The predictive value of biochemical parameters in evaluating patients with abdominal trauma: The new scoring system

Ekrem Musalar [a], Murat Ersel [b, *], Funda Karbek Akarca [b], Güçlü Selahattin Kıyan [b], Özge Can [b]

[a] Koc University Hospital, Emergency Department, Davutpaşa Caddesi No:4, 34010, Topkapı, İstanbul, Turkey
[b] Ege University School of Medicine, Emergency Department, Bornova, 35100, İzmir, Turkey

ARTICLE INFO

ABSTRACT

Aim: The aim of this study was to investigate the contribution of non-invasively and rapidly obtained biochemical parameter results to the diagnosis and follow-up of intraabdominal injuries in multitrauma patients.

Material and Methods: A total of 2604 multitrauma patients who were treated following their referral to our emergency department between January 2009 and January 2012 were retrospectively reviewed. A logistic regression analysis was used in the risk assessment.

Results: Statistically significant associations between intraabdominal injury and certain biochemical variables measured at the time of the referral were determined. These variables were hemoglobin ≤ 9.99 g/dL [odds ratio (OR): 6.25, 95% CI: 2.86–13.52, p < 0.0001], serum alanine amino transferase (ALT) ≥ 100 IU/L (OR: 34.45, 95% CI: 21.76–54.54, p < 0.0001), and serum lipase ≥ 61 U/L (OR: 10.44, 95% CI: 6.56–16.49, p < 0.0001). The pretest probability score was determined for each patient by adding the scores that were obtained from each factor. ROC curve analysis was performed to determine the diagnostic value of the pretest probability score for detecting intra-abdominal injury (area = 0.88; p < 0.0001).

Conclusion: The results of our study demonstrated that biochemical parameters may contribute to the diagnosis and follow-up of intraabdominal injuries in multitrauma patients. In particular, ALT, AST, CK and myoglobin were found to have higher ORs than low hemoglobin. After these parameters are tested in larger scale studies in conjunction with the gold standard multislice abdominal CT, they may be used for establishing scores to evaluate the severity of abdominal injuries.

1. Introduction

Trauma is an important cause of morbidity and mortality worldwide and in Turkey.[1,2] According to the World Health Organization (WHO), in 2000, 5.8 million people died worldwide due to trauma caused by accidents.[2] Therefore, in multitrauma patients, diagnosing intraabdominal injuries accurately and in a timely manner is crucial. Undetected intraabdominal injuries can lead to late-stage mortality and morbidity due to trauma.[3] In multitrauma patients, certain algorithms, consisting of a synthesis of vital signs, physical examination and screening methods, are used to investigate intraabdominal injury to more easily diagnose intraabdominal trauma.[3–5] It has been reported that abdominal CT for detecting intraabdominal pathology in hemodynamically stable patients with blunt abdominal trauma has a sensitivity of 92–97.6% and a specificity of 98.7%.[5] However, it has also been reported that there must be a significant amount of bleeding for hemoperitoneal signs such as abdominal sensitivity and distention to occur, and in some cases, these signs may appear hours or days afterward.[6] A CT scan provides rapid and reliable data compared to biochemical tests for abdominal trauma patients. However, it has been reported that abdominal CT screening has some limitations, such as an increase in treatment costs, the absence of a radiologist on call for 24 h and

* Corresponding author.
E-mail addresses: emusalar@hotmail.com (E. Musalar), murat.ersel@ege.edu.tr (M. Ersel), fundakarbek@gmail.com (F.K. Akarca), selahattinkiyan@ege.edu.tr (G.S. Kıyan), ozgece83@hotmail.com (Ö. Can).
Peer review under responsibility of The Emergency Medicine Association of Turkey.

limited use in selected patients due to the radiation load. Furthermore, under conditions in which abdominal CT screening is not currently possible, biochemical tests may be predictors for intra-abdominal injuries and may be associated with the injury level.[7–9] The priority and precedence of diagnostic methods in patients with abdominal trauma is determined on an individualized basis rather than the recommendations of guidelines. We aimed to investigate the contribution of non-invasively and rapidly obtained biochemical parameter results to the diagnosis and follow-up of intra-abdominal injuries in multitrauma patients. Second, we aimed to develop a scoring system and to investigate its clinical applicability as a pretest probability score to determine whether abdominal CT should be performed during the diagnosis and follow-up of intra-abdominal injury patients.

2. Methodology

2.1. Study design

This study, which included patients who were referred to a university hospital emergency department, had a cross-sectional, retrospective and analytical design. The study center has a 2000-bed capacity and receives 100,000 referrals to the emergency department annually. Following the approval of the local ethics committee (Ege University Clinical Trials Ethics Committee 12–2.1/6 30/05/2012), the study data were obtained by retrospectively screening abdominal trauma patients older than 18 years of age who were referred to the medical faculty emergency department between January 01, 2009 and December 31, 2011. Abdominal CT and clinical outcomes were accepted as gold standards in the evaluation of the intraabdominal injuries of the included patients.

2.2. Study population

In this study, 4299 multitrauma patients who were referred to the emergency department between the aforementioned dates were assessed. Among these patients, 82 were excluded due to insufficient patient records and 731 were excluded because these patients were younger than 18 years of age, and 882 patients were excluded because no abdominal trauma diagnosis was considered, and hence, no diagnostic tests were performed. Following the exclusion of these patients, 2604 patients were included in the study (Fig. 1).

2.3. Data collection

The data extracted from files of 4299 patients with multiple injuries was analyzed after a two-month archive scan. Demographic characteristics, vital signs at the time of referral, laboratory results [hemoglobin, creatinine kinase (CK), myoglobin, alanine amino transferase (ALT), aspartate amino transferase (AST), amylase, lipase], screening methods, identified pathologies, the ISS, which was calculated according to these pathologies, and data regarding how the patients were released from the emergency department were recorded. The cut-off values provided in Table 1 below are grouped according to the biochemical reference values and standard medical practices guided by the literature. Free intra-abdominal liquid and/or solid organ injury were considered positive for intra-abdominal injury in patients who underwent extended focused assessment by sonography in trauma (E-FAST).

2.4. Statistical analysis

Statistical analyses of the data were performed using IBM SPSS Statistics for Windows, Version 22.0 (released 2013, IBM Corp. Armonk, NY, USA). The chi-square test was used to compare variables between groups and logistic regression analysis was performed to identify independent predictors. The t-test was performed for numerical variables that were normally distributed, whereas the Mann-Whitney U Test was used for numerical variables that were not normally distributed. An ROC curve analysis was used in the determination of numerical data. The sensitivity, specificity, positive likelihood ratio ($+LR$) and negative likelihood ratio ($-LR$) were calculated.

3. Results

Seventy-four percent of the patients (n = 1927) were male, with a median age of 34 years (IQR 25 to 48). Among the patients included in the study, inside-the-vehicle accidents constituted 54.7% (n = 1424), outside-the-vehicle accidents constituted 20.1% (n = 524), motorcycle accidents constituted 16% (n = 416) and falls constituted 9.2% (n = 240) of the admissions to the emergency department. Summary of the analysis of the demographic characteristics and laboratory parameters of patients with intraabdominal injuries is given in Table 2.

The mean ISS of the included patients was 9.43 (median 0, IQR 0 to 16), and 1.15% of the patients (n = 30) died in the emergency
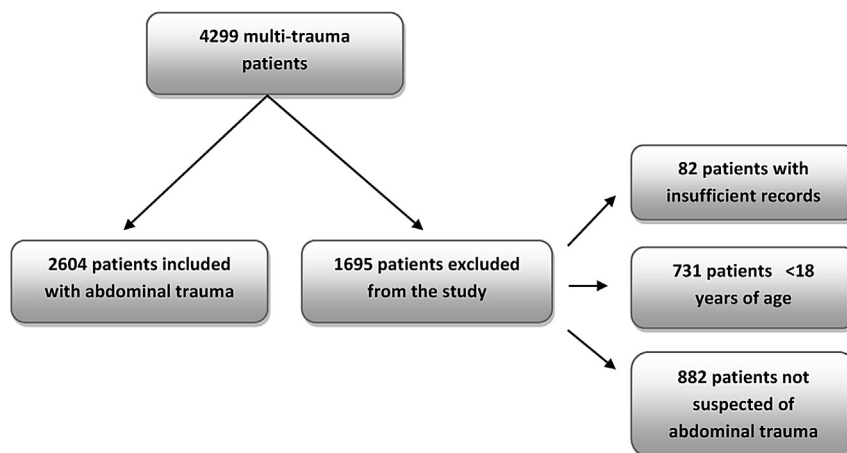

Fig. 1. Data collection process.