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Original Research Article

Clinical Profile, Surgical Management, and Predictors of Mortality Among Patients with Blunt Abdominal Trauma Undergoing Emergency Laparotomy: A Prospective Study.

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Abstract: ***Background:*** Blunt abdominal trauma (BAT) is an important cause of morbidity and mortality among trauma victims in low- and middle-income settings, where road traffic accidents dominate the injury landscape. Timely identification of patients who require emergency laparotomy and recognition of factors that predict adverse outcome remain central to surgical decision-making. ***Objectives:*** To describe the clinical profile, spectrum of intra-abdominal injuries, and operative management of patients undergoing emergency laparotomy for BAT, and to identify pre-operative and intra-operative predictors of in-hospital mortality. ***Methods:*** A prospective observational study was conducted in the Department of General Surgery, FAME Hospital and Research Institute, Mysore, over a two-month period (15 March 2026 to 15 May 2026). Forty-five consecutive adult patients (≥18 years) who underwent emergency exploratory laparotomy for BAT were enrolled after informed consent. Demographic details, mechanism of injury, admission Glasgow Coma Scale (GCS), systolic blood pressure (SBP), Focused Assessment with Sonography for Trauma (FAST) and contrast-enhanced computed tomography (CECT) findings, Injury Severity Score (ISS), operative findings, procedures performed, transfusion requirements, complications, and 30-day outcomes were recorded on a structured proforma. Data were analysed with SPSS v.25.0 using the χ^2 test, Fisher exact test, Student t test, Mann–Whitney U test, and stepwise multivariable logistic regression; $P < 0.05$ was considered significant. ***Results:*** The mean age was 34.6 ± 12.8 years and 36 (80.0 %) were male. Road traffic accident was the leading mechanism (28/45, 62.2 %). At presentation, 17 patients (37.8 %) had systolic hypotension (SBP < 90 mm Hg) and 7 (15.6 %) had a GCS ≤ 8. FAST was positive in 39 patients (86.7 %). The spleen (17, 37.8 %), small bowel (14, 31.1 %), and liver (12, 26.7 %) were the most commonly injured organs; 22 patients (48.9 %) had injury to more than one intra-abdominal organ. Splenectomy was performed in 12 patients (26.7 %) and primary bowel repair or resection–anastomosis in 15 (33.3 %). Damage-control laparotomy was employed in 6 patients (13.3 %). Postoperative morbidity occurred in 22 patients (48.9 %); surgical site infection (12, 26.7 %) and pneumonia (7, 15.6 %) were the commonest complications. Overall in-hospital mortality was 17.8 % (8/45). On univariate analysis, admission SBP < 90 mm Hg, GCS ≤ 8, ISS > 25, ≥ 3 organs injured, need for massive transfusion, and time from injury to operation > 6 hours were significantly associated with death. On multivariable logistic regression, admission SBP < 90 mm Hg (adjusted OR 9.4; 95 % CI 1.8–48.7; P = 0.007) and ISS > 25 (adjusted OR 11.2; 95 % CI 2.0–63.4; P = 0.006) remained independent predictors of mortality. ***Conclusion:*** Young men injured in road traffic accidents accounted for the bulk of BAT requiring emergency laparotomy at our centre. The spleen and small bowel were the most frequently injured organs. Admission haemodynamic instability, a low GCS, high Injury Severity Score, and delay to definitive operation were closely associated with mortality; among these, haemodynamic status at arrival and overall injury burden emerged as independent predictors. Streamlined pre-hospital transfer, early damage-control resuscitation, and prompt operative intervention are essential to improve survival.

Keywords: blunt abdominal trauma; emergency laparotomy; mortality predictors; Injury Severity Score; damage-control surgery.

INTRODUCTION

Trauma remains a major public health challenge, contributing to nearly one in ten deaths worldwide and disproportionately affecting economically productive individuals in low- and middle-income countries. Within this burden, abdominal trauma accounts for a significant proportion of both admissions and deaths, and blunt mechanisms predominate in civilian practice. Road traffic accidents (RTA), falls from height, occupational crush injuries, and assaults constitute the principal aetiologies, with RTA responsible for the majority of cases in most Indian series.

Blunt abdominal trauma (BAT) is particularly challenging because the extent of intra-abdominal injury is often disproportionate to external signs. Solid visceral injuries, hollow viscus perforation, mesenteric tears, retroperitoneal haematomas, and diaphragmatic ruptures can present with subtle findings, and physical examination has limited sensitivity, especially in patients with altered sensorium or associated head, thoracic, or spinal injury. The introduction of Focused Assessment with Sonography for Trauma (FAST) and rapid multidetector contrast-enhanced computed tomography (CECT) has substantially improved early triage, but haemodynamic instability, evolving peritonitis, or a positive FAST in a shocked patient still mandates emergency exploratory laparotomy.

The past three decades have seen a paradigm shift from routine operative management toward selective non-operative management (NOM) of solid-organ injuries in stable patients, supported by better imaging, angioembolisation, and structured observation protocols. Yet a substantial subset of patients—those with haemodynamic instability, evisceration, peritonitis, hollow viscus injury, or failed NOM—continue to require urgent laparotomy, and their outcomes depend on prompt resuscitation, appropriate operative decision-making, and access to critical care. Damage-control principles, balanced blood-product resuscitation, and staged reconstruction have become integral to the management of the physiologically deranged patient.

Reported in-hospital mortality after emergency laparotomy for BAT ranges from approximately 10 % to 30 % across published series, with wide variation reflecting differences in case-mix, injury severity, transfer times, and institutional resources. Multiple studies have identified age, admission systolic blood pressure, Glasgow Coma Scale (GCS), Injury Severity Score (ISS), number of organs injured, and requirement for massive transfusion as important prognostic variables. Contemporary data from tertiary centres in southern India that describe the clinical profile of BAT and quantify predictors of mortality remain, however, comparatively sparse.

Against this background, the present prospective study was conducted at a tertiary-care teaching hospital in Mysore, Karnataka, to (i) describe the demographic and clinical characteristics of adult patients undergoing emergency laparotomy for BAT, (ii) document the spectrum of intra-abdominal injuries and the surgical procedures performed, and (iii) identify pre-operative and intra-operative variables that predict in-hospital mortality.

MATERIALS AND METHODS

Study design and setting

This was a prospective, single-centre observational study carried out in the Department of General Surgery, FAME Hospital and Research Institute, Mysore, Karnataka, India—a tertiary-care teaching hospital serving both urban and adjoining rural populations. The study extended from 15 March 2026 to 15 May 2026, a period of two months during which consecutive eligible patients presenting to the Emergency Department (ED) with BAT and subsequently undergoing emergency laparotomy were recruited.

Study population

Inclusion criteria

Adults aged 18 years or older with a documented history of blunt trauma to the abdomen who underwent emergency exploratory laparotomy on clinical grounds—haemodynamic instability despite resuscitation, generalised peritonitis, evisceration, positive FAST in a shocked patient, or CECT evidence of hollow viscus perforation, active bleeding, or mesenteric injury—during the study period.

Exclusion criteria

Patients with penetrating abdominal injury, isolated extra-abdominal trauma, pregnant women, patients who were brought dead or who died before operative intervention, patients managed non-operatively, and those who declined consent were excluded.

Sample size

At our centre, the anticipated caseload of adult BAT requiring emergency laparotomy is approximately 20–25 patients per month. Based on this estimate and the fixed two-month recruitment window, a convenience sample of 40–50 consecutive patients was planned. Forty-five patients were ultimately enrolled and included in analysis.

Patient management protocol

All patients received standard trauma care according to Advanced Trauma Life Support (ATLS) principles. The primary survey (airway, breathing, circulation, disability, exposure) was completed within minutes of arrival. Wide-bore intravenous access, warmed crystalloid resuscitation, blood-group and cross-match, and empirical broad-spectrum antibiotics (ceftriaxone with metronidazole, or piperacillin–tazobactam when perforation was suspected) were commenced in the ED. Bedside FAST was performed by the on-call surgical registrar; haemodynamically stable patients underwent CECT of the abdomen and pelvis. Haemodynamically unstable patients with a positive FAST were transferred directly to the operating room. Damage-control resuscitation—early balanced ratio (1 : 1 : 1) blood-product transfusion, permissive hypotension, and correction of the lethal triad of hypothermia, acidosis, and coagulopathy—was applied to physiologically deranged patients. The choice between a definitive single-stage repair and an abbreviated damage-control laparotomy was made intra-operatively by the attending surgeon on the basis of physiology and the complexity of injury.

Data collection

A pre-tested structured proforma was used to record: age, sex, mechanism and time of injury, pre-hospital care, time from injury to hospital arrival, time from arrival to operation, vital signs at admission, GCS, associated injuries, laboratory investigations (haemoglobin, haematocrit, arterial pH, base deficit, lactate, coagulation profile), FAST result, CECT findings, ISS calculated using the Abbreviated Injury Scale, operative findings (organs injured and grades of injury per American Association for the Surgery of Trauma (AAST) organ-injury scale), surgical procedures performed, intra-operative blood loss, transfusion requirements, postoperative course, complications graded by the Clavien–Dindo classification, duration of ventilation, ICU and hospital stay, and 30-day outcome.

Statistical analysis

Data were entered in Microsoft Excel and analysed with IBM SPSS Statistics version 25.0. Continuous variables are expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), and categorical variables as frequencies and percentages. Between-group comparisons employed the Student t test or Mann–Whitney U test for continuous variables and the χ^2 test or Fisher exact test for categorical variables, as appropriate. Variables with $P < 0.10$ on univariate analysis were entered into a stepwise multivariable logistic regression to identify independent predictors of in-hospital mortality; adjusted odds ratios (aOR) with 95 % confidence intervals (CI) are reported. A two-sided P value < 0.05 was considered statistically significant.

RESULTS

Demographic profile

During the two-month study period, 51 adult patients presented with BAT; of these, 6 were managed non-operatively and remained clinically stable, and 45 patients underwent emergency laparotomy and formed the study cohort. The mean age was 34.6 ± 12.8 years (range, 18 – 68 years); the age band 20 – 39 years accounted for 26 patients (57.8 %). Thirty-six patients (80.0 %) were male, giving a male-to-female ratio of 4 : 1 (Figure 1). Twenty-nine patients (64.4 %) came from a rural background, and 32 (71.1 %) were manual labourers, drivers, or agricultural workers.

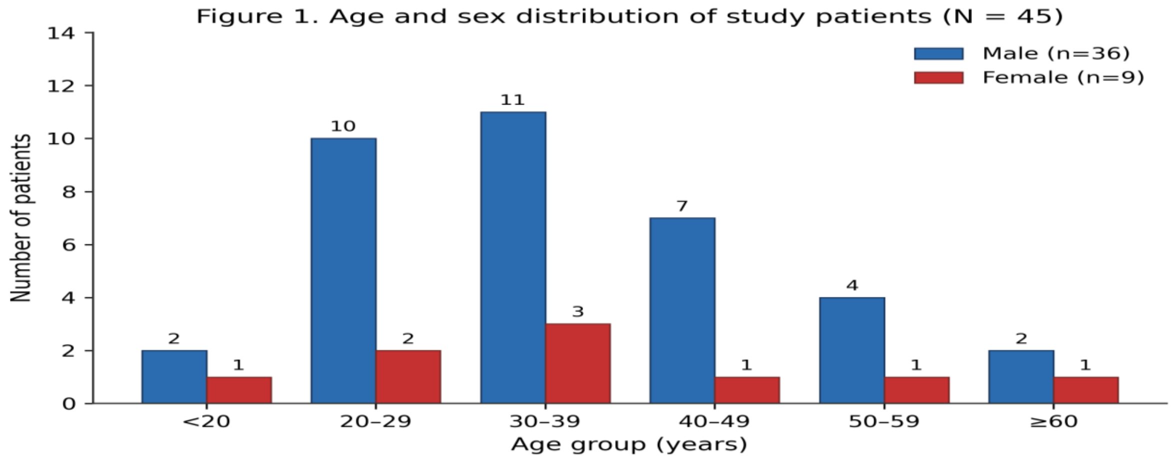

Figure 1. Age and sex distribution of the 45 patients undergoing emergency laparotomy for blunt abdominal trauma.

Mechanism of injury and pre-hospital interval

Road traffic accident was the leading mechanism, seen in 28 patients (62.2 %); of these, 15 (53.6 %) were motorcyclists, 8 (28.6 %) were occupants of four-wheelers, and 5 (17.9 %) were pedestrians. Fall from height accounted for 8 (17.8 %), physical assault for 5 (11.1 %), occupational or crush injury for 3 (6.7 %), and sports or other mechanisms for 1 (2.2 %) (Figure 2). The median interval from injury to hospital arrival was 3.2 hours (IQR, 1.8 – 5.6). Only 11 patients (24.4 %) were transported by a formal ambulance service; the remainder arrived by private vehicle or auto-rickshaw. The median interval from admission to skin incision was 3.7 hours (IQR, 2.1 – 5.9); 19 patients (42.2 %) reached the operating room more than 6 hours after injury.

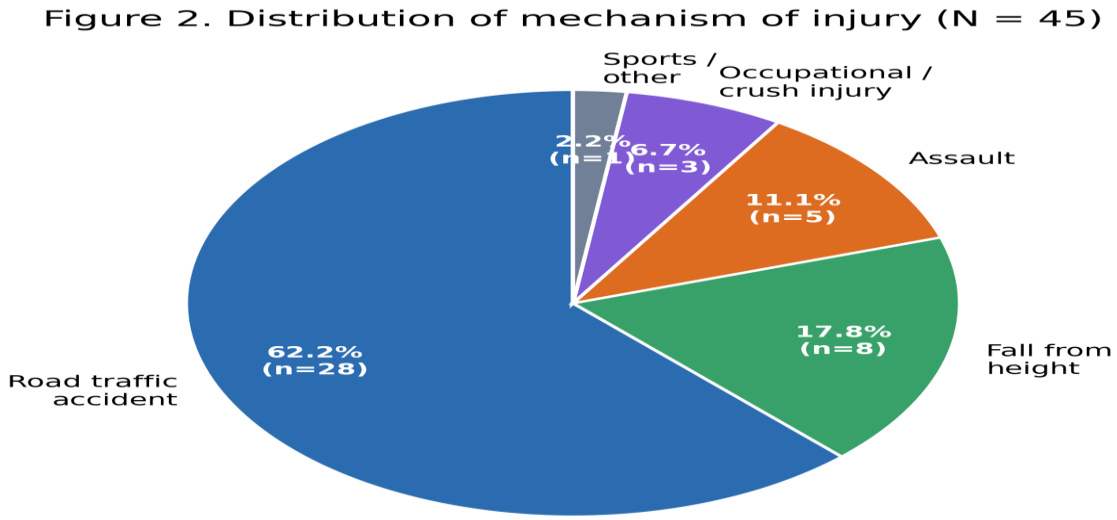

Figure 2. Mechanism of injury distribution (N = 45).

Clinical presentation and baseline investigations

Abdominal pain was reported by all 45 patients (100 %), abdominal distension by 21 (46.7 %), and vomiting by 14 (31.1 %). On examination, abdominal tenderness was elicited in 42 (93.3 %), guarding or rigidity in 27 (60.0 %), and absent bowel sounds in 18 (40.0 %). Seat-belt or handlebar contusion was documented in 9 patients (20.0 %). Associated extra-abdominal injuries included head injury in 12 (26.7 %), thoracic injury in 11 (24.4 %), pelvic fracture in 6 (13.3 %), and long-bone fractures in 9 (20.0 %); 21 patients (46.7 %) had at least one associated injury. Admission clinical and laboratory characteristics are summarised in Table 1.

Table 1. Baseline demographic and admission characteristics of the study cohort (N = 45).

Variable	Value
Age, years — mean ± SD	34.6 ± 12.8
Age range	18 – 68
Male sex — n (%)	36 (80.0)
Rural residence — n (%)	29 (64.4)
Injury to arrival interval, h — median (IQR)	3.2 (1.8 – 5.6)
Admission to operation interval, h — median (IQR)	3.7 (2.1 – 5.9)
Systolic blood pressure < 90 mm Hg — n (%)	17 (37.8)
Heart rate > 110 / min — n (%)	24 (53.3)
Glasgow Coma Scale ≤ 8 — n (%)	7 (15.6)
Glasgow Coma Scale 9 – 12 — n (%)	6 (13.3)
Glasgow Coma Scale 13 – 15 — n (%)	32 (71.1)
Haemoglobin < 8 g/dL — n (%)	14 (31.1)
Base deficit > 6 mmol/L — n (%)	15 (33.3)
Serum lactate > 4 mmol/L — n (%)	13 (28.9)
Positive FAST — n (%)	39 (86.7)
Injury Severity Score — mean ± SD	22.4 ± 9.6
Injury Severity Score > 25 — n (%)	18 (40.0)
Associated extra-abdominal injury — n (%)	21 (46.7)

Abbreviations: FAST, Focused Assessment with Sonography for Trauma; IQR, interquartile range; SD, standard deviation.

Diagnostic imaging

Bedside FAST was carried out in all patients and demonstrated free intraperitoneal fluid in 39 (86.7 %). The 6 patients with a negative FAST were haemodynamically stable and proceeded to CECT; all 6 subsequently demonstrated intra-abdominal pathology, giving an overall FAST sensitivity of 86.7 % in this operative cohort. Thirty-four patients (75.6 %) underwent CECT of the abdomen and pelvis; findings are shown in Table 2.

Table 2. Findings on Focused Assessment with Sonography for Trauma (FAST) and contrast-enhanced computed tomography (CECT).

Investigation / finding	n	Percentage of applicable patients (%)
FAST performed	45	100.0
FAST positive for free fluid	39	86.7
CECT performed	34	75.6
Solid-organ laceration on CECT	23	67.6
Contrast blush / active extravasation	11	32.4
Free intraperitoneal air	9	26.5
Bowel-wall thickening or mesenteric stranding	13	38.2
Retroperitoneal haematoma	7	20.6
Free fluid without solid-organ injury	6	17.6

Denominators: FAST performed in 45 patients; CECT performed in 34 patients.

Intra-operative findings

The spleen was the most commonly injured organ (17, 37.8 %), followed by the small bowel (14, 31.1 %) and liver (12, 26.7 %). Twenty-two patients (48.9 %) had injury involving two or more intra-abdominal organs, and 6 patients (13.3 %) had injury to three or more organs. Detailed frequencies are shown in Figure 3.

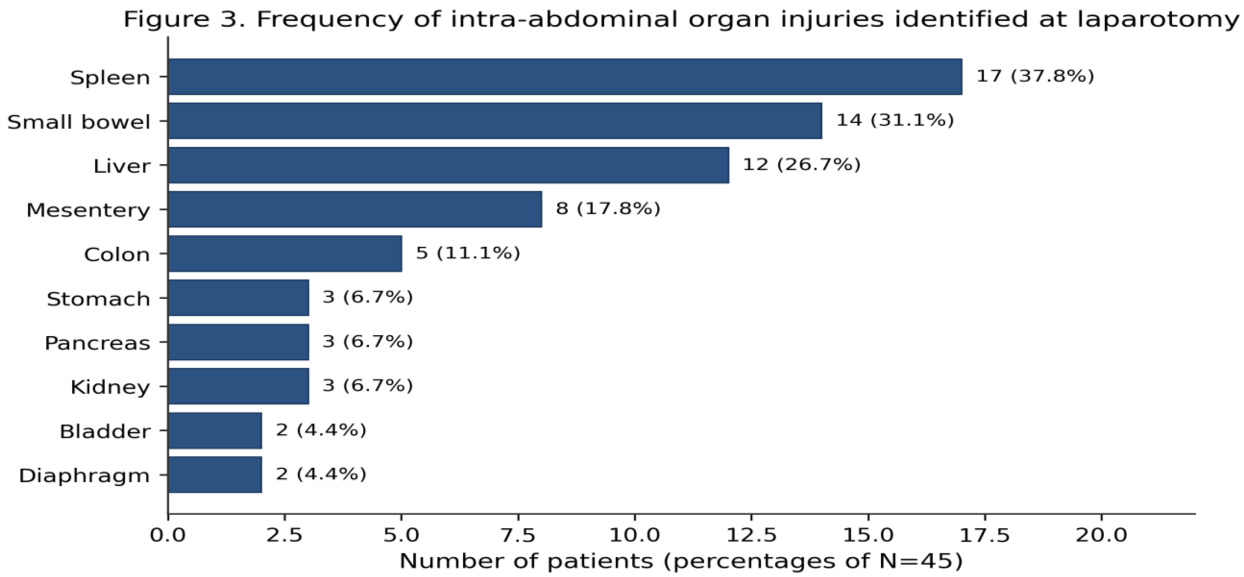

Figure 3. Frequency of intra-abdominal organs injured at emergency laparotomy (N = 45; patients may have more than one organ injured).

Splenic injuries were graded according to the AAST organ injury scale: 3 patients had grade II, 5 had grade III, 6 had grade IV, and 3 had grade V injury. Hepatic injuries comprised 4 grade II, 5 grade III, 2 grade IV, and 1 grade V. Small-bowel injuries included isolated perforation (n = 8), multiple perforations (n = 4), and full-thickness devitalised segments requiring resection (n = 2).

Surgical procedures

Splenectomy was performed in 12 patients (26.7 %); splenic preservation with splenorrhaphy or partial splenectomy was possible in 5 (11.1 %). Hepatic injuries were managed by perihepatic packing in 6 (13.3 %), hepatorrhaphy in 4 (8.9 %), and non-anatomical resection in 2 (4.4 %). Small-bowel perforations were managed by primary repair in 9 (20.0 %) and resection with anastomosis in 5 (11.1 %). Colonic injuries were managed by primary repair with proximal loop diversion in 2 (4.4 %) and Hartmann-type resection in 3 (6.7 %). A damage-control approach with abdominal packing and temporary closure was employed in 6 patients (13.3 %); all underwent planned re-look at 24 – 48 hours. Details are shown in Table 3.

Table 3. Surgical procedures performed at emergency laparotomy (N = 45).

Procedure	n	%
Splenectomy	12	26.7
Splenorrhaphy / partial splenectomy	5	11.1
Perihepatic packing (damage control)	6	13.3
Hepatorrhaphy	4	8.9
Non-anatomical hepatic resection	2	4.4
Small-bowel primary repair	9	20.0
Small-bowel resection and anastomosis	5	11.1
Colonic primary repair with loop diversion	2	4.4
Hartmann procedure	3	6.7
Gastric repair	3	6.7
Distal pancreatectomy	2	4.4
Diaphragmatic repair	2	4.4
Nephrectomy	1	2.2
Bladder repair	2	4.4
Mesenteric repair / ligation	8	17.8
Damage-control laparotomy with re-look	6	13.3

Percentages exceed 100 % because many patients underwent more than one procedure.

Blood-product requirement

Intra-operative and 24-hour transfusion data were available for all 45 patients. The median number of packed red-cell units transfused within 24 hours was 3 (IQR, 1 – 6). Twelve patients (26.7 %) received a massive transfusion (≥ 10 packed red-cell units within 24 hours, or ≥ 4 units within 1 hour). Balanced blood-product resuscitation with a plasma-to-red-cell ratio close to 1 : 1 was achieved in 9 of these 12 patients.

Postoperative course and complications

Twenty-four patients (53.3 %) required admission to the ICU, and 17 (37.8 %) needed mechanical ventilation for a median of 3 days (IQR, 1 – 7). Postoperative complications occurred in 22 patients (48.9 %). Surgical site infection (12, 26.7 %) and pneumonia (7, 15.6 %) were the commonest. Details are shown in Table 4.

Table 4. Postoperative complications and Clavien–Dindo grading (N = 45).

Complication	n	%	Clavien–Dindo grade (predominant)
Surgical site infection	12	26.7	II
Pneumonia / ventilator-associated	7	15.6	II – IVa
Sepsis / septic shock	6	13.3	IVa – V
Acute kidney injury	5	11.1	II – IVa
Anastomotic leak / enterocutaneous fistula	3	6.7	IIIb
Intra-abdominal abscess	3	6.7	IIIa
Wound dehiscence	3	6.7	IIIb
Deep vein thrombosis	2	4.4	II
Post-splenectomy portal vein thrombosis	1	2.2	II
Any complication (per patient)	22	48.9	—

The median hospital stay for survivors was 12 days (IQR, 8 – 18), and the median ICU stay was 4 days (IQR, 2 – 8).

Mortality and its predictors

Eight of the 45 patients died in hospital, giving an overall in-hospital mortality of 17.8 %. Five deaths (62.5 %) occurred within the first 72 hours after operation, primarily due to exsanguinating haemorrhage, refractory shock, or associated severe head injury. The remaining three late deaths (37.5 %) resulted from multi-organ dysfunction complicating sepsis. Mortality across key clinical strata is shown in Figure 4.

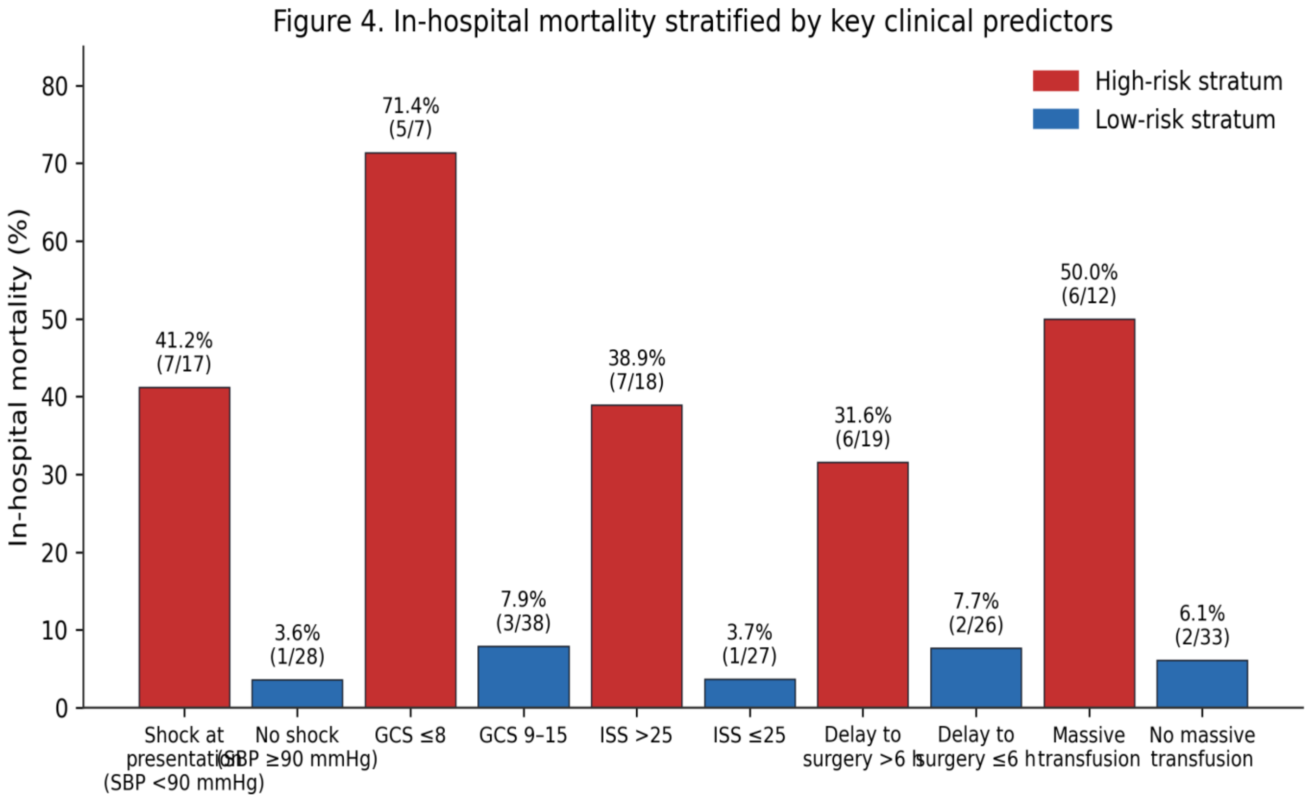

Figure 4. In-hospital mortality stratified by admission systolic blood pressure, Glasgow Coma Scale, Injury Severity Score, time from injury to operation, and massive transfusion requirement.

Univariate comparison of survivors and non-survivors is presented in Table 5. Age, sex, and mechanism of injury did not differ significantly between the two groups. Admission SBP < 90 mm Hg, GCS ≤ 8, ISS > 25, involvement of ≥ 3 intra-abdominal organs, need for massive transfusion, and time from injury to operation > 6 hours were all significantly associated with mortality (P < 0.05).

Table 5. Univariate analysis of factors associated with in-hospital mortality.

Variable	Survivors (n = 37)	Non-survivors (n = 8)	P value
Age, years — mean ± SD	33.4 ± 12.1	40.1 ± 15.2	0.19
Male sex — n (%)	30 (81.1)	6 (75.0)	0.65
Road traffic accident — n (%)	23 (62.2)	5 (62.5)	0.98
Injury-to-operation > 6 h — n (%)	13 (35.1)	6 (75.0)	0.04
SBP < 90 mm Hg on arrival — n (%)	10 (27.0)	7 (87.5)	0.002
Heart rate > 110 / min — n (%)	17 (45.9)	7 (87.5)	0.03
GCS ≤ 8 — n (%)	2 (5.4)	5 (62.5)	< 0.001
Injury Severity Score — mean ± SD	19.7 ± 7.8	34.9 ± 6.1	< 0.001
ISS > 25 — n (%)	11 (29.7)	7 (87.5)	0.003
≥ 3 organs injured — n (%)	3 (8.1)	3 (37.5)	0.03
Massive transfusion — n (%)	6 (16.2)	6 (75.0)	0.001
Base deficit > 6 mmol/L — n (%)	9 (24.3)	6 (75.0)	0.006
Serum lactate > 4 mmol/L — n (%)	7 (18.9)	6 (75.0)	0.002
Associated head injury — n (%)	7 (18.9)	5 (62.5)	0.02

Abbreviations: GCS, Glasgow Coma Scale; ISS, Injury Severity Score; SBP, systolic blood pressure; SD, standard deviation. Categorical variables analysed with the χ^2 test or Fisher exact test; continuous variables with the Student t test.

Variables with P < 0.10 on univariate analysis were entered into a stepwise multivariable logistic regression model. Admission SBP < 90 mm Hg and ISS > 25 emerged as independent predictors of in-hospital mortality (Table 6).

Table 6. Multivariable logistic regression: independent predictors of in-hospital mortality.

Variable	Adjusted odds ratio (aOR)	95 % CI	P value
SBP < 90 mm Hg on arrival	9.4	1.8 – 48.7	0.007
ISS > 25	11.2	2.0 – 63.4	0.006
GCS ≤ 8	5.9	0.9 – 39.4	0.07
Injury-to-operation > 6 h	4.7	0.8 – 27.9	0.09
Massive transfusion	3.8	0.6 – 23.1	0.15
Base deficit > 6 mmol/L	2.6	0.4 – 16.5	0.30

Hosmer–Lemeshow goodness-of-fit χ^2 = 4.32, df = 6, P = 0.63; Nagelkerke R^2 = 0.71; overall model classification accuracy 91.1 %.

The corresponding 30-day survival curves stratified by admission systolic blood pressure are depicted in Figure 5.

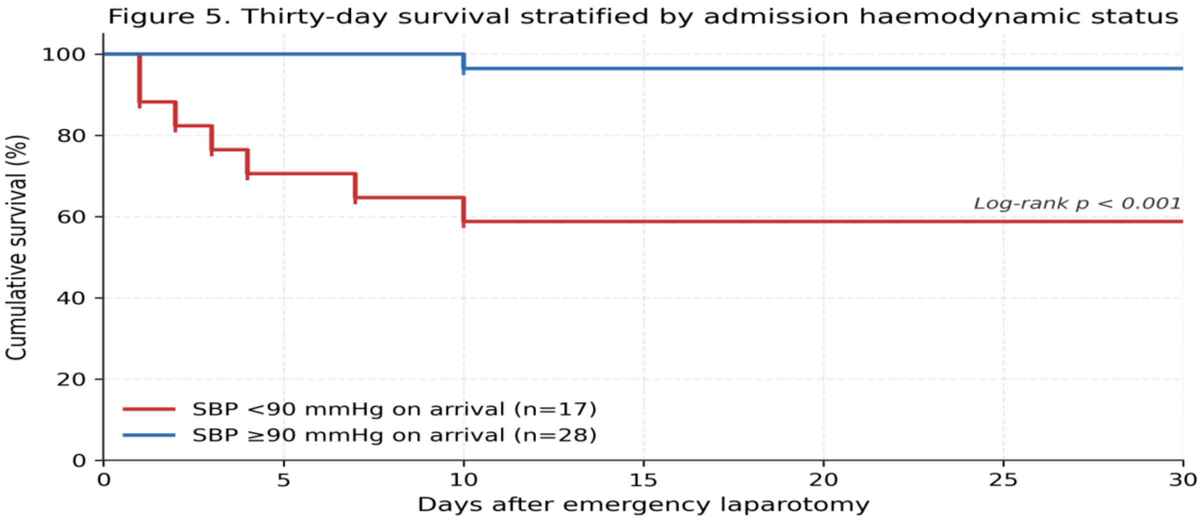

Figure 5. Thirty-day survival curves stratified by admission systolic blood pressure. Log-rank comparison, P < 0.001.

Table 7. Summary of outcomes at 30 days (N = 45).

Outcome	n	%
Alive and discharged	37	82.2
In-hospital mortality	8	17.8
Early mortality (≤ 72 h)	5	11.1
Late mortality (> 72 h)	3	6.7
ICU admission	24	53.3
Mechanical ventilation	17	37.8
Any postoperative complication	22	48.9
Re-operation within 30 days	9	20.0
Median hospital stay for survivors (days)	12 (IQR 8–18)	—
Median ICU stay (days)	4 (IQR 2–8)	—

DISCUSSION

This prospective study of 45 adult patients undergoing emergency laparotomy for blunt abdominal trauma at a tertiary-care centre in southern India confirms a demographic and injury profile that is consistent with the wider Indian and international literature: a strong male predominance, a peak incidence in the third and fourth decades, and road traffic accidents as the dominant mechanism.[1–5] Similar findings have been reported by Mehta et al. from Nepal, Gad et al. from Egypt, and Arumugam et al. from Qatar, all of whom identified RTA as the leading cause and young men as the most frequently injured group.[2,28,29]

The spleen and small bowel were the most commonly injured intra-abdominal organs in our series, followed by the liver. This pattern reflects both anatomical vulnerability and the biomechanics of deceleration and blunt compressive forces. Comparable rank orders have been reported in most contemporary series;[4,8,13,14] some Western series report a slightly higher relative frequency of hepatic injury, reflecting differences in the epidemiology of high-speed motor vehicle crashes and the widespread availability of restraint devices.[13,14]
The role of FAST as a first-line triage tool in the shocked patient is now well established.[9,10] In our study, FAST was positive in 39 of 45 patients (86.7 %), which is consistent with the pooled operating characteristics reported by Stengel et al. in a Cochrane review.[10] Importantly, all six FAST-negative patients in our operative cohort had intra-abdominal pathology at CECT—a reminder that a negative FAST does not exclude injury and, in the haemodynamically stable patient, CECT remains the reference standard.[15,17] Fakhry et al. have emphasised the particular difficulty of diagnosing perforated hollow viscus injury early, and our observations reinforce the need for a low threshold for early CECT and, when clinical concern persists, timely laparotomy.[17]

The proportion of patients managed by damage-control laparotomy (13.3 %) is in keeping with contemporary practice for physiologically deranged patients.[19–21] The rationale of abbreviated first-stage surgery aimed at haemorrhage and contamination control, followed by resuscitation in the ICU and delayed definitive repair, has become the standard for patients presenting with the lethal triad.[19,21] Our results align with those of Duchesne et al., who reported significant survival benefit when damage-control resuscitation and surgery were integrated in the highest-risk group.[21]

An overall in-hospital mortality of 17.8 % in our series lies within the range reported by other Indian and international studies of BAT requiring laparotomy, which typically report mortality between 10 % and 30 %.[1,3,5,28–30] Gad et al. reported an overall mortality of 15.8 % in Egyptian trauma patients with abdominal injury, and Mehmood et al. reported 17 % mortality in a Pakistani cohort.[28,30] Differences between series largely reflect case-mix, delay to definitive care, and the availability of ICU resources and blood products.

Our analysis identified several factors significantly associated with mortality on univariate analysis, including admission SBP < 90 mm Hg, GCS ≤ 8, ISS > 25, involvement of ≥ 3 intra-abdominal organs, need for massive transfusion, elevated base deficit and lactate, delay to operation, and associated head injury. On multivariable analysis, admission SBP < 90 mm Hg (aOR 9.4) and ISS > 25 (aOR 11.2) emerged as independent predictors. These findings mirror those of Champion et al. in the Major Trauma Outcome Study,[26] Baker et al. in the original description of the Injury Severity Score,[6] and more recent large registry analyses.[28–30] The prognostic weight of admission SBP as a bedside surrogate for the depth of shock has been repeatedly confirmed, and its inclusion in the Revised Trauma Score reflects that role.[5]

Delay from injury to operation exceeding 6 hours was significantly associated with mortality in the univariate analysis (31.6 % vs 7.7 %; P = 0.04) but did not achieve independent significance in the multivariable model, most likely because delay correlated closely with severity of shock and injury burden. In a resource-limited context, however, the "golden hour" concept remains highly relevant. Kirkpatrick et al. have highlighted the importance of streamlined resuscitation pathways,[7] and Mock et al. have argued for the systematic development of trauma systems in low- and middle-income countries as a public-health priority.[27] Our data suggest that improvements in pre-hospital transport, coordination with peripheral hospitals, and rapid intra-institutional triage would probably yield the largest incremental gains in survival at our centre.

The requirement for massive transfusion in 26.7 % of our patients underscores the need for a functioning trauma-directed blood-bank protocol. Balanced 1 : 1 : 1 resuscitation, as validated in the PROPPR trial, is now considered standard for the massively bleeding trauma patient,[18] and our observed adherence to this ratio in three-quarters of massively transfused patients reflects both institutional readiness and areas for further quality improvement. Contemporary WSES guidelines on liver and splenic trauma provide a valuable framework for triaging patients to operative versus non-operative pathways.[11,12,23,24]

Strengths and limitations

Strengths of this study include its prospective design, complete follow-up to 30 days, standardised proforma-based data collection, and use of validated injury-severity metrics. Limitations must, however, be acknowledged. First, this is a single-centre study conducted over a two-month window and reflects the case-mix of one tertiary hospital; the findings may not generalise directly to other settings. Second, the sample size is modest, and the multivariable logistic regression model, while statistically valid, was inevitably limited in the number of covariates that could be entered simultaneously without over-fitting. Third, some pre-hospital variables (initial resuscitation at referring facilities, transport modality, ambient temperature at arrival) could not be captured with complete accuracy because many patients arrived through informal channels. Finally, the study was not designed to compare operative and non-operative strategies, and the small number of patients (n = 6) selected for successful NOM did not permit meaningful comparative analysis.

CONCLUSION

Blunt abdominal trauma at our centre predominantly affects young men involved in road traffic accidents, with the spleen and small bowel emerging as the most commonly injured organs. Emergency laparotomy was associated with an overall in-hospital mortality of 17.8 %, and admission systolic hypotension and a high Injury Severity Score independently predicted death. Reducing pre-hospital delay through better transport systems, ensuring rapid intra-institutional triage supported by FAST and selective CECT, adhering to damage-control principles for the physiologically deranged patient, and maintaining a balanced blood-product transfusion strategy are likely to translate directly into improved survival. Larger multicentre studies with longer follow-up are needed to validate these predictors and to refine risk-stratification tools tailored to Indian and other low- and middle-income country contexts.

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