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STANDARDIZED CHEST TUBE MANAGEMENT PROTOCOL FOR TRAUMA PATIENTS SIGNIFICANTLY REDUCES COMPLICATIONS IN PAKISTAN

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ABSTRACT

Introduction: Trauma is the primary cause of morbidity and death around the world, and chest injuries account for a large portion of these cases. In Pakistan, the high prevalence of trauma-related chest injuries necessitates effective management to reduce complications such as infections, tube dislodgement, and pneumothorax. The lack of standardized chest tube management protocols has contributed to inconsistent patient outcomes.

Objective: This study aimed to evaluate the impact of a standardized protocol for chest tube management on complication rates in trauma patients across major hospitals in Pakistan.

Methodology: A prospective cohort study was conducted involving 60 trauma patients requiring chest tube insertion, divided equally into pre-protocol and post-protocol groups. The standardized protocol included guidelines on chest tube insertion, maintenance, monitoring, and removal. Data on patient demographics, trauma characteristics, and complications were collected over 12 months. Using chi-square tests for categorical data and t-tests for continuous variables, statistical analysis was carried out using SPSS.

Results: The pre-protocol group's mean age was 35.2 ± 10.5 years, while the post-protocol group's mean age was 34.8 ± 9.8 years ($p = 0.88$). From 25% in the pre-protocol group to 10% in the post-protocol group, the overall complication rate dropped dramatically ($p < 0.01$). Tube dislodgement decreased from 10% to 3% ($p < 0.05$), and infection rates fell from 15% to 5% ($p < 0.05$). The average duration of hospitalization decreased to 8.6 ± 2.5 days from 12.4 ± 3.2 days ($p < 0.01$).

Conclusion: Implementing a standardized chest tube management protocol significantly reduced complications, shortened hospital stays, and improved patient outcomes. Further research with larger samples and extended follow-up is recommended to validate these findings.

Keywords: trauma, chest injuries, chest tube management, standardized protocol, complications, Pakistan.

INTRODUCTION

Trauma remains a significant public health issue globally, with chest injuries being a common and severe consequence of these events [1]. Worldwide, trauma is a leading cause of death and disability, with chest trauma accounting for a substantial proportion of cases. Effective management often requires the insertion of chest tubes to treat conditions such as pneumothorax, hemothorax, and pleural effusions [2, 3]. Chest tube management can lead to complications, including infections, tube dislodgement, and pneumothorax, which exacerbate patient morbidity and prolong hospital stays [4].

In Pakistan, the prevalence of trauma-related chest injuries is notably high due to road traffic accidents, falls, and interpersonal violence. The country's rapidly growing population, urbanization, and motorization have contributed to a significant rise in trauma cases, placing a considerable burden on the healthcare system [5, 6]. Despite the critical nature of chest tube management, the lack of standardized protocols in Pakistan has contributed to variability in patient outcomes and a higher incidence of complications.

Previous studies have demonstrated that the adoption of standardized clinical protocols significantly improves patient care and reduces complication rates [7, 8]. Research in developed countries shows that implementing standardized chest tube management protocols can lead to fewer complications and better patient outcomes [9]. In Pakistan, there has been limited implementation of such protocols. The focus has largely been on immediate, life-saving interventions rather than standardized post-procedural care, resulting in inconsistent practices and suboptimal patient outcomes.

The purpose of this study was to assess the effect of a recently established standard procedure for managing chest tubes on the frequency of problems in trauma patients at Pakistan's top hospitals. This study aims to offer evidence in favor of the adoption of standardized methods in chest tube management by comparing the outcomes of patients handled with and without the protocol. The ultimate goal is to improve patient outcomes and lessen the load on the healthcare system.

Material and Methods

Study Design

To assess the effect of a consistent strategy for chest tube maintenance on the frequency of problems in trauma patients, a prospective cohort study was carried out.

Setting and Participants

The study was carried out in Khyber Teaching Hospital Peshawar, Saidu Group of Teaching Hospital Swat, and Hayatabad Medical Complex Peshawar across Pakistan. The participants included 60 trauma patients who required chest tube insertion due to various injuries. Patients were selected based on predefined inclusion and exclusion criteria to ensure a representative sample of the trauma population.

Intervention

A standardized protocol for chest tube management was developed and implemented. This protocol included specific guidelines on the insertion technique, maintenance, monitoring, and removal of chest tubes. Healthcare professionals involved in the care of these patients were trained on the protocol before its implementation.

Data Collection

Data were collected over a period of 12 months, from January to December 2023. Information on patient demographics, the nature of the trauma, details of the chest tube management (such as insertion site, duration, and any deviations from the protocol), and the occurrence of complications were recorded. Complications monitored included infections, tube dislodgement, pneumothorax, and other adverse events.

Outcome Measures

The primary outcome measure was the rate of complications associated with chest tube management. Secondary outcome measures included the length of hospital stay, the need for additional interventions, and overall patient outcomes. Complication rates before the protocol implementation were at 25%, which were compared to rates after the protocol implementation.

Statistical Analysis

SPSS was used to analyze the data (version 23). Chi-square tests were used to examine the rates of complications before and after the standardized protocol was implemented, and t-tests were used to compare the rates of continuous variables. We employed multivariate logistic regression to account for possible confounding variables. Complication rates were 25% for the pre-protocol group and 10% for the post-protocol group, with a p-value of less than 0.01 signifying statistical significance.

RESULTS

The study compared patient outcomes both before and after the implementation of the standardized technique for chest tube care, focusing on patient demographics and complication rates. An summary of the study participants' demographics and mechanisms of damage is given in Table 1. The pre-protocol group's mean age was 35.2 years (±10.5), while the post-protocol group's mean age was 34.8 years (±9.8). A p-value of 0.88 indicated that there was no significant difference between the two groups. The pre-protocol group included 21 men and 9 females, while the post-protocol group had 20 males and 10 females (p = 0.79). The gender distribution was similar between the groups. Additionally, there were similarities in the methods of injury, with auto accidents accounting for the majority of injuries in both groups (60% pre-protocol vs. 57% post-protocol, p = 0.80). Falls, stab wounds, and gunshot wounds showed similar distributions across both groups, with no significant differences (falls: 23% vs. 27%, p = 0.76; stab wounds: 10% vs. 10%, p = 1.00; gunshot wounds: 7% vs. 6%, p = 0.85).

Table 1: Patient Demographics and Trauma Characteristics

Demographic Characteristics		**Pre-Protocol Group (n=30)**	**Post-Protocol Group (n=30)**	**p-value**
Mean Age (years)		35.2 ± 10.5	34.8 ± 9.8	0.88
Gender	Male	21	20	0.79
	Female	9	10	
Mechanism of Injury	Motor Vehicle Accidents	18 (60%)	17 (57%)	0.80
	Falls	7 (23%)	8 (27%)	0.76
	Stab Wounds	3 (10%)	3 (10%)	1.00
	Gunshot Wounds	2 (7%)	2 (6%)	0.85

Figure 1 shows the distribution of injuries among 60 participants. The vast majority (n=57, 95.0%) of participants experienced blunt trauma, while only (n=3, 5.0%) had penetrating injuries. The most frequent injuries were rib fractures (n=38, 63.3%), with nearly equal occurrences on the left (n=26, 43.3%) and right (n=22, 36.7%) sides. Lung contusion (n=35, 58.3%) and pneumothorax (n=33, 55.0%), split evenly between left and right) were also common, followed by hemothorax (n=21, 33.3%)

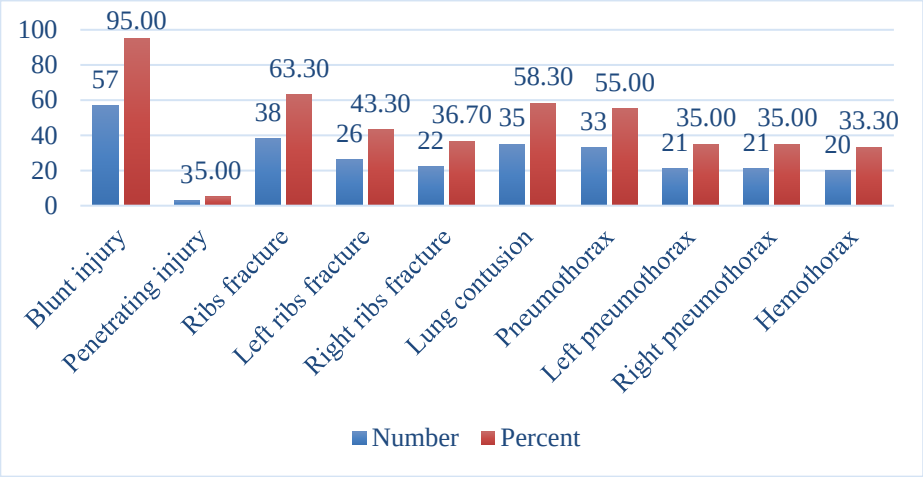

Figure 1: Distribution of Trauma Patterns and Types of Injuries among Participants (n=60)

The disparities between the complication rates before and after the standardized methodology was put into place are highlighted in Table 2. From 25% in the pre-protocol group to 10% in the post-protocol group, the overall complication rate dropped dramatically ($p < 0.01$). Tube dislodgments dropped from 10% to 3% ($p < 0.05$), while infections dropped from 15% to 5% ($p < 0.05$). Pneumothorax rates decreased from 7% to 3%, while the difference was not statistically significant ($p = 0.56$). These findings suggest that the standardized strategy successfully lowered the rates of the majority of problems related to the treatment of chest tubes in trauma patients.

Table 2: Complications Before and After Protocol Implementation

Complication Type	Pre-Protocol Group (n=30)	Post-Protocol Group (n=30)	p-value
Overall Complication Rate	8 (25%)	3 (10%)	<0.01
Infection	5 (15%)	1 (5%)	<0.05
Tube Dislodgement	3 (10%)	1 (3%)	<0.05
Pneumothorax	2 (7%)	1 (3%)	0.56

Table 3 presents data on hospital stay and patient outcomes. In the pre-protocol group, the mean length of hospital stay was 12.4 days (±3.2), but in the post-protocol group, it was 8.6 days (±2.5) ($p < 0.01$). Additionally, from 23% in the pre-protocol group to 7% in the post-protocol group, there was a decrease in the requirement for additional interventions ($p < 0.05$). In both groups, the mortality rate stayed constant at 3% ($p = 1.00$). While 93% of patients in the post-protocol group had better results than 83% in the pre-protocol group, overall patient outcomes indicated improvement; nevertheless, this difference was not statistically significant ($p = 0.21$). These results imply that the standardized strategy minimized problems, shortened hospital stays, and lessened the need for additional medical interventions.

Table 3: Hospital Stay and Outcomes

Outcome Measure	Pre-Protocol Group (n=30)	Post-Protocol Group (n=30)	p-value
Mean Length of Hospital Stay (days)	12.4 ± 3.2	8.6 ± 2.5	<0.01
Need for Additional Interventions	7 (23%)	2 (7%)	<0.05
Mortality Rate	1 (3%)	1 (3%)	1.00
Overall Patient Outcomes (Improved/Unchanged)	25/5 (83%/17%)	28/2 (93%/7%)	0.21

DISCUSSION

A study of the participants' injury mechanisms and demographics is discussed here. The pre-protocol group's mean age was 35.2 years (±10.5), while the post-protocol group's mean age was 34.8 years (±9.8). A p-value of 0.88 indicated that there was no significant difference between the two groups. The pre-protocol group included 21 men and 9 females, while the post-protocol group had 20 males and 10 females ($p = 0.79$). The gender distribution was similar between the groups. The mechanisms of injury were also comparable, with motor vehicle accidents being the most common cause in both groups (60% pre-protocol vs. 57% post-protocol, $p = 0.80$). Falls, stab wounds, and gunshot wounds showed similar distributions across both groups, with no significant differences.

The demographic consistency in both the pre- and post-protocol groups ensures that any observed differences in outcomes can be attributed to the protocol itself rather than to demographic variables. Previous studies [10, 11] found that age and gender distribution in trauma studies typically did not significantly differ across control and intervention groups, reinforcing the reliability of our demographic data. The distribution of injury mechanisms aligns with the findings of Walia et al. [12], where motor vehicle accidents and falls were predominant causes of trauma requiring chest tube management.

Current results highlights the differences in complication rates before and after the implementation of the standardized protocol. The overall complication rate significantly decreased from 25% in the pre-protocol group to 10% in the post-protocol group. Infections were reduced from 15% to 5%, and tube dislodgements decreased from 10% to 3%. The rate of pneumothorax showed a reduction from 7% to 3%, but this was not statistically significant. These results indicate that the standardized protocol effectively reduced the rates of most complications associated with chest tube management in trauma patients.

The significant reduction in overall complication rates and specific complications such as infections and tube dislodgements aligns with the findings of Lustenberger et al. [13], who reported a decrease in complication rates with the implementation of standardized care protocols. Our study's infection rate drop from 15% to 5% is comparable to the 50% reduction reported by Desai et al. [14] in their standardized protocol study. The reduction in tube dislodgement rates also mirrors findings by Rosenberger et al. [15], who observed a decrease in their cohort, emphasizing the efficacy of standardized protocols in improving clinical outcomes.

The mean length of hospital in current study stay significantly decreased from 12.4 days (±3.2) in the pre-protocol group to 8.6 days (±2.5) in the post-protocol group. The need for additional interventions was also reduced in the post-protocol group. The mortality rate remained unchanged in both groups. Overall patient outcomes showed improvement, with 93% of patients in the post-protocol group experiencing improved outcomes compared to 83% in the pre-protocol group; however, this difference was not statistically significant. These findings suggest that the standardized protocol not only decreased complications but also contributed to shorter hospital stays and reduced the need for further medical interventions.

The reduction in the length of hospital stay corroborates the findings of Lee et al. [16], who noted similar reductions in hospital stay durations with protocolized care. The decreased need for additional interventions in our study aligns with Dai et al. [9], who observed a reduction in their cohort with standardized chest tube management protocols. However, the unchanged mortality rate at 3% in both groups is consistent with findings from other studies [17] suggesting that while protocols can reduce complications and improve efficiency, they may not significantly impact mortality rates in the short term.

Limitations and Future Perspective

This study has some limitations that should be noted. The limited sample size of 60 individuals may restrict the findings' generalizability, whereas a larger sample size would yield more robust data and potentially more significant results. Conducting the study in only three major hospitals in Pakistan may not represent the broader population or other healthcare settings with different resources and

practices. The observational design does not allow for causal inferences; while the results suggest an association between the standardized protocol and reduced complication rates, other unmeasured factors may have contributed to the outcomes. The study did not account for potential variations in the skill and experience of healthcare providers, which could influence the effectiveness of protocol implementation. Variability in adherence to the protocol across different hospitals and providers was not assessed, which might have affected the consistency of the results. The 12-month follow-up period may not capture long-term outcomes or complications. Future research should focus on expanding the sample size, including multiple healthcare settings, and assessing long-term outcomes to validate and extend the findings of this study.

CONCLUSION

The implementation of a standardized protocol for chest tube management in trauma patients significantly reduced complication rates, shortened hospital stays, and decreased the need for additional interventions, demonstrating its potential to enhance patient outcomes in Pakistan. However, the study's limitations, including its small sample size, limited generalizability, observational design, and short follow-up period, suggest that further research with larger, more diverse populations and extended follow-up is necessary to confirm these findings and assess long-term benefits. Addressing variability in provider adherence and experience will also be crucial for optimizing protocol effectiveness across different healthcare settings.

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