Original Article

Clinical Profile and Outcomes of Thoracic Trauma Managed with Tube Thoracostomy: A Five-Year Retrospective Cohort Study at a Tertiary Care Hospital in Punjab, Pakistan

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ABSTRACT

Background: Thoracic trauma is a leading cause of injury-related morbidity and mortality worldwide, disproportionately affecting young, economically active adults, particularly in low- and middle-income settings. Tube thoracostomy remains the cornerstone of its emergency management, yet locoregional data describing the clinical profile and outcomes of thoracic trauma managed this way remain scarce in Pakistan. This study describes the clinical profile, management, and short-term procedural outcomes of thoracic trauma patients requiring tube thoracostomy at a tertiary care hospital.

Methodology: This retrospective cohort study included 700 patients with blunt or penetrating thoracic trauma who underwent tube thoracostomy at the Department of Thoracic Surgery, Services Hospital, Lahore, over five years (January 2019-December 2024). Data on demographics, department performing the procedure, documented mechanism of injury, and procedure-related complications were extracted from hospital records using pre-specified operational definitions. Continuous variables were summarized as mean ± standard deviation and categorical variables as frequencies and percentages, using SPSS version 26.

Results: Of 700 patients, 526 (75.1%) were male and 174 (24.9%) female; 480 (68.5%) were aged 12-50 years. The Thoracic Surgery Department performed 457 of 700 procedures (65.3%); 144 (20.6%) patients were referred after tube placement elsewhere. A documented traumatic mechanism was recorded in 352 of 700 patients (50.3%), most commonly hemopneumothorax (141/352, 40.1%) and pneumothorax (94/352, 26.7%). Technical complications occurred in 244 of 700 procedures (34.9%), predominantly lung parenchymal malposition (163/244, 66.8%); process-related complications occurred in 323 of 700 (46.1%), most often ineffective placement requiring re-intervention (113/323, 35.0%).

Conclusion: Thoracic trauma managed with tube thoracostomy in this cohort predominantly affected young males and was associated with a substantial procedure-related complication rate, most often related to tube malposition and ineffective placement.

Keywords: Thoracic Injuries; Thoracostomy; Pneumothorax; Hemothorax; Postoperative Complications.

INTRODUCTION

Thoracic trauma is a major global cause of injury-related morbidity and mortality, contributing substantially to preventable death when management is delayed or inadequate.[10] In low- and middle-income countries, it disproportionately affects young, economically active males, largely through road traffic collisions, interpersonal violence, and occupational injury, and imposes a considerable socioeconomic burden on health systems that are often already resource-constrained.[11,12]

In Pakistan, tertiary care centres continue to report a substantial burden of thoracic trauma; a recent cohort from Peshawar described a marked predominance of penetrating injury among young males presenting to a tertiary trauma unit.[11] Tube thoracostomy remains the primary emergency intervention for hemothorax, pneumothorax, and hemopneumothorax resulting from thoracic trauma, restoring adequate lung ventilation and tissue oxygenation by evacuating air or fluid from the pleural space.[1-3,6] However, the procedure is not without risk: a contemporary systematic review and meta-analysis restricted to trauma-related tube thoracostomy reported a pooled complication rate of approximately 19%, with substantial variability attributable to insertion technique, operator experience, and clinical setting.[7]

Despite this burden, published data describing the clinical profile, department-level management, and short-term procedural outcomes of thoracic trauma patients managed with tube thoracostomy in Punjab, Pakistan remain limited. This study was therefore conducted to describe the clinical profile, management, and short-term procedural outcomes of thoracic trauma patients under-

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going tube thoracostomy at a tertiary care hospital in Punjab, Pakistan.

METHODOLOGY

This retrospective cohort study was conducted in the Department of Thoracic Surgery, Services Hospital, Lahore, Punjab, Pakistan, over the five-year period from January 2019 to December 2024. Ethical approval was obtained from the Institutional Review Board of Services Hospital, Lahore. As the study was retrospective and used de-identified departmental records, individual informed consent was waived.

All patients admitted with thoracic trauma who underwent tube thoracostomy during the study period were consecutively identified from departmental procedure records and included; no additional sampling was performed. Patients of all ages with blunt or penetrating thoracic trauma, confirmed by clinical examination, imaging (chest radiography, ultrasonography, or computed tomography), or operative findings, who underwent tube thoracostomy were recruited in the study. While patients with isolated non-traumatic chest pathology (e.g., pneumonia, spontaneous pneumothorax) and those with incomplete or missing medical records were excluded.

Data were extracted from departmental tube thoracostomy procedure logs and hospital medical records by the study team and included patient demographics (age, gender), the department performing the procedure, the documented mechanism of thoracic injury where available, and the occurrence of procedure-related complications as defined below.

Technical complications were defined as anatomically confirmed misplacement or injury occurring at the time of tube insertion: lung parenchymal placement (tube tip within pulmonary parenchyma rather than the pleural space, confirmed on imaging), extra-pleural placement (tube lying outside the pleural cavity, e.g., subcutaneous or intramuscular), massive subcutaneous emphysema, abdominal injury including diaphragmatic perforation, massive hemothorax requiring emergency thoracotomy, and major air leak necessitating thoracotomy.

Process-related complications were defined as errors in tube management occurring after insertion, distinct from anatomic misplacement: ineffective chest tube placement requiring re-intervention, empyema formation or clotted hemothorax requiring decortication, inappropriate clamping, and improper handling of the underwater-seal or suction system, spontaneous tube dislodgement, and persistent pneumothorax due to a loose stitch.

Data were analyzed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation, and categorical variables as frequencies and percentages of the relevant denominator. Records with missing data for a given variable were excluded from the denominator for that specific variable rather than from the overall cohort.

RESULTS

A total of 700 patients with thoracic trauma who underwent tube thoracostomy over the five-year study period were included. Males constituted 526 of 700 (75.1%), and females 174 of 700 (24.9%), a male-to-female ratio of approximately 3:1. Regarding age distribution, 480 of 700 (68.5%) were aged 12-50 years, 198 of 700 (28.3%) were older than 50 years, and 22 of 700 (3.1%) were younger than 12 years. The Thoracic Surgery Department performed 457 of 700 procedures (65.3%); 144 of 700 (20.6%) patients were referred to the department after initial tube placement elsewhere; and 99 of 700 (14.1%) procedures were performed by the General Surgery Department (Table 1). A specific traumatic mechanism was documented in the departmental records of 352 of 700 patients (50.3%); for the remaining 348 patients, the procedure log did not specify a mechanism. Among the 352 with a documented mechanism, hemopneumothorax was the most common (141/352, 40.1%), followed by pneumothorax (94/352, 26.7%), hemothorax (69/352, 19.6%), lung contusion with hemopneumothorax (29/352, 8.2%), and flail chest (19/352, 5.4%) (Table 2).

Technical complications, as operationally defined in Methods, occurred in 244 of 700 procedures (34.9%). Of these, 163 (66.8%) involved lung parenchymal placement of the tube, 49 (20.1%) were extra-pleural placements, 17 (7.0%) resulted in massive subcutaneous emphysema, 6 (2.4%) caused abdominal injury including diaphragmatic perforation, 3 (1.2%) resulted in massive hemothorax requiring emergency thoracotomy, and 3 (1.2%) resulted in major air leak necessitating thoracotomy.

Table 1: Department performing tube thoracostomy (n = 700).

Department	Frequency, n (%)
Thoracic Surgery Department	457 (65.3%)
Referred (after initial tube placement)	144 (20.6%)
General Surgery Department	99 (14.1%)

Table 2: Documented mechanism of thoracic trauma (n = 352 of 700 with mechanism recorded).

Mechanism	Frequency, n (%)
Hemopneumothorax	141 (40.1%)
Pneumothorax	94 (26.7%)
Hemothorax	69 (19.6%)
Lung contusion with hemopneumothorax	29 (8.2%)
Flail chest	19 (5.4%)

Table 3: Process-related complications of tube thoracostomy (n = 323 of 700).

Complication	Frequency, n (%)
Ineffective chest tube placement	113 (35.0%)
Empyema formation requiring decortication	81 (25.1%)
Inappropriate clamping of tube	35 (10.8%)
Improper suction system handling	28 (8.7%)
Covered outlet vents of chest bottle	22 (6.8%)
Spontaneous tube dislodgment	20 (6.2%)
Lost underwater suction control	18 (5.6%)
Persistent pneumothorax due to loose stitch	6 (1.9%)

Process-related complications, as operationally defined in Methods, occurred in 323 of 700 procedures (46.1%) (Table 3): ineffective chest tube placement requiring a second tube thoracostomy in 113 (35.0%); pleural empyema or clotted hemothorax requiring decortication in 81 (25.1%); inappropriate clamping of the tube in 35 (10.8%); improper handling of the suction system in 28 (8.7%); covered outlet vents of the underwater-seal bottle in 22 (6.8%); spontaneous tube dislodgement in 20 (6.2%); loss of underwater suction control in 18 (5.6%); and persistent pneumothorax due to a loose stitch in 6 (1.9%).

DISCUSSION

This five-year retrospective cohort of 700 thoracic trauma patients managed with tube thoracostomy demonstrated a clear male predominance (75.1%) and a concentration of injury within the economically productive 12-50-year age group (68.5%). This demographic pattern is consistent with previous Pakistani and regional reports[11] and with a 2025 multicentre report describing thoracic trauma in low- and middle-socioeconomic settings, in which young, working-age males were similarly over-represented.[12] This consistency supports road traffic collisions, interpersonal violence, and occupational exposure as principal mechanisms driving thoracic injury in young males across resource-constrained settings, and reinforces the socioeconomic relevance of thoracic trauma as a disease predominantly affecting economically active adults.[12]

The Thoracic Surgery Department performed the majority of procedures (65.3%), while 20.6% of patients were referred after tube placement elsewhere. Evidence on the optimal care pathway for emergency chest tube placement in trauma remains mixed regarding which service is best positioned to perform the initial procedure,[13] but more recent evidence indicates that structured, simulation-based mastery-learning curricula can standardize procedural competency across trainee grades irrespective of specialty.[18] Earlier work has also linked simulation-based teaching modules to improved trainee confidence and technical familiarity with chest tube insertion, although that evidence addressed feasibility of teaching rather than downstream complication rates.[17] Read together, this literature suggests that the referral pattern observed here may partly reflect variability in structured training availability outside the thoracic surgery service, though our retrospective design cannot establish this causally.

The overall technical complication rate of 34.9% observed in this cohort is higher than the pooled rate of approximately 19% reported in a systematic review and meta-analysis restricted to trauma-related tube thoracostomy using uniform complication definitions,[7] and higher than complication rates reported in a 2022 Brazilian prospective cohort of trauma patients[14] and a 2024 Japanese cohort managed within a structured respiratory-medicine service (11.8%).[15] Because these comparator cohorts differ from ours in trauma mechanism, injury severity, operator speciality, and healthcare setting, this disparity should be interpreted cautiously; it is nonetheless consistent with the possibility that local variability in operator training, insertion technique, and access to image- or ultrasound-guided placement contributes to complication risk beyond what is intrinsic to the procedure itself.[6]

Malposition-related complications, including lung parenchymal injury (66.8%) and extrapleural placement (20.1%), were the most frequent technical errors in this cohort, consistent with prior computed-tomography-based evidence identifying malposition as a common finding after tube thoracostomy in critically ill patients[2] and with case-level reports of similar malposition patterns.[9] Isolated historical case reports have also described rare but serious vascular injury from tube or catheter insertion near the intercostal vessels;[20] a separate case report describes fatal intercostal artery aneurysm rupture as a late complication of thoracotomy rather than tube thoracostomy specifically.[21] These reports illustrate the anatomic risk posed by the intercostal neurovascular bundle during blind insertion, though as isolated case reports they cannot quantify the frequency of this specific injury in a cohort such as ours.

Beyond technical misplacement, process-related complications were common, particularly ineffective placement requiring re-intervention (35.0%) and empyema or clotted hemothorax requiring decortication (25.1%). Post-traumatic empyema has previously been linked to inadequate initial drainage and delayed recognition of retained hemothorax,[19] and comparable patterns of process-related pitfalls, including inappropriate clamping and suction mismanagement, have been reported in other Pakistani and regional tertiary-care series.[22,23] Taken together, these findings support closer adherence to standardized insertion and maintenance protocols and reinforce the potential value of structured, simulation-

based training demonstrated in a recent randomized comparison to reduce technical and process-related errors of tube thoracostomy.[18]

This study has several limitations. Its retrospective, single-centre design limits generalizability, and the mechanism of injury could only be characterized for 352 of 700 patients because it was inconsistently documented in departmental procedure logs; findings regarding specific injury patterns should therefore be interpreted as applying to this documented subset rather than the full cohort. Injury severity scores, mechanism-specific outcomes, length of hospital stay, and mortality were not consistently available in the data source used and could not be analyzed; their inclusion in future prospective work would allow a more complete characterization of thoracic trauma outcomes at this centre, beyond the procedural focus of the present study. Because the study was observational, the comparisons drawn with other published cohorts are descriptive rather than causal, and the suggestion that structured training or referral pathways could reduce complications, while supported by external trial evidence, was not directly tested in this cohort and warrants prospective evaluation.

CONCLUSIONS

In this five-year retrospective cohort, thoracic trauma managed with tube thoracostomy predominantly affected young males aged 12-50 years, most procedures were performed within the Thoracic Surgery Department, and a substantial proportion of procedures were associated with technical or process-related complications, most often related to tube malposition and ineffective placement.

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Author Contributions

AAT: Conception and design, analysis and interpretation of data.
MSNB: Analysis and interpretation of data, proofreading.
ZS: Acquisition of data, conception and design, analysis and interpretation.

Artificial Intelligence (AI) Use Disclosure

ChatGPT (OpenAI) and Gemini (Google) was used during the preparation of this manuscript for language editing and improvement of manuscript clarity. The AI tool was not used to generate or manipulate original research data, perform statistical analysis, or independently develop scientific conclusions or interpretations. All AI-assisted text and suggestions were critically reviewed, edited, and approved by the authors. The authors remain fully responsible for the accuracy, originality, integrity, scientific content, data interpretation, and conclusions of the manuscript.

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