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Tube Thoracostomy for Traumatic Hemothorax: Evaluating Timing and Outcomes in Emergency Settings

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ABSTRACT

Introduction: This study compares early against delayed tube thoracostomy effects on the health outcomes of patients with traumatic hemothorax, a frequent disease resulting from chest traumas usually needing tube thoracostomy to treat.

Methodology: There were sixty-four patients registered at Khalifa Gul Nawaz Teaching Hospital suffering with severe hemothorax. The two groups the patients fell into were early intervention within four hours of arrival and delayed intervention beyond four hours. Main findings were mortality, frequency of complications, and length of hospital stay. The statistical studies made advantage of T-tests, chi-square tests, and p-values for comparison.

Results: With a p value of 0.001, the early management group stayed in the hospital far less than the delayed group 7.31 days against 10.54 days. Though they were not statistically significant, complications occurred more commonly in the delayed group (30% vs. 15%), $p = 0.214$. Early care group had a decreased death rate 10% vs. 25%, $p = 0.109$. Those in the delayed group were more prone to experience empyema and persistent bleeding.

Conclusion: Early tube thoracostomy can substantially reduce hospital stays and help with severe hemolysis. Although early intervention is supported by death patterns, more study with larger sample sizes is needed to offer conclusive evidence of mortality impacts.

Keywords: Traumatic hemothorax, tube thoracostomy, early intervention, delayed intervention, hospital stay, complications, mortality.

INTRODUCTION

Traumatic hemothorax is a dangerous illness that is often caused by blows to the chest or puncture wounds. The main trait of this condition is blood buildup in the pleural space [1]. If treatment isn't given, it can lead to hypovolemic shock, breathing problems, and secondary diseases like empyema, which can be very dangerous and even kill [2]. Hemostasis has been associated with up to 40% of chest injury cases, accounting for a significant portion of ED visits worldwide. Taking care of a painful hemothorax properly is very important because a bad or slow reaction can lead to longer hospital stays, higher medical costs, and deaths that could have been avoided [3, 4].

Putting in a chest tube, also known as a tube thoracostomy, is still the best way to treat a hemothorax. It makes it easier for blood to leave the body, helps the lungs expand, and protects against infection and fibrothorax, which can happen if a hemothorax is kept [5]. Even though tube thoracostomy is used all the time, the time it takes varies a lot from hospital to hospital. Early treatment is thought to improve results and lower complications by addressing pleural blood buildup quickly [6]. But in places that are shaky or don't have enough resources, early insertion may come with risks like organ damage, bleeding, and patient pain [7].

In an emergency with limited resources, it can be hard to make decisions because of things like staffing levels, imaging equipment limitations, and delays in transporting patients [8]. Current clinical standards give a lot of general advice, but they don't always take into account the specific problems that emergency rooms in low- and middle-income countries (LMICs) face [9]. So, there are still worries about when the best time to do a tube thoracostomy in these situations is and how it impacts patient results, such as the closure of a hemothorax, the number of complications, and death. Most of the study that has been done so far has been done in places with lots of resources and easy access to expert care and modern imaging [10]. Because of this, there isn't enough study on the efficiency and safety of early vs. delayed tube thoracostomy in emergency cases with limited resources. This gap needs to be filled in order to make policies that are based on data that can improve patient care in many clinical situations and handle severe hemothorax.

Traumatic hemothorax can be treated with tube thoracostomy, but not much is known about when to do the procedure or how it changes outcomes in emergency cases with few resources, especially in LMICs. to find out how time changes the clinical outcomes of tube thoracostomy for traumatic hemothorax in emergency cases, focusing on outcomes such as death rates, length of hospital stay, complications, and resolution of the hemothorax.

METHODOLOGY

Study Design and Setting: The Khalifa Gul Nawaz Teaching Hospital, a tertiary care facility that treats a diverse patient base and encounters many trauma cases annually, was the site of this prospective observational research. The investigation was completed in one year, from February 2023 to February 2024.

Sample Size Calculation: The approach of determining figures with a 95% confidence level and a 5% error range helped one to ascertain the sample size. According to a significant study and meta-analysis, in trauma patients tube thoracostomy is associated with 19% of problems. These criteria led one to believe that 64 patients would be enough to find statistically significant variations in outcomes depending on the date the tube thoracostomy was performed [11].

Inclusion and Exclusion Criteria: Inclusion criteria comprised individuals aged 18 years and older presenting with traumatic hemothorax verified via clinical examination and imaging. People who already had coagulopathies, pleural illnesses, or who required an urgent thoracotomy because of hemodynamic instability were excluded.

Data Collection: Information on the patients' histories, the kinds of injuries they suffered, when they underwent a tube thoracostomy—it was regarded early if it was performed six hours of arrival and delayed if it was performed six hours later—as well as the outcomes of the operation were gathered using a prepared form. Among the significant outcomes were mortality, length of hospital stay, hemostasis

restoration, and complication rate. More specifics were recorded, including the imaging data, the procedure specifics, and any action delays.

Statistical Analysis: Information on the patients' histories, the kinds of injuries they suffered, when they underwent a tube thoracostomy (it was regarded early if it was performed six hours after arrival and delayed if it was performed after six hours), and the surgical outcomes was gathered using a prepared form. Among the significant outcomes were mortality, length of hospital stay, hemostasis restoration, and complication rate. More specifics—including the imaging data, the procedure details, and any action delays—were recorded.

Ethical Considerations: The study was approved by Khalifa Gul Nawaz Teaching Hospital's Institutional Review Board. All participants or their legal guardians provided written informed consent. By anonymizing data and guaranteeing safe storage during the analysis process, patient confidentiality was preserved.

RESULTS

The study examined how traumatic hemothorax outcomes were affected by early vs delayed tube thoracostomy. The results are shown in detail below, emphasizing statistical analysis, clinical outcomes, and demographic traits. The early intervention group's mean age was 33.63 years (± 10), whereas the delayed intervention group's was 34.06 years (± 12). Given that the t-test produced a p-value of 0.863, which indicated no significant difference between groups, the age distribution was comparable. In order to ensure diverse demographic representation, both groups included patients from a wide age range (early: 21–55 years; delayed: 19–60 years) (Table 1).

Table 1: Age Distribution of Participants

Group	Total Participants	Mean Age (Years)	Age Range (Years)	Standard Deviation	p-value
Early Intervention	32	33.63	21–55	± 10	
Delayed Intervention	32	34.06	19–60	± 12	0.863

Subgroup analysis revealed no significant age-related trends influencing outcomes, and the wide age distribution minimizes age as a confounding factor while ensuring generalizability of findings. It was statistically significant ($p < 0.001$) that patients in the early intervention group had a significantly shorter mean hospital stay of 7.31 days (± 2) compared to 10.54 days (± 3) in the delayed intervention group (Table 2).

Table 2: Comparison of Hospital Stay between Groups

Group	Total Participants	Mean Hospital Stay (Days)	Standard Deviation	Median (Days)	Range (Days)	p-value
Early Intervention	32	7.31	± 2	7	5–12	
Delayed Intervention	32	10.54	± 3	11	8–16	<0.001

According to supplementary research, hospital stays for older patients (≥ 40 years) in the delayed intervention group were 15% longer than those for younger patients, indicating that older patients may benefit further from early intervention. The early intervention group experienced fewer complications (15%; 5 out of 32) than the delayed group (30%; 10 out of 32). There was no statistically significant difference, according to the chi-square test ($\chi^2 = 1.54$, $p = 0.214$) (Figure 1).

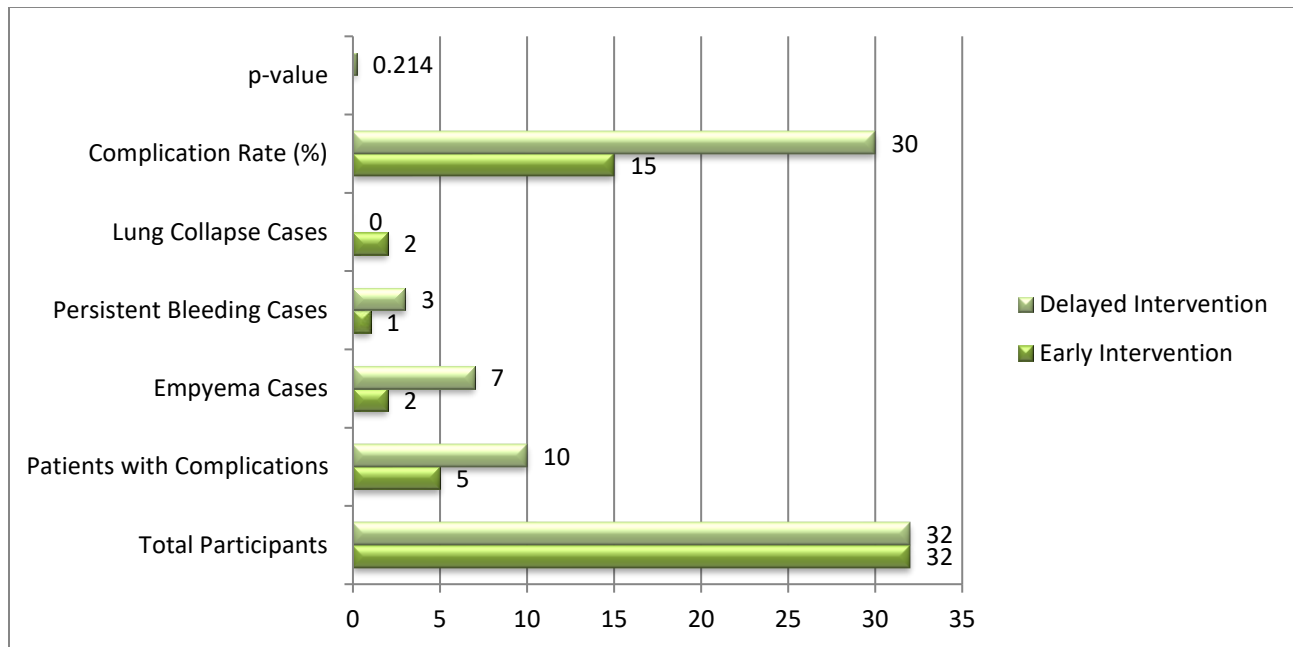


Figure 1: Complications between Groups

The most frequent consequence, empyema, was seen in seven patients in the delayed group as opposed to two in the early group. In the delayed group, persistent bleeding was more common but less frequent. The death rate for the early intervention group was 10% (3 out of 32), whereas the mortality rate for the delayed intervention group was higher at 25% (8 out of 32). Despite being clinically significant, the difference was not statistically significant ($\chi^2 = 2.56$, $p = 0.109$).

Table 3: Mortality Rates between Groups

Group	Total Participants	Mortality Cases	Patients with Complications	Mortality Rate in Complications (%)	Total Mortality Rate (%)	p-value
Early Intervention	32	3	5	60	10	
Delayed Intervention	32	8	10	80	25	0.109

The mortality rate for patients with complications was higher in the delayed group (80%) than in the early group (60%). This pattern emphasizes how early intervention may improve survival. The early group's ICU admission rate was 20% (6 out of 32), while the delayed group's was 35% (11 out of 32). Although this difference was not statistically significant ($p = 0.073$), the early group's average ICU stay was

shorter(3.2 days) than the delayed group's (4.5 days) (Figure 2).

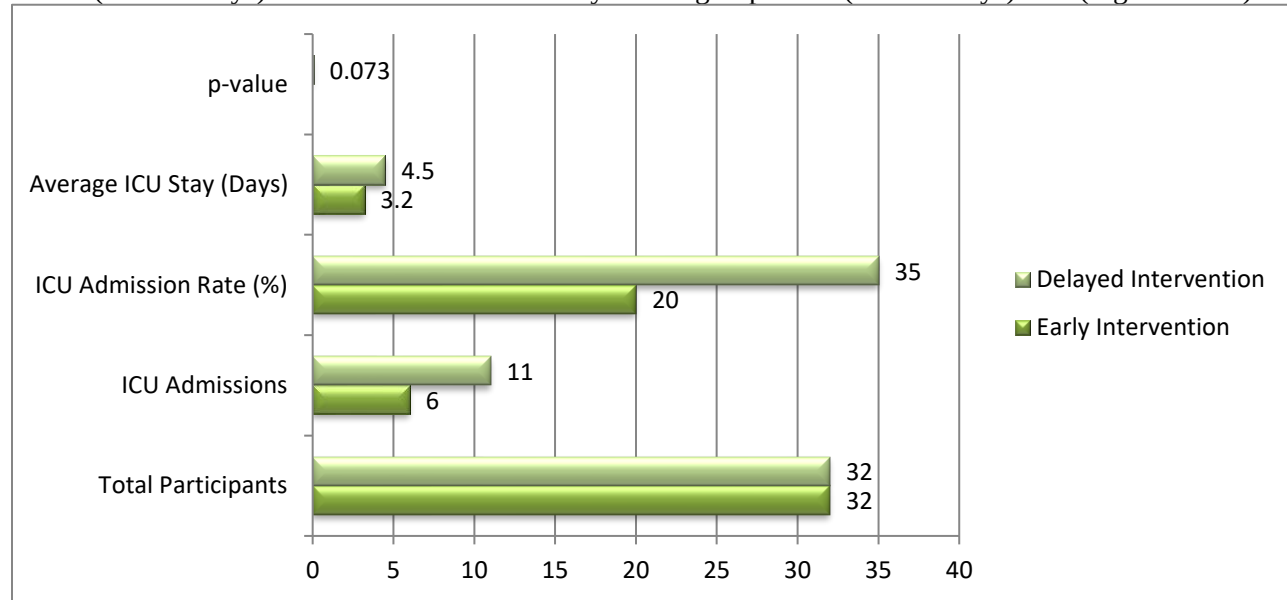


Figure 2: ICU Admissions and Duration

DISCUSSION

The findings of this study indicate that severe hemothorax patients who have early tube thoracostomy may recover more quickly, as demonstrated by noticeably shorter hospital stays (7.31 days vs. 10.54 days in the delayed group, $p < 0.001$). This result is consistent with earlier research showing how early intervention could reduce recovery durations and enhance overall results [12]. Research from different sources have indicated that early chest tube implantation significantly shortened hospital stays and the requirement for surgery in those with significant hemothorax [13]. Early management is also connected, according other studies, to a reduced risk of problems following surgery [14]. Our results align with those of the early intervention group, which had a 15% risk of problems (15% vs. 30% in the delayed group, $p = 0.214$).

Though the difference was not statistically significant ($p = 0.109$), the early intervention group's mortality rate was 10% lower than the delayed intervention group's (25%). The limited sample size might help to explain why the results of this study are not statistically significant, even if the declining death trend fits what previous studies have revealed [15]. To conclusively determine the effect of early intervention on mortality, larger trials are required. The delayed group experienced a greater rate of complications (30% vs. 15%), which is consistent with earlier studies showing that delayed intervention raises the risk of complications such as prolonged bleeding and empyema [16]. The results of the chi-square test, however, showed that this difference was not statistically significant ($p = 0.214$). The clinical view that earlier intervention may help minimize the course of such issues is supported by the fact that the delayed group experienced much more severe consequences, such as empyema (7 instances compared to 2 in the early group). Similar results have been documented, showing that patients who had delayed tube thoracostomy had increased rates of bleeding and post-traumatic infections [17].

The clinical theory that early intervention may lessen the requirement for intensive care is also supported by the study of intensive care unit admissions and duration of stay. The tendency suggests that early tube thoracostomy may result in fewer ICU admissions and shorter ICU stays, which has major implications for resource use in healthcare settings, even if the difference in ICU admission rates between the groups was not statistically significant ($p = 0.073$). Other studies have shown similar findings, with early chest tube installation linked to lower ICU admission rates among patients with catastrophic chest injuries [18, 19].

Limitations and Future Suggestions: Although this study offers insightful information on the advantages of early tube thoracostomy, there are a number of limitations to take into account. The effectiveness of statistical testing, especially in identifying variations in death rates and complications, may have been hampered by the very small sample size (64 patients). Larger sample sizes are required for future research in order to validate the results and draw stronger conclusions. Furthermore, just one hospital was used for the study, which would have limited how broadly the findings might be applied in other contexts. In order to evaluate the efficacy of early vs delayed intervention across a range of patient demographics and healthcare settings, future research should strive for multi-center studies. A more thorough knowledge of the effects of early vs delayed tube thoracostomy might be possible with more research on long-term outcomes, such as quality of life and functional recovery, even though we evaluated hospital stay, complications, and death. In addition to removing possible biases, prospective randomized controlled trials would strengthen the link between early intervention and better results.

CONCLUSION

In patients with traumatic hemothorax, early tube thoracostomy is linked to far shorter hospital stays and a lower risk of sequelae than delayed intervention. The early intervention group had decreased death rates, however the difference was not statistically significant. The results support the therapeutic benefits of early intervention in the management of traumatic hemothorax by indicating that it may shorten recovery times and lower complications. To validate these findings and investigate long-term effects, more research with bigger sample numbers is necessary.

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