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Original Article

Efficacy of new scoring system for diagnosis of abdominal injury after blunt abdominal trauma in patients referred to emergency department

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ABSTRACT

Purpose: The blunt abdominal trauma (BAT) is a common emergency and is significantly associated with morbidity and mortality. Our study was conducted to achieve the goal that a new scoring system could be used for the BAT patients.

Methods: The statistical population of this study was 1000 patients with BAT referred to emergency department of Imam Hossein Hospital, Tehran, Iran. Sampling was carried out in a convenience non-random manner and continued to reach the required sample size. All the patients with BAT due to road traffic accidents, falls, and other direct blunt traumas such as punctures and kickbacks were included in the study. Exclusion criteria were after 3 months of pregnancy, under the age of 18, warfarin taking, no reliable medical history providing and penetrating trauma. The study questionnaire was based on BAT scoring system. The data were analyzed by SPSS V20 software. The receiver operating characteristic curve was used to analyze the effectiveness of the new scoring system in predicting the BAT patients' outcome.

Results: The mean age of the patients ($n = 1000$) was (35.79 ± 13.09) years. The mean score of patients was (6.29 ± 5.80). Based on this scoring system, the patients were divided into three categories. The first group was patients at low risk with score of less than 8, the second group was patients at moderate risk with score of 8–12 and the third group was patients at high risk with score of 12–24. The score of 661 (66.1%) patients were low, 109 (10.9%) were moderate and 230 (23%) had a high score. The association between hip fracture and abdominal tenderness with abdominal injury was significant ($p < 0.001$). Cronbach's alpha was 0.76 showing the reliability of this questionnaire to predict the future of patients.

Conclusions: The study tool has a sensitivity to predict the BAT patients' outcome, and has a proper specificity that can be used to reduce the use of harmful modalities such as computed tomography scan.

Introduction

It is generally accepted that trauma is one of the causes of morbidity and mortality in developing countries and is the leading reason for death in people under the age of 45 years.[1] In the meantime, the abdomen is the third most prevalent cause of body organ damage, 85% of abdominal injuries are blunt, and the spleen and liver are the most commonly susceptible organs following the blunt trauma.[2] The abdominal trauma is one of the major causes of mortality and the third most traumatic cause of death, so that about 13%–51% of the traumas result in death.[1,2] The early deaths occurring due to severe and extensive bleeding from major abdominal artery injuries or abdominal solid organs (such as the liver, spleen, and kidneys), so that the emergency surgery is vital to control bleeding in these patients.[3,4] A member or system is rarely damaged in the intraabdominal trauma. It can be said that 70% of the spleen, liver and kidney injuries can be controlled as preservative, while the ventral hollow organs (such as intestines) require laparotomy in most cases, so that rapid diagnosis and immediate treatment can be life-saving actions.[5]

The blunt abdominal trauma (BAT) is a common emergency and is significantly associated with morbidity and mortality. BAT range varies from one to several organs.[6] The abdominal findings may not exist in 40% of patients with retroperitoneal hemorrhage.[7] In the blunt trauma patients, the abdominal trauma is involved in less

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than 10% of cases.[4–8] Significant percentages of patients represent asymptomatic abdominal injuries and abdominal symptoms.[9]

This study aims to the design a new scoring system that could be used for the BAT patients in emergency care.

Methods

The present analytical study was performed to evaluate the reliability of the blunt abdominal trauma scoring system (BATSS). The statistical population of this study was 1000 patients with BAT referred to emergency department of Imam Hossein Hospital, Tehran, Iran. Duration of the study was 18 months started from June 2017. One month after the first referral, patients were again followed up by telephone or face-to-face for possible traumatic complications. Sampling was carried out in a convenience non-random manner and continued to reach the required sample size.

The study was drafted as double-blind design. Thus, the patients were unaware of the measurement system because there is no time to explain in emergency treatment condition. All of them received ultimately the best treatment required, and no disturbances were there in their treatment. On the other hand, the therapists were also unaware of the study process and provided normal treatment for patients. Only the researcher recorded data about patients without involvement in the therapeutic interventions.

Inclusion criteria were all patients with BAT due to car accidents, falls, pedestrian strikes, motorcycle accidents and direct blunt traumas such as punctures and kickbacks. Exclusion criteria were pregnant women with gestational age greater than 3 months, patients under 18 years of age, those who received warfarin, subjects who were unable to provide reliable history taking for any reason, and people with penetrating trauma.

Based on the protocol of the emergency department, all patients were under computed tomography (CT) scans that were considered as a gold standard.[10–12] The study tool was BATSS. The questionnaire consists of 24 points, which were measured and scored in this study as follows: abdominal pain (2 points), abdominal tenderness (3 points), chest symptoms (1 point), hip fracture (5 points), focused assessment with sonography for trauma (FAST) (8 points), systolic blood pressure less than 100 mmHg (4 points), and heart rate more than 100 beats/min (1 point). Based on this scoring system, the patients were divided into three categories. The first group was patients at low risk with score of less than 8, the second group was patients at moderate risk with score of 8–12 and the third group was patients at high risk with score of 12–24. Finally, each hospitalized patient was individually examined and followed up during the course of the treatment, and the treatment process was divided into one of three categories: discharge, hospital supervision and abdominal surgery.

The data were analyzed by SPSS V20 software using descriptive statistics (percentage, median, and mean) and analytical statistics (Chi-squared and *t*-test). Cronbach's alpha was used to examine the correlation between information and reliability of the questionnaire.

Results

The mean age of patients was (35.79 ± 13.09) (range 19–64) years including 942 (94.2%) males and 58 (5.8%) females; with 50% ($n = 500$) of the accidents related to the motorcyclists and 11.6% ($n = 116$) related to the pedestrians. The mean score of patients was (6.29 ± 5.80) (range 1.1–19.3). The present study evaluated 1000 patients with trauma. Moreover, 448 (44.8%) needed surgery and 276 (27.6%) were transferred to the ward. The score of 661 (66.1%) of the patients were low, 109 patients were moderate and 230 (23.0%) 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 (Table 1). All people with pelvic fracture ($n = 115$) had intra-abdominal injury. However, in patients without hip fracture ($n = 885$), 44.2% ($n = 391$) had intra-abdominal injury. The association between hip fracture and abdominal injury was significant ($p < 0.001$). All people with abdominal tenderness also had abdominal injury ($n = 281$). However, in people without abdominal tenderness ($n = 719$), only 31.3% ($n = 225$) had abdominal injury. The correlation between tenderness and abdominal injury was significant ($p < 0.001$). Among low-scoring subjects, only 167 (25.3%) had abdominal injury, and all those with high and moderate scores (109 and 230, respectively) had abdominal injury. The relationship between scoring and abdominal injury by CT scan and wards was significant ($p < 0.001$) (Tables 2 and 3). The results were analyzed using Cronbach's alpha, which was ultimately 0.76, indicating the reliability of this questionnaire to predict the future of patients.

The receiver operating characteristic (ROC) curve was used to analyze the effectiveness of the new scoring system in predicting the BAT patients' outcome. The area under curve (AUC) for the scoring variable was 0.788 based on the category of each person, which shows the scoring system able to detect 78% of the cases correctly. That is, 78% of the expected cases were the observed cases, and the confidence interval (*CI*) was 0.713–0.883. In the 1.5 (low class) score, the sensitivity of the applied criterion was 0.627 with the specificity of 0.825, that is, when patients place in the low class and obtain equal to 1.5 and more score, 62% of the cases experience the outcome of interest (Table 4) (Fig. 1).

When the score of abdominal injury prediction was entered in the ROC model, the AUC obtained 0.823 (*CI*: 0.79672–0.84942), with the highest point sensitivity (0.627) and specificity (0.525). That is, the score equal to 2.55 or more than 2.55 predict 82% of cases correctly (Table 5) (Fig. 2). In both type of variables (categorical or continuous), the cut point score was obtained in the low class, that is, even low class can predict the outcome of interest (abdominal injury) indicating poor efficiency of scoring.

Discussion

Holmes et al.[13] investigated 18-year-old patients with BAT in order to determine the very low risk cases for detecting the lack of further examination and early discharge from the emergency

Table 1
Distribution of demographic characteristics among patients in the study.

Variables	*n* (%)
Gender	
Female	58 (5.8)
Male	942 (94.2)
Mechanism of accident	
Motorcycle	500 (50.0)
Driver	51 (5.1)
Passenger	58 (5.8)
Pedestrian	116 (11.6)
Fall from height	224 (22.4)
Others	51 (5.1)
Outcome	
Surgery	448 (44.8)
ICU	58 (5.8)
Ward	276 (27.6)
Discharge	218 (21.8)
CT	
Positive	608 (60.8)
Negative	392 (39.2)
Scoring	
Low	661 (66.1)
Moderate	109 (10.9)
High	230 (23.0)

ICU: intensive care unit, CT: computed tomography.

Table 2
Relationship among scoring classes (low, moderate and high) and the outcome of patients by CT scan, (*n*).

Variable	CT Scan		Total	*p* value
	Negative	Positive		
Scoring				0.001
Low	334	327	661	
Moderate	58	51	109	
High	0	230	230	
Outcome				0.001
Surgery	116	332	448	
ICU	58	0	58	
Discharge	102	116	218	
Ward	116	160	276	

ICU: intensive care unit, CT: computed tomography.

Table 3
Relationship among scoring classes (low, moderate and high) and the outcome of patients by wards, (*n*).

Variable	Outcome				Total	*P* value
	Ward	Discharge	ICU	Surgery		
Scoring						0.001
Low	218	218	58	167	661	
Moderate	58	0	0	51	109	
High	0	0	0	230	230	

ICU: intensive care unit.

Table 4
Area under curve for scoring classes for diagnosis of abdominal injury.

Observation	Area under roc	Standard error	95% Confidence interval	
			Minimum	Maximum
1000	0.7881	0.0128	0.76288	0.81322

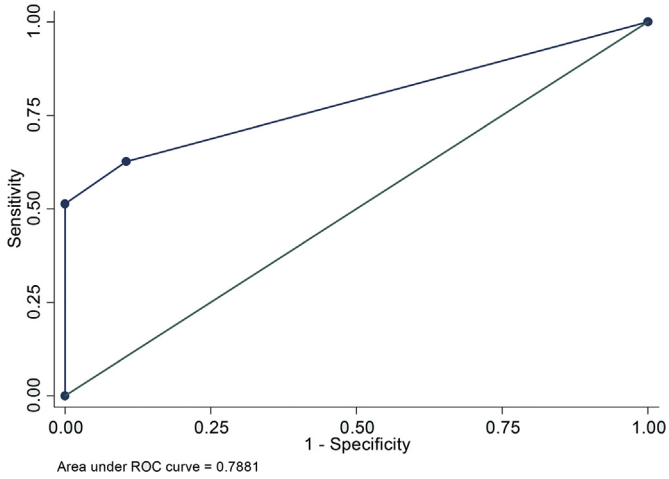

Fig. 1. Area under curve for scoring classes for diagnosis of abdominal injury.

Table 5
Area under curve for the score obtained from the diagnostic criteria of abdominal injury.

Observation	Area under roc	Standard error	95% Confidence interval	
			Minimum	Maximum
1000	0.8231	0.0134	0.79672	0.84942

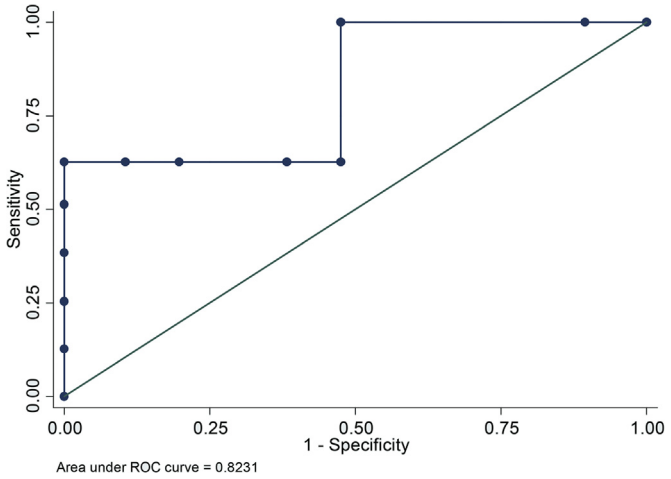

Fig. 2. Area under curve for the score obtained from the diagnostic criteria of abdominal injury.

department. They found that 91% of the people with BAT had abdominal organ injury, but about 74% of those with intra-abdominal injury had abdominal tenderness or had no abdominal clinical symptoms.

Parreira et al.[14] found that injuries sustained in a traumatic event without abdominal pain or without changes in the clinical examination of the abdomen; these injuries may be severe and require special surgical treatment. The study also emphasized that clinical scoring has not yet been validated to better identify the victims of traumatic risk with intra-abdominal injury.[15]

Shojaei et al.[16] divided the patients into two high and low risk groups based on the presence or absence of abdominal injury, and then identified positive findings in the medical history, examination and primary ultrasound as part of the examination and the results of urinalysis and the related cases. Low-risk patients were discharged from the emergency department after re-ultrasound, other necessary measures, explanation of the warning signs and justification for recurrence in case of any complications. Risky patients were those who had pelvic free fluid in primary or secondary ultrasound, had clear clinical hematuria in test, or had a serious pelvic fracture that caused suspicion of intra-abdominal injury. Finally, the score was determined to express the relationship between clinical signs and abdominal organ damage and limit the use of CT scan for a large number of blunt trauma injuries.[17–21] Our study was conducted to use this score and to validate this new scoring system. A study by Hemolz et al.[13] between 2002 and 2004 in the Los Angeles department of emergency and surgery aimed to identify low-risk cases of very low abdominal injury. It was a prospective cohort study that examined individuals with 18 years of age with BAT as target population, as well as selected clinical and laboratory markers as findings related to abdominal pain.[1,13,22–28] These symptoms included abdominal tenderness, abdominal distension, side abdominal tenderness, costal margin tenderness, and intraperitoneal stimulation, seat belt sign on the side and abdomen, hematuria and Glasgow coma scale (GCS) > 14.

In 2015, Parreira et al.[14] performed a study to evaluate the severity and treatment of occult intra-abdominal trauma in patients with blunt trauma. This retrospective study was conducted between 2008 and 2010, in which 5785 patients with blunt trauma were within the age range of 14–82 with the mean age of 34 years (range 23–47), of which 79% were male. Their exclusion criteria were patients with retroperitoneal hemorrhage, patients with no specific injury and those who had only lumbar spine fractures. The

abdominal imaging protocol was routinely performed on the basis of FAST, sonography and CT, and laboratory tests such as white blood cell, amidase, to evaluate the possibility of abdominal injuries. Leukocytosis, elevated amidase level and metabolic acidosis were suggested for injuries that may not be detected by imaging examinations and in future evaluations. The severity of traumatic injury indexes was categorized using: reduced trauma scale, GCS, injury severity scale, organ injury scale and abbreviated injury scale. The mechanisms of the injuries to pedestrians were cars, motorcycles, level falls, and 76% of patients had GCS >13 and injuries following were identified: spleen, liver, kidneys, intestines, diaphragm, and bladder. Surgical procedures were splenectomy, diaphragmatic suture, intestine and bladder. In this study, there were no deaths directly related to abdominal injuries, and they showed that the clinical score that should help to better identify the victims with high-risk intra-abdominal trauma has not yet been validated.[14]

The study tool has a sensitivity to predict and has a proper specificity that can be used to reduce the use of harmful modalities such as CT scan.

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Nil.

Ethical Statement

This study was approved by the Research Ethics Committee of the Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences (IR.SBMU.MSP.REC.1396.54).

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Declaration of Competing Interest

Authors declare that there is no conflict of Interests in our study.

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