African Journal of Emergency Medicine 10 (2020) 123–126

Contents lists available at ScienceDirect

African Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/afjem

Original article

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

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ARTICLE INFO

Keywords:
Blunt abdominal trauma
Operative
Non-operative management
Solid organs

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 χ^2 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

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https://doi.org/10.1016/j.afjem.2020.02.002
Received 3 April 2019; Received in revised form 1 February 2020; Accepted 17 February 2020
Available online 05 May 2020

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 $\pm$ 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 $\geq$18 years; mean arterial pressure (MAP) $>$ 65 mm Hg; heart rate (HR) $<$ 110 bpm; hemoglobin (Hb) $\geq$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 $\pm$ 360.3 ml NOP vs. 1155.17 $\pm$ 380.4 ml OP; $p = 0.0001$) (Table 2). The mean LOS was 8.29 $\pm$ 2.8 days for NOP patients vs. 6.45 $\pm$ 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, NOP_{PSM} (14, 37.8%) and OP_{PSM} (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
	82 (73.9%)	29 (26.1%)		14 (37.8%)	23 (62.2%)	
Gender						
Male	60 (73.2%)	24 (82.8%)	0.30	9 (64.3%)	14 (60.9%)	0.33
Female	22 (26.8%)	5 (17.2%)		5 (35.7%)	9 (39.1%)	
Age, mean (years)	32.5 ± 13.6	32.7 ± 14.9	0.32			
Vital signs (mean)						
MAP (t_0) (mm Hg)	83.6 ± 7.7	77.1 ± 5.4	< 0.0001	81.4 ± 6.5	75.7 ± 3.2	0.12
Systolic (t_0) (mm Hg)	109.2 ± 9.4	98.6 ± 8.3	< 0.0001	104.3 ± 4.3	86.8 ± 10.3	0.06
Heart rate (t_0) (bpm)	88.9 ± 11.2	98.7 ± 9.2	0.041	83.7 ± 14.3	94.5 ± 8.6	0.48
Hb, mean (t_0) (mg/dL)	10.8 ± 1.5	8.9 ± 0.9	0.033			
Injury Severity Score (ISS)	24 ± 10	28 ± 11	0.126			
Mechanism of injury	χ^2 = 1.01		0.603			
Road traffic collision	61 (74.4%)	20 (69.0%)				
Fall from height	5 (6.1%)	1 (3.5%)				
Assault	16 (19.5%)	8 (27.6%)				

Table 2
Associated injuries of blunt solid organ injury patients.

	NOP	OP	*p*-Value
	82 (73.9%)	29 (26.1%)	
Associated injuries			
Intestinal perforation	0 (0%)	2 (6.9%)	
Fracture ribs/clavicle	20 (24.4%)	3 (10.3%)	
Maxillofacial injuries	3 (3.7%)	0 (0%)	
Extremity injuries	7 (8.5%)	3 (10.3%)	
Retroperitoneal hematoma	7 (8.5%)	7 (24.1%)	
Pelvic fracture	1 (1.2%)	1 (3.5%)	
Associated pathology			
Hypersplenism	0 (0%)	1 (3.5%)	
Polycystic kidney	1 (1.2%)	0 (0%)	
Splenomegaly with cirrhosis	1 (1.2%)	0 (0%)	
Injured organ	Pearson $\chi^2(7)$ = 6.0643 *p* value = 0.532		
Spleen only	36 (43.9%)	14 (48.3%)	
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%)	
Grade of organ injury	Pearson $\chi^2(3)$ = 60.8239 *p* value = 0.000		
I	15 (18.3%)	0 (0%)	
II	53 (64.6%)	1(3.5%)	
III or IV	14 (17.1%)	23 (79.3%)	
IV or V	0 (0%)	5 (17.2%)	

raising the possibility that additional patients may have been safely managed conservatively.

OP patients in our study received on average almost 1 L of PRBCs greater than NOP patients despite the fact that, as Croce and associates reported, even high-grade liver trauma can be managed conservatively while receiving significantly less transfused blood than OP patients (1.9 vs. 4 units).

Blunt abdominal trauma patients with solid organ injury managed conservatively in our study had an average LOS 1.84 days longer than those who underwent operative care. Given that these patients also received less blood transfusion than operative patients and did not exhibit new injuries on follow up imaging, we cannot attribute this to HD instability. We hypothesize that this may reflect heightened caution by surgical teams rather than objective need for additional hospitalization. Since the result of the PSM analysis revealed no significant difference in LOS between groups the increased LOS in the unmatched analysis may reflect additional lower acuity patients in the unmatched NOP group.

Although mean values for presenting vital signs were in the stable range by our inclusion criteria, statistically significant differences between individual vital signs of the two groups might have influenced clinicians' decisions to choose operative management (e.g. lower SBP despite exceeding threshold values for HD stability and adequate MAP). Further, despite adequate power, our sample size was modest. Additional studies with larger numbers might more definitively model the factors that led to selection of operative management in these patients.

In light of our findings, the following recommendations for TUH are proposed:

1. Protocols should be defined for the management of abdominal trauma using agreed upon cutoffs for HD stability with their subsequent prospective evaluation.
2. For HD stable abdominal trauma patients, interventional radiology procedures might reduce the need for laparotomy and thus should be evaluated in our setting.
3. Objective discharge criteria should be developed for blunt abdominal trauma patients to define a safe evaluation period and potentially reduce length of hospitalization.

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 assessment of HDS in these patients as treating clinicians may over-rely on isolated measurements (e.g. systolic blood pressure) when deciding

Table 3
Outcomes of interest by management type.

Outcome	NOP	OP	*p*-Value	NOP_{PSM}	OP_{PSM}	*p*-Value
	82 (73.9%)	29 (26.1%)		14 (37.8%)	23 (62.2%)	
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

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.

Acknowledgements

Special thanks to the Egyptian Ministry of Higher Education, Tanta University, and to Yale University for their support. The manuscript was copyedited by Linda J. Kesselring, MS, ELS.

Funding

Dr. Ibrahim, Dr. Hirshon, and Dr. El-Shinawi acknowledge funding support from Health Fogarty International Center grant 5D43TW007296 from the National Institutes of Health.

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.

References

[1] Puvanachandra P, Hoe C, El-Sayed HF, et al. Road traffic injuries and data systems in Egypt: addressing the challenges. Traffic Inj Prev 2012;13(Suppl. 1):44–56.
[2] 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(3):129–34.
[3] Schroeppel TJ, Croce MA. Diagnosis and management of blunt abdominal solid organ injury. Curr Opin Crit Care 2007;13(4):399–404.
[4] Stawicki SP. Trends in nonoperative management of traumatic injuries - a synopsis. Int J Crit Illn Inj Sci 2017;7(1):38–57.
[5] Raza M, Abbas Y, Devi V, Prasad KV, Rizk KN, Nair PP. Non operative management of abdominal trauma - a 10 years review. World J Emerg Surg 2013;8:14.
[6] Loggers SAI, Koedam TWA, Giannakopoulos GF, Vandewalle E, Erwteman M, Zuidema WP. Definition of hemodynamic stability in blunt trauma patients: a systematic review and assessment amongst Dutch trauma team members. Eur J Trauma Emerg Surg 2017;43(6):823–33.
[7] Hebert PC, Wells G, Blajchman MA, et al. A multicenter, randomized, controlled clinical trial of transfusion requirements in critical care. Transfusion Requirements in Critical Care Investigators, Canadian Critical Care Trials Group. N Engl J Med 1999;340(6):409–17.
[8] van der Wilden GM, Velmahos GC, Emhoff T, et al. Successful nonoperative management of the most severe blunt liver injuries: a multicenter study of the research consortium of New England centers for trauma. JAMA Surg 2012;147(5):423–8.
[9] Sartorelli KH, Frumiento C, Rogers FB, Osler TM. Nonoperative management of hepatic, splenic, and renal injuries in adults with multiple injuries. J Trauma 2000;49(1):56–61. [discussion 61-52].
[10] Abri B, Shams Vahdati S, Paknezhad S, Sepehri majd P, Alizadeh S. Blunt abdominal trauma and organ damage and its prognosis. J Anal Res Clin Med 2016;4(4):228–32.