# Predictors of morbidity and mortality in blunt abdominal trauma: The TRAFIC score

**Original Article**

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## ABSTRACT

**Background:** Blunt abdominal trauma (BAT) is a frequent reason for hospital admission and a significant cause of death. Many scoring systems are designed to predict management outcomes. However, it is challenging because many variables affect the prognosis of trauma patients. The study aimed to create a simple score for prediction of morbidity and mortality in BAT which could be applied without the need for complex mathematical equations based upon initial physiological parameters, imaging, and response to initial resuscitation.

**Patients and Methods:** This prospective observational cohort study included patients who presented to Kasr Alainy emergency unit with BAT during the period from December 2020 to April 2021. Data obtained included socio-demographic data, assessment using advanced trauma life support, imaging findings, definitive management, and outcome. Logistic regression was done for selected statistically significant factors forming the BAT score.

**Results:** A total of 193 patients admitted for conservative/operative management following BAT were studied. The incidence of morbidity and mortality was 26.9 and 5.7%, respectively. Significant predictors for morbidity and mortality to BAT (Mnemonic: TRAFIC score) included: (T) trauma associated severe hemorrhage score greater than 10, (R) Response to fluid therapy, (A) positive abdominal examination, (F) positive FAST for moderate or marked amount of intra-abdominal free fluid collection (more than 500cc), (I) ICU admission, (C) positive compute tomography findings, Consciousness (Low glasgow coma score), Circulation (hemodynamic instability). A score of more than 5 is highly suggestive of morbidity, and a score of more than 6 is highly suggestive of mortality.

**Conclusion:** 'TRAFIC' is a simple score that can predict the morbidity and mortality in BAT. However, more studies are needed to validate the score.

**Key Words:** Abdominal trauma, blunt trauma, morbidity, mortality, scoring system.

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## INTRODUCTION

Abdominal trauma is the third most common cause of death from trauma. The injury mechanisms include blunt, penetrating, and blast injuries[1]. The management of blunt abdominal trauma (BAT) is challenging; intra-abdominal injuries are less obvious, and the indications for laparotomy especially in the hemodynamically stable patient are not as clear as in penetrating trauma[2]. Accurate and timely diagnosis of blunt intra-abdominal injury is paramount as early management can reduce mortality by up to 50%[3]. Factors that predict morbidity and mortality are important in the prioritization and triaging of patients especially, in trauma centers, mass casualty events, and those with signs indicating urgent laparotomy. Examples of these factors include: physiological signs on presentation especially hypotension, the time interval between injury and abdominal surgery if needed, and associated injuries, especially head trauma[4]. Many scoring systems are designed to monitor victims of BAT and to predict patients who are more critically ill thus dictating a higher level of care. However, it is difficult to get a solid score for the prediction of morbidity and mortality because there are many variables with subjective implementation affecting the outcome[4].

### *Aim*

This work aimed to identify significant factors that may be attributed to morbidity and mortality in BAT cases used as predictors for a scoring system. This can help in decision making, decrease the time for management, with improve the outcome.

## PATIENTS AND METHODS:

This prospective observational cohort study included 193 patients who presented to Kasr Alainy emergency

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unit with BAT (isolated BAT, part of a polytrauma event) during the 5-month period starting from December 2020 to April 2021. All patients requiring hospital admission for conservative or operative management were included. Patients with no positive clinical or radiological evidence of abdominal trauma, not requiring admission as those with a history of trauma days before presentation or a history of minor trauma, deceased on arrival, pregnant women, and cognitively impaired patients were all excluded.

### *Methods of the study*

Patients presenting with BAT were initially evaluated according to the advanced trauma life support protocol.

The primary survey aimed to resuscitate the patient, and identify and treat conditions that threaten life. This was achieved by assessment of the 'ABCs' (Airway with cervical spine protection, Breathing, and Circulation, disability, exposure, and control of the environment) through a coordinated team at the same time rather than sequential steps. Life-threatening injuries were identified and treated by adding the adjuncts to the trauma victim. Primary survey imaging was done in the form of radiographs (chest, spine, and pelvis) and abdominal evaluation with US for the detection of any free fluid collection.

The secondary survey started after making sure of the stability of each patient, by taking a detailed history of the case/relatives using the AMPLE system (Allergies, Medications, past illnesses or Pregnancy, Last meal, and Events related to the injury) with the head-to-toe examination.

### ***Detailed Local examination of the abdomen included:***

(a) Inspection for free abdominal movement with respiration, abrasions, ecchymosis, or bruises. Ecchymosis involving the flanks (Grey Turner sign) or the umbilicus (Cullen sign), abdominal distension.

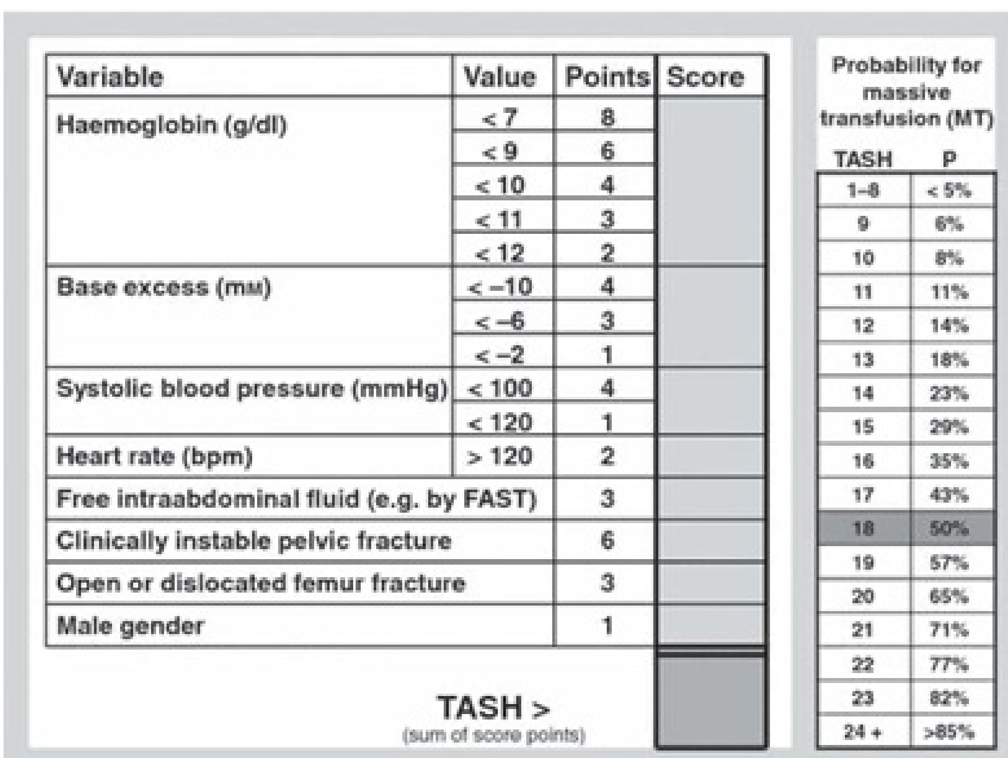
(b) Palpation for signs suggestive of peritoneal irritation as guarding, rigidity, tenderness, or rebound tenderness. Crepitation or instability of the thoracic cage.

(c) Percussion for dullness, resonance, and the most tender point.

(d) Auscultation of bowel sounds in the thorax may indicate the presence of a diaphragmatic injury.

(e) Digital rectal examination for any evidence of bony penetration secondary to pelvic fracture, high riding prostate suggests urethral injury, and assessment of perineal injuries.

Routine blood samples were withdrawn including samples for cross-matching, complete blood count, Coagulation profile, KFTs, LFTs, electrolytes, and amylase. Also, Calculations of trauma-associated severe hemorrhage (TASH) score for activation of massive blood transfusion protocol (Fig. 1). Furthermore, computed tomography (CT) abdomen and pelvis with IV contrast was done in stable patients as indicated.



| Variable | Value | Points | Score |
|---|---|---|---|
| Haemoglobin (g/dl) | < 7 | 8 | |
| | < 9 | 6 | |
| | < 10 | 4 | |
| | < 11 | 3 | |
| | < 12 | 2 | |
| Base excess (mM) | < –10 | 4 | |
| | < –6 | 3 | |
| | < –2 | 1 | |
| Systolic blood pressure (mmHg) | < 100 | 4 | |
| | < 120 | 1 | |
| Heart rate (bpm) | > 120 | 2 | |
| Free intraabdominal fluid (e.g. by FAST) | | 3 | |
| Clinically instable pelvic fracture | | 6 | |
| Open or dislocated femur fracture | | 3 | |
| Male gender | | 1 | |
| TASH > (sum of score points) | | | |

Probability for massive transfusion (MT)

| TASH | P |
|---|---|
| 1–8 | < 5% |
| 9 | 6% |
| 10 | 8% |
| 11 | 11% |
| 12 | 14% |
| 13 | 18% |
| 14 | 23% |
| 15 | 29% |
| 16 | 35% |
| 17 | 43% |
| 18 | 50% |
| 19 | 57% |
| 20 | 65% |
| 21 | 71% |
| 22 | 77% |
| 23 | 82% |
| 24 + | >85% |

**Fig. 1:** Trauma associated severe hemorrhage (TASH) score[5].

Accordingly, the patients were either discharged home on warning signs if no clinical or radiological evidence of any organ injury, admitted for conservative management, or operative intervention.

***In operated patients:***

(a) Written consent was taken from all patients who needed operative intervention.

(b) All Laparotomies were done under general anesthesia through a midline incision with the exploration of any solid/hollow organ injury, any diaphragmatic injuries, and the integrity of retroperitoneal structures.

(c) Patients were transferred to ICU if needed for continuous monitoring of vital signs then they could be transferred to the ward when indicated.

***In patients undergoing conservative management:***

(a) Continuous Monitoring of the vital signs, and a serial abdominal examination were done regularly.

(b) Medications were prescribed in the form of IV fluids, antibiotics, anti-inflammatory drugs, PPI, and potent analgesics.

(c) Follow-up laboratory and radiological investigations were done as required.

***The results of conservative management were as follows:***

(a) Discharge of the patient home on warning signs such as (pallor, any sudden obvious change in daily activities, repetitive vomiting, any symptoms suggestive of GI bleeding such as hematemesis or melena, any symptoms of pain, discomfort, distension, any change of bowel habits).

(b) Delayed laparotomy if significant worsening of vital signs, abdominal examination, or investigation findings.

(c) Endoscopic or radiological interventions were used if required.

***All included patients were divided into two groups:***

(a) Recovery group.

(b) Morbidity and Mortality group.

Morbidity was defined as illness, impairment, and degradation of health after BAT that can affect the function of any organ and impair the daily routine activities. This includes a need for advanced pharmacological support, endoscopic or radiological intervention.

***The following parameters were compared between the groups:***

(a) Sociodemographic factors (age, sex, BMI, associated co-morbidities).

(b) Analysis of the event (mode of trauma, duration before presentation).

(c) Assessment of the patient (Airway, breathing, circulation).

(d) Response to fluid therapy. (Responders are those patients that demonstrate improvement of their physiological parameters, transient responders show an initial improvement followed by further deterioration of their hemodynamic status. Nonresponders are those who continue to deteriorate despite fluid resuscitation).

(e) TASH score

(f) FAST, CT scan findings.

(g) Operative or conservative management.

(h) Need for ICU admission.

(i) Outcome using the Clavien–Dindo classification as a well-validated reference.

***Statistical analysis***

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 26 (IBM Corp., Armonk, New York, USA). Data were summarized using mean, standard deviation, median, minimum, and maximum, in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between quantitative variables were done using the nonparametric Mann–Whitney test[6]. For comparing categorical data, the $\chi^2$ test was performed. Exact test was used instead when the expected frequency is less than 5[7]. Receiver operating characteristic (ROC) curve was constructed with the area under curve analysis performed to detect the best cutoff value of numerical parameters for the detection of morbidity and mortality. The associations between the data and the presence of morbidity and mortality were explored using univariate logistic regression and expressed as odds ratios (ORs) with a 95% confidence interval (CI). Those variables that demonstrated statistically significant univariate ORs were included in a diagnostic scoring system to predict the presence of morbidity and mortality as described by[8]. Briefly, the regression coefficients of any statistically significant predictors on univariate analysis were changed into item-assigned scores by dividing with the smallest coefficient (1.276) and rounding up to the nearest integer. These individual item scores were then summed to create a total score. The ROC curve was constructed with the area under the curve analysis performed to detect the best cutoff value of score for the detection of morbidity and mortality. *P values* less than 0.05 were considered statistically significant.

## RESULTS:

This observational study included 193 patients who presented to Kasr Alainy emergency department with BAT (isolated trauma or polytrauma events) during the period from December 2020 to April 2021. Patients were divided into two groups according to the outcome; recovery group and morbidity or mortality group.

### *Patient characteristics*

The mean age was 15.3 years. 67.9% of patients were males, M : F ratio was 2 : 1. (Table 1). The incidence of morbidity and mortality was 26.9 and 5.7%, respectively. (Table 1). In all, 22.8% of patients included in the study had associated comorbidities. The majority (86%) of trauma cases were due to polytrauma events while 14% of cases were due to direct trauma to the abdomen. The mean prehospital time was 5.9 h. There was no statistical difference in age, sex, comorbidities, and mode of trauma between the two groups. (*P=0.7*, 0.6, 0.09, and 0.81, respectively) (Table 2).

### *Predictors of morbidity and mortality*

### *Airway*

In all, 6.7% of patients were intubated; those patients had a mortality rate of 46.2%, a statistically significant predictor (*P<0.001*) (Table 3).

### *Breathing*

Fourteen percent of patients needed insertion of a chest tube for hemothorax or pneumothorax, and 4% of patients had mild lung contusions (Table 1). There was no statistical difference in patients with cardiothoracic emergencies between the two groups (*P=0.51*).

### *Circulation*

In all, 44.6% of patients presented with hemodynamic instability in the form of SBP less than 100 mmHg, pulse greater than 100 bpm. In all, 22.3% of cases were transient responders to the fluid therapy while 2% of cases were nonresponders (Table 1). Presentation with hemodynamic instability and response to resuscitation were significant predictors of morbidity and mortality (*P=0.001*) (Table 2).

### *Trauma associated severe hemorrhage (TASH score): (predictor of the need for blood transfusion)*

In all, 30.6% of patients needed blood transfusion according to (TASH) score (Table 1). A score greater than 11 significantly predicted morbidity and mortality (*P<0.001*) (Table 2).

### *Glasgow coma score (GCS)*

The mean glasgow coma score (GCS) of patients was 14. GCS was severely affected in patients with traumatic brain injury (Table 1). Using ROC curves, GCS score less than 15 significantly predicted morbidity and mortality.

### *Abdominal examination*

A total of 35.2% of patients had a positive abdominal examination (Table 1). Those were associated with a morbidity and mortality rate of 63.2% (*P<0.001*) (Table 2).

### *FAST findings*

The positive FAST exam was found in 98.4% of the patients; moderate collection (more than 500cc) and marked collection (more than 1000cc) were detected in 29 and 3% of the cases, respectively, with a mortality rate of 3.5 and 33.3% (Table 3).

Moreover, 5% of patients with mild collection died because of associated injuries, six cases had a traumatic brain injury, and one case had massive hemothorax (Table 3).

FAST examination showing moderate and marked collection was a statistically significant predictor to morbidity and mortality (*P<0.001*) (Table 2).

### *CT abdomen and pelvis*

CT abdomen and pelvis with IV contrast was done for all BAT cases except seven hemodynamically unstable cases. The details of the findings are summarized in Table 1. Positive CT scan findings were a statistically significant predictor of worse outcomes, *P* less than 0.001 (Table 2).

### *Definitive management*

The majority (77.2%) of cases were admitted for conservative management, while 21.8% required operative intervention with a consequent morbidity and mortality of 85.7%. The need for operative intervention significantly increased the liability for morbidity and mortality (*P<0.001*) (Table 2).

### *Organ failure requiring ICU admission*

In all, 25.4% of cases had organ failure requiring ICU admission such as respiratory failure, DIC, liver cell failure, renal failure, and severe neurological insult (Table 1). Ten cases died resulting in a mortality rate of 20.4%. One patient who was not admitted to ICU died because of pulmonary embolism (mortality rate 0.7%). This factor was a significant predictor for mortality (*P<0.001*) (Table 3).

### *Significant predictors of morbidity and mortality*

The physiological factors and the initial management of the patients proved to be the most important predictors of the outcome (*P<0.001*). Sociodemographic factors had a low role in morbidity or mortality, yet they had a role in the recovery of patients (Table 2).

### *Blunt abdominal trauma score*

Statistically significant factors that predict morbidity and mortality in blunt were calculated. Logistic regression was used to detect the independent factors. A scoring system was created based on these predictors. The score consisted of eight factors, ranging from 1 to 16 points. Using ROC curve was done for the detection of morbidity and mortality using the score, it was found that a score greater than 5 is a predictor of morbidity and mortality with a sensitivity of 90% while a score greater than 6 was a significant predictor for mortality with sensitivity and specificity of 90.9 and 71.4%, respectively (Table 4).

**Table 1:** Patient demographics

| | Count (%) |
|---|---|
| Sex | |
| Male | 131 (67.9) |
| Female | 62 (32.1) |
| Comorbidities | |
| Yes | 44 (22.8) |
| No | 149 (77.2) |
| BMI | |
| <25 | 133 (68.9) |
| 25–30 | 33 (17.1) |
| 30–35 | 27 (14.0) |
| Mode of trauma | |
| MVCs | 78 (40.4) |
| Fall from height | 88 (45.6) |
| Isolated blunt abdominal trauma | 27 (14.0) |
| Airway | |
| Patent and secure | 180 (93.3) |
| Intubated | 13 (6.7) |
| Breathing | |
| Normal | 158 (81.9) |
| Lung contusion | 8 (4.1) |
| Chest tube | 27 (14.0) |
| Circulation | |
| Stable | 107 (55.4) |
| Unstable | 86 (44.6) |
| Resuscitation | |
| Fluid responder | 146 (75.6) |
| Transient responder | 43 (22.3) |
| Non responder | 4 (2.1) |
| FAST | |
| No | 3 (1.6) |
| Mild | 127 (65.8) |
| Moderate | 57 (29.5) |
| Marked | 6 (3.1) |
| CT abdomen and pelvis with IV contrast details | |

| | Count (%) | | | | |
|---|---|---|---|---|---|
| Splenic injury | 28 (14.5) | | | | |
| Liver injury | 6 (3.1) | | | | |
| Collection | 24 (12.4) | | | | |
| Air under diaphragm | 3 (1.6) | | | | |
| No solid or hollow organ injury. | 125 (64.8) | | | | |
| N/A | 7 (3.6) | | | | |
| Definitive management | | | | | |
| Operative | 42 (21.8) | | | | |
| Conservative | 149 (77.2) | | | | |
| Arrest | 2 (1.0) | | | | |
| Blood transfusion | | | | | |
| Yes | 59 (30.6) | | | | |
| No | 134 (69.4) | | | | |
| Orthopedic injuries | | | | | |
| Yes | 37 (19.2) | | | | |
| No | 156 (80.8) | | | | |
| Serial abdominal examination details | | | | | |
| Lax | 125 (64.8) | | | | |
| Tenderness/Rebound tenderness | 9 (4.7) | | | | |
| Rigidity | 4 (2.1) | | | | |
| Guarding | 55 (28.5) | | | | |
| ICU Admission | | | | | |
| Yes | 49 (25.4) | | | | |
| No | 144 (74.6) | | | | |
| Outcome details | | | | | |
| Recovery | 130 (67.4) | | | | |
| Morbidity class 1 | 13 (6.7) | | | | |
| Morbidity class 2 | 33 (17.1) | | | | |
| Morbidity class 3 | 6 (3.1) | | | | |
| Mortality | 11 (5.7) | | | | |
| | Mean | Standard Deviation | Median | Minimum | Maximum |
| Age | 15.35 | 13.77 | 10.00 | 1.00 | 61.00 |
| Duration before presentation | 5.96 | 9.99 | 3.00 | 1.00 | 72.00 |
| GCS | 14.08 | 2.04 | 15.00 | 5.00 | 15.00 |
| TASH Score | 8.86 | 3.41 | 8.00 | 4.00 | 23.00 |

**Table 2:** Predictors of morbidity and mortality in blunt abdominal trauma

| | Outcome | | |
|---|---|---|---|
| | Recovery | Morbidity or mortality | *P* value |
| | Count (%) | Count (%) | |
| Sex | | | |
| Male | 87 (66.4) | 44 (33.6) | 0.684 |
| Female | 43 (69.4) | 19 (30.6) | |
| Comorbidities | | | |
| Yes | 25 (56.8) | 19 (43.2) | 0.090 |
| No | 105 (70.5) | 44 (29.5) | |
| Mode of trauma | | | |
| MVCs | 52 (66.7) | 26 (33.3) | 0.815 |
| Fall from height | 61 (69.3) | 27 (30.7) | |
| Blunt abdominal trauma (fight) | 17 (63.0) | 10 (37.0) | |
| Circulation | | | |
| Stable | 97 (90.7) | 10 (9.3) | <0.001 |
| Unstable | 33 (38.4) | 53 (61.6) | |
| Resuscitation | | | |
| Fluid responder | 117 (80.1) | 29 (19.9) | <0.001 |
| Transient responder | 13 (30.2) | 30 (69.8) | |
| Non responder | 0 | 4 (100.0) | |
| FAST | | | |
| No | 2 (66.7) | 1 (33.3) | <0.001 |
| Mild | 102 (80.3) | 25 (19.7) | |
| Moderate | 26 (45.6) | 31 (54.4) | |
| Marked | 0 | 6 (100.0) | |
| CT abdomen and pelvis with IV contrast | | | |
| No solid or hollow organ injury. | 98 (78.4) | 27 (21.6) | <0.001 |
| Abnormal | 32 (52.5) | 29 (47.5) | |
| N/A | 0 | 7 (100.0) | |
| Serial abdominal examination | | | |
| Lax | 105 (84.0) | 20 (16.0) | <0.001 |
| Abnormal | 25 (36.8) | 43 (63.2) | |
| ICU Admission | | | |
| Yes | 1 (2.0) | 48 (98.0) | <0.001 |
| No | 129 (89.6) | 15 (10.4) | |
| Definitive management | | | |
| Operative | 6 (14.3) | 37 (85.7) | <0.001 |
| Conservative | 124 (83.2) | 26 (16.8) | |

| | Outcome | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Recovery | | | | | Morbidity or mortality | | | | | *P* value |
| | Mean | SD | Median | Minimum | Maximum | Mean | SD | Median | Minimum | Maximum | |
| Age | 15.02 | 12.98 | 9.50 | 1.00 | 54.00 | 16.03 | 15.36 | 11.00 | 1.00 | 61.00 | 0.740 |
| Duration before presentation | 5.00 | 5.67 | 3.00 | 1.00 | 48.00 | 7.94 | 15.37 | 3.00 | 1.00 | 72.00 | 0.355 |
| GCS | 14.61 | 1.05 | 15.00 | 8.00 | 15.00 | 13.00 | 2.98 | 15.00 | 5.00 | 15.00 | <0.001 |
| TASH Score | 7.62 | 2.36 | 8.00 | 4.00 | 13.00 | 11.43 | 3.81 | 12.00 | 5.00 | 23.00 | <0.001 |

**Table 3:** Independent predictors of mortality in blunt abdominal trauma

| | Mortality | | |
|---|---|---|---|
| | Death | No | *P* value |
| | Count (%) | Count (%) | |
| Sex | | | |
| Male | 7 (5.3) | 124 (94.7) | 0.748 |
| Female | 4 (6.5) | 58 (93.5) | |
| Comorbidities | | | |
| Yes | 4 (9.1) | 40 (90.9) | 0.276 |
| No | 7 (4.7) | 142 (95.3) | |
| Mode of trauma | | | |
| MVCs | 3 (3.8) | 75 (96.2) | 0.573 |
| Fall from height | 7 (8.0) | 81 (92.0) | |
| Isolated blunt abdominal trauma | 1 (3.7) | 26 (96.3) | |
| Airway | | | |
| Patent and secure | 5 (2.8) | 175 (97.2) | <0.001 |
| Intubated | 6 (46.2) | 7 (53.8) | |
| Circulation | | | |
| Stable | 1 (0.9) | 106 (99.1) | 0.003 |
| Unstable | 10 (11.6) | 76 (88.4) | |
| Resuscitation | | | |
| Fluid responder | 2 (1.4) | 144 (98.6) | <0.001 |
| Transient responder | 7 (16.3) | 36 (83.7) | |
| Non responder | 2 (50.0) | 2 (50.0) | |
| FAST | | | |
| No | 0 | 3 (100.0) | 0.074 |
| Mild | 7 (5.5) | 120 (94.5) | |
| Moderate | 2 (3.5) | 55 (96.5) | |
| Marked | 2 (33.3) | 4 (66.7) | |
| CT abdomen and pelvis with IV contrast | | | |
| No solid or hollow organ injury | 5 (4.0) | 120 (96.0) | 0.005 |
| Abnormal | 3 (4.9) | 58 (95.1) | |
| N/A | 3 (42.9) | 4 (57.1) | |
| Serial abdominal examination | | | |

| | Mortality | | |
|---|---|---|---|
| | Death | No | *P* value |
| | Count (%) | Count (%) | |
| Lax | 3 (2.4) | 122 (97.6) | 0.018 |
| Abnormal | 8 (11.8) | 60 (88.2) | |
| ICU Admission | | | |
| Yes | 10 (20.4) | 39 (79.6) | <0.001 |
| No | 1 (0.7) | 143 (99.3) | |

| | Mortality | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Death | | | | | No | | | | | *P* value |
| | Mean | SD | Median | Minimum | Maximum | Mean | SD | Median | Minimum | Maximum | |
| Age | 13.91 | 15.36 | 6.00 | 1.00 | 50.00 | 15.44 | 13.71 | 10.00 | 1.00 | 61.00 | 0.388 |
| Duration before presentation | 6.18 | 13.88 | 2.00 | 1.00 | 48.00 | 5.95 | 9.75 | 4.00 | 1.00 | 72.00 | 0.002 |
| GCS | 9.00 | 3.52 | 7.00 | 5.00 | 15.00 | 14.39 | 1.44 | 15.00 | 8.00 | 15.00 | <0.001 |
| TASH Score | 13.18 | 4.87 | 12.00 | 8.00 | 23.00 | 8.60 | 3.14 | 8.00 | 4.00 | 19.00 | <0.001 |

**Table 4:** Blunt abdominal trauma score showing predictors of morbidity and mortality

| | Regression coefficient | *P* value | OR | 95% CI | | |
|---|---|---|---|---|---|---|
| | | | | Lower | Upper | Item score |
| Morbidity and mortality | | | | | | |
| Unstable circulation | 2.746 | <0.001 | 15.579 | 7.122 | 34.077 | 2 |
| GCS<15 | 1.359 | <0.001 | 3.893 | 1.965 | 7.711 | 1 |
| TASH Score>11 | 2.517 | <0.001 | 12.388 | 5.989 | 25.624 | 2 |
| ICU Admission | 6.023 | <0.001 | 412.800 | 53.079 | 3210.396 | 4 |
| Abnormality in Serial abdominal examination | 2.201 | <0.001 | 9.030 | 4.544 | 17.945 | 2 |
| CT abdomen and pelvis with IV contrast (abnormal) | 1.407 | <0.001 | 4.083 | 2.155 | 7.736 | 1 |
| Resuscitation (transient responder or nonresponders) | 2.356 | <0.001 | 10.552 | 4.947 | 22.506 | 2 |
| FAST (Moderate or Marked) | 1.739 | <0.001 | 5.692 | 2.941 | 11.019 | 1 |

## DISCUSSION

BAT is one of the most common causes of morbidity and mortality, whether isolated BAT or polytrauma events. Because of the morbidity associated with BAT, many strategies have been adopted to manage lethal causes as early as possible.

This prospective observational study included 193 patients who presented to Kasr Alainy emergency unit with BAT during the period from November 2020 to April 2021. The patients were divided into two groups: the recovery group and the morbidity or mortality group. Statistical analysis was done to identify predictors of morbidity and mortality.

In this study, we used Clavien–Dindo classification as a reference to assess morbidity and mortality as a verified scoring system, considering class 1 as recovery for our study purpose. Class II, III, and IV as morbidities, and class V as mortality.

The patients usually encountered in trauma are young males, and polytrauma events were the most common mechanism of trauma[9,10]. In this study, most of the patients were young males with a mean age 14±13 years with M : F ratio 2 : 1. It is worth mentioning that pediatric population has different anatomical and physiological features compared with adults, such as a larger abdominal organ-to-body ratio and greater flexibility of the rib cage, which can affect injury patterns and outcomes. The pediatric patients have a higher risk of solid organ injuries due to the relatively larger size of their organs in proportion to their bodies. Children may have difficulty expressing their symptoms or may present with nonspecific symptoms, making diagnosis challenging[11]. However, Both groups of the study had similar epidemiology in agreement with the literature. In our study, age-associated comorbidities had no statistically significant impact on both groups. Similarly, Pimentel *et al*. found no impact of age and comorbidities on outcome[12]. However, several studies concluded that age over 55 years old or comorbidities were worse prognostic variables in trauma[13,14]. In the current study, the mode of trauma did not affect the outcome. A study by Farrath *et al*. found that road traffic accidents were the most common mechanisms of trauma, but these were not related to mortality, this goes with the results of this study[15].

In the current study, the physiological signs on presentation were the most important factors predicting morbidity or mortality, especially life-threatening conditions managed in the primary survey.

For example, airway compromise or low GCS were significant predictors for morbidity and mortality. Similarly, many studies concluded that traumatic brain injury, affecting the GCS, is a typical factor for mortality in multiple trauma patients. This result highlights the importance of hemodynamic stabilization to maintain brain perfusion in these patients[16,17].

Furthermore, presentation with shock and poor response to fluid resuscitation significantly predicted poor outcomes in their study. A recent systematic review found that the odds of mortality in patients with abdominal injuries were 6.19 times higher among patients presenting with shock[18]. Similarly, in a retrospective study on 86 patients, shock at presentation carried a 2.4 times higher risk of death. Also, Gad *et al*. concluded in his study that those patients had a mortality rate of 56%[14]. The same result was found in several studies[19–22].

This result demonstrates the importance of fast and efficient resuscitation in the prehospital and initial care which is recommended in the literature[14,23,24].

Of note, the presence of extra-abdominal injuries is the leading cause of late mortality in multi-trauma patients who underwent laparotomy[16,24]. This is in agreement with our study which found that the combination of abdominal, pelvic, or head injuries is associated with an increased risk of adverse outcomes ($P<0.001$).

Furthermore, organ failure requiring ICU admission was a significant predictor of morbidity and mortality ($P<0.001$). A reasonable explanation for this result is the fact that ICU admission reflects a severe injury and/or major surgical intervention with the consequent outcome. Moreover, these patients are prone to complications such as acute kidney injury, Acute respiratory distress syndrome (ARDS), cerebrovascular accident, decubitus ulcer, deep venous thrombosis, pulmonary embolism, myocardial infarction, unplanned intubation, urinary tract infection, and sepsis.

In the present study, positive clinical findings, positive FAST for moderate or marked collection, and CT evidence of solid or hollow viscus injury were all significant predictors of morbidity and mortality.

A reasonable explanation for this result is the fact that BAT patients with multiple organ injuries are higher-risk patients who have an increased likelihood for surgical intervention, blood transfusion, greater need for ICU, and days of hospitalization with the subsequent risk of morbidity and mortality[12,23].

### *Scoring system*

Establishing scoring systems for assessment of the severity of injury helps to improve outcomes based on appropriate stratification of trauma patients.

In 1981, Champion *et al*. published the trauma score as a system for field triage as the earliest trauma deaths were due to injury to one or more of three systems: Central nervous system (CNS), cardiovascular system, and respiratory system. A cohort study was done on 1,084 patients, with analysis of variables representing the functional status of these systems, resulting in 5 main variables: GCS, respiratory rate, respiratory expansion, systolic blood pressure, and capillary refill[25].

In 1989, the revised trauma score was done as a reevaluation of the TS by the same authors. It consisted of 3 parameters: GCS, systolic blood pressure, and respiratory rate. Capillary refill and respiratory expansion were excluded as they are difficult to assess properly in trauma patients with a wide margin of interpretation[26].

The revised trauma score can range from 0 to 12 with lower scores representing increasing severity. Its limitations included GCS estimation – especially in ventilated, intoxicated patients and children. Also, it does not account for the duration of physiological derangement and may underscore rapidly resuscitated patients.

Several scoring systems are currently in use for the assessment of patients in emergency settings. The physiological and operative severity scoring for the enumeration of mortality and morbidity (POSSUM) risk-adjusted scoring system is based on 12 physiological and six operative variables from the patient (Table 10). These factors are graded as 1, 2, 4, or 8 to form a physiological score and operative severity score (OSS)[6].

The Portsmouth-POSSUM (P-POSSUM), was made in 1998 by Prytherch *et al*. which aimed to produce a closer fit with the observed outcomes because the original POSSUM was found to over predict the overall risk of death by more than twofold and the risk of death for patients at the lowest risk (5% or less) by more than sevenfold[27]. This score has been tested and validated in various centers to assess the morbidity and mortality in acute surgical emergency cases, yet it is not used in trauma cases. Moreover, it requires data on operative parameters also rather than initial findings.

The emergency trauma score (EMTRAS) is a score that uses parameters that are available within 30 min, without knowledge of anatomic injuries, and accurately predicts mortality. EMTRAS comprises four parameters: patient age, GCS, base excess, and prothrombin time[28].

Validation of EMTRAS in 3, 314 patients showed that it accurately predicted mortality and that, surprisingly, knowledge of the anatomic injury was not needed[28].

In the current study, significant predictors for morbidity and mortality to BAT included low GCS, need for intubation, hemodynamic instability, positive abdominal examination suggesting intra-abdominal bleeding/peritonitis, positive FAST for moderate or marked amount of intra-abdominal free fluid collection (more than 500cc), positive findings in postcontrast CT and organ failure requiring ICU admission.

These factors were included in a scoring system which is named 'TRAFIC' score (T: TASH score, R: Response to fluid therapy, A: Abdominal examination, F: FAST examination, I: ICU admission, C: Circulation, Conscious level, CT findings), (Fig. 2). It contains eight factors with a total score of 16. A score of 5 or more is highly suggestive of morbidity, and a score of 6 or more is highly suggestive of mortality. The potential advantages of the proposed scoring system are that it is based on initial fundamental parameters and it is relatively simple and could be easily calculated to predict morbidity and mortality, thus stratifying patients accordingly. Limitations include being a single-center study, the relatively small number of patients, and the lack of validation to confirm the findings. Further studies are needed to validate the score.

| **TRAFIC score** | | |
|---|---|---|
| T: TASH score | <10<br>>10 | 0<br>2 |
| R: Response to fluid therapy | Fluid responder<br>Transient or nonresponder | 0<br>2 |
| A: Abdominal examination | Normal findings<br>Positive findings | 0<br>2 |
| F: FAST examination | Negative, mild collection<br>Moderate, Marked collection | 0<br>1 |
| I: ICU admission | Organ failure require ICU admission<br>No<br>Yes | <br><br>0<br>5 |
| C:<br>Circulation,<br>Conscious level,<br>CT findings | Hemodynamics on presentation:<br>- Stable<br>- Unstable<br>Conscious level (GCS):<br>- 15<br>- <15<br>CT findings:<br>- Normal<br>- Positive findings | <br>0<br>2<br><br>0<br>1<br><br>0<br>1 |

**Fig. 2:** TRAFIC score.

## CONCLUSION

Morbidity and mortality in patients with BAT may be due to several causes; many of which can be prevented if diagnosed early enough. For this reason. Many trials were done to identify predictors for morbidity and mortality in such patients. In the present study, there was no statistically significant impact of epidemiology and mechanism of injury on morbidity or mortality. The statistically significant factors were grouped into a scoring system called TRAFIC score. The score contains eight factors ranging from 1 to 16. A score of 5 or more is highly suggestive of morbidity, and a score of 6 or more is highly suggestive of mortality. Further studies are needed to validate our score.

## CONFLICT OF INTEREST

There are no conflicts of interest.

## REFERENCES

1. Minino AM, Heron MP, Murphy SL, *et al*. Deaths: final data for 2004. Natl Vital Stat Rep 2007; 55:1–119.

2. Starling SV, Drummond DAF. Non-operative treatment of 1,768 patients with massive abdominal visceral injuries due to blunt trauma treated at Hospital João XXIII. Rev Med Minas Gerais 2014; 24:432–440.

3. Chardoli M, Rahimi-Movaghar V. Analysis of trauma outcome at a university hospital in Zahedan, Iran using the TRISS method. East Afr Med J 2006; 83:440–442.

4. Wang SY, Liao CH, Fu CY, Kang SC, Ouyang CH, Kuo IM, *et al*. An outcome prediction model for exsanguinating patients with blunt abdominal trauma after damage control laparotomy: a retrospective study. BMC Surg 2014; 14:24.

5. Yücel N, Lefering R, Maegele M, Vorweg M, Tjardes T, Ruchholtz S, *et al*.; Polytrauma Study Group of the German Trauma Society. Trauma Associated Severe Hemorrhage (TASH)-Score:probability of mass transfusion as surrogate for life threatening hemorrhage after multiple trauma. J Trauma. 2006; 60:1228–1236.

6. Chan YH. Biostatistics102: Quantitative Data – Parametric & Non-parametric Tests. Singapore Med J (2003a); 44: 391–396.

7. Chan YH. Biostatistics 103: Qualitative Data – Tests of Independence. Singapore Med J (2003b); 44:498–503.

8. Kane JS, Rotimi O, Everett SM, *et al*. Development and validation of a scoring system to identify patients with microscopic colitis. Clin Gastroenterol Hepatol (2015); 13:1125–1131.

9. Lima SO, Cabral FLD, Pinto Neto AF, Mesquita FNB, Feitosa MFG, Santana VR. Epidemiological evaluation of abdominal trauma victims submitted to surgical treatment. Rev Col Bras Cir 2012; 39:302–306.

10. Leite S, Taveira-Gomes A, Sousa H. Lesão visceral em trauma abdominal: um estudo retrospectivo. Acta Med Port 2013; 26:725–730.

11. 11. Snyder CL, Jain VN, Saltzman DA, Strate RG, Perry JF Jr, Leonard AS. Blunt Trauma in Adults and Children: A Comparative Analysis. J Trauma: Injury, Infect Crit Care 1990; 30:1239–1245.

12. Pimentel S, Sawczyn G, Mazepa M, Rosa F, Nars A, Collaço I. Risk factors for mortality in blunt abdominal trauma with surgical approach. Revista do Colégio Brasileiro de Cirurgiões (2015); 42:259–264.

13. Berg RJ, Okoye O, Teixeira PG, Inaba K, Demetriades D. The double jeopardy of blunt thoracoabdominal trauma. Arch Surg 2012; 147:498–504.

14. 14. Gad MA, Saber A, Farrag S, Shams ME, Ellabban GM. Incidence, patterns, and factors predicting mortality of abdominal injuries in trauma patients. N Am J Med Sci 2012; 4:129–134.

15. Farrath S, Parreira JG, Perlingeiro JAG, Soldá SC, Assef JC. Identifying severe abdominal injuries during the initial assessment in blunt trauma patients. Rev Col Bras Cir 2012; 39:295–301

16. Mohamed AA, Mahran KM, Zaazou MM. Blunt abdominal trauma requiring laparotomy in poly-traumatized patients. Saudi Med J 2010; 31:43–48.

17. Wudel JH, Morris JA Jr, Yates K, Wilson A, Bass SM. Massive transfusion: outcome in blunt trauma patients. J Trauma 1991; 31:1–7.

18. Endeshaw, D, Delie, AM, Adal, O *et al*. Mortality and its predictors in abdominal injury across sub-Saharan Africa: systematic review and meta-analysis. BMC Emerg Med (2024); 24:57.

19. Adenuga AT, Adeyeye A. Pattern of Presentation and Outcome of Adult Patients with Abdominal Trauma - A 7-Year Retrospective Study in a

Nigerian Tertiary Hospital. J Emerg Trauma Shock 2023; 16:8–12.

20. Chalya PL, Mabula JB. Abdominal trauma experience over a two-year period at a tertiary hospital in north-western Tanzania: a prospective review of 396 cases. Tanzan J Health Res. 2013; 15:230–239.

21. Pereira Júnior GA, Lovato WJ, Carvalho JB, Horta MFV. Aborda- gem geral trauma abdominal. Medicina 2007; 40:518–530.

22. Sánchez Portela CA, Delgado Fernández JC, Robaina Arias LE, Rodríguez Lorenzo S, Díaz Arteaga Y. Morbilidad y mortalidad por traumatismo abdominal (2002 a 2004). Rev Cubana Cir [periódico na Internet] 2007; 46:(3).

23. Swaid F, Peleg K, Alfici R, Matter I, Olsha O, Ashkenazi I, *et al*. Concomitant hollow viscus injuries in patients with blunt hepatic and splenic injuries: an analysis of a National Trauma Registry database. Injury 2014; 45:1409–1412

24. Hildebrand F, Winkler M, van Griensven M, Probst C, Musahl V, Krettek C, *et al*. Blunt abdominal trauma requiring laparotomy: an analysis of 342 polytraumatized patients. Eur J Trauma 2006; 32:430–438.

25. Champion HR, Sacco WJ, Carnazzo AJ, *et al*. The trauma score. Crit Care Med 1981; 9:672–676.

26. Champion HR, Sacco WJ, Copes WS, *et al*. A revision of the trauma score. J Trauma 1989; 29:623–629.

27. Prytherch DR, Whiteley MS, Higgins B, Weaver PC, Prout WG, Powell SJ. POSSUM and Portsmouth POSSUM for predicting mortality. Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity. Br J Surg 1998; 85:1217–1220.

28. Raum MR, Nijsten MW, Vogelzang M, *et al*. Emergency trauma score: an instrument for early estimation of trauma severity. Crit Care Med 2009; 37:1972–1977.