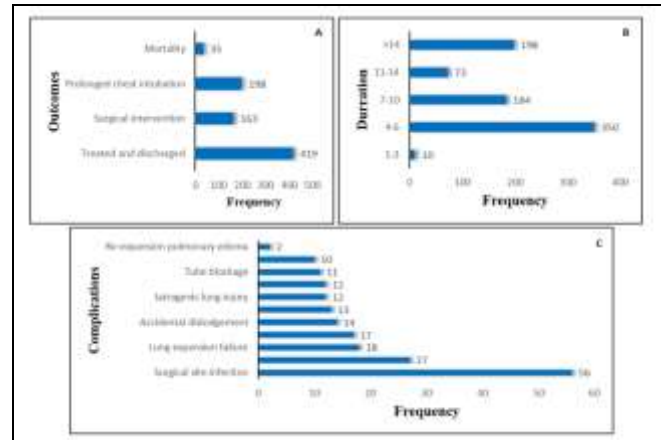
		Values
Age (years), Mean±SD (Range)		47.01±17.03 (18-80)
Gender	Male	564(69.20%)
	Female	251(30.80%)
Comorbidities	Non	398(48.83%)
	Diabetes	176(21.60%)
	IHD	116(14.23%)
	Hypertension	49(6.01%)
	Asthma/COPD	44(5.40%)
	Tuberculosis	28(3.44%)
	Pneumonia/LRTI	4(0.49%)
Cause	Blunt Trauma	200(24.54%)
	Penetrating Trauma	60(7.36%)
	Iatrogenic	68(8.34%)
	Non-traumatic	487(59.75%)
Performed by	Thoracic surgery	363(44.50%)
	General surgery	201(24.70%)
	Emergency medicine	241(29.60%)
	Other specialty	10(1.20%)

Table-II: Characteristics of the Intubation and its Indications (n=815)

		n(%)
Intubation site	Right	390(47.85%)
	Left	368(45.15%)
	Bilateral	57(6.99%)
Position	Mid-axillary	505(61.96%)
	Posterior axillary	189(23.19%)
	Anterior axillary	38(4.66%)
	Anterior midclavicular	11(1.35%)
	Not specified	72(8.83%)
Tube size	20	0(0.0%)
	24	3(0.40%)
	26	7(0.90%)
	28	449(55.10%)
	30	188(23.10%)
	32	168(20.60%)
Indication	Primary Pneumothorax	151(18.53%)
	Secondary Pneumothorax	107(13.13%)
	Hemothorax	132(16.20%)
	Empyema	89(10.92%)
	Chronic Lung Disease	8(0.98%)
	Chronic Kidney Disease	65(7.98%)
	Indeterminate Pleural Effusion	22(2.70%)
	Malignancy/Malignant pleural effusion	74(9.08%)
	Traumatic Pneumothorax	167(20.49%)

Most of the patients, who underwent tube thoracostomy, were treated and discharged (n=419), however, 198 patients were documented with prolonged intubation, 163 patients required further surgical intervention, and 35 patients had died as given in Figure-2(A). regarding chest tube duration, most of the patients were presented with 4-6 days intubation (n=350), followed by >14 days (n=198) and 7-10 days (n=184) as shown in Figure-2(B). Among 815 patients, 638(78.28%) presented with no complications. However, surgical site infections were more common (n=56) followed by pain at tube site (n=27), lung expansion failure (n=18) and vasovagal syncope

(n=17). The details of the complications can be seen in Figure-2(C). The results of the chi-square analysis demonstrate a strong association between the tube thoracostomy settings and complications ($p<0.001$), where the non-traumatic settings are major causes of tube blockage in addition to failure of lung expansion.

**Figure-2: Illustration of the chest intubation outcome (A), duration (B), and complications (C) (n=815)**

DISCUSSION

Tube thoracostomy stands as a critical intervention in the realm of emergency medicine, often serving as a pivotal measure in life-threatening situations.¹¹ While its efficacy in managing pleural effusions and pneumothoraxes is well-documented, it is imperative to acknowledge the substantial morbidity associated with this procedure.^{9,12} The intricacies involved in thoracostomy tube placement underscore the delicate balance between life-saving potential and the risks inherent in its execution. Factors such as clinicians' expertise, the specific clinical indications for the procedure, and the context, whether elective or emergency, further complicate the landscape of potential complications and mortality rates. These considerations merit a thorough examination to enhance patient outcomes and refine procedural protocol.^{9,11}

The indications for chest thoracostomy primarily revolve around the urgent need to decompress the pleural space, alleviating the detrimental effects of trapped air or fluid.¹³ Conditions such as traumatic pneumothorax, which poses an immediate threat to hemodynamic stability, and significant pleural effusions that impair respiratory function necessitate prompt intervention. Additionally, traumatic injuries resulting in hemothorax call for rapid management to restore normal pleural pressures and optimize

respiratory mechanics.^{14,15} Similarly in the current study chest thoracostomy were mostly indicated in traumatic pneumothorax followed by primary pneumothorax and hemothorax. Recognizing these critical circumstances is essential for timely and effective treatment, ensuring that patients receive the benefits of this life-saving procedure when they need it most.

The complications arising from chest thoracostomy are intricately linked to the duration of chest tube intubation, with prolonged placement often correlating with an increased risk of adverse events.¹⁶ Extended intubation periods may lead to conditions such as infection, chest wall pain, and lung complications.^{17,18} Moreover, the association with mortality becomes pronounced in cases where complications manifest; such incidents can culminate in a cascade of physiological destabilization in already vulnerable patients.¹⁹ Consistently, in the current study it has been observed that surgical site infection was more prevalent, followed by the pain at tube site and lung expansion failure. Moreover, in the current study mortality rate of 4.29% was observed which can be associated with complication and may be exacerbated by diabetes, as it significantly heightens the risk of surgical site infections in chest thoracostomy patients due to its adverse effects on immune function and wound healing.²⁰ Understanding this relationship is crucial for clinicians, as strategically minimizing the duration of chest tube placement can significantly enhance patient outcomes and reduce mortality risk. Thus, a careful balance of timely intervention and vigilant monitoring is essential to navigate the complexities of thoracostomy management.

LIMITATION OF STUDY

Our study is based upon findings in a single tertiary care setup, which may not be generalized to other health care facilities. Moreover, the use of convenient sampling might limit robust conclusion across various population groups.

CONCLUSION

In conclusion, tube thoracostomy is associated with favorable outcomes, as most of the patients were successfully treated and discharged. Surgical site infection, prolonged intubation was notable incidence of complications. This study highlights the critical need for enhanced management protocols. Furthermore, in resource-limited settings, implementing targeted training for healthcare providers on optimal intubation techniques, improving infection control measures, and ensuring close

postoperative monitoring could significantly contribute to better patient outcomes and lower complication rates in such a high-risk population.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

JZK & FAM: Data acquisition, data analysis, critical review, approval of the final version to be published.

FU & SSC: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

KUM & NF: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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