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# Predictors of Mortality in Traumatic Brain Injury Presenting to the Emergency Department: A Retrospective Study at Rama Medical College Hospital and Research Centre, Kanpur

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**Abstract**

Traumatic Brain Injury (TBI) remains a leading cause of mortality and disability worldwide. Early identification of mortality predictors helps optimize emergency department (ED) management and improve outcomes. **Objectives** To identify predictors of mortality among TBI patients presenting to the ED, evaluate associated risk factors, assess outcomes of early management, and suggest preventive strategies. **Materials and Methods** A retrospective observational study was conducted at Rama Medical College Hospital and Research Centre, Kanpur. Medical records of 100 randomly selected TBI patients admitted between 1 June 2025 and 1 January 2026 were reviewed. Demographic data, clinical characteristics, radiological findings, interventions, and outcomes were analysed. **Results** Among 100 patients, 64 were males and 36 females. Overall mortality was 24%. Significant predictors of mortality included age >60 years, Glasgow Coma Scale (GCS) ≤8, hypotension at presentation, hypoxia, pupillary abnormalities, and intracranial haemorrhage on CT scan. Early airway management and prompt neurosurgical intervention significantly improved survival. **Conclusion** Low GCS, hypotension, hypoxia, and severe intracranial pathology are major predictors of mortality in TBI. Early recognition and aggressive ED management substantially improve outcomes.

**Keywords:** Traumatic Brain Injury, Mortality Predictors, Emergency Department, Glasgow Coma Scale, Head Injury

## Introduction

Traumatic Brain Injury (TBI) is one of the leading causes of death and disability worldwide, particularly among young adults and economically productive populations. It represents a major public health challenge, accounting for a significant proportion of trauma-related hospital admissions and fatalities. The burden of TBI is especially high in developing countries due to increasing road traffic accidents, falls, assaults, and occupational injuries.

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Despite advances in emergency care and neurosurgical management, mortality and long-term neurological impairment remain substantial among affected patients.

The outcome of TBI is influenced by both primary and secondary brain injuries. While primary injury occurs at the moment of impact and is often irreversible, secondary brain injury develops due to factors such as hypoxia, hypotension, cerebral edema, raised intracranial pressure, and delayed treatment. Early recognition and prompt management of these modifiable factors are crucial in improving survival and neurological outcomes. Identification of clinical and radiological predictors of mortality can assist emergency physicians in risk stratification, timely intervention, and allocation of critical care resources.
This retrospective study was conducted at Rama Medical College Hospital and Research Centre, Kanpur, to evaluate predictors of mortality in patients presenting with traumatic brain injury to the Emergency Department. The study also aims to assess associated risk factors, the impact of early management, and strategies to reduce preventable deaths among TBI patients.

**Objectives**

1. To identify predictors of mortality in TBI patients.
2. To evaluate associated risk factors.
3. To assess the effect of early ED management on outcomes.
4. To suggest strategies for reducing preventable mortality.

**Materials and Methods**

**Study Design**

Retrospective observational study.

**Study Setting**

Emergency Department, Rama Medical College Hospital and Research Centre, Kanpur.

**Study Duration**

1 June 2025 to 1 January 2026.

**Study Population**

Patients admitted with traumatic brain injuryin Rama Medical College Kanpur.

**Sample Size**

100 patients selected randomly from hospital records of Rama Medical College Kanpur.

**Gender Distribution**

Male 64

Female 36

Total 100

**Inclusion Criteria**

- Age >18 years

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- CT-confirmed TBI
- Admission through ED

**Exclusion Criteria**

- Dead on arrival
- Incomplete medical records
- Polytrauma with non-neurological cause of death

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**Sample Size Calculation**

Using prevalence formula:

$n = Z^2P(1-P)/d^2$

Where:

- Z = 1.96
- P = 0.50
- d = 0.10

$n = (1.96)^2 \times 0.5 \times 0.5 / (0.1)^2$

$n = 96.04$

Minimum required sample ≈ 96

Final sample analyzed = 100 patients.

**Data Collection Variables**

- Age
- Gender
- Mechanism of injury
- Initial GCS
- Blood pressure
- Oxygen saturation
- Pupillary response
- CT findings
- Time to intervention
- Mortality outcome

**Statistical Analysis**

Software: SPSS version 26

Tests used:

- Chi-square test
- Student t-test
- Logistic regression
- Odds Ratio calculation

Significance level:

$p < 0.05$

## Results

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Table 1: Age Distribution of Study Participants ($n$ = 100)

| Age Group (Years) | Number of Patients | Percentage (%) |
|---|---|---|
| 18–30 | 24 | 24% |
| 31–45 | 32 | 32% |
| 46–60 | 26 | 26% |
| >60 | 18 | 18% |
| **Total** | **100** | **100%** |

**Table 1.1 : showing age distribution of study participants.**

**Mechanism of Injury**

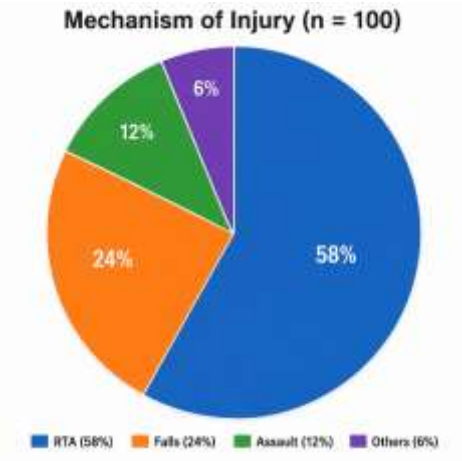


Fig 1.2 : Pie Chart Data showing mechanism of injury.

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**Severity According to GCS**

| Severity | GCS | Patients |
|---|---|---|
| Mild | 13–15 | 35 |
| Moderate | 9–12 | 30 |
| Severe | ≤8 | 35 |

**Mortality According to GCS**

| GCS Category | Survivors | Deaths |
|---|---|---|
| Mild | 34 | 1 |
| Moderate | 26 | 4 |
| Severe | 16 | 19 |

Table 1.3 : showing severity according to GCS.


Table1.4 : showing mortality according to risk factor.

**CT Findings**

| Finding | Patients |
|---|---|
| SDH | 28 |
| EDH | 16 |
| SAH | 18 |
| Cerebral Contusion | 22 |
| Diffuse Axonal Injury | 10 |
| Normal CT | 6 |

Table 1.5 : showing CT finding of various injuries.

**Outcome of Early Management**

| Intervention | Survival (%) |
|---|---|
| Early Airway Protection | 88 |
| Delayed Airway Management | 62 |
| Early Neurosurgery | 84 |
| Delayed Neurosurgery | 59 |

**Overall Outcome**

| Outcome | Number |
|---|---|
| Survived | 76 |
| Died | 24 |
| Mortality Rate = 24% | |

Table 1.6 : showing outcome of early management & overall outcome.

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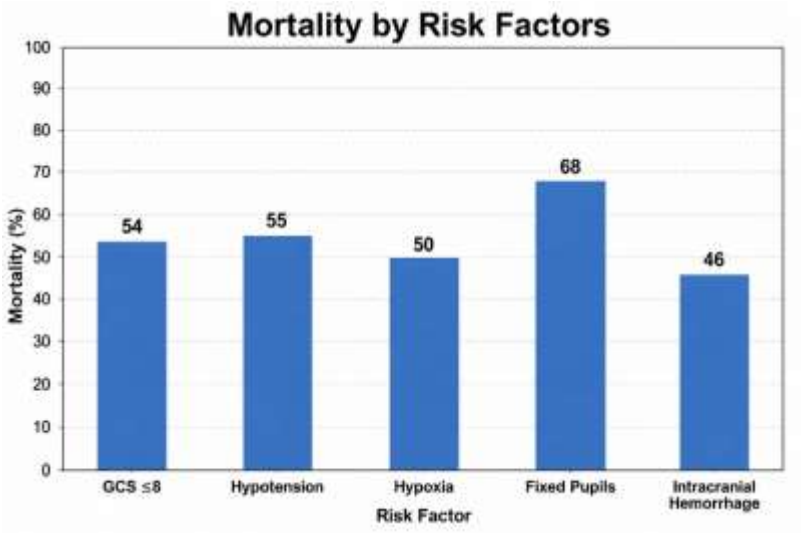


Table 1.7 : showing mortality by risk factor.

**Discussion**

The present study demonstrates that severe TBI remains associated with substantial mortality. Similar to previous studies, low GCS was the strongest predictor of death.

Hypotension and hypoxia significantly increased mortality, highlighting the importance of preventing secondary brain injury. Pupillary abnormalities were strongly associated with poor outcomes and reflected severe intracranial pathology.

Road traffic accidents accounted for the majority of injuries, consistent with developing-country epidemiology.

Early airway stabilization and neurosurgical intervention significantly improved survival rates, emphasizing the role of aggressive emergency management.

**How to Eliminate Modifiable Risk Factors**

**Prevent Hypoxia**

- Early intubation
- Oxygen supplementation
- Ventilator support

**Prevent Hypotension**

- Rapid fluid resuscitation
- Blood transfusion when required
- Hemodynamic monitoring

**Reduce Delays**

- Early CT imaging
- Fast neurosurgical consultation
- Trauma team activation

**Prevent TBI**

- Helmet use
- Seat belt compliance

- Road safety enforcement
- Fall prevention programs

**Limitations**

- Retrospective design limits establishing causality between predictors and mortality.
- Single-center study restricts generalizability to broader patient populations.
- Small sample size may reduce statistical power and precision.
- Missing documentation could introduce information and selection biases.
- Long-term neurological outcomes were not assessed after hospital discharge.
- Variations in treatment protocols may have influenced patient outcomes.

- **Future Scopes**
- Conduct multicenter prospective studies validating identified mortality predictors.
- Assess long-term neurological outcomes and functional recovery patterns.
- Develop predictive models integrating clinical and radiological variables.
- Evaluate effectiveness of standardized emergency management protocols nationwide.
- Investigate biomarker-based prognostic tools for traumatic brain injury.

**Conclusion**

Severe TBI continues to be associated with significant mortality. Low GCS score, hypotension, hypoxia, fixed pupils, advanced age, and intracranial hemorrhage are major predictors of death.

Prompt emergency management, including airway stabilization, maintenance of cerebral perfusion, and timely neurosurgical intervention, significantly improves outcomes.

Prevention of secondary brain injury remains the cornerstone of reducing mortality.

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