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Solid Organs Injuries in Blunt Abdominal Trauma Patients

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ABSTRACT

Background: Trauma is a major public health problem worldwide, morbidity and mortality in solid organ injuries (SOIs) following blunt abdominal trauma are often related to the severity of associated injuries. The management of SOIs depends upon the hemodynamic status of the patients. Hemodynamically unstable patients often require surgical management. Nonoperative management (NOM) is preferred in hemodynamically stable patients.

Objective: This study was conducted to detect both incidence of solid organs injuries in blunt abdominal trauma patients and pattern of injuries as well as outcome in operative management comparing to non-operative management patients. **Patients and methods:** During the study period, total number of 6908 polytrauma patients presented to Mansoura University Emergency Hospital. Among them 685 (9.9%) presented by abdominal trauma. There were 173 cases with penetrating abdominal trauma and 512 cases with blunt abdominal trauma (BTA). Among the cases with BAT, 268 cases were excluded and the remaining 244 were included in the current study.

Results: The most common cause of trauma was road traffic accidents (RTA) (64.3%) of the cases. Solid organs were affected in (70.1%) of the cases, bowels and other abdominal organs were affected in (24.2%), combined solid organs and other abdominal injuries were detected in (5.7%) of the cases. Spleen was the most affected organ in 55.1% of the cases. Total operative management (OM) was required in 70 cases (37.8%) and total NOM was required in 115 cases (62.2%). The overall incidence of mortality was 5.4%. There was no statistically significant difference in the length of hospital stay between the cases according to management (operative or non-operative).

Conclusion: Hemodynamically stable blunt abdominal trauma with solid organ injury may be managed safely using a NOM approach.

Keywords: Blunt Abdominal Trauma, NOM, Solid Organs Injuries.

INTRODUCTION

Trauma is the main cause of mortality in individuals under 45 years of age, and one of the leading causes of mortality in all age groups. Blunt abdominal trauma is the leading cause of intra-abdominal injury with motor vehicle accidents being the leading cause of blunt abdominal trauma. Sports injuries and falls are some of the other causes [(1)]. Abdominal trauma is generally divided into blunt and penetrating trauma. Blunt trauma can affect any intra-abdominal organ, and the injuries may not always be apparent clinically. Prompt and accurate diagnosis is essential in such patients [(2)]**.** Nonoperative management has been widely used in solid organs injury. However, many cases require surgical and invasive ways of diagnosis and treatment [(3)]**.** Injury to abdominal organs occurs through a several mechanisms such as crush injury from direct trauma, and/or transmission of stress wave from direct trauma, and/or shear injury due to deceleration. These mechanisms explain multiple intra-abdominal organ injuries that are not close to each other [(4)]**.** Thus, it is important to evaluate all the structures in the abdomen as they can be injured in various ways not only from direct trauma. The liver and spleen are the most commonly injured organs after blunt abdominal trauma likely due to their close proximity to the abdominal wall. Injuries to the pancreas, kidney, and bladder are less common and less easy to diagnose [(5)]. Due to high rate of operative mortality and morbidity non-operative management of blunt liver and spleen trauma was widely accepted in stable pediatric patients, but the general surgeons were skeptical to adopt it for adults. Patients with liver or spleen injury managed non-operatively can return to light activity immediately and unrestricted activity 3 months after injury [(6)]. The aim of the present study was to detect both incidence of solid organs injuries in blunt abdominal trauma patients and pattern of injuries as well as outcome in operative management comparing to non-operative management patients and to utilize an evidence-based approach across all levels of care in Mansoura University Emergency Hospital.

PATIENTS AND METHODS

This is a retrospective study, which included the cases presented over 3-year duration from January 2016 to December 2018 as shown in the Flow chart.

Inclusion criteria: Blunt abdominal trauma adult patient above 18 years old.

Exclusion criteria: Pregnant patients, and age group under 18 years old.

Data collection: The medical records of patients were reviewed and collected using computerized sheet including all studied data for each patient. The patient's medical records were presented in two forms. Records till June 2017 were regular paper records, while records starting from July 2017 were computerized records

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using the software system Ibn Alhaitham, which is used in Mansoura University Emergency Hospital (MUEH).

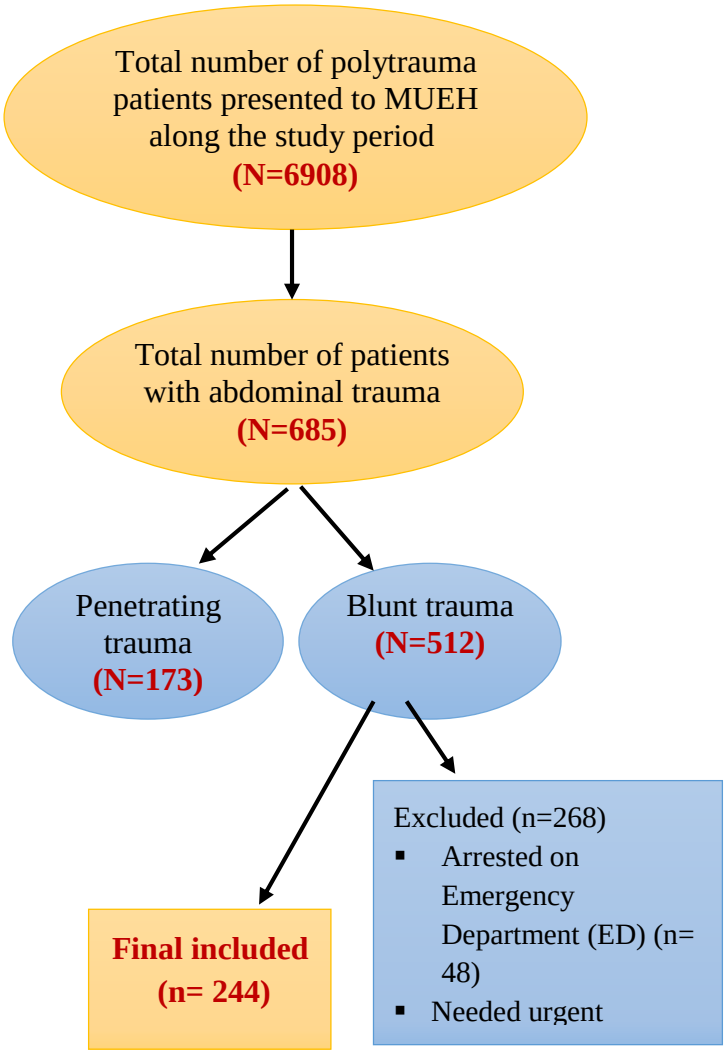

Figure (1): Flow chart of the cases included in the study

Ethical consideration:

The whole study design was approved by the Institutional Review Board (IRB), Faculty of Medicine, Mansoura University. Confidentiality and personal privacy was respected in all levels of the study. Collected data were not used for any other purpose.

Methods (Standard protocol for management of polytrauma):

1- The primary survey:

The initial resuscitation occurs concurrently with primary assessment. When a life-threatening condition is found, immediate corrective actions must be taken, and its effects evaluated before moving on to the next step. The primary assessment should proceed with using the "ABCDE" approach

A. Airway and cervical Spine: The airway is the first priority in the resuscitation phase. Intubation if GCS score ≤8. The cervical spine must be stabilized.

B. Breathing and ventilation: Adequate gas exchange. The goal was to maintain SaO2 of >90%, and pCO2 of 35–40 mmHg. The respiratory rate used was 10–14 breaths/min.

C. Circulation and bleeding control: Adequate cerebral perfusion pressure (CPP) was tried to be maintained by keeping adequate blood pressure and avoiding hypotension.

D. Disability and neurologic assessment: Rapid neurological assessment is performed to define the level of consciousness, using the GCS and pupils size, symmetry and reaction and any lateralizing signs.

E. Exposure and environment control: The patients must completely undressed by cutting off the clothes to allow complete examination. After examination, try to prevent heat loss with warming devices, warmed blankets, etc.

To complete the primary survey, all polytrauma unstable patients were exposed in the resuscitation room to the following:

1. FAST (Focused assessment sonography for trauma patient): in polytrauma patients for possible internal hemorrhage.
2. Chest and pelvis X-ray.

2- The secondary survey:

I. After initial resuscitation effort, all patients were subjected to full history taking including age, mode and time of trauma, time of arrival and resuscitation.

II. AMPLE History taking:

A = **A**llergies
M = **M**edication currently used.
P = **P**ast illnesses/**P**regnancy.
L = **L**ast meal.
E = **E**vents/**E**nvironment related to injury.

III. Clinical examination of the patients at the trauma room including:

1) Vital signs.

2) Neurological examination: Glasgow Coma Scale (GCS) used to define the level of consciousness.

3) Complete general examination: head-to-toe examination to define other associated or occult injuries.

4) Assessment of state of vascular affection through limbs examination to detect: Hard signs, and soft signs.

IV. Investigations:

A. Laboratory tests:

- CBC, INR, ABO grouping.
- Kidney functions (BUN, serum creatinine).
- Liver enzymes (ALT, AST).
- Serum lipase, and Amylase.

B. Specific Radiological investigations:

- FAST (Focused assessment sonography for trauma patient).
- X-ray.
- A computed tomography (CT) Abdomen.

3- Management: Operative or Non-Operative Management (NOM).

4- Outcome and discharge

For each group Operative and NOM**:**
1 – ICU admission.
2 – Length of hospital stays award or ICU.
3 – Mortality.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for the Social Sciences) version 26 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data of categorical variables were presented as number (frequency) and comparison between two groups containing qualitative data was compared using Chi-Square test (χ^2). Quantitative data were presented as mean ± SD, median, and range. P value < 0.05 was considered significant.

RESULTS

The demographic data, mode of trauma and types and sites of injuries of cases included in study are shown in table 1.

Table (1): Age, gender, causes of BAT, types of abdominal injuries and other abdominal injuries of cases included in study.

Number of cases (N=244)		
Age		
Mean ± SD	33.34 ± 15.1	
Median (Min-	32 (18-79)	
	Frequency	**Percentage**
Gender		
Male	204	83.6 %
Female	40	16.4 %
Mode of Trauma		
Road traffic accidents (RTA)	157	64.3 %
Falls from heights (FFH)	44	18 %
Assault with violence	26	10.7 %
Fall on heavy object	17	7 %
Types of injuries		
Solid organs	171	70.1 %
Other abdominal	59	24.2 %
Solid organs associated with	14	5.7 %
Total solid	185	75.8 %
Total other	73	29.9 %
Sites of injuries		
Small intestine	34	13.9 %
Colorectal, retroperitoneal,	39	16 %

As regarding the distribution of the cases according to the solid organs affection, spleen was the most affected organ (Table 2).

Table (2): Distribution of individual solid organs injuries in the cases included in the study.

Solid organs cases (N=185)		
	Frequency	**Percentage**
Sites of injuries		
Spleen	102	55.1 %
Liver	85	45.9 %
Kidney	36	19.5 %
Pancreas	4	2.2 %
Combined 2	36	19.5 %
Combined 3	3	1.6 %

Spleen injuries represented 41.8% of the total BAT and 55.1% of the total solid organs' injuries. Liver injuries represented 34.8% of the total BAT and 45.9% of the total solid organs' injuries. Kidney injuries represented 14.8% of the total BAT and 19.5% of the total solid organs' injuries. Pancreas injuries represented 1.6% of the total BAT and 2.2% of the total solid organs' injuries (Table 3).

Table (3): Distribution of individual solid organs injuries according to the total number of the BAT in the cases included in the study

	Total BAT (244)	**Total solid (185)**
Spleen (102)	41.8%	55.1 %
Liver (85)	34.8%	45.9 %
Kidney (36)	14.8%	19.5 %
Pancreas (4)	1.6%	2.2 %

Other associated extra abdominal injuries in the cases of the study included mainly orthopedic injuries (Table 4).

Table (4): Analysis of total number of associated Extra-abdominal injuries in the cases included in the study

	Total number of associated injuries (N=102)	
Orthopedic	43	42.2 %
Cardiothoracic	27	26.5 %
Head and neck	19	18.6%
Two systems or more	13	12.7%

The details of management in the cases of the study are shown in table 5.

Table (5): Managements of solid organs injury, spleen injuries, liver injuries, kidney injuries and pancreas injuries in the cases included in the study

Managements	Frequency	Percentage
Number of patients with solid organ injury (N=185)		
Total operative management (OM)	70	37.8%
Total Non-operative management (NOM)	115	62.2%
Number of patients with spleen injury (N=102)		
Non-operative management	53	51.9%
• Grade I-III		
Operative management (OM)	49	48.1%
• Grade IV	31	30.3%
• Grade V	14	13.7%
• Grade II or III with failed conservative treatment	4	3.9%
Number of patients with liver injury (N=85)		
Non-operative management (NOM)	76	89.4%
Operative management (OM)	9	10.6 %
• Failed conservative treatment	4	4.7%
• Active bleeding	5	5.9%
Number of patients with kidney injury (N=36)		
Non-operative management (NOM)	26	72.2 %
Operative management (OM)	10	27.8%
• Grade V	4	11.1%
• Failed conservative	3	8.3%
• Both kidneys (haemostasis)	1	2.7%
• Active bleeding	2	5.4%
Number of patients with pancreas injury (N=4)		
Non-operative management (NOM)	2	50%
Operative management (OM)	2	50%
• Grade V	1	25%
• Associated with stomach	1	25%

The overall incidence of mortality was 5.4%. The causes of mortality are listed in table 6.

Table (6): Overall mortality in the cases included in the study

Management	Number of patients with solid organ injury (N=185)	
	Frequency	Percentage
Survived	**175**	**94.6 %**
Died	**10**	**5.4 %**
• Liver injury	1	0.5%
• Other associated injuries	9	4.9%
➢ Head trauma	4	2.2%
➢ Sepsis	3	1.6%
➢ Multiple organs failure	2	1.1%

All the cases with other associated injuries both intra and extra abdominal stayed for ≥ 7 days with high statistically significant difference. The cases with solid organs only, 7.2% of them stayed for < 7 days while the remaining 92.8% of the cases stayed for ≥ 7 days with high statistically significant difference (Table 7).

Table (7): Length of hospital stay in the cases included in the study

Management	Number of patients with solid organ injury (N=185)		P value
	< 7 Days	≥ 7 days	
Cases associated with extra abdominal injury (102)	0 (0%)	102 (100%)	<0.001*
Cases associated with abdominal injury (14)	0 (0%)	14 (100%)	<0.001*
Solid organs only (69)	5 (7.2%)	64 (92.8%)	<0.001*

There was no statistically significant difference in the length of hospital stay between the cases according to management (operative or non-operative) (Table 8).

Table (8): Length of stay in SOIs without associated injuries

Management	Number of patients with solid organ injury (N=185)		P value
	OM (N=27)	NOM (N=42)	
< 7 Days	2 (7.4%)	3 (7.1%)	0.967
≥ 7 days	25 (92.6%)	39 (92.9%)	

DISCUSSION

The aim of this study was to detect both incidence of solid organs injuries in blunt abdominal trauma patients and pattern of injuries as well as outcome in operative management comparing to non-operative management patients and to utilize an evidence-based approach across all levels of care in Mansoura University Emergency Hospital.

The incidence of different mechanism of abdominal injuries varies according to geographic regions. However, data frequently show that blunt abdominal trauma is more common than penetrating abdominal trauma[7]. This agreed with the results of the current study as cases with blunt abdominal trauma (BAT) represented 7.4% of the polytrauma cases presented to MUEH and 74.7% of the cases with abdominal trauma. Approximate incidence was shown by **Ibrahim *et al.*** [8] who included 4254 trauma patients presented to Emergency Department (ED) in Tanta University Emergency Hospital, from them 790 patients had blunt abdominal trauma and 111 (14.1%) met inclusion criteria.

In the current study, the final number of included cases were 244 with BAT who were presented to MUEH during the study period and met the inclusion criteria for selection.

In this study, the mean age of the cases is 33.34 ± 15.1, the minimum age was 19 years and the maximum age was 79 years. Regarding the gender, 204 (83.6%) of the cases were males and 40 cases were females (16.4 %). This is in agreement with **Abdelshafy *et al.*** [9] who showed that male: female ratio of the cases included in their study was 2: 1. This is also in agreement with **Boutros *et al.*** [10] who showed that the mean age of the patients was 28 years (range 11–65 years). The most commonly affected group was between 15 and 35 years (69% of patients). Similar results were reported by **Cortés-Samacá *et al.*** [11] who showed that among 196 trauma patients included in their study the mean age was 30 years and 91.84% were males.

In the present study, the most common cause of trauma was RTA (64.3%) followed by FFH (18%), assault with violence (10.7%) and fall on heavy object (7%). The results came in accordance with **Abdelshafy *et al.*** [9] who showed that road traffic accidents are the commonest cause of blunt abdominal trauma followed by fall from heights and assaults. The results also agreed with **Sisodiya and Malpani** [12] who showed that the most frequent mode of injury was found to be road traffic accident (81.1%) followed by fall from height (9.9%) and assault (8.8%). This could be explained because of recklessness and negligence of the drivers, poor maintenance of vehicles, often driving under the influence of alcohol or drugs and complete disregard of traffic laws. On the contrary, **Al-Ayoubi *et al.*** [13] reported that fall from height was the most common mechanism.

In the current study, solid organs were affected in (70.1%) of the cases, bowels and other intra-abdominal injuries were affected in (24.2%), while solid organs injuries associated other intra-abdominal injury were detected in (5.7%) of the cases. Other abdominal injuries in this study included small intestinal injuries in 13.9% and colorectal, retroperitoneal, urinary bladder, stomach and diaphragm in 16% of the cases. Similar results were obtained by **Sisodiya and Malpani** [12] who showed that small bowel was most common injured hollow viscus organ (12 cases) in which jejunum was most frequently involved followed by ileum and duodenum. 1 case of large bowel injury was reported, which had sigmoid colon involvement.

In the current study, spleen was the most affected organ in 55.1% of the cases, liver was the second most affected organ in 45.9%, kidney in 19.5% of the cases, pancreas in 2.2% of the cases. Combination of 2 solid organs affection were present in 19.5% of the cases and combination of three organs were present in 1.6% of the cases. The current study results came in accordance with **Abdelshafy *et al.*** [9] who showed that spleen was the most affected organ in their study (34%) followed by liver in (22%) of the cases. Renal injury was seen in only 3 cases. **Hassan *et al.*** [14] also previously reported that the spleen is the most commonly injured abdominal organ, which accounts for 49% of blunt abdominal injuries. However, in the study conducted by **Sisodiya and Malpani** [12] the most common solid organ injured was liver in 39 (43.3%) cases followed by spleen in 26 (29%) cases. Moreover, **El-Menyar *et al.*** [15] reported that the most frequently injured organ was liver (45%) followed by spleen (30%) and kidney (18%). One-fifth of patients had multiple SOIs, of that 87% had two injured organs. This difference could be explained as liver is largest of all organs and more anteriorly placed, thus more susceptible to injury in blunt trauma [16, 17].

In the current study, other associated extra abdominal injuries in the cases of the study included orthopedic injuries (42.2%), cardiothoracic injuries (26.5%), head and neck in (18.6%) and two symptoms or more in (12.7%). According to **Sisodiya and Malpani** [12], the most common extra abdominal injury was head injury seen in 18 (20%) followed by rib fracture in 16 (17.7%) and hemothorax in 12 (13.3%). Also, **El-Menyar *et al.*** [15] showed that rib fracture (43%), head injury (32%) and lung contusion (30%) were the frequently observed associated injuries in their study.

Mild to moderate solid organ injury according to trauma scale is managed conservatively with closed monitoring of clinical vitals, based on ultrasonography (USG) and plain radiography. Those patients with stable blood pressure, adequate urine output, maintained abdominal girth and insignificant changes in laboratory investigations were managed conservatively [18]. Conservative management has an established and

accepted management protocol for most BTA injuries [19].

In the current study, the higher percentage of the included cases were managed by conservative treatment. Total operative management (OM) was required in 70 cases (37.8%) and total non-operative management (NOM) was required in 115 cases (62.2%). This agreed with **Sisodiya and Malpani** [12] who showed that 61% cases were managed non-operatively or conservatively and 32 % had to undergo operative intervention. The current study results were also in accordance with **Ibrahim *et al.*** [8] who showed that eighty two (73.9%) of the included cases underwent NOM and 29 (26.1%) underwent OM.

In the current study, the overall incidence of mortality was 5.4%. The causes of mortality included liver injury in 1 case and other associated injuries in 9 cases (due to head trauma, sepsis and multiple organ failure (MOF)). This was exactly in accordance with the results conducted in India where the overall mortality was 5 (5.5%) with 85 (94.5%) discharged successfully from hospital. Most common cause of death was shock with sepsis followed by cardiopulmonary arrest [12].

In the current study, there was no statistically significant difference in the length of hospital stay between the cases according to management (operative or non-operative). Duration of stay in hospital depends on type of management, operative or conservative, general condition of patient, and associated injuries [20].

In the current study, all the cases with other associated extra abdominal injuries stayed for ≥ 7 days with high statistically significant difference. All the cases of solid organs with other abdominal injuries stayed for ≥ 7 days with high statistically significant difference. In the cases with solid organs only, 7.2% of them stayed for < 7 days while the remaining 92.8% of the cases stayed for ≥ 7 days with high statistically significant difference. However, **Sisodiya and Malpani** [12] in their study showed that conservative management has a significant decrease in length of hospital stay (LOS) and morbidity compared to the patient who undergoes surgery. Moreover, **Ibrahim *et al.*** [8] showed that 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 ($p > 0.05$). This could be explained due to high caution and experience by surgical teams rather than objective need for additional hospitalization. It is understood that successful NOP management of polytrauma patients can be achieved with close monitoring and modern diagnostic imaging [21, 22].

In the current study, management of spleen injuries included non-operative management (NOM) in 51.9% of the cases and operative management (OM) in 48.1%. The cases underwent OM included grade IV splenic injury, grade V splenic injury and grade II or III with failed conservative treatment.

Splenic lacerations may be superficial (≤3 cm in depth, grades I-II) or deep (≥3 cm in depth, grade III). Subcapsular and intraparenchymal hematomas and lacerations are easily visible on contrast-enhanced CT. Subcapsular hematomas appear as elliptic collections of low-attenuation blood between the splenic capsule and the splenic parenchyma, whereas active bleeding appears on CT images as areas of contrast extravasation with high attenuation, which are typically larger and more irregular than contained injuries [14]. An intraparenchymal hematoma appears as a hypodense area within a normally perfused splenic parenchyma. Parenchymal laceration and capsular disruption appear as linear defects [23]. A laceration that devascularizes ≥25% of the spleen is defined as a grade IV injury; whereas, a shattered spleen or a hilar vascular injury is defined as grade V injury. Published literature has shown a significant mortality rate (22.7%) from grade V injuries [24].

CONCLUSION

- Road traffic accidents are the most common cause responsible for solid organs injuries presentation. Spleen is the most affected solid organs in cases of blunt abdominal trauma.
- Hemodynamically stable blunt abdominal trauma with solid organ injury may be managed safely using a NOM approach.
- Confined solid organs injuries not affecting post traumatic mortality rates in the presence of good hospital follow up.

RECOMMENDATIONS

1. Early stabilization of patients with suspected polytrauma or abdominal trauma.
2. All patients with abdominal trauma (especially blunt abdominal trauma) should undergo conclusive and definitive assessment using careful clinical and radiological assessment.
3. Strict observation and follow up of patients with BAT with positive findings on initial assessment.
4. 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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