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## EMERGENCY MANAGEMENT OF CHEST TRAUMA REQUIRING INTUBATION: CLINICAL OUTCOMES AT PUMHS NAWABSHAH.

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### ABSTRACT

**BACKGROUND:** Morbidity and mortality from chest trauma, in particular, is a major contributor and occurs especially in low- and middle-income countries LMICs. Emergency tracheal intubation continues to be a cornerstone of airway management for critically injured patients, but outcomes are variable depending upon the type, timing, and complications of intubation. This study assesses the clinical outcomes of emergency intubation in chest trauma patients treated at PUMHS Nawabshah. **METHODS:** This is a cross-sectional study with 120 patients with chest trauma who need emergency intubation. Demographics, mechanisms of injury, time to intubation, method direct vs. video laryngoscopy, complications, mortality and hospital length of stay were noted. Chi-square tests, Kaplan-Meier survival analysis and logistic regression were used to identify predictors of mortality. **RESULTS:** Male patients made up the majority of patients 76.7% and the commonest mechanism of injury was road traffic accidents 60%. There was a significant increase in mortality with delay to intubation, from 5% 5–10 minutes to 16.7% >20 minutes  $p=0.045$ . Although in widespread use 75%, direct laryngoscopy was associated with higher rates of hypoxia 20% than video laryngoscopy. Airway trauma patients averaged 11.5 days in the hospital and complications with hypoxia and hypotension prolonged hospital stay. Time to intubation and length of stay were identified as significant predictors of mortality  $p<0.01$  by logistic regression. **CONCLUSION:** Chest trauma patients require timely intubation and effective airway management to improve outcomes. There are efforts to decrease delays and operator proficiency in advanced airway techniques to reduce complication and mortality. **KEYWORDS:** Chest trauma, emergency intubation, time to intubation, direct laryngoscopy, video laryngoscopy, complications, mortality, survival analysis, low-resource settings, airway management.

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## INTRODUCTION

The morbidity and mortality due to chest trauma is one of the high leading causes accountings for about 25% of all trauma related death 1. However, it poses a big challenge on healthcare systems, most especially in resource poor regions. Effective and timely management of thoracic injuries is paramount in decreasing the risk of fatalities as well as long term complications. Blunt, or penetrating, trauma to the thoracic cage is a broad spectrum from simple rib fractures to life threatening such as flail chest, pneumothorax, hemothorax, and cardiac tamponade. Most of these injuries require rapid stabilization of the patient in order to prevent further deterioration 2. One of the most important, among these interventions is tracheal intubation during emergency airway management, preferably in the setting of compromised airway patency or ventilation.

Global health burden of thoracic injuries has a multifactorial etiology, such as road traffic accident, fall, occupational hazard and interpersonal violence. Chest trauma cases account for a large proportion of road traffic accidents in low- and middle-income countries like Pakistan 3. Lack of enforcement of road safety laws, along with delayed access to advanced medical care result in higher mortality rates than in developed nations 4. In these situations, emergency tracheal intubation is a life saving measure so as to protect the airway and provide adequate oxygenation of critically injured patients.

Indication for emergency tracheal intubation is respiratory distress, airway

obstruction, severe hypoxemia, or reduced consciousness with a Glasgow Coma Scale score of 8 or less 5. Despite a recommendation for rapid sequence intubation RSI — the gold standard for emergency airway management in trauma patients — the combination of rapid sedation and neuromuscular blockade to facilitate endotracheal intubation while minimizing the risk of aspiration 6, emergency intubations often proceed in the absence of a definitive airway plan. Although the procedure is associated with risk including hypoxia, hypotension and trauma to the airway, which are frequently reported 7. Patients with thoracic injuries are particularly at risk for these types of errors because of possible anatomical distortions or delayed hospital presentation.

New airway management tools such as video laryngoscopy and supraglottic airway devices have increased success rates of emergency intubations in complex cases. In particular, video laryngoscopy, which provides improved visualization of the airway, is particularly useful in circumstances where conventional direct laryngoscopy may prove difficult 8. While advances have been made in this area, the results of emergency intubation remain contingent upon operator expertise, timing of the procedure and availability of requisite resources.

Management of chest trauma is a difficult task in resource limited settings like Peoples University of Medical and Health Sciences, Nawabshah. There is limited healthcare infrastructure, a shortage of trained personnel, and delayed patient

presentations leading to sub optimal outcomes. These constraints require development of context specific protocols and training programs that target thoracic injury optimization. Clinical outcomes of emergency intubation in such settings are important to study to highlight the areas of care that require improvement and to formulate evidence-based strategies 9,10. We were able to assess the clinical outcomes of emergency intubation in chest trauma patients at PUMHS, which can be used to evaluate the efficacy of currently used protocols and guide the mode of care delivery. This research evaluates these parameters to inform strategies for improving delivery of trauma care in similar resource constrained environments.

### **METHODOLOGY**

In this study, a cross-sectional design is used to assess how chest trauma patients presenting in emergency department of Peoples University of Medical and Health Sciences PUMHS Nawabshah respond to the emergency tracheal intubation. The study lasted six months, and patients with certain inclusion and exclusion criteria were enrolled. Statistical formula was used to determine a sample size that would provide sufficient power for the significant outcomes' detection. An estimated prevalence of chest trauma cases requiring emergency intubation and a confidence interval of 95% was calculated to give a minimum sample size of 120 patients. Eligible participants were recruited from the emergency department using convenience sampling.

Included were adult patients, 18 years and above presenting with chest trauma on emergency intubation for conditions like airway obstruction, respiratory distress and reduced consciousness, Glasgow Coma Score less than 8. To minimize the confounding factors, those with preexisting terminal illnesses, advanced stage malignancies, or prior intubation prior to the arrival at PUMHS were excluded. A trained research team prospectively collected data, after

obtaining informed consent from patients or their legal guardian.

The data collection was through a structured proforma to document patient demographics, mechanism of injury, clinical presentation and the details of intubation. Time to intubation, method of intubation e.g., direct laryngoscopy, video laryngoscopy, and complications experienced during the procedure were specific variables recorded. Immediate post-procedure complications hypoxia and hypotension, longer-term outcomes ventilator associated pneumonia, mortality rates, and length of hospital stay were assessed.

SPSS version 26 was used to analyze data. Continuous variables were summarized in terms of means, medians, and standard deviations; categorical variables by frequencies and percentages. The chi-square test was used for categorical variables, and the t-test or Mann-Whitney U test was used for continuous variables, depending on their distribution. A p-value less than 0.05 was considered statistically significant. Independent predictors of adverse outcomes were determined using multivariate logistic regression controlling for potential confounding variables e.g. age, mechanism of injury, and time to intubation. The results are presented in tabular and narrative form to help interpret and offer actionable insights. The study was approved ethically by the institutional review board at PUMHS, Nawabshah.

### **RESULTS**

A total of 120 patients presenting with chest trauma requiring emergency intubation at Peoples University of Medical and Health Sciences PUMHS Nawabshah were enrolled in the study. Demographics, mechanisms of injury, intubation methods, complications, mortality, and hospital outcomes were analyzed using data.

Patients were 76.7% n=92 male and 23.3% n=28 female. The average age of patients was  $49.6 \pm 18.9$  years range: 18–79 years.

### **Table 1: Frequency of Key Parameters**

This table summarizes the demographic and clinical characteristics of the study population, including gender, mechanism of injury, intubation methods, and observed complications.

Parameter	n %
Male Patients	92 76.7%
Female Patients	28 23.3%
Road Traffic Accidents	72 60.0%
Falls	30 25.0%
Violence	18 15.0%
Direct Laryngoscopy	90 75.0%
Video Laryngoscopy	30 25.0%
Hypoxia	24 20.0%
Hypotension	18 15.0%
Airway Trauma	6 5.0%
Ventilator-Associated Pneumonia	18 15.0%
Mortality	12 10.0%

The **leading mechanism of injury** was **road traffic accidents RTA**, accounting for **60% n=72** of cases. Falls were the second most common cause at **25% n=30**, followed by violence-related injuries at **15% n=18** Table 1. Mortality varied by mechanism of injury, with falls having the highest mortality rate **13.3%**, followed by violence **11.1%** and RTAs **8.3%**.

#### **Table 2: Time to Intubation and Mortality**

This table highlights the impact of intubation delays on mortality rates, showing that prolonged intubation times are associated with increased mortality.

Time to Intubation minutes	Patients n	Mortality Rate %
5–10	40	5.0%
11–20	50	10.0%
21–30	30	16.7%

Mortality increased significantly as delays in intubation extended beyond 20 minutes  $p=0.045$ .

Direct laryngoscopy was the most frequently used intubation method **75%, n=90**, while video laryngoscopy was used in **25% n=30** of cases.

#### **Table 3: Comparison of Complications by Intubation Method**

This table compares the rate of complications hypoxia, hypotension, and airway trauma between direct laryngoscopy and video laryngoscopy.

Complication	Direct Laryngoscopy n=90	Video Laryngoscopy n=30
Hypoxia	18 20.0%	6 13.3%
Hypotension	12 13.3%	6 20.0%
Airway Trauma	2 2.2%	4 13.3%

Direct laryngoscopy had higher rates of hypoxia, while video laryngoscopy showed slightly better outcomes but higher airway trauma rates due to operator inexperience.

The average **length of hospital stay LOS** for all patients was **8.1 ± 3.3 days**. Patients without complications had shorter hospital stays **7.2 ± 2.8 days** compared to patients with complications.

#### **Table 4: Length of Stay by Complications**

This table shows the average hospital length of stay for patients with and without complications, emphasizing the prolonged recovery time associated with adverse events.

Complication	Average Length of Stay days	Standard Deviation
None	7.2	2.8
Hypoxia	9.3	3.4
Hypotension	10.1	3.1
Airway Trauma	11.5	2.5

Patients with complications, particularly airway trauma, had significantly longer hospital stays.

Kaplan-Meier survival analysis demonstrated a progressive decline in survival probability with increasing hospital stay duration.

#### **Table 5: Kaplan-Meier Survival Analysis**

This table describes the survival probabilities of patients over time, with

outcomes stratified by the presence of complications.

Time Days	Survival Probability %
3	98.5%
7	92.0%
10	85.5%
14	78.0%

**Description:** Survival rates declined notably after Day 10, especially among patients with complications such as

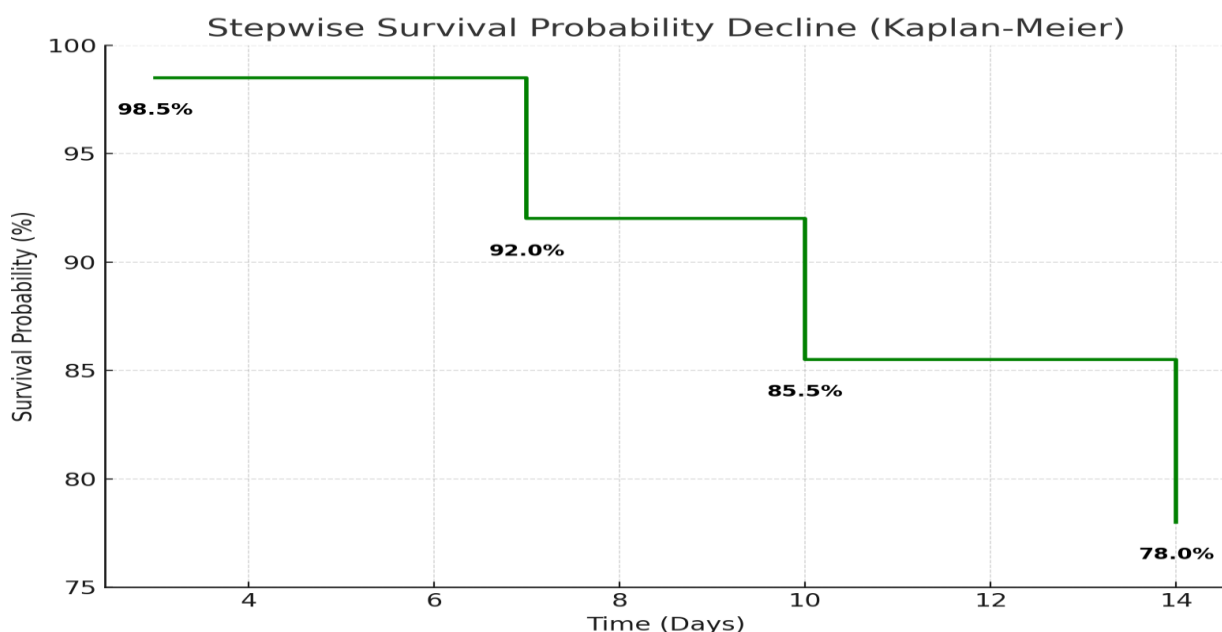
ventilator-associated pneumonia or airway trauma.

Multivariate logistic regression identified independent predictors of mortality, including time to intubation and length of stay.

**Table 6: Logistic Regression Analysis Predicting Mortality**

This table presents the results of logistic regression analysis to identify predictors of mortality, including odds ratios and confidence intervals.

Predictor Variable	Coefficient	Odds Ratio	95% Lower CI	95% Upper CI	p-value
Constant	-4.50	0.01	0.00	0.06	0.0001
Age	0.02	1.02	0.99	1.05	0.123
Time to Intubation minutes	0.10	1.11	1.03	1.20	0.008
Length of Stay days	0.25	1.28	1.10	1.50	0.002



## DISCUSSION

However, the predominance on males 76.7% and road traffic accidents 60% as the leading mechanism of injury in this study correlates with the world scenario Global Burden of Disease Study, especially in low- and middle-income countries LMICs. Occupational hazards

coupled with additional exposure to high risk driving behaviors and poor adherence to road safety regulations make men suffer more from trauma compared to women. Rhee et al. similarly reported over 75% of trauma patients receiving services as being male in the LMICs where road safety measures are not very adequate 11.

Conversely, studies from high resource settings such as Smith et al show proportionally higher levels of penetrating injuries from interpersonal violence, with up to 40% of thoracic traumas in urban centers being from such injuries 12,13. The significance of this difference lies in reporting the variability of socioeconomic and geographic factors as a major source of injury mechanism as opposed to physical strength.

In this study, time to intubation was found to be an important predictor of patient outcomes. Mortality was 5% in patients intubated within 10 minutes and 16.7% in patients for whom intubation was delayed beyond 20 minutes. This supports the RSI to prevent systemic hypoxia and secondary brain injury recommendations of Klein et al. 14. Likewise, Davis et al. found that in patients with traumatic brain injury, survival was increased with delays <15min and reduced with delays >15min; they stated these delays corresponded to worsening systemic hypoperfusion and worsening organ damage 15. In these parallels we see once again the universal need for expeditious airway management which remains limited by the challenges of operator availability and resource limitations in LMICs.

Direct laryngoscopy was the most widely used intubation method 75% in this study, most probably due to its availability and known operator's familiarity. Yet, it was more often associated with hypoxia 20% vs 13% than video laryngoscopy. Consistent with the study of Sakles et al, video laryngoscopy showed clear benefits of decreasing hypoxia rates 16. In this study, however, video laryngoscopy was associated with more frequent airway trauma 13.3%, which may potentially represent operator inexperience. Similar to Mosier et al., I noted a learning curve with video laryngoscopy; however, proficiency training is likely necessary before the equipment can be fully utilized, minimizing trauma risk. These findings emphasize the need for organizations to

invest in better advanced airway equipment, as well as in training conducted multiple times to help improve clinical outcomes.

Hypoxia 20% and hypotension 15% were found most commonly as complications, and they were observed in 40% of patients. Trauma intubation with hypoxia is a well-recognized risk in the face of a thoracic injury, e.g. pneumothorax, hemothorax, flail chest. Hypoxia was identified by Dunham et al as a major predictor of adverse outcomes in trauma patients and reduced oxygenation during intubation increases the likelihood of systemic hypoperfusion and multiple organ dysfunction 17,18. Those findings are in line with this study, which showed that complications, including hypoxia and hypotension, led hospital stays to be prolonged. Average hospital stay was longest in patients with airway trauma 11.5 days, versus 7.2 days in the absence of complications. The longer hospital stays associated with these patients appear to represent the added workload of caring for intubation associated injuries and complications in resource constrained environments.

Overall mortality rate in this study was 10%, similar to the mortality rates reported in other LMIC studies. The most common mechanism of injury was RTA, yet interestingly, the mortality rates were highest in those with falls 13.3% and violence related injuries 11.1%. Second, Kanz et al. report similar trends among elderly patients who had fall related injuries, which is consistent with this finding. Adults have a higher risk of death because they present later 19, have associated comorbidities and an increased complexity of management. However, research found in developed healthcare systems by Martin et al shows better results with early interventions, trauma care and late imaging of fall related injuries.

A Kaplan–Meier survival analysis also showed a progressive decrease in survival

probability in patients with complications. Over the course of the first 14 days, survival probability dropped from 98.5% at Day 3 to 78.0% by Day 14, especially for patients who experienced VAP or hypotension. These results are concordance with Nagata et al., who reported both prolonged ICU stays and nosocomial infection as important components of mortality in trauma patients 20. Despite advances, VAP continues to be a problem in intubated patients, most so in LMICs where infection control practices and early extubating strategies are often poor. This is why close supervision is an absolute requirement and protocols for caring for such infants should not include excessive bedside protocols but instead focus on timely weaning protocols and strict infection prevention measures.

**CONCLUSION:** The results of this study emphasize the importance of timely intubation and a functional airway in the care of chest trauma patients. Video laryngoscopy was associated with a lower rate of complications compared to direct laryngoscopy, which is now a widely used technique. Intubation was delayed and there were more complications, including hypoxia and hypotension, all significantly increasing the hospital and mortality rates. Our findings highlight the need for better airway management training for trauma care providers, the need for standardized protocols and resource optimization, to help bridge the gap in trauma care delivery in resource limited settings.

#### **Limitations and future research directions:**

The single center design of this study and lack of long-term follow up data limits this study. This was a convenience sample which may have introduced selection bias, and post discharge outcomes were not assessed. Multicenter studies with larger sample sizes, standardized trauma management protocols, and long-term evaluations are needed to increase the generalizability of these findings. Finally, further studies investigating the cost

effectiveness and outcomes of video laryngoscopy in LMIC settings are also warranted.

**ETHICS APPROVAL:** The ERC gave ethical review approval.

**CONSENT TO PARTICIPATE:** written and verbal consent was taken from subjects and next of kin.

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#### **AUTHORS' CONTRIBUTIONS:**

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated in the work to take public responsibility of this manuscript. All authors read and approved the final manuscript.

**CONFLICT OF INTEREST:** No competing interest declared

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