Non-operative management of blunt abdominal solid organ trauma in adult patients

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ABSTRACT

Introduction: Despite agreement in the literature that “stable” blunt trauma patients may be managed conservatively, in Egypt many such patients receive operative management. This paper presents the results of a pragmatic, prospective, observational study to evaluate outcomes of non-operative (NOP) versus operative (OP) management of blunt abdominal solid organ trauma in hemodynamically stable adults admitted to Tanta University Emergency Hospital (TUH) in Egypt.

Methods: A prospective observational study enrolled adult blunt abdominal trauma patients with solid organ injury at TUH over a 3-year period (June 2014–June 2017). Inclusion criteria were age ≥18 yr, mean arterial pressure > 65 mm Hg, heart rate < 110 bpm, hematocrit ≥7 mg/dl, and abdominal organ injury diagnosed by ultrasound or computed tomography (CT). Excluded patients were those with pelvis and femur fractures; patients with penetrating abdominal trauma; predominate burn injuries, children and pregnant women. All patients were assigned to non-operative or operative management based on clinician preference. Outcomes of interest were 30-day mortality, blood transfusion volume, and length of stay. Descriptive statistics and χ² were used to compare outcomes.

Results: During the study period, 4254 trauma patients presented to TUH. Of these, 790 had blunt abdominal trauma and 111 (14.1%) met inclusion criteria. Injury severity scores for each group were comparable (24 ± 10 – NOP vs. 28 ± 11 – OP, p = 0.126). NOP received less transfused blood (213.41 ± 360.3 ml [NOP] vs. 1155.17 ± 380.4 ml [OP] (p < 0.0001)) but had a longer length of stay (8.29 ± 2.8 [NOP] vs. 6.45 ± 1.97 days [OP] (p = 0.012)). There was no difference in mortality between groups (p = 0.091).

Conclusion: Our study demonstrated that non-operative management in Egypt of blunt abdominal trauma was safe and resulted in fewer procedures, fewer units of blood transfused, and no increase in mortality. Longer length of stay for non-operative patients might reflect treating physician caution in their management.

African Relevance

• Trauma is a leading global cause of mortality, with 90% of the burden falling on low- and middle-income countries.
• Despite familiarity with non-operative approaches, there remains significant heterogeneity in actual practice.
• The local clinical environment in African countries can support close monitoring for non-operative management.
• Research is needed to establish the safety and efficacy of a non-operative approach for blunt abdominal trauma

Introduction

Trauma is a leading global cause of mortality, with 90% of the burden falling on low- and middle-income countries (LMICs). As in many developing economies, incidence of trauma in Egypt is increasing, road traffic injury (RTI) is the most common cause [1] and blunt abdominal trauma is the most common associated injury [2].

In the early 20th century, non-operative (NOP) approaches to blunt abdominal injuries were common. In ensuing decades, more aggressive operative (OP) approaches were employed based on surgical...
experiences during the wars of the mid-century [3]. Since then, widespread access to advanced imaging technology, adjuvant minimal invasive techniques, and improved monitoring capabilities have made it easier for surgeons to choose NOP management for hemodynamically stable (HDS) patients [4]. Modern studies demonstrate that close monitoring of HDS patients with multiple abdominal injuries can be done safely with high rates of success [5]. A 2017 Dutch review of the definition of HDS in blunt trauma patients identified a variety of cutoffs and parameters used with systolic blood pressure (SBP) alone (53.2%) or SBP and heart rate (HR) (29.8%) most commonly used [6]. While there was variability in the cutoffs, the majority of the studies used baseline SBP > 90 ± HR < 100–120 as cutoffs to define HDS in these patients. In addition, the 1999 Transfusion Requirements in Critical Care (TRICC) trial found decreased mortality in patients using a hemoglobin transfusion trigger of 7 g/dL and an updated 2016 Cochrane Review supported restrictive transfusion strategy for patients with hemoglobin concentrations > 7–8 g/dL [7]. In Egypt, despite familiarity with NOP approaches, there remains significant heterogeneity in actual practice. While most providers agree that HDS patients may be managed conservatively, disagreements persist as to which patients actually fit this definition and whether the local clinical environment can support close monitoring for NOP management. Research is needed to establish the safety and efficacy of a NOP approach for blunt abdominal trauma in LMICs such as Egypt. This paper presents the results of a pragmatic, prospective, observational study that analyzed outcomes for HDS patients with blunt abdominal trauma treated in a public tertiary care hospital in Tanta, Egypt.

Methods

From June 2014–June 2017, adult patients with blunt abdominal solid organ trauma were enrolled at Tanta University Emergency Hospital (TUH), a 500-bed tertiary hospital that serves five governorates in the Nile Delta region of Egypt with monitoring facilities, laboratories, > 2000 clinicians and that averages 1500 trauma admissions annually.

Trauma patients presenting to the Emergency Department were screened for inclusion in this study by treating clinicians. Inclusion criteria were age ≥18 years; mean arterial pressure (MAP) > 65 mm Hg; heart rate (HR) < 110 bpm; hemoglobin (Hb) ≥7 mg/dL; and solid organ injury diagnosed by ultrasound or computed tomography (CT). Patients with documented hypotension (MAP < 65 mm Hg) or tachycardia (> 110 bpm) on arrival; Hb < 7 mg/dL; associated pelvis and femur fractures; penetrating injuries or burns; and pregnant women and children were excluded. Patients that met inclusion criteria were consented by treating physicians for inclusion in the study.

To assess actual clinical practice, we conducted a pragmatic, non-blinded study in which decisions regarding NOP and OP management were made by the treating surgeon. NOP patients who died in the hospital or subsequently required surgical intervention in the first 24 h were considered NOP failures. OP patients who died during hospitalization were considered OP failures.

All patients with suspected abdominal injury underwent focused abdominal sonography for trauma (FAST) by trained radiologists. Patients with equivocal FAST results and those for whom the treating surgeon had heightened clinical concern underwent CT scan with intravenous (IV) contrast to evaluate for occult solid organ injury. Patients who underwent laparotomy for any reason were classified as being treated operatively.

Vital signs, level of consciousness and Hb levels were documented on arrival and at 6, 12, and 24 h. Outcomes of interest were strategy failure rate, units of blood transfused, in-hospital complications, hospital length of stay (LOS), and inpatient mortality.

All patients were admitted to intensive or immediate care units and followed up by the emergency physicians assigned to their care. Study patients received a follow-up ultrasound study or CT with IV contrast along with serial complete blood counts. Patients with no evidence of additional injury and stable hematocrit were advanced to light activities and discharged.

Data collected included demographic data, mechanism of injury, time to presentation, VS, GCS, Hb, results of diagnostic imaging (plain radiography, CT, ultrasound), volume of PRBC transfused, disposition, LOS, and inpatient mortality. Injury severity scores were calculated for comparison of the two groups. Data were collected in paper logs and transcribed into Microsoft Excel. Statistical analysis was conducted using Stata 14.0 (Stata Corp. 2001. Statistical Software: Release 14.0. College Station, TX: Stata Corporation.) To assess for possible confounding from differences in mean vital signs between the operative and non-operative groups results were re-analyzed using propensity score matching (PSM) using greedy nearest-neighbor matching without replacement.

Approval was obtained from the Ethics’ Review Committee at TUH and from the Institutional Review Board at the University of Maryland, Baltimore. Informed consent was obtained from all participants.

Results

During the study period, 4254 trauma patients presented to TUH, 790 patients had blunt abdominal trauma and 111 (14.1%) met our study's inclusion criteria. Eighty two (73.9%) were NOP and 29 (26.1%) were OP. Males were the majority in both groups (60, 73.2% - NOP; 24, 82.8% - OP). Mechanisms of injury were similar in both groups. Road traffic injury (RTI) was predominate (61, 74.4% - NOP; 20, 68.9% - OP) followed by assault (16, 19.5% - NOP; 8, 27.6% - OP) and falls from height (5, 6.1% - NOP; 1, 3.5% - OP). There was no statistical difference in Injury Severity Score (ISS) between groups (Table 1). Associated injuries are reported in Table 2.

No NOP patient subsequently required operative care. There was a statistically significant difference in mean volume of blood transfusion (213.41 ± 360.3 ml NOP vs. 1155.17 ± 380.4 ml OP; p = 0.0001) (Table 2). The mean LOS was 8.29 ± 2.8 days for NOP patients vs. 6.45 ± 1.97 days for OP patients, (p = 0.012). All patients in the NOP group survived, whereas one OP patient died (p > 0.05) (Table 3).

Analysis after PSM on cases with grade 3 or 4 solid organ injury and vital sign parameters revealed no statistically significant differences between the matched groups, NOPPSM (14, 37.8%) and OPPSM (23, 62.2%), Table 1. The PSM analysis confirmed the unmatched analysis for transfusion with the operative group requiring approximately 900 ml more PRBC and no change in mortality. The PSM analysis for length of hospitalization, however, revealed no statistical difference in the length of stay between matched groups.

Discussion

Increased mechanization and motorization in LMICs have caused a rising burden of trauma, especially injuries sustained in road traffic incidents. Despite the increasing use of NOP strategies and sufficient awareness of them in Egypt, heterogeneity remains in actual clinical practice.

It is understood that successful NOP management of polytrauma patients can be achieved with close monitoring and modern diagnostic imaging [8,9].

In our study, there were 82 (73.87%) NOP patients and 29 (26.13%) OP patients, despite meeting criteria for HD stability on arrival. There were no statistical differences observed in mortality between both groups and no patient for whom non-operative management was selected went on to require operative management. In a similar study in Iran with 332 blunt abdominal trauma patients only 32 (9.6%) were managed operatively [10]. The observed operative rate in our center is 2.5 times higher than that for similar patients reported in the literature.
Table 1
Relationship between patient characteristics and types of management.

|                   | NOP     | OP      | p-Value | NOP_PSM  | OP_PSM  | p-Value |
|-------------------|---------|---------|---------|----------|----------|---------|
| Gender            |         |         |         |          |          |         |
| Male              | 82 (73.9%) | 29 (26.1%) | 0.30    | 14 (37.8%) | 23 (62.2%) | 0.33    |
| Female            | 58 (26.1%) | 77 (73.9%) |         | 5 (25.5%)  | 17 (74.5%) |         |
| Age, mean (years) | 32.5 ± 13.6 | 32.7 ± 14.9 | 0.32    | 5 (35%)   | 9 (29%)  |         |
| Vital signs (mean) |         |         |         |          |          |         |
| MAP (t0) (mm Hg)  | 83.6 ± 7.7 | 77.1 ± 5.4 | < 0.0001 | 81.4 ± 6.5 | 75.7 ± 3.2 | 0.12    |
| Systolic (t0) (mm Hg) | 109.2 ± 9.4 | 96.6 ± 8.3 | < 0.0001 | 104.3 ± 4.3 | 86.8 ± 10.3 | 0.06    |
| Heart rate (t0) (bpm) | 88.9 ± 11.2 | 98.7 ± 9.2 | 0.041    | 83.7 ± 14.3 | 94.5 ± 8.6 | 0.48    |
| Hb, mean (mg/dL)  | 10.8 ± 1.5 | 8.9 ± 0.9 | 0.033    | 9.7 ± 1.5 | 9.0 ± 0.9 |         |
| Injury Severity Score (ISS) | 24 ± 10 | 28 ± 11 | 0.126    | 82 (73.9%) | 29 (26.1%) |         |
| Mechanism of injury |      |         |         |          |          |         |
| Fall from height  | 5 (6.1%) | 1 (3.5%) |         | 5 (6.1%)  | 1 (3.5%)  |         |
| Mechanism of injury |      |         |         |          |          |         |
| Road traffic collision | 61 (74.4%) | 20 (69.0%) | 0.30    | 9 (64.3%)  | 14 (60.9%) | 0.33    |
| Pelvic fracture    | 1 (1.2%) | 1 (3.5%) |         | 1 (1.2%) | 1 (3.5%)  |         |
| Associated injuries |      |         |         |          |          |         |
| Intestinal perforation | 0 (0%)   | 2 (6.9%) |         | 0 (0%)   | 2 (6.9%) |         |
| Fracture ribs/clavicle | 20 (24.4%) | 3 (10.3%) |         | 10 (35.7%) | 3 (13.8%) |         |
| Maxillofacial injuries | 3 (3.7%) | 0 (0%) |         | 3 (3.7%) | 0 (0%) |         |
| Extremity injuries  | 7 (8.5%) | 3 (10.3%) |         | 7 (8.5%) | 3 (10.3%) |         |
| Retroperitoneal hematoma | 7 (8.5%) | 7 (24.1%) |         | 7 (8.5%) | 2 (6.9%) |         |
| Pelvic fracture     | 1 (1.2%) | 1 (3.5%) |         | 1 (1.2%) | 1 (3.5%) |         |
| Associated pathology |      |         |         |          |          |         |
| Hypersplenism       | 0 (0%) | 1 (3.5%) |         | 0 (0%) | 1 (3.5%) |         |
| Polycystic kidney   | 1 (1.2%) | 0 (0%) |         | 1 (1.2%) | 0 (0%) |         |
| Splenomegaly with cirrhosis | 1 (1.2%) | 0 (0%) |         | 1 (1.2%) | 0 (0%) |         |
| Injured organ       |         |         |         |          |          |         |
| Pearson \( \chi^2 \) | 82 (73.9%) | 29 (26.1%) |         | 15 (18.3%) | 0 (0%) |         |
| Intestinal perforation | 0 (0%)   | 2 (6.9%) |         | 0 (0%) | 2 (6.9%) |         |
| Liver only          | 17 (20.7%) | 1 (3.5%) |         | 17 (20.7%) | 1 (3.5%) |         |
| Kidney only         | 13 (15.9%) | 4 (13.8%) |         | 13 (15.9%) | 4 (13.8%) |         |
| Spleen and liver    | 6 (7.32%) | 4 (13.8%) |         | 6 (7.32%) | 4 (13.8%) |         |
| Liver and kidney    | 2 (2.4%) | 2 (6.9%) |         | 2 (2.4%) | 2 (6.9%) |         |
| Spleen and kidney   | 8 (9.8%) | 3 (10.4%) |         | 8 (9.8%) | 3 (10.4%) |         |
| Spleen, liver, and kidney | 0 (0%) | 1 (3.5%) |         | 0 (0%) | 1 (3.5%) |         |
| Grade of organ injury | Pearson \( \chi^2 \) | 82 (73.9%) | 29 (26.1%) | 0.000 | 0.000 |         |
| I                  | 15 (18.3%) | 0 (0%) |         | 15 (18.3%) | 0 (0%) |         |
| II                 | 53 (64.6%) | 1 (3.5%) |         | 53 (64.6%) | 1 (3.5%) |         |
| III or IV          | 14 (17.1%) | 23 (79.3%) |         | 14 (17.1%) | 23 (79.3%) |         |
| IV or V            | 0 (0%) | 5 (17.2%) |         | 0 (0%) | 5 (17.2%) |         |

Table 2
Associated injuries of blunt solid organ injury patients.

| Associated injuries | NOP  | OP   | p-Value |
|---------------------|------|------|---------|
| Intestinal perforation | 0 (0%) | 2 (6.9%) |         |
| Liver only           | 17 (20.7%) | 1 (3.5%) |         |
| Kidney only          | 13 (15.9%) | 4 (13.8%) |         |
| Spleen and liver     | 6 (7.32%) | 4 (13.8%) |         |
| Liver and kidney     | 2 (2.4%) | 2 (6.9%) |         |
| Spleen and kidney    | 8 (9.8%) | 3 (10.4%) |         |
| Spleen, liver, and kidney | 0 (0%) | 1 (3.5%) |         |

Table 3
Outcomes of interest by management type.

| Outcome               | NOP    | OP     | p-Value | NOP_PSM  | OP_PSM  | p-Value |
|-----------------------|--------|--------|---------|----------|----------|---------|
| PRBC transfused (ml.), mean | 213 ± 360.3 | 1155 ± 380.4 | < 0.0001 | 453 ± 334.3 | 1345 ± 289.2 | < 0.0001 |
| Length of hospitalization, mean (days) | 8.3 ± 2.8 | 6.5 ± 2.0 | 0.012 | 12.1 ± 1.3 | 8.4 ± 1.2 | 0.208 |
| Mortality             | 0 (0%) | 1 (3.5%) | 0.091   | 0 (0%) | 1 (4.3%) | 0.43    |

Conclusion

Hemodynamically stable blunt abdominal trauma with solid organ injury may be managed safely using a NOP approach in Egypt. Additional work must be done to establish agreed upon criteria for HD stability with their subsequent prospective evaluation. For HD stable abdominal trauma patients, interventional radiology procedures might reduce the need for laparotomy and thus should be evaluated in our setting. Objective discharge criteria should be developed for blunt abdominal trauma patients to define a safe evaluation period and potentially reduce length of hospitalization.
on stability of these patients. Further randomized, controlled studies may be useful to establish trauma management protocols appropriate to the level of monitoring and follow-up available at Egyptian hospitals.

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Authors' contributions

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: WI contributed 40%, HM contributed 20%, GM contributed 20%, and JH and MS each contributed 10%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Dissemination of results

Results from this study were presented locally with staff members at Tanta University.

Declaration of competing interest

The authors have no conflicts of interest to report.

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