

# New scoring system for intra-abdominal injury diagnosis after blunt trauma

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**【Abstract】 Objective:** An accurate scoring system for intra-abdominal injury (IAI) based on clinical manifestation and examination may decrease unnecessary CT scans, save time, and reduce healthcare cost. This study is designed to provide a new scoring system for a better diagnosis of IAI after blunt trauma.

**Methods:** This prospective observational study was performed from April 2011 to October 2012 on patients aged above 18 years and suspected with blunt abdominal trauma (BAT) admitted to the emergency department (ED) of Imam Hussein Hospital and Shohadaye Hafte Tir Hospital. All patients were assessed and treated based on Advanced Trauma Life Support and ED protocol. Diagnosis was done according to CT scan findings, which was considered as the gold standard. Data were gathered based on patient's history, physical exam, ultrasound and CT scan findings by a general practitioner who was not blind to this study. Chi-square test and logistic regression were done. Factors with significant relationship with CT scan were imported in multivariate regression models, where a coefficient ( $\beta$ ) was given based on the contribution of each of them. Scoring system

was developed based on the obtained total  $\beta$  of each factor.

**Results:** Altogether 261 patients (80.1% male) were enrolled (48 cases of IAI). A 24-point blunt abdominal trauma scoring system (BATSS) was developed. Patients were divided into three groups including low (score<8), moderate ( $8 \leq \text{score} < 12$ ) and high risk (score $\geq 12$ ). In high risk group immediate laparotomy should be done, moderate group needs further assessments, and low risk group should be kept under observation. Low risk patients did not show positive CT-scans (specificity 100%). Conversely, all high risk patients had positive CT-scan findings (sensitivity 100%). The receiver operating characteristic curve indicated a close relationship between the results of CT scan and BATSS (sensitivity=99.3%).

**Conclusion:** The present scoring system furnishes a high precision and reproducible diagnostic tool for BAT detection and has the potential to reduce unnecessary CT scan and cut unnecessary costs.

**Key words:** *Abdominal injuries; Tomography, X-ray computed; Diagnosis*

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**A**bdominal injury is the third most common cause of death from trauma.<sup>1</sup> Early diagnosis and treatment can reduce mortality by up to 50%.<sup>2</sup> Some questions may arise when facing a patient with sus-

pected blunt abdominal trauma (BAT) in the emergency department (ED). These questions include but not limit to "is there intraabdominal injury (IAI)", "how deep is the damage", "what risks are associated with this damage", and "how can I diagnose and manage it". There is no exact available protocol to prioritize diagnostic procedures in BAT. Some diagnostic methods are not reliable, and some if can be trusted are not available or too expensive and have serious side effects.

IAI diagnostic methods include physical exam, ultrasound, CT scan, laparoscopy, laparotomy and laboratory tests.<sup>3</sup> All of these methods has advantages and disadvantages. Careful physical exam is very important in determining the choice of diagnostic approach and management, but its accuracy is low, especially

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in unconscious patients.<sup>4-8</sup> Although ultrasound is the first diagnostic approach for IAI,<sup>9</sup> its accuracy is quite operator-dependent and has low efficacy for hollow viscous and non-bleeding parenchymal injuries. Therefore it is not very reliable in detecting BAT.<sup>10-12</sup> CT scan is the gold standard for assessing BAT,<sup>13-15</sup> but in addition to being expensive and not easily accessible, it entails irradiation to the patient.<sup>16,17</sup> As previously stated, emergency physicians do not have clinical prediction tool to identify trauma patients at risk for IAI after BAT. Each diagnostic method has disadvantages that limit its use. In other words, use of various diagnostic methods is not only time consuming, but also expensive and imposes high costs to the patient as well as the health care system. Thus designing a scoring system for correct selection of patients based on risk assessment and performing suitable diagnostic tests or discharging the patients would be highly recommended. Therefore, this study was established to present an applicable scoring system for selection of patient suspected with BAT, and sought to make easy triage to save time, reduce unnecessary CT scans, radiation exposures and costs for diagnosis and treatment.

## METHODS

This prospective study was performed between April 2011 and October 2012 in the ED of Imam Hussain Hospital and Shohadaye Hafte Tir Hospital (Tehran, Iran). The two hospitals are both level I trauma centers. Inclusion criteria consisted of all BAT victims due to motor vehicle crash, fall, acceleration-deceleration, pedestrian trauma, motorcycle crash, direct trauma. Exclusion criteria were pregnant women with gestational age > 3 months (based on previously performed ultrasound or last menstrual period), patients under 18 years old, patients on a warfarin, patients who did not have reliable history or physical exam (such as GCS less than 15, alcohol toxicity during history obtaining and physical exam, impaired verbal patients unable to give careful history), and penetrating abdominal trauma.

Based on ATLS and ED protocol, all patients were assessed first followed by appropriate treatment. CT scans were also performed based on ED protocol and results were considered as the gold standard. Questionnaire (closed-response format questionnaire) was filled based on patient history, physical exam, ultrasound findings, and completed after CT scan. In physi-

cal exam, we gathered data on vital signs like blood pressure and pulse rate (PR), abdominal pain, abdominal guarding, abdominal tenderness, abdominal wall sign (erythema, ecchymosis, abrasion), low chest rib (6 lower ribs) tenderness, chest wall sign (erythema, ecchymosis, abrasion), and pelvic fracture.

Focused Assessment with Sonography in Trauma (FAST) of 4 abdominal areas (hepatorenal, splenorenal, pericardial and perivesical) by ultrasound device (Honda 2000 and 3.5 MHz probe) was performed. Detection of free fluid was considered positive and pathologic.

Abdomino-pelvic CT scan with intravenous contrast was done by 8 slice machine from the diaphragm to the pelvic outlet. The distance between each cut of CT images was 1 cm. Obtained images were interpreted immediately by the emergency medicine specialist and then reviewed by a radiologist expert for final analysis. In the present study, CT scan was considered as the gold standard for IAI detection. Unfortunately investigators were not blinded to the purpose of the study. Patients' outcomes were categorized in three groups: discharge, IAI observation and operating room referral.

## Statistical analysis

Data were analyzed by SPSS 18 statistical software. Relationship between each factor and CT scans was assessed by Chi-square test. Factors with significant relationship were imported in multivariate regression models. In logistic regression analysis, the factors associated with CT scan were determined, and based on coefficient ( $\beta$ ) the contribution of each of them came at the rated score system. Scoring system was developed based on the obtained total  $\beta$  of factor. Patients were divided into three groups: low risk, moderate risk, and high risk. The sensitivity and specificity of this scoring system was calculated based on CT findings. Finally ROC curve was plotted to determine the relationship between CT scan and the designed scoring system.  $P < 0.05$  was assumed significant.

## RESULTS

Totally, 261 patients (80.1% male) were assessed in the present study. Forty eight (18.4%) of them had IAI. Most patients (46.4%) were in the age of 21-30 years old. Clinical characteristics of the investigated patients are presented in Table 1. Based on CT scan,

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