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Diagnostic Evaluation of Blunt Abdominal Trauma Scoring System (BATSS)

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ABSTRACT

Background: Blunt force abdominal trauma is a typical emergency room presentation in both adults and children. Trauma is widely acknowledged as one of the primary causes of illness and mortality in poor nations, as well as the greatest cause of death in those under the age of 45.

Objectives: This study aims to study the diagnostic evaluation of blunt abdominal trauma scoring system (BATSS) in patients with blunt abdominal trauma in Zagazig University Hospital.

Patients and methods: This study was conducted on 48 patients suffering from blunt abdominal trauma in Emergency Department of Zagazig University Hospital from January 2021 to June 2021.

Result: The mean age of patients in the study was 25.87±10.7 years (range 17–61 years). Of the forty eight patients in the study there were 13 females (27.1%) and thirty five males (72.9%).There was statistically significant difference between blunt abdominal trauma scoring system (BATSS) and types of injury $p<0.001$. There was no statistically significant difference between blunt abdominal trauma scoring system (BATSS) and each of patients' sex and causes of injury $p>0.05$. **Conclusion:** The BATSS score system can be used as an initial screening to predict blunt abdominal trauma outcome and can be the basis of management in patients who experience blunt abdominal trauma.

Keywords: Blunt abdominal trauma, Diagnostic, Scoring system (BATSS).

INTRODUCTION

Blunt force abdominal trauma is a typical emergency room presentation in both adults and children [(1)]. The spleen and liver are the most often injured organs after acute abdominal trauma, accounting for around 85 percent of all abdominal injuries [(2)]. 70 percent of spleen, liver, and kidney injuries may be treated conservatively, but hollow organs (such as the intestines) almost always require laparotomy [(3)].

Motor vehicle accidents are the leading cause of blunt abdominal injuries in the United States. Other uncommon causes include falls from great heights, bicycle injuries, sports-related injuries, and industrial accidents. The most prevalent causes of death in youngsters are motor vehicle and bicycle accidents [(4)].

Up to 20% of severe trauma patients have severe abdominal trauma, which is associated with a high fatality risk of roughly 20% [(5)]. In situations of blunt abdominal trauma, quick examination and identification of abdominal injury is critical for care and avoidance of morbidity and death [(6)].

This study aimed to early assessment of patients with blunt abdominal trauma in Zagazig University Hospital, by studying the diagnostic evaluation of blunt abdominal trauma scoring system (BATSS) in these patients.

PATIENTS AND METHODS

This prospective clinical study was conducted in Emergency Department of Zagazig University Hospital from January 2021 to June 2021, on 48 patients suffering from blunt abdominal trauma.

Inclusion criteria: Patients with blunt injury abdomen, age more than 18 years.

Exclusion criteria:

Life threatening injuries other than abdomen injury, penetrating abdominal trauma, pregnant women, and patients who did not have reliable history or physical exam (Such as Glasgow Coma Scale (GCS) less than 15, alcohol intoxication history diagnosed by taking and physical exam, impaired verbal patients).

All patients were subjected to the following:

Full history taking: Age, sex, mechanism of injury, ICU admission, concurrent injury, and associated medical illness. Operative findings, operative procedures, complications during the stay in the hospital and during subsequent follow-up period.

Complete general and abdominal examination to detect different factors like fractures of lower chest ribs, contusion and abrasions of the abdominal wall, presence of fractured lumbar vertebrae with retroperitoneal hematoma, and reduced level of consciousness.

Lab investigations: Complete blood count; kidney functions, liver functions, coagulation profile, serum sodium and potassium level, blood sugar level; and serum amylase.

The presence of free fluid within the abdominal cavity was accepted as a positive sign for hemoperitoneum. US examinations were performed with SSA-270A (Toshiba, Japan) sonography device with a 3.75 MHz convex probe.

Scans were obtained with the patient in the supine position to evaluate for the presence of free fluid in the bilateral upper quadrants, including the hepatorenal and splenorenal regions, and paracolic gutters. The pelvis was also scanned for free fluid, although this scan was sometimes obtained without the

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benefit of a well-distended bladder providing an optimal acoustic window. Subxiphoid views of the heart were obtained when there was a history of possible chest trauma.

CT examinations were carried out with spiral CT (Xpres/GX, TSX-002a, and Toshiba, Japan). A scout image was obtained while the patient was lying down on supine position and the area from the lower thoracic level to the pubic symphysis was identified as the field of examination.

During the examination all patients were administered 120 ml of intravenous non-ionic contrast material at a flow rate of 3 ml/sec. Before performing the examination patients also received 1,000 ml of 3% diluted oral contrast within 45-60 min to the extent their general conditions allowed them. Patients with unfavorable general conditions had the examination performed with only the intravenous contrast material.

CT examination started 60 seconds after the initiation of contrast material injection. Scanning parameters were 150 mAs, 120 kV, slice thickness of 10 mm, and table moving speed of 10 mm /s (step rate 1).

BATSS is a 24 – point was developed based on factors like abdominal pain (2 points), abdominal tenderness (3 points), systolic blood pressure <100 mmHg (4 points), pulse rate >100 bpm (1 point), chest wall hematoma (1 point), pelvic fracture (5 points), (FAST) Focused Assessment Sonography for Trauma (8 points)**.**

Each patient was examined and followed up during the course of the treatment, and the treatment process was divided into three categories: (1) Outpatient, (2) Observation, and (3) Surgical intervention.

In non-operative, each hospitalized patients were followed up by physical examinations, blood tests analysis, with follow up ultrasound and further investigations if needed. After discharge patients were followed up for one week in outpatient department (OPD). In surgical intervention the operation data was recorded and compared with score result.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation of the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

All data were collected, tabulated and statistically analyzed using SPSS 24.0 for windows (SPSS Inc., Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Wilk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (χ^2) and Fisher exact were used to calculate difference between qualitative variables as indicated. Quantitative data were expressed as mean ± SD (Standard deviation) for parametric and median and range for non-parametric data. Mann Whitney test was used to calculate difference between quantitative variables in the two groups. Receiver operating characteristic (ROC) curve was constructed to permit selection of threshold values for test results and comparison of different testing strategies. All statistical comparisons were two tailed with significance level of P-value ≤ 0.05 indicates significant, and p <0.001 indicates highly significant difference.

RESULTS

Table 1 illustrates the demographic data of the studied patients.

Table (1): Demographic characters of studied group

Variables	Study group (n=48)	
Age (years) Mean ± SD (range)	25.87±10.7 17-61	
	n.	**%**
Gender Females Males	 13 35	 27.1 72.9

Most common cause of blunt trauma was road traffic accident (Table 2).

Table (2): Causes of blunt trauma of studied group (n. 48)

Causes of blunt trauma	n.	%
Road traffic accident (RTA) Fall from height (FFH) Assaults	29 16 3	60.4 33.3 6.3

As illustrated in table (3) 38 patients (79.2%) had abdominal pain, (95.0%) had pulse rate >90 bpm, 68.7% had normal systolic blood pressure.

Table (3): Clinical characteristics of the studied patients with blunt injury abdomen

Item	Category	no	%
Abdominal pain	**Present**	38	79.2
Pulse rate	**<90 /min**	2	4.1
	>90 /min	46	95.9
Systolic blood pressure	**>120 mmHg**	11	22.9
	90-120 mmHg	33	68.7
	<90 mmHg	4	8.3

The values of blunt abdominal trauma scoring of the studied group are shown in table 4.

Table (4): Blunt abdominal trauma scoring system (BATSS) for studied group (n. 48)

Items	Mean ± SD	Median (range)
Pain (../2)	1.83±0.37	2(1-2)
Tenderness (../3)	1.48±0.92	1(0-3)
SBP (…/4)	1.94±0.75	2(1-4)
Pulse Rate (../1)	0.96±0.2	1(0-1)
Chest Wall Sign (../1)	0.15±0.36	0(0-1)
Pelvic Fracture (../5)	0.104±0.72	0(0-5)
FAST (../8)	3.5±1.3	3(0-7)
Total score	**9.8±2.9**	**9 (5-16)**
BATSS level		
Low risk	7	14.6
Moderate risk	31	64.6
High risk	10	20.8

Table (5) shows that there was statistically significant relation between level of risk and both abdominal pain and systolic blood pressure with all high risk patients had abdominal pain and had normal or low systolic blood pressure.

Table (5): Relation between blunt abdominal trauma scoring system (BATSS) and different factors

Items	Category	Blunt abdominal trauma scoring system (BATSS)			χ^2	P value
		Low risk n. 7	Moderate risk n.31	High risk n.10		
		N (%)	N (%)	N (%)		
Gender	**Female**	2 (28.6)	9 (29.0)	2 (20.0)	0.32	0.85
	Male	5 (71.4)	22 (71.0)	8 (80.0)		
Cause of injury	**RTA**	5 (71.4.0)	17 (54.8)	7 (70.0)	2.2	0.69
	FFH	2 (28.6)	11 (35.3)	3 (30.0)		
	BAT	0 (0.0)	3 (9.7)	0 (0.0)		
Abdominal pain	**Present**	1 (14.3)	27 (87.1)	10 (100.0)	**15.4**	**<0.001***
	Absent	6 (85.7)	4 (12.9)	0 (0.0)		
Pulse rate	**<90 /min**	1 (14.3)	1 (3.2)	0 (0.0)	**2.55**	0.279
	>90 in	6 (85.7)	30 (96.8)	10 (10.0)		
Systolic bl. Pressure	**>120 mmHg**	4 (57.1)	7 (22.6)	0 (0.0)	**11.5**	**0.021***
	90-120 mmHg	2 (28.6)	24 (77.4)	7 (70.0)		
	<90 mmHg	1 (14.3)	0 (0.0)	3 (30.0)		

*= Significant, χ^2= chi square test

Table (6) indicates that there was significantly higher median of tenderness score, SBP, chest wall sign score, FAST score in patients who were subjected to laparotomy.

Median of total BATSS score was significantly higher [15 with range (14-16)] among patients need Laparotomy compared to 9 (5-16) for discharge patients.

Table (6): BATSS score items based on outcome among studied group (n. 48)

Items	Outcome		u	p
	Discharge n.40	Laparotomy n.8		
Pain (../2)	2 (1-2)	2 (2-2)	1.37	0.170
Tenderness (../3)	1 (0-3)	3 (2-3)	4.38	0.0001**
SBP (…/4)	2 (1-4)	2 (2-4)	2.84	0.005*
Pulse Rate (../1)	1 (0-1)	1 (1-1)	0.64	0.523
Chest Wall Sign (../1)	0 (0-1)	1 (0-1)	4.16	0.0001**
Pelvic Fracture (../5)	0 (0-5)	0 (0-0)	0.45	0.655
FAST (../8)	3 (0-8)	6 (5-7)	5.3	0.0001**
BATSS Score(24)	9 (5-16)	15 (14-16)	4.3	0.0001**

U= Mann-Whitney U test, *= Significant, **= Highly significant,

Figure 1 shows that area under curve (AUC) was 0.938. So, trauma scoring system (BATSS) was excellent parameter to discriminate CT finding for blunt abdominal trauma.

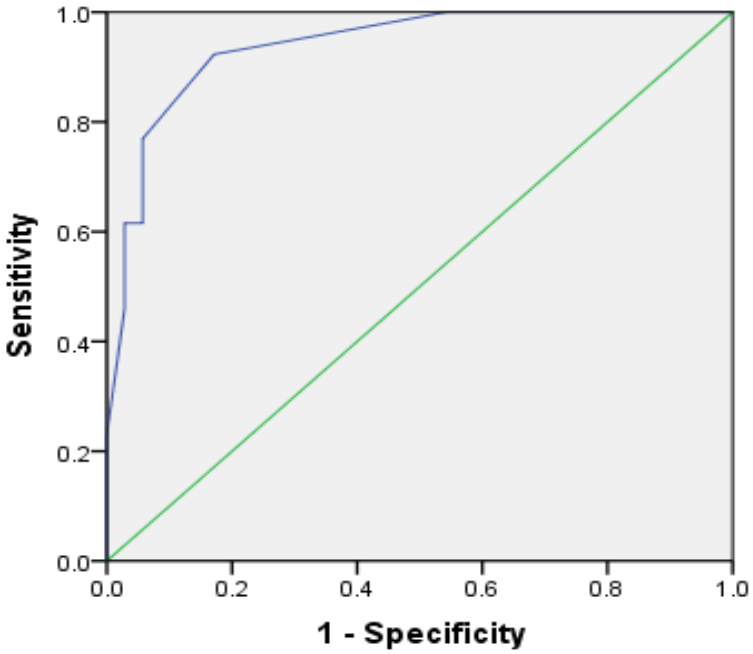

Figure (1): ROC curve to detect the best cut-off value for blunt abdominal trauma scoring system (BATSS) in the prediction of CT finding of blunt abdominal trauma.

DISCUSSION

Abdominal trauma is one of the most prevalent types of injuries that occur as a result of car accidents. 75 to 80 percent of blunt abdominal damage occurs as a result of car accidents. A fall from a great height, an assault with blunt items, sports injuries, and a fall while riding a bicycle can all result in a blunt abdominal injury. Abdominal trauma that isn't severe is frequently undetectable [(7)].

The importance of a clinical examination cannot be overstated. The patient's or first responders' history aids in the analysis of the accident's dynamics. All high-energy blunt injuries should be suspected of causing intestinal or mesenteric damage. The first priority is to take a pulse, blood pressure, and hemodynamic status reading [(8)].

X-ray erect abdomen, ultrasonography, diagnostic peritoneal lavage, computed tomography, and diagnostic laparoscopy are some of the diagnostic methods used to assess abdominal trauma [(9)]. Abdominal Trauma Severity Score in a Nutshell Radiography and ultrasonography are used in conjunction with the clinical evaluation. The blunt abdominal trauma severity score can be used as a first step in predicting intra-abdominal organ harm and as the foundation for treatment in individuals who have had blunt abdominal trauma [(6)].

A 24-point of blunt abdominal trauma severity score (BATSS) was developed based on β sums

obtained from each factor. The point of each factor was: abdominal pain (2), abdomen tenderness (3), chest wall sign (1), pelvic fracture (5), FAST(8), SBP<100 mmHg(4), PR> 100 beats/min(1) **[10].** This score is tabulated in the proforma at the time of receiving the patient and the score is documented. Patients are classified into three groups based on the score (low risk < 8, medium risk 8 to 11 and high risk ≥ 12) **[11].**

This prospective clinical study was conducted in Emergency Department of Zagazig University hospital from January 2021 to June 2021. This study was conducted on 48 patients suffering from blunt abdominal trauma to early assess patients with blunt abdominal trauma in Zagazig University Hospital.

Regarding the demographic characters of studied group, we found that the mean age of patients in the study was 25.87±10.7 years (range 17–61 years). Of the forty-eight patients in the study there were 13 females (27.1%) and thirty-five males (72.9%). A study by **Majid *et al.*** **[3]** aimed to evaluate the reliability of the blunt abdominal trauma scoring system (BATSS). They enrolled 1000 patients with mean age (35.79 ± 13.09) (range 19-64) years including 942 (94.2%) males and 58 (5.8%) females.

Also, in line with our study a cross sectional study by **Ragab *et al.*** **[12]** aimed to determine blunt abdominal trauma patients signs, clinical data, and to clarify the accuracy, sensitivity, specificity, positive and negative predictive value of blunt abdominal trauma severity score (BATSS), the study enrolled 100 cases included 50 males (50%) and 50 females (50%), their ages ranged from 18 to 60 years (mean ±SD 38.53 ± 12.11); included majority of cases from 20 to 40 year (54%).

In the current study the causes of blunt trauma were road traffic accidents in 29 patients (60.4%), fall from height in 16 patients (33.3%), while in the other three patients (6.3%) it was assaults. While, **Majid *et al.*** **[3]** revealed that the most prevalent cause of blunt trauma was road traffic accidents (61.6%), followed by fall from height (22.4%) then others (16%). Furthermore, the study by **Sivarajan *et al.*** **[13]** reported that the main reasons of blunt trauma were road traffic accident (61%), fall from height (25%) and assaults (14%).

Regarding the clinical characteristics of the studied patients with blunt injury abdomen, we found that 38 patients (79.2%) had abdominal pain, (95%) had pulse rate >90 bpm, 68.7% had normal systolic blood pressure. However, the study of **Karjosukarso *et al.*** **[6]** reported that 50 % has pulse rate <100 bpm, 75% had abdominal pain, 77.3 % had abdominal tenderness, 22.7% had chest wall sign, 88.6 % had pelvic fracture, and FAST Score was positive in 86.4% .

As regard blunt abdominal trauma scoring of the studied group, the current results showed that the mean value of pain was (1.83±0.37), tenderness was (1.48±0.92), SBP (1.94±0.75), pulse rate (0.96±0.2), chest wall sign (0.15±0.36), pelvic fracture (0.104±0.72), FAST (3.5±1.3) and the mean value of (BATSS) was (9.8±2.9). Classification blunt abdominal trauma scoring system illustrated that; low risk: 7 patients (14.6%), moderate risk: 31 patients (64.6%), high risk: 10 patients (20.8%) with mean± SD (9.8±2.9) and range from 5 to 16. In line with our results **Ragab *et al.*** **[12]** study revealed that 64% were of high risk (≥12) according to blunt abdominal trauma severity score, 26% was of medium risk (8 – 11), and only 10% was of low risk (< 8). Also, **Majid *et al.*** **[3]** revealed that the score of 661 (66.1%) of the patients were low, 109 patients were moderate and 230 (23%) had a high score. The mean score among the referrals was (6.29 ± 5.8) and the highest score was 19.3 out of 24.

Our results revealed that there was no statistically significant difference between blunt abdominal trauma scoring system (BATSS) and patients' sex. Also, there was no statistically significant difference between blunt abdominal trauma scoring system (BATSS) and causes of injury.

Results indicated that there was significantly higher median of tenderness score, SBP, chest wall sign score, FAST score, while there was insignificant difference in pain score or pelvic fracture score. Median of total BATSS score was 15 with range (14-16) among patients needed laparotomy compared to 9 (range 5-16) for discharge patients. While the study by **Shojaee *et al.*** **[14]** revealed that in agreement with our results there were statistically significant correlations between total BATSS score and SBP, chest wall sign score, FAST score, but in disagreement with our results they revealed that there were statistically significant correlations between BATSS score and abdominal pain and pelvic fracture score, and no significant correlation with tenderness score.

We used ROC curve analysis to detect the best cut-off value of blunt abdominal trauma scoring system (BATSS) in the prediction of surgical outcome of blunt abdominal trauma. Area under curve (AUC) was 0.938. So, trauma scoring system (BATSS) was excellent parameter to discriminate surgical need for blunt abdominal trauma from discharge individuals. We also found that the sensitivity of trauma scoring system was 100%, with the specificity of 97.5%, accuracy: overall probability that a patient is correctly classified was (97.9%). We also performed pilot study on 10% (5 cases) to estimate reliability of blunt abdominal trauma scoring system (BATSS). Results defined that Cronbach's Alpha that is used to measure the internal consistency (reliability of used tool) was 0.842.

Our results were in agreement with **Shojaee *et al.*** **[14]** who reported that low risk patients did not show positive CT scans (specificity 100%). Conversely, in high-risk patients all had positive CT scan findings (sensitivity 100%). All patients referred to the operating room were placed in high-risk group. No one in this group was early discharged from ED. The plotted ROC curve also indicated a close relationship between the results of CT scan and BATSS. Based on this curve the sensitivity of BATSS was 99.3%, which demonstrated a high accuracy of this scoring system.

Also, our results were further supported by **Karjosukarso *et al.* [6]** who revealed that the validity test of BATSS score obtained 91.4% sensitivity, 77.77% specificity, positive predictive value 94.1%, and negative predictive value 70%. So, they reported that BATSS can be a tool of early identification and stratification of patients at high risk of the occurrence of intra-abdominal organ injury due to blunt abdominal trauma.

Furthermore, **Sivarajan *et al.* [14]** revealed that the CASS score has a specificity of 100% sensitivity of 54% positive predictive value of 100% and negative predictive value of 78.7%. They also revealed that the BATSS value more than 12 can be strong predictor for laparotomy, with a specificity of 100%, sensitivity of 83.5%, positive predictive value of 100%, and negative predictive value of 91.3%. A value of 12 or more in either scoring system is associated with need of laparotomy and such patients should be planned for laparotomy as soon as the patient is received in the casualty. A value of 8 or less in BATSS scoring systems are associated with no mortality and no need for laparotomy and no need for further imaging after FAST. Hence BATSS was found to be superior to CASS.

CONCLUSION

The BATSS score system can be used as an initial screening to predict blunt abdominal trauma outcome and can be the basis of management in patients who experience blunt abdominal trauma.

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