Polytrauma in Emergency Settings: A Multidisciplinary Approach to Skeletal and Neurological Stabilization

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Abstract

Introduction:
Polytrauma is a leading contributor to morbidity and mortality globally, particularly in low- and middle-income countries.

Objective:
This study evaluated the epidemiological trends, injury profiles, and outcomes of polytrauma patients in an emergency setting in Bangladesh, with a focus on skeletal and neurological stabilization and the role of multidisciplinary care.

Methods:
A 12-month prospective observational study was conducted at the National Institute of Traumatology and Orthopedic Rehabilitation, Dhaka, on 120 adult polytrauma patients (≥18 years) presenting within 6 hours of injury. Data collected included demographics, injury types, Glasgow Coma Scale (GCS), interventions, ICU admissions, and functional outcomes via Glasgow Outcome Scale (GOS). Cox proportional hazards modeling was applied to identify predictors of recovery.

Results:
The mean age was 38.2±14.6 years; 65% were male. Road traffic accidents accounted for 60% of injuries. Long bone fractures (51.7%) and TBIs (46.7%) were most frequent. External fixation was the most common intervention (35%). Multidisciplinary management was provided in 63.3% of cases and significantly improved outcomes ($p<0.001$). Mortality was 11.7%; 48.3% achieved good recovery (GOS 5). Cox analysis showed better outcomes with multidisciplinary care (HR=1.68, $p=0.009$), higher GCS, and younger age.

Conclusion:
Multidisciplinary trauma care is vital for improving functional outcomes in polytrauma. Early stabilization and collaborative interventions should be prioritized in resource-limited emergency settings.

Keywords: Polytrauma, Skeletal injuries, Traumatic brain injury (TBI)

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Introduction:

Trauma remains one of the leading causes of mortality and disability worldwide, particularly among young adults in their most productive years. According to the World Health Organization (2023), injuries account for nearly 4.4 million deaths annually, with road traffic accidents (RTAs), falls, and interpersonal violence as major contributors. Over 90% of trauma-related deaths occur in low- and middle-income countries (LMICs), where specialized care is often scarce.[1] Polytrauma, severe injuries involving multiple systems, represents a complex clinical challenge, especially when both the musculoskeletal and central nervous systems are affected. Studies report that 35–45% of polytrauma patients sustain skeletal fractures alongside traumatic brain or spinal cord injuries, significantly increasing morbidity and recovery times.[2]

Polytrauma is often defined by an Injury Severity Score (ISS) of 16 or greater. Still, the Berlin Definition refines this to include at least two severe injuries accompanied by physiological compromise such as hypotension, acidosis, or coagulopathy.[3] Early recognition and intervention during the "golden hour" remain critical for survival.[4] Emergency departments (EDs) serve as the first line of care, where rapid stabilization, airway protection, and imaging depend on structured trauma teams, effective communication, and standardized protocols. Institutions with coordinated trauma systems report faster surgical access and improved outcomes.[5]

A multidisciplinary approach is central to polytrauma care, involving emergency physicians, orthopedic surgeons, neurosurgeons, anesthesiologists, and radiologists. Each specialty contributes at different stages, from resuscitation and damage control surgery to imaging and postoperative management.[6-8]

In Bangladesh, the trauma burden is severe but under-managed. RTAs are the leading cause, driven by poor infrastructure and unregulated transport. Unique injury patterns, such as scarf injuries, highlight mechanism-specific risks.[9-11] Systemic issues, including limited trauma centers, poor ambulance coverage, and a lack of trained personnel, exacerbate outcomes.[12] This study investigated skeletal and neurological injury management in Bangladesh's emergency settings, aiming to inform resource-sensitive, multidisciplinary models tailored for LMIC contexts.

Methods:

This prospective observational study was carried out at the National Institute of Traumatology and Orthopedic Rehabilitation, Dhaka, Bangladesh, from January to December 2022 after approval from Institutional Ethics Committee. Adult patients (≥18 years) presenting within 6 hours of injury with polytrauma involving at least one skeletal and one neurological injury were included, while pediatric cases, isolated injuries, and pre-evaluation deaths were excluded. Data were collected using a structured form documenting demographics, mechanism of injury, time to arrival, injury types, initial Glasgow Coma Scale (GCS), interventions, ICU admission, complications, and outcomes measured by the Glasgow Outcome Scale (GOS) at discharge. The Glasgow Coma Scale (GCS) is a validated tool for assessing consciousness after traumatic brain injury, based on eye, verbal, and motor responses, with scores ranging from 3–15.[13] It aids in triage, prognostication, imaging decisions, and determining ICU or neurosurgical needs. The Glasgow Outcome Scale (GOS) categorizes functional recovery into five levels, from death to good recovery, and is widely used in TBI and polytrauma research to standardize assessment of outcomes.[14] It reliably reflects recovery trajectories, rehabilitation needs, and quality of life. Cox proportional hazards modeling assessed predictors of recovery, including age, GCS, multidisciplinary involvement, and baseline outcomes. Analyses were conducted with SPSS v25, with significance set at $p<0.05$.

Results:

Among 120 adult polytrauma patients, the mean age was 38.2 years, with males comprising 65%. Road traffic accidents were the leading cause (60%), followed by falls (23.3%) and assaults (10%) (p=0.036). Comorbidities were present in 28.3% of patients (p=0.021). Over half (53.3%) reached the hospital within one hour, and early arrival showed a significant association with outcomes (p=0.045) (Table-I).

Table-I: Basic characteristics of the study population (N=120)

Basic characteristic	no. (%)	p- value
Age (mean±SD)	38.2±14.6	-
Sex - Male	78(65.0)	0.412
Sex - Female	4235.0()	
Mechanism of injury		
Road traffic accident	72(60.0)	
Fall from height	28(23.3)	
Assault	12(10.0)	0.036
Others	8(6.7)	
Comorbidities present	34(28.3)	0.021
Time to hospital		
≤1hr	64(53.3)	0.045
>1hr	56(46.7)	

Table-II: Types and distribution of injuries (N=120)

Type of injury	no. (%)	p- value
Skeletal injury		
Long bone fractures	62(51.7)	0.004
Pelvic fractures	18(15.0)	
Spinal fractures	22(18.3)	
Multiple skeletal injuries	36(30.0)	
Neurological injury type		
Traumatic brain injury (TBI)	56(46.7)	
Spinal cord injury (SCI)	24(20.0)	
Peripheral nerve injury	14(11.7)	0.028
GCS ≤8 (Severe TBI)	20(16.7)	
GCS 9–12 (Moderate TBI)	18(15.0)	
GCS 13–15 (Mild TBI)	18(15.0)	

Among 120 patients, long bone fractures were most common (51.7%, p=0.004), followed by spinal (18.3%) and pelvic fractures (15.0%). Additionally, 30% sustained multiple skeletal injuries, emphasizing the severity of trauma and the need for prompt orthopedic intervention in polytrauma care. Neurological injuries were common, with TBI affecting 46.7% of patients (p=0.028), followed by spinal cord injuries (20%) and peripheral nerve injuries (11.7%). By GCS, 16.7% had severe TBI, 15% moderate, and 15% mild, highlighting significant neurological compromise requiring prompt neurosurgical and critical care attention.

External fixation (35%) was the most frequent intervention, followed by ORIF (25%), spinal stabilization (15%), and decompressive craniectomy (10%). Multidisciplinary trauma teams managed 63.3% of patients, a highly significant factor (p<0.001), underscoring the importance of integrated, coordinated care in improving polytrauma outcomes (Table-III).

Table-III: Interventions and multidisciplinary management (N=120)

Intervention type	no. (%)	p-value
External fixation	42(35.0)	
ORIF (Open reduction)	30(25.0)	0.011
Spinal stabilization surgery	18(15.0)	
Decompressive craniectomy	12(10.0)	
Multidisciplinary team involved	76(63.3)	<0.001

ICU care was required in 40% of patients (p=0.003). Complications included sepsis (8.3%), neurological decline (10%), and re-operations (5%). Overall mortality was 11.7% (p=0.019), underscoring the severity of polytrauma and the necessity of timely, multidisciplinary management to improve outcomes.

Table-IV: Complications and ICU admission (N=120)

Complication/Outcome	no. (%)	p-value
ICU admission required	48(40.0)	
Sepsis	10(8.3)	0.003
Re-operation	6(5.0)	
Neurological deterioration	12(10.0)	
Mortality	14(11.7)	0.019

At discharge, 48.3% of patients achieved good recovery (GOS 5), 23.3% had moderate disability, 15% severe disability, 5% remained in a vegetative state, and 8.3% died. Outcomes were statistically significant (p<0.001), with nearly three-quarters showing functional recovery and almost half attaining favorable results.

Table-V: Functional outcomes at discharge (N=120)

Outcome Score	no. (%)	p-value
Good recovery (GOS 5)	58(48.3%)	
Moderate disability (GOS 4)	28(23.3%)	
Severe disability (GOS 3)	18(15.0%)	<0.001
Persistent vegetative (GOS 2)	6(5.0%)	
Death (GOS 1)	10(8.3%)	

Cox regression showed that prior good clinical status increased recovery likelihood by 85% (HR=1.85, p=0.002), while age reduced by 3% per year (HR=0.97, p=0.018). Each point increase in GCS improved recovery by 12% (HR=1.12, p=0.007). Multidisciplinary care significantly enhanced recovery speed by 68% (HR=1.68, p=0.009).

Table-VI: Cox proportional hazards interpretation for time to recovery

Outcome score	Variable Hazard Ratio (HR)	95% Confidence Interval	p-value	Interpretation
Previous good outcome	1.85	1.25 – 2.74	0.002	85% more likely to recover sooner
Age (per year)	0.97	0.95 – 0.99	0.018	3% slower recovery per year
GCS initial (per point)	1.12	1.03 – 1.21	0.007	12% faster recovery per GCS point
Multidisciplinary care	1.68	1.14 – 2.46	0.009	68% more likely to recover sooner

Discussion:

This study provided an in-depth evaluation of polytrauma patients in Bangladesh, emphasizing epidemiology, injury patterns, interventions, and predictors of outcome. The mean age of 38.2±14.6 years confirmed that trauma disproportionately affected economically active adults, consistent with global findings identifying trauma as a major burden among individuals aged 20–45 years.[15] Although males represented 65% of the cohort, the gender difference was not statistically significant (p=0.412), aligning with reports that show male predominance but no consistent outcome disparities.[16]

Road traffic accidents (RTAs) accounted for 60.0% of cases, followed by falls (23.3%), a statistically significant distribution (p=0.036). This reflected the dominance of vehicular trauma in LMICs, where infrastructural weaknesses and poor regulation drive injury patterns.[17] Comorbidities were present in 28.3% of patients and significantly associated with presentation severity (p=0.021), echoing findings that pre-existing health conditions worsen trauma outcomes.[18] Over half of patients (53.3%) presented within the first hour (p=0.045), supporting the "golden hour" as a critical determinant of survival and neurologic preservation.[19] Skeletal injuries were dominated by long bone fractures (51.7%, p=0.004), followed by spinal fractures (18.3%) and pelvic injuries (15.0%), a distribution consistent with patterns observed in high-energy trauma.[20] Neurologically, TBI was the most frequent injury (46.7%, p=0.028), with severity stratified as severe (16.7%), moderate (15.0%), and mild (15.0%), reflecting trends reported in comparable cohorts.[21,22] Intervention data emphasized the surgical burden. External fixation was the most common procedure (35.0%, p=0.011), followed by ORIF (25.0%), spinal stabilization (15.0%), and decompressive craniectomy (10.0%), similar to study conducted by sun X et al.[23] Multidisciplinary care was employed in 63.3% of cases (p<0.001), strongly reinforcing global evidence that coordinated trauma teams improve outcomes.[24] ICU admission was required in 40.0% of patients, aligning with international data.[25] Complications included neurological deterioration (10.0%), sepsis (8.3%), and re-operation (5.0%), comparable to LMIC trauma cohorts.[24] Mortality was 11.7% (p=0.019), consistent with international estimates of 10–15% in severe polytrauma. Functional outcomes showed nearly half of patients (48.3%) achieving good recovery, while 23.3% and 15.0% sustained moderate and severe disability, respectively, paralleling GOS-based models.[26] Cox regression identified strong prognostic factors: prior good clinical trajectory improved recovery likelihood by 85% (HR=1.85; p=0.002); younger age and higher GCS scores predicted faster recovery (HR=0.97, p=0.018; HR=1.12, p=0.007); and multidisciplinary care accelerated recovery by 68% (HR=1.68; p=0.009). These findings reaffirm international evidence underscoring the value of integrated trauma systems in improving outcomes.[24, 27, 28)]

Limitations:

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion:

This study underscored the burden of polytrauma in Bangladesh, where RTAs predominantly affect young adults and lead to frequent long bone fractures and TBIs. Early hospital arrival and timely surgical intervention significantly improved outcomes, while multidisciplinary care was strongly linked with faster recovery and fewer complications. These findings highlight the urgent need for structured trauma teams, standardized

protocols, and adequately equipped centers. Strengthening prehospital care and developing scalable, resource-sensitive trauma models remain essential priorities for improving outcomes in low- and middle-income countries.

Conflict of interest: None declared

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