ARSI UNIVERSITY

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF SURGERY

Tube Thoracostomy Outcomes and Associated Factors among Patients Treated for Chest Injuries in Asella Referral Teaching Hospital, Asella, Ethiopia

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ABBREVIATIONS AND ACRONYMS

AOR	Adjusted Odds Ratio
ARTH	Asella Referral and Teaching Hospital
ArsU	Arsi University
BP	Blood Pressure
BTS	British Thoracic Society
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
COR	Crude Odds Ratio
DM	Diabetes Mellitus
ER	Emergency Room
ETB	Ethiopian Birr
MD	Medical Doctor
MoI	Mechanism of Injury
MOH	Ministry of Health
MOR	Minor Operating Room
MPH	Master of Public Health
PI	Principal Investigator
R2	Year Two Resident
RH	Retained Hemothorax
RR	Respiratory Rate
SaO2	Oxygen Saturation
SPSS	Statistical Package for the Social Sciences
TT	Tube Thoracostomy
WHO	World Health Organization

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ABSTRACT

Background: Chest trauma remains a leading cause of global morbidity, with tube thoracostomy serving as the definitive intervention for most thoracic injuries. In resource-limited settings, identifying clinical and procedural predictors is essential for optimizing surgical outcomes and reducing preventable morbidity.

Objective: This study aimed to evaluate the clinical outcomes of tube thoracostomy and identify independent predictors of prognosis among chest trauma patients at Asella Referral Teaching Hospital.

Methods: A hospital-based cross-sectional study was conducted, reviewing the medical records of patients treated with tube thoracostomy for chest injuries between 2020 and 2024. Data were analyzed using SPSS Version 26.0. Initially, the statistical analysis included bivariate screening for variables having p-value < 0.25, followed by multivariable logistic regression to isolate independent variables associated with patient outcomes. Association between variables was taken as statistically significant for the variables resulted in p-value <0.05 on multivariate logistic regression.

Results: A total of 171 patients were reviewed, with a strong male predominance (80.7%) and a mean age of 42.93 years (SD=16.27). Blunt trauma was the leading mechanism of injury (81.9%). While the majority of patients (91.2%) achieved a "good" clinical outcome, the overall complication rate was 24%, primarily driven by retained hemothorax (7.9%). Multivariable analysis identified post-procedural complications (AOR = 48.9, 95% CI [5.3-455.6], p=0.001)

and tube insertion performed at bedside in Emergency room (AOR=41.7, 95%CI (2.4-718.9), p=0.010), as the two most significant independent predictors of a bad outcome.

Conclusion and Recommendation: Although most patients achieved favorable outcomes, prognosis is heavily influenced by the setting of the procedure and the occurrence of preventable complications. Clinical focus must prioritize standardized procedural environments and early, adequate pleural space evacuation to mitigate risks.

Keywords: Tube Thoracostomy, Chest Tube, Trauma, Complications, Outcomes, Ethiopia.

1. INTRODUCTION

1.1 Back ground

A chest tube, also known as a tube thoracostomy (TT), is a flexible tube that can be inserted through the chest wall into the pleural space. The pleural cavity is the potential space between the visceral pleura that envelops the lungs and parietal pleura covering the chest wall, diaphragm and mediastinum. Air and abnormal fluid can accumulate in this space, causing mass effect and disruptions in the normal negative intrathoracic pressure (1). Following chest tube placement, evacuation of air and fluid within the pleural cavity allows for lung reexpansion and return to normal ventilatory function (2). Indications for chest tube placement include pneumothorax, penetrating chest trauma, hemothorax, chylothorax, bronchopleural fistula, symptomatic pleural effusion, empyema or postoperative use in thoracic/cardiac surgery (3).

Tube thoracostomy is one of the most common procedures done in routine clinical practice by clinicians of different ranks and sub-specialties (4). All personnel involved with insertion of chest drains should be adequately trained and supervised. This procedure is usually done under possible aseptic technique using local anesthesia (5). It is performed from bedside to operating room, from life-threatening emergencies to postoperative chest drainage in elective surgery. In a chest trauma patient, TT may be lifesaving and facilitates evacuation and monitoring of hemothorax, it also prevents the development of tension pneumothorax (3).

Majority (85%) of chest traumas resulting in hemothorax or pneumothorax are managed with chest tube alone. These injuries are either blunt or penetrating chest injuries (6). Hemothorax is

second only to rib fractures as the most common finding in patients presenting with thoracic trauma and is present in approximately 25% of these patients. (7).

Being invasive procedure in nature, placement of chest tube comes with potential risks and complications (4). Unfortunately, more than 25% of patients with thoracostomy tubes will encounter some associated complications. These can be categorized into insertional, positional or infective (8). Insertional complications such as bleeding, injury to surrounding structures like spleen or liver and extrapleural placement are less common. More commonly seen are positional complications when tube does not perform adequately, such as tube kinking, obstruction, or entrapment in the major fissure. Positional complications often necessitate placement of new tube or sometimes surgery (9). Postremoval complications involving pneumothorax, bleeding or spontaneous tube dislodgment are less common (2). Surgical site infection at the tube insertion site or pleural space infection is usually unexpected with the use of sterile technique (9).

One of the most common problems encountered is incomplete evacuation of a hemothorax, resulting in a retained hemothorax (RH). It has a tendency to form mature clot, resistant to subsequent drainage via a thoracostomy tube with significant risks for developing late complications such as empyema and fibrothorax with lung entrapment. Once late complications occur, morbidity and mortality increase dramatically, and the only definitive treatment is surgery (thoracotomy). So, evaluation for effective drainage by repeat imaging is advised. (4,5).

Empyema after TT has a reported incidence of 1% to 25%, depending on the study population characteristics. In trauma patients, factors associated with the development of empyema include prolonged TT dwelling time, length of intensive care stay, the presence of a pulmonary contusion, laparotomy and retained hemothorax (3). Empyema occurs more frequently after

penetrating chest trauma because penetrating injuries allow direct pleural entry of microorganisms. Treatment options for empyema include continued TT drainage, new tube placement, image-directed drainage, intrapleural fibrinolytic therapy, thoracoscopy, and open pleural decortication (3) The risk of complication is also greatest in older population with increased ventilator days, pneumonia and acute respiratory distress syndrome when compared with younger ages (12).

Given that surgical procedures and traumatic injuries represent distinct clinical scenarios, the management of chest tubes following insertion in trauma patients remains a topic of significant debate (13). Trauma patients may necessitate different strategies for tube management. Consequently, the findings from studies on postoperative tube management should be applied to trauma patients with caution (14).

Current practice management guidelines from the Eastern Association for the Surgery of Trauma recommend all hemothoraces be considered for drainage, regardless of size. Although all hemothoraces should be considered for drainage, tube thoracostomies are associated with complication rates of 20% to 40%, and there is literature that suggests small-volume hemothoraces (<300 mL) are able to be successfully managed without tube thoracostomy (15). If management without tube thoracostomy is elected, monitoring should be performed with serial chest x-rays to document resolution (11).

1.2 Statement of the problem

Chest tube insertion is one of the most common procedures performed in routine clinical practice by clinicians, particularly trauma surgeons. It has been classified as a compulsory lifesaving procedure. Despite the simplicity of the procedure, a chest tube might result in increased morbidity and mortality in otherwise stable patients, if not properly cared for it (4).

Complications of chest drainage occur in 5-35% of cases and include technical failures, malposition of the chest tube, iatrogenic injuries, retained hemothorax, non-expansion of the lung, and pleural empyema. These pleural complications increase the length of hospital stay, costs, the frequency of unscheduled reoperations, and deaths (16).

Post-traumatic empyema and pneumonia can occur between 2% and 25% of patients with isolated chest injuries who undergo tube thoracostomy (17). The primary risk factors for these complications are the contamination of the pleural space by breaching aseptic technique during the insertion of the chest drain, direct penetrating injuries to the chest, perforation of the viscus accompanied by diaphragmatic injury, the presence of retained pleural fluid, or the dissemination of infections from other sites to the pleural space (8,17). Other predictors like indwelling time of tube and necessity of relocation of the drain are also mentioned (16).

Other complications are mal positioned chest tube like intrafissural, intraparenchymal, extra thoracic or obstructed. The malpositioned TT may often lead to retention of pneumothorax or hemothorax, necessitating insertion of an additional chest tubes or possibly surgery. This in turn markedly increased hospitalization costs (8).

Even if placement of a chest tube is considered as a “clean contaminated” procedure, there is no agreement on whether the use of antibiotic prophylaxis during insertion decreases the occurrence of infections like SSI or empyema (3, 19). Some concluded that use of prophylactic antibiotics had significantly reduced incidence of thoracic empyema while others suggest no discernible difference in infection rates (19).

Studies have shown that insertion by nonsurgical residents and outside of the trauma bay were predictive of complications. Others also demonstrate that complication rates were lower while inserting in the operating room than the emergency room and in turn the emergency room had less complication than the inpatient wards (8). Tube thoracostomy complications and their reported rates are highly variable. Complication rates did not change significantly overtime for insertional, immunologic or removal. Despite decrement in infectious TT-related complications were reported, positional complications had increased (9).

With regard to the use of low pressure suction or water seal for optimal method of tube management, some studies showed that suction seems to have a positive effect on duration of chest tube treatment, length of hospital stay and persistent air leak in chest trauma (14). In contrary, other studies suggested TT can be a relatively safe procedure with acceptable complication rates even with improvised underwater seal drainage bottles (13).

While chest tube placement is a well-established procedure, there is a need to investigate the outcomes associated with this intervention in patients with chest injuries. Specially, in developing countries like ours in a resource limited set up, where lifesaving emergency procedures can’t be provided at the trauma scene, patients come late after the trauma and the use of improvised underwater seal drainage bottle might make the outcomes of tube thoracostomy

different from the previous assumption that majority of chest trauma patients can only be treated by chest tube alone. Complications related to TT insertion are underestimated, yet remain a source of significant morbidity, mortality and cost.

1.3 Significance of the study

In my observation at ARTH, TT is done for many patients with chest trauma who have indication for it. Some respond well to the treatment while others get complicated, stays long in the wards, might be given different additional managements and some also have died. Since there is no major chest surgeries being done in the hospital currently, those patients with morbidity necessitating thoracotomy are obliged to be referred to a higher center where chest surgery experts are available.

There is also no previous study done on tube thoracostomy outcomes at ARTH. So understanding the magnitude of the outcomes in our set up can inform clinical decision-making and improve patient care. Findings from this research can identify potentially determining factor for patient outcome and also guide healthcare professionals in optimizing chest tube management strategies and improving patient outcomes.

Additionally, the study can contribute to the existing body of literature on chest injuries and chest tube management. It may fill gaps in knowledge and serve as a reference for future research and clinical practice guidelines. Therefore, this study will assess tube thoracostomy outcomes and associated factors among chest trauma patients treated in Asella referral teaching hospital from Jan 2020-Dec 2024.

2. LITERATURE REVIEW

2.1 Clinical Patterns

In one study done in USA, longer times from injury to intervention are associated with increased likelihood of needing surgery for hemothorax evacuation. Patients were included in the delayed group if they received a drainage procedure >24 hours after injury(20). Other study in Nigeria showed 22% of patients present to hospital late beyond 24hr after they sustained chest trauma and this was associated with development of complications and increased morbidity and mortality (21).

A study done in Saudi Arabia showed around 26% of chest trauma patients needed tube thoracostomy and males account for about 90% of chest trauma patients due to their more exposure to the external environment (22). Similarly studies done in Burundi, Tanzania and South Africa also indicated majority of the chest trauma patients belonged to the productive age group 20-39yrs and with male to female ratio of 3:1 (23–25).

The most common symptoms noted before TT placement were chest pains and difficulty of breathing as a result of pneumothorax or hemothorax. Common clinical findings in patients with chest trauma for whom chest tube was inserted were chest tenderness in 84% of patients, decreased breath sounds(75%) and surgical emphysema(9%) (22,26).

In a study done in Australia in 2024, patients with chest trauma and comorbidities like cardiopulmonary disease, acute myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, liver disease, diabetes, renal disease, malignancy,

AIDS/HIV were found to have 34% increased likelihood of having a prolonged length of hospital stay. Chest tube was inserted for about 13% of these patients (27).

2.2 Injury Characteristics

A study done in Turkey, among patients underwent tube thoracostomy for chest trauma, indicates 37% of them were penetrating while the rest 63% were blunt chest traumas (28).

A research study conducted in Saudi Arabia involved 365 patients suffering from chest trauma. Among these individuals, 348 patients (95.5%) experienced blunt chest trauma, while 17 patients (4.5%) sustained penetrating chest trauma. The most prevalent injury observed was rib fractures, affecting 237 patients (64.93%) following blunt chest trauma. Additionally, lung injuries were significant, resulting in pneumothorax in 115 cases (31.5%), hemothorax in 80 cases (21.91%), hemopneumothorax in 65 cases (17.80%), and lung contusion in 38 cases (10.41%). Chest tube was inserted for 27% of patients. There was no mortality found in penetrating trauma patients, whereas a mortality rate of 1.64% found in blunt chest trauma patients. These mortalities were associated with traumatic brain injury (22). Another study done in the same country also showed almost half of chest trauma patients required chest tube insertion. Extra-thoracic injuries involving head, limbs and abdominal organs occurred in 80% of the patients (29).

In a study done at South Africa indications for TT were hemopneumothorax, hemothorax, simple pneumothorax, tension pneumothorax and open pneumothorax in decreasing order. 95% of the intercostal drains were unilateral while the rest are bilateral. Penetrating chest trauma accounts for 75% of the cases while 25% sustained blunt trauma (24).

In a hospital-based cross-sectional study done in Tanzania among patients with chest injuries, the majority of patients (95.58%) sustained blunt injuries. Road traffic crush was the most common cause of injuries affecting 65.79% of patients. Lung contusion, hemothorax, and rib fractures were the most common type of injuries accounting for 54.4%, 27.2%, and 21.1%, respectively. Associated injuries were noted in 85.7% of patients, and head injury (60.5%) was found in most patients. Underwater seal tube thoracostomy was performed for 38% of chest trauma patients and 14% of them had complications of surgical site infection (25).

A study conducted at Tikur Anbessa Hospital, among the victims of road traffic accidents, 19 individuals (8.3%) experienced thoracic injuries, with pneumohemothorax being the most prevalent type, affecting 10 individuals (52.6%). This was followed by hemothorax and pneumothorax, each representing 10.5% of the cases. Additionally, tube thoracostomy was performed on 8% of the affected individuals (30).

In retrospective cross-sectional study conducted in Debretabor university, majority of chest trauma patients sustained blunt chest injuries. Among these 2/3rd of the patients were treated successfully with chest tube for hemopneumothorax or hemothorax. Associated extra-thoracic injuries were noted in 70% of patients (12).

2.3 Management outcomes and associated factors

In USA, Denver, retrospective review of trauma patients undergoing TT was done and out of 451 patients, 171 (37.9%) had at least one TT malpositioning or complication. Placement in the emergency department, placement by emergency medicine physicians, and body mass index >30 kg/m^2 were independent predictors of complication. Malpositioning increased the

likelihood of early complication (6.5%–53.5%), and early complication increased the likelihood of late complication (4.3%–13.6%). Patients with a late complication had, on average, a 7.56 day longer hospital stay than patients without a late complication (31).

The study done in Turkey showed the overall rate of posttraumatic empyema was 3.1%. The independent predictors of empyema in these patients were prolonged duration of tube thoracostomy, length of ICU stay, presence of contusion, laparotomy and retained hemothorax (28).

In a study conducted in Alabama, patients with a chest tube placed outside the trauma center had an increased likelihood of malposition, residual hemothorax , residual pneumothorax , and having a second chest tube placed . However, the patients with a chest tube placed outside of the trauma center were also less likely to develop pneumonia. There were no differences in the odds of developing an empyema, the need for video-assisted thoracoscopic surgery, thoracotomy, or death (8).

In Saudi Arabia, in 2019 the majority of chest trauma patients (43.5%) required a chest tube for duration of 6 to 8 days. Notably, there were no fatalities among patients with penetrating trauma; however, associated injuries like traumatic brain injuries in blunt chest trauma patients result in higher mortality rate (22).

In South Africa, insertion of TT by junior doctors was associated with significantly higher complication rates. Junior doctors had a significantly higher complication rate (24%) compared with senior doctors (5%). Among identified complications 18% were kinked, 18% were inserted

subcutaneously, 13% were too shallow and 7% were dislodged due to inadequate fixation. 2% of them developed visceral injuries (24).

In a study done in Tanzania, Kilimanjaro medical center, the median length of hospital stay in patients with chest tube for chest trauma was 4.5 days. The mortality rate was 21%. Associated injuries such as head injuries, were found to contribute to a high mortality rate (25). In another study conducted in the same country, most of the chest trauma patients 27/51 (52.9%) were managed by tube thoracostomy. Mortality was around 21.6%. Independent factors associated with mortality were: associated injuries, more than 24 hours to treatment, bilateral chest involvement, and invasive ventilation (23).

A study done at Debretabor University involving patients with chest trauma who were treated with chest tubes found that mortality was significantly linked to several factors: age over 50 years, late presentation beyond six hours, bilateral chest injuries, penetrating chest injuries, the presence of extra-thoracic injuries, and the requirement for mechanical ventilation. Pneumonia, atelectasis and wound sepsis were among the complications identified (12).

In one systematic review and meta-analysis a favorable effect of antibiotic prophylaxis on the incidence of pulmonary infection was found. Patients who received antibiotic prophylaxis had an almost three times lower risk of empyema than those who did not receive antibiotic treatment. A subgroup analysis in patients with penetrating chest injuries showed that antibiotic prophylaxis in these patients reduced the risk of infection after tube thoracostomy, whereas in a relatively small blunt trauma subgroup no effect of antibiotic prophylaxis after blunt thoracic injury was found (18).

2.4 Conceptual Frame work

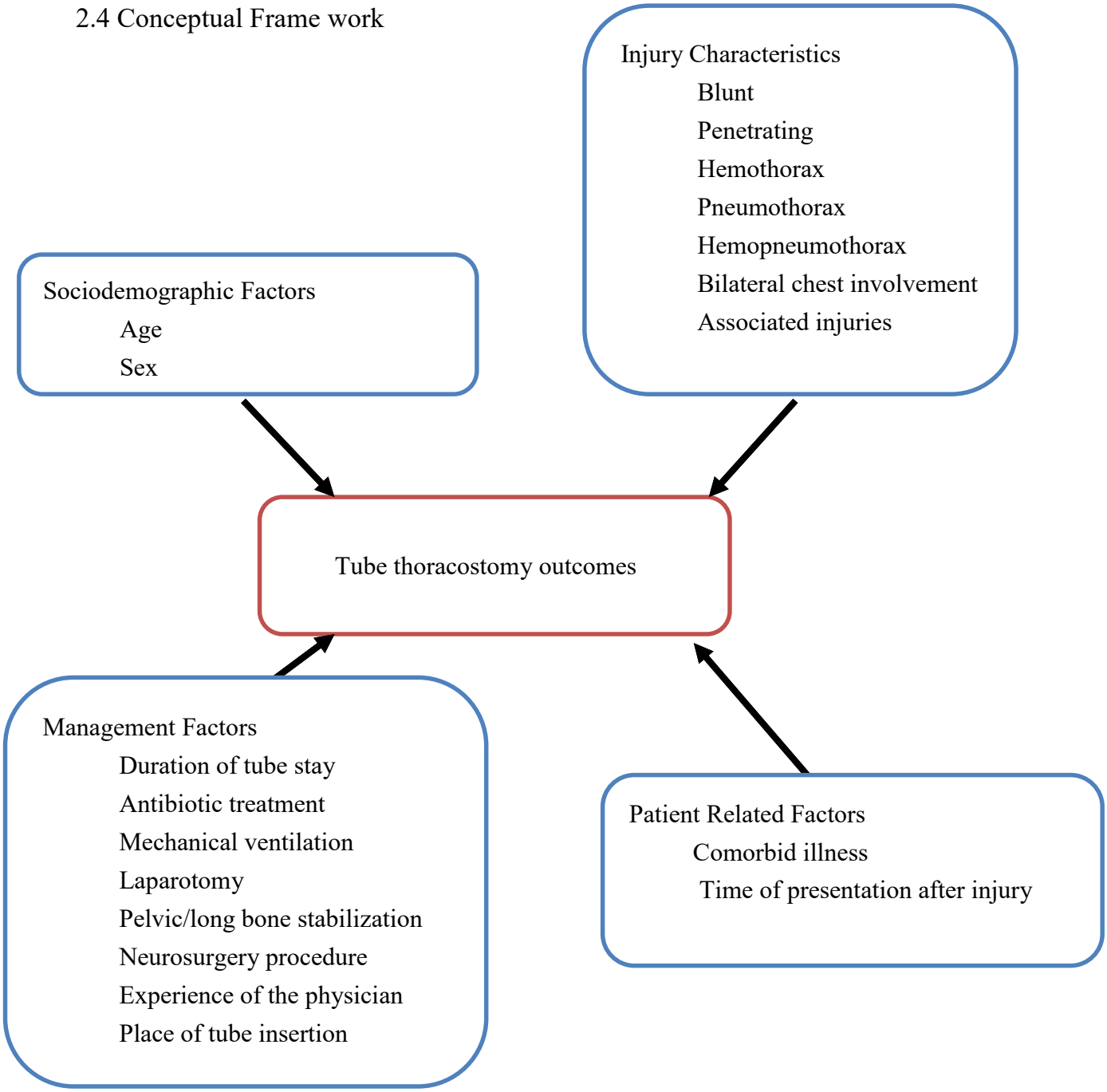

Figure 1: Conceptual framework for the study on chest tube outcomes and associated factors in chest injury patients treated at Asella Referral Teaching Hospital (Source: (18,20,32))

3. OBJECTIVES

3.1 General objective

- To determine the tube thoracostomy outcomes and associated factors in patients treated with chest tube for chest injuries in Asella Referral Teaching Hospital from 2020 to 2024.

3.2 Specific objectives

- To characterize the types of chest trauma among patients managed with chest tube

- To describe the tube thoracostomy outcomes among patients treated with chest tube for chest injuries

- To identify factors associated with tube thoracostomy outcome among patients admitted for chest trauma.

4. METHODS AND MATERIALS

4.1 Study Area and Study period

This study was conducted in Asella Referral Teaching Hospital, Asella, Ethiopia. Asella is a capital town of Arsi zone Oromia region, located 164km South-East away from Addis Ababa, the capital city of the country. Asella Teaching and Referral Hospital was founded in 1964 and is part of Arsi University, under College of Health Sciences. It is one of the teaching hospitals in the region. As a tertiary hospital it has 297 beds and serves as a referral hospital for the Arsi Zone, providing healthcare for its more than 3.5 million inhabitants.(33)

The study was conducted on patients with chest injury and treated with chest tube placement, whom were seen in ARTH from January 2020 to December 2024 and the study period was from May 2025 to Jan 2026.

4.2 Study Design

Institution-based cross sectional study was conducted from May 2025 to Jan 2026.

4.3 Population

4.3.1 Source Population

All chest trauma patients seen at Asella Referral Teaching Hospital

4.3.2 Study Population

All chest trauma patients with chest tube at ARTH from January 2020 to December 2024

4.4 Inclusion and exclusion criteria

4.4.1 *Inclusion criteria*

All chest tube records of patients with chest trauma visited ARTH during the study period from January 2020 to December 2024 and had complete records on the study variables.

4.4.2 *Exclusion criteria*

Those patients whose chart had incomplete medical record due to any reason at the time of data collection as well as those charts of patients who left against medical advice were excluded.

4.5 Sample Size determination and Sampling Technique

For the 1st objective, which determines tube thoracostomy outcome, from a study done in Hawasa University hospital, the mortality rate of chest trauma patients who were managed with chest tube was 11.7% (34). So taking this value as proportion (P), confidence interval 95% and margin of error 5%; the sample size for this study can be calculated as follows:-

$$n = \frac{(Z\alpha/2)^2 x\ p(1-p)}{d^2} = \frac{(1.96)^2 x\ 0.117x(1-0.117)}{(0.05)^2} = 159 \text{ subjects}$$

Where; n= sample size

z = standard normal value at 95% confidence

p = proportion of complications resulting in chest tube patients for chest trauma

d= margin of error

For the 2nd objective, which is planned to determine associated factors with the outcome, study from Hawasa university hospital which stated 33.3% rate of complications (34). Taking this as a proportion value and calculating sample size with similar formula above will give us 340. Since our source population (N) is about 400, which is less than 10,000, finite population correction formula will be used:

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

Adjusted sample size for the first and second objectives are 116 and 184 respectively. So we use the larger number 184 as our final sample size. All medical records of patients with chest tube for chest trauma in the period 2020 to 2024 were selected.

4.6 Variables

4.6.1 Dependent Variables

- Tube thoracostomy outcomes (Good or Bad)

4.6.2 *Independent variables*

-Age

-Sex

-Duration of presentation after trauma

-Length of hospital stay

-Mechanism of injury

-Type of injury

-Associated injuries

-Comorbid disease

-Number of tube inserted

-Place of tube insertion

-Antibiotic administration

-Mechanical ventilation

-Complications

4.7 Operational definition

- Good Outcome**:** A clinical state where the patient experienced successful lung re-expansion and resolution of the pleural collection (air or fluid) following tube thoracostomy, leading to the removal of the chest tube without the need for major surgical escalation (like thoracotomy) and discharge from the hospital in a stable condition.

- Bad Outcome**:** A clinical state defined by the failure of primary tube thoracostomy and the requirement of referral for additional major surgical interventions (thoracotomy), or in-hospital mortality.

- Complications: any deviation from normal course of chest tube and occurrence of any of the following like tube malpositioning, retained hemothorax, empyema, surgical site infection, massive hemothorax, perisitent air leak, or hospital acquired pneumonia

- Retained Hemothorax**:** The presence of residual clotted blood or fluid in the pleural space, which remains visible on imaging, often requiring secondary intervention for evacuation.

- Empyema is purulent pleural effusion which can happen due to undrained hemothorax(6)

- Death: is a process involving cessation of physiological functions, and the determination of death is the final event in that process(35). Any patient admitted and started treatment at ARTH after chest tube was inserted for chest injuries but lost his/her life in the hospital during the course of treatment before discharged from the hospital.

4.8 Data collection procedures

Medical chart of patients who were admitted after chest tube insertion for chest injury were initially identified from the log books of the minor OR, major OR and morning reporting formats of ARTH. Relevant information will be extracted from the patients' records about sex, age, duration of presentation, duration of hospital stay, mechanism of injury, type of chest injury, associated injuries, post-procedure complications and outcome. English language check list using kobo tool was developed by reviewing certain literatures. The data collectors were interns and residents.

4.9 Data Quality control

The supervisors and data collectors were trained by principal investigator for one day. They were recruited based on their data collection experiences and competence. Pretest was done at Adama medical college hospital on about 20 chest trauma patients prior to data collection and possible

corrections to the check list was made. The collected data was checked for completeness and edited frequently after data collection by the principal investigator and supervisors.

4.10 Data processing and Analysis

This study used staged approach to ensure clinical accuracy and statistical rigor. Initially, all collected data underwent a verification process for completeness. Once the dataset was finalized, it was exported to SPSS Version 26.0, where the primary statistical computations were performed. Socio-demographic and clinical characteristics were summarized using descriptive statistics, including frequency counts and percentages for categorical variables, alongside mean and standard deviation for continuous data.

The analytical stage utilized a tiered logic to identify significant predictors of chest tube outcomes. First, a bivariate analysis was conducted to screen for potential associations. Following these screening method, variables that demonstrated a p-value < 0.25 in this initial phase were entered into a multivariable logistic regression model. This model allowed for the calculation of Adjusted Odds Ratios (AOR) with 95% Confidence Intervals, effectively isolating the independent impact of each factor while controlling for confounding variables.

To ensure the reliability of the findings, the multivariable model was assessed for its predictive accuracy to correctly classify the final outcomes. For all tests conducted in the final analysis, a p-value of < 0.05 was strictly maintained as the threshold for statistical significance.

4.11 Ethical considerations

The aim of the study and patient confidentiality was explained to the medical director of ARTH and ethical clearance was obtained from Arsi University College of health science institutional review board. Official letter was written from the medical director to the respective medical record room for chart retrieving and data collection.

4.12 Dissemination of Results

The findings of the study will be presented during final thesis defense at Arsi University, Health Science College, department of surgery. Copies of final thesis will be sent to the University libraries, forwarded to hospital management and department of surgery. It will also be presented in national symposiums. Lastly possible effort will be made to publish the finding on national and international journals.

5. RESULT

5.1 Socio-demographic and clinical characteristics

In this study, a total of 171 chest trauma patients who were managed with chest tube were included, which is almost comparable to the calculated sample size (184). There is a notable predominance of male patients accounting for 138 (80.7%) as compared to 33 (19.3%) females. This makes about 1:4 female-to- male ratio. The mean age of the patients was 42.93 years (SD=16.27), with ages ranging from a minimum of 9 years to a maximum of 82 years. The age distribution revealed that the largest group of patients fell within the 20-40 years age, comprising 75 individuals (43.9%), followed by 61 patients (35.7%) aged between 41 and 60 years. Other sociodemographic profiles like residency area, educational background, income and marital status were missing data, so not included in the result section.

In this study, it was observed that the majority (64.9%) of patients sought medical attention within 24 hours of the incident while around 35.1% of the patients present with ≥ 24hrs of the trauma. 95.9% of the patients reported no significant chronic health issues, indicating a low prevalence of comorbidity in this study. Specifically, only 4.1% of patients had documented comorbid conditions, with diabetes mellitus noted in just one patient and cardiovascular disease affecting five individuals. Notably, there were no cases of malignancy, asthma/COPD, HIV, liver or renal disease among the participants.

The mean respiratory rate of the patients with chest trauma that needed chest tube management at presentation was 26.42 breaths per minute (SD = 4.347), with values ranging from 18 to 42

breaths per minute, while the mean oxygen saturation at room air was 89.99% (SD = 7.805), with a minimum of 56% and a maximum of 99%.

Table 1: Socio-demographic and clinical presentation characteristics of the 171 chest trauma patients treated with chest tube at ARTH, from 2020-2024

Variables	**Category**	**Frequency**	**Percentage (%)**
Sex	Female	33	19.3
	Male	138	80.7
Age	< 20yrs	11	6.4
	20-40yrs	75	43.9
	41-60yrs	61	35.7
	>60yrs	24	14
Duration of presentation to hospital after trauma	< 24hrs	111	64.9
	≥ 24hrs	60	35.1
Comorbidity	Yes	7	4.1
	No	164	95.9
Symptoms	Chest pain	169	98.8
	SoB	98	57.3
	Cough	4	2.3
Signs	Chest tenderness	129	75.4
	Bleeding	30	17.5
	Decreased breath sound	166	97.1
	Subcutaneous emphysema	50	29.2

5.2 Injury Characteristics

Regarding the mechanism of injury, blunt trauma was the most frequent, occurring in 140 (81.9%) patients, while penetrating trauma accounted for 31 (18.1%) cases. Among those with penetrating injuries, the most common etiology was bullet wound (n=19, 11.1%), followed by stab wounds (n=11, 6.4%) and goring injuries (n=1, 0.58%).

The clinical indications for tube thoracostomy were categorized based on pleural space findings. The most frequent diagnosis was hemopneumothorax, present in 98 (57.3%) patients, followed by hemothorax 27.5%, pneumothorax 10.5% and sucking chest wound 4.7%.

Associated intra-thoracic injuries were highly prevalent in this study. A total of 133 patients (77.8%) presented with at least one associated injury, while only 38 (22.2%) had isolated chest trauma. Rib fractures were the most common associated injury, identified in 99 (57.9%) patients. More severe extra-thoracic injuries like pelvic or long bone fractures (9.9%) and head injuries (8.8%) were also noted.

Table 2: Injury characteristics of chest trauma patients who were then treated with chest tube at ARTH, from 2020-2024

Variables			**Frequency**		**Percentage (%)**
Circumstance of injury	RTA		60		35.1%
	Fight or violence		45		26.3%
	Falling down accident		50		29.2%
	Goring or Ox attack		16		9.4%
Mechanism of chest injury	Blunt		140		81.9%
	Penetrating	Goring	1	31	18.1%
		Stab	11		
		Bullet	19		
Clinical indications for tube thoracostomy	Hemopneumothorax		98		57.3%
	Hemothorax		47		27.5%
	Pneumothorax		18		10.5%
	Sucking chest wound		8		4.7%
Associated injury	Yes		133		77.8%
	No		38		22.2%

5.3 Management factors

Management regarding antimicrobial therapy was split among the study population. Prophylactic or therapeutic antibiotics were administered to 97 (56.7%) patients, while 74 (43.3%) patients did not receive antibiotic treatment during their course of care.

The majority of patients (n=160, 93.6%) required unilateral chest tube insertion, while 11 patients (6.4%) underwent bilateral tube thoracostomy. Chest tube insertion procedure was most frequently performed by year 1 surgery residents (n=95, 55.6%) with assistance of their respective senior resident while the rest being performed by non-year 1 residents (n=76, 44.4%).

Regarding the place of tube insertion, the minor operating room (minor OR) was the primary site (n=162, 94.7%), with only a small number of the procedures performed at the bedside in the emergency room (5.3%).

Blood transfusion was required in only 14 (8.2%) patients. The mean duration for the chest tube to remain in situ (tube dwelling time) was 7.0±3.75 days. Beyond tube thoracostomy, 22 patients (12.9%) required additional surgical interventions. The most common procedures were orthopedic stabilization (long bone/pelvic/spine) for 15 cases (8.8%), laparotomy for 6 cases (3.5%), and neurosurgical procedures for 1 case (0.6%).

5.4 Post-Procedural Complications

Complications occurred in 41 patients (24%) from the total study population. It is important to note that some patients experienced multiple complications concurrently. The most common post

chest tube complication noted in our study was retained hemothorax in 14 patients (8.2%), followed by hospital acquired pneumonia (n=11, 6.4%) and tube malposition (n=9, 5.3%).

Table 3: Profile of post chest tube insertion complications among chest trauma patients treated in ARTH from 2020-2024

Type of Complications	Frequency (n)	Percentage of Total (N=171)
Retained Hemothorax	14	8.2%
Hospital Acquired Pneumonia	11	6.40%
Tube Malposition	9	5.3%
Persistent Air Leak	7	4.1%
Empyema thoracis	3	1.8%
Surgical Site Infection	3	1.8%
Kinking of Tube	2	1.2%
Massive Hemothorax	2	1.2%

5.5 Clinical outcomes and associated factors

In terms of patient outcomes for the study population (N=171), the vast majority of patients (91.2%, n=156) experienced a "good" final outcome, characterized by successful recovery and discharge. Conversely, 8.8% (n=15) were categorized as having a "bad" outcome, referring to 4.7% (n=8) died, and 4.1% (n=7) required referral to higher health facility for thoracotomy. The reasons for referral were due to severe complications such as massive hemothorax, retained hemothorax, or empyema.

Table 4: Frequency table for final outcome of chest trauma patients treated with chest tube at ARTH

Outcome Category		**Frequency**	**Percentage (%)**
Good Outcome (Recovered/Discharged)		156	91.2%
Bad Outcome (Total)		15	8.8%
	Died	*8*	*4.7%*
	Referred for Thoracotomy	*7*	*4.1%*

Variables were selected for inclusion in the multivariable logistic regression model based on a stepwise logistic regression. Initially, bivariate analysis was performed for each independent variable with final outcome as dependent variable. Those demonstrating a p-value <0.25 were considered candidates for the final multivariate regression analysis. This threshold value was chosen not to exclude early the potentially relevant variables that might be important when adjusted for other factors.

Variables like duration of presentation, SaO2 level, mechanism of injury, chest physiotherapy, blood transfusion, place of tube placement, additional surgical procedure done like laparotomy, and presence of complications all these show p value <0.25. Then, they were included for multivariate analysis to identify independent predictors of the final clinical outcome adjusting for other factors.

In the multivariate logistic regression analysis, complications following chest tube insertion (AOR 48.9, 95% CI 5.3–455.6, p=0.001) and insertion of the tube in the EOPD (AOR 41.7, 95% CI 2.4–718.9, p=0.010) were the only independent predictors of a bad outcome. This study highlights patients with complications are nearly 49 times more likely to have a bad outcome. Additionally, chest tube insertion in the EOPD is also associated with significantly higher odds of a bad outcome. This might reflect the emergency nature of those cases or differences in sterile technique/environment. This finding emphasizes that preventing procedural complications is a critical factor in reducing mortality in chest trauma patients.

Among patients requiring thoracotomy, three of them had retained hemothorax while 1 patient had developed empyema. From the mortalities, two patients had HAP, one patient retained

hemothorax, and one patient died of empyema. And also from procedures performed at bed side in the EOPD, 44.4% of them had developed complications.

On the other hand, factors like duration of presentation after the trauma, mechanism of injury, presence of comorbidity or associated injuries didn't show significant effect on the patient outcome in our study.

5.6 Management of Complications

For the 41 patients who developed complications, management primarily involved chest tube manipulation (n=21), pharmacological adjustment via revision of antibiotic therapy (n=13) and 7 patients required ICU admission and mechanical ventilation.

Table 5: Bivariate and Multivariate Logistic Regression Analysis of Predictors for Clinical Outcome.

Variables	Category	Bad	Good	COR(95%CI)	AOR(95%CI)	P-value
Duration of presentation	<24hrs	12(10.8%)	99(89.2%)	2.303(0.624-8.505)	1.408(0.237-8.382)	0.707
	≥24hrs	3(5%)	57(95%)	1		
SaO2 level at presentation	≥80%	12(7.5%)	147(92.5%)	0.245(0.058-1.026)	1.48(0.184-11.937)	0.713
	< 80%	3(25%)	9(75%)	1		
MoI	Blunt	9(6.4%)	131(93.6%)	0.286(0.094-0.876)	0.268(0.061-1.188)	0.083
	Penetrating	6(19.4%)	25(80.6%)	1		
Chest physiotherapy	YES	14(8.3%)	155(91.7%)	0.090(0.005-1.523)	0.039(0.0-6.161)	0.210
	NO	1(50%)	1(50%)	1		
Blood transfusion	YES	6(42.9%)	8(57.1%)	12.3(3.518-43.232)	2.878(0.486-17.028)	0.244
	NO	9(5.7%)	148(94.3%)	1		
Place of tube insertion	EOPD	5(55.6%)	4(44.4%)	19.0(4.403-81.995)	41.737(2.423-718.892)	0.010
	Minor OR	10(6.2%)	152(93.8%)	1		
Was laparotomy performed	No lap	13(7.9%)	152(92.1%)	0.171(0.029-1.024)	15.014(0.363-621.091)	0.154
	lap	2(33.3%)	4(66.7%)	1		
Complications	YES	12(29.3%)	29(70.7%)	17.517(4.643-66.095)	48.939(5.257-455.623)	0.001
	NO	3(2.3%)	127(97.7%)	1		

6. DISCUSSION

This study evaluated the outcomes of tube thoracostomy and identified the factors influencing those outcomes among chest trauma patients at Asella Referral Teaching Hospital (ARTH). The findings provide critical insights into the clinical patterns, procedural efficacy, and risk factors associated with morbidity in a resource-limited setting.

6.1 Clinical Patterns and Socio-Demographics

Elderly patients over 50 years with chest tube for chest trauma were having high mortality rate, noted in study at Debre Tabor University in contrary to our study where age had no significant relation with the patient outcome (12). Interestingly, while a study in Nigeria and Tanzania linked delayed presentation (>24 hours) to increased morbidity, our study found that the duration of presentation was not a significant predictor of the final clinical outcome ($p=0.707$) (21,23). This suggests that the subsequent procedural and follow up quality may outweigh the initial delay in our patient population.

6.2 Injury Characteristics and Indications

Blunt trauma was the most frequent mechanism of injury in our study (81.4%), being comparable result with studies done in Turkey, Saudi Arabia and Tanzania, where blunt injuries accounted for 63%, 95.5% and 95.58% of cases respectively (23,28,29). As opposed to our finding, penetrating chest trauma was by far more common than the blunt injuries in study done in south Africa accounting about 75% of the cases (24). Unlike the results from Debre Tabor University, mechanism of injury was not having significant effect on the patient outcome in our study. (12).

The most common clinical indication for tube thoracostomy in our study was hemopneumothorax accounting for 57.1% of patients paralleling the results found in Tikur Anbessa Hospital (52.6%) and South Africa (24,30). Although this is not the case in Saudi Arabia, where pneumothorax accounting for 31.5% is more common than hemopneumothorax(17.8%) necessitating chest tube insertion (22).

From the associated injuries identified, rib fractures were the most common associated injury, identified in 58.2% of our patients, a similar finding with study from Saudi Arabia where there was 64.93% prevalence of rib fracture (22). More severe associated injuries like pelvic or long bone fractures (9.6%) and head injuries (9.0%) were less frequent in our study population as compared to the studies done in Debre Tabor university and Tanzania, where the incidence of associated injuries were high, reaching up to 70%. Bilateral chest trauma needing tube thoracostomies were predictors of mortality but not in our study population (12,25).

6.3 Outcomes and Associated Factors

Our study identified two significant independent risk factors for the bad outcome following tube thoracostomy for chest injury: presence of complications and insertion at bedside in the EOPD.

Studies from Denver and Alabama, which found that insertion at the trauma scene or in an emergency department was a primary predictor of malposition and other complications (8,31). Similarly in our study, insertion of chest tube at bedside in the EOPD increased the odds of bad outcome ($p=0.010$). This might be due to breach in aseptic technique or severity of the injury which precludes transporting the patient to the minor OR.

The overall complication rate in our study was 24%, which falls within the 5–35% range cited globally for chest drainage (16). This was also comparable to the result from Denver, USA showing 37.9% complication rate (31). Our study revealed that the occurrence of any complication was the strongest independent predictor of a "bad" outcome (AOR = 48.9, 95%CI 5.2-455.6, p=0.001). These findings are strongly supported by the Turkish study, which also identified complications like retained hemothorax as a major predictor for late-stage infectious complications like empyema (28).

In terms of patient outcomes for our study population, the vast majority of patients (91.2%) experienced a "good" final outcome, characterized by successful recovery and discharge. This aligns with the global rate of tube thoracostomy effectiveness rate of about 85% (6). Mortality in our study population was relatively small accounting only about 4.7% of cases. But, the studies from Tanzania indicated high rate of mortality reaching up to 21% may be due to high number of severe associated extrathoracic injuries (25).

7. STRENGTH AND LIMITATIONS

7.1 Strength

This study's strength lies in its comprehensive multivariable analysis, which makes the research beyond simple description to isolate independent predictors, thereby providing strong statistical evidence for clinical decision-making. By offering specific data from one of a high-volume Ethiopian referral hospital, it fills a critical gap in local surgical literature and ensures high contextual relevance. Furthermore, the detailed complication profile, offers actionable insights into the precise drivers of mortality.

7.2. Limitations of the study

While the study provides valuable clinical insights into chest tube outcomes, several limitations warrant consideration. First, its single-center design at ARTH may limit the generalizability of the findings to other facilities with different resources or trauma protocols. The retrospective nature of the research meant that the depth of analysis was occasionally constrained by the quality of historical medical records and missing documentation.

Furthermore, the small sample size resulted in wide confidence interval in the independent predictors, which might decrease the precision of the results. Finally, the observational nature of the research allows for the identification of clinical associations but precludes the definitive proof of causality that a randomized controlled trial would provide.

8. CONCLUSION AND RECOMMENDATION

8.1 Conclusion

The majority of chest trauma patients at Asella Referral Teaching Hospital (91.2%) achieved successful clinical outcomes following tube thoracostomy, a finding consistent with global standards for trauma care. However, this study underscores that prognosis is not merely determined by the initial injury, but is heavily influenced by procedural and post-procedural factors.

The most critical determinants of a bad outcome, defined as mortality or the need for thoracotomy, are the location of tube insertion and the occurrence of post-procedural complications. Patients undergoing insertion in the EOPD at bedside and those developing complications like retained hemothorax face significantly higher odds of a poor prognosis. These findings suggest that while tube thoracostomy is a lifesaving procedure, its success depends on maintaining a controlled, aseptic environment and ensuring early, complete evacuation of the pleural space to prevent morbidity and mortality.

8.2. Recommendations

For Clinical Practice:

- The physician should prioritize performing tube thoracostomies in a controlled setting, such as a Minor Operating Room, whenever possible. Bedside insertions in the EOPD should be reserved for immediate, life-threatening emergencies where stabilization is required before transfer.

- Since retained hemothorax was the most frequent complication (7.9%), clinicians should perform early follow-up imaging (ultrasound or chest X-ray) to ensure complete evacuation and prevent the progression to empyema.
- Implementation of a standardized checklist and supervised training for residents and interns is recommended to minimize technical errors such as malpositioning or kinking, which contribute to the high "bad outcome" odds associated with complications.

For Future Research:

- Future researchers should consider prospective study designs to better evaluate the impact of antibiotic prophylaxis and specific insertion techniques on infectious complications like empyema.
- Larger, multicenter studies are needed to provide more stable statistical estimates (narrower confidence intervals) regarding the risk factors for mortality in the Ethiopian trauma context.

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10. ANNEXES

Data Collection Tool : English Version

ARSI UNIVERSITY SCHOOL OF MEDICINE

DEPARTMENT OF SURGERY

Data collection tool for Tube thoracostomy outcome and its associated factors in chest trauma patients treated in ATRH.

The study will have a significant input in identifying effectiveness of chest tube and the factors affecting outcomes of chest trauma patients. It will be used as a resource for another study in the future. It also helps to provide information for health care workers to focus on this problem so that will improve outcome of treatment.

Code _____ Department_____

Socio-demography	
1 Sex	1 Male 2 Female
2 Age	_____yrs
Clinical patterns	
3Duration between trauma and hospital arrival in (hrs)	i.<24hrs ii.>/=24hrs but <72hrs iii. >/= 3days
4 Comorbidity	1 YES 2 NO
5If Yes for Q#4	1Diabetes Mellitus 2Cardio vascular disease 3Asthma/ COPD 4RVI 5Malignancy 6Liver disease

	7Renal disease 8 Others (specify) _____	
6Compliants of the patient	1Chest pain 2Shortness of breath 3Cough	
7Chest Physical Examination Finding	1Chest tenderness 2Active bleeding 3Decreased breath sound on the chest 4Subcutaneous emphysema	
8Respiratory condition	1RR _____bpm 2SO2 _____%	
Injury characteristics		
9Circumstances of injury	a. Road Traffic Accident b. Violence c. Fall down d. Other (specify)_____	
10 Mechanism of injury	a. Blunt	
	b. Penetrating	1 stab
		2 bullet
11Types of chest injury	a. Hemothorax b. Pneumothorax c. Hemopneumothorax d. Sucking chest wound e. Subcutaneous emphysema	
12Is there associated injury	1 yes 2 no	
13If Yes for Q#12	a. Lung contusion b. Rib fracture c. Diaphragmatic injury d. Head injury e. Intra-abdominal organ injury f. Pelvic/Long bone fracture	
Management		
14The types of intervention given	a. Unilateral chest tube b. Bilateral chest tubes c. Prophylactic antibiotics	

		d. Analgesics e. Chest physiotherapy f. Laparotomy g. Neurosurgical procedure h. Long bone or pelvic stabilization i. Blood transfusion
15Duration of tube indwelling		_____days
16Length of hospital stay		_____ days
17Who inserted the chest tube		a Year 1 surgery resident b R2 c R3 d R4 e Consultant Surgeon
18Place of tube insertion		1Emergency room at bed side 2Minor OR 3Major OR 4Ward at bed side
19 Total amount of blood drained in hemothorax		_____ml
Complications		
20Complications	insertional	a. Tube malposition b. Kinking of tube c. Tube dislogdment
	infective	d. Pneumonia e. Empyema f. ARDS g. Surgical site infection
	removal	h. Persistent air leak i. Retained hemothorax j. Death k. None
21Management for the complications		a. Manipulation of chest tube b. Antibiotic therapy c. Mechanical ventilation
22Outcomes		i.Improved & discharged alive ii.Referred for thoracotomy iii.Went against medical advice iv.Died

Declaration of Investigator

I, the undersigned student of specialty in general surgery, declare that this thesis is my original work, submitted in partial fulfillment of the requirement for the specialty degree of general surgery, to the best of my knowledge.

Name of investigator: _____

Signature: _____

Date:_____

Declaration of Advisors

We, the undersigned, advisors, hereby declare that we have carefully reviewed this thesis and provided guidance for its preparation. We confirm that this thesis is ready for defense with our approval as the university advisor(s), and to the best of our knowledge, the work presented meets the academic standards and is in partial fulfillment of requirement for the specialty degree of general surgery.

1. Name of Primary Advisor: _____

   Signature: _____

   Date: _____

2. Name of secondary Advisor: Dr. Wegene Tadesse _____

   Signature: 

   Date: _____

Examiners' Declaration

We, the undersigned members of the board of examiners of the final open defense by Dr Abdi Lemma, have read and evaluated his thesis entitled “Tube Thoracostomy Outcomes and Associated Factors Among Patients Treated for Chest Injuries in Asella Referral Teaching Hospital, Asella, Ethiopia” and examined the candidate. This is, therefore, to declare that the thesis is ready for partial fulfillment of the requirements for specialty degree in General Surgery.

Chair Person name: _____

Signature: _____

Date: _____

Name of External Examiner : _____

Signature: _____

Date: _____

Name of Internal Examiner : _____

Signature: _____

Date: _____

Name of Department Head: _____

Signature: _____

Date: _____