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Trauma indices for prediction of acute respiratory distress syndrome

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ARTICLE INFO

Article history:
Received 21 August 2015
Received in revised form
12 November 2015
Accepted 24 November 2015
Available online 30 November 2015

Keywords:
Acute respiratory distress syndrome (ARDS)
Acute lung injury (ALI)
Injury severity score (ISS)
trauma
Critical care
Glasgow coma score (GCS)

ABSTRACT

Background: A myriad of trauma indices has been validated to predict probability of trauma survival. We aimed to compare the performance of commonly used indices for the development of the acute respiratory distress syndrome (ARDS).

Materials and methods: Historic, observational cohort study of 27,385 consecutive patients admitted to a statewide referral trauma center between July 11, 2003 and October 31, 2011. A validated algorithm was adapted to identify patients with ARDS. Each trauma index was evaluated in logistic regression using the area under the receiver operating characteristic curve.

Results: The case rate for ARDS development was 5.8% (1594). The receiver operating characteristics for injury severity score (ISS) had the best discrimination and had an area under the curve of 0.88 (95% confidence interval [CI] = 0.87–0.89). Glasgow coma score (0.71, 95% CI = 0.70–0.73), A Severity Characterization of Trauma (0.86, 95% CI = 0.85–0.87), Revised Trauma Score (0.71, 95% CI = 0.70–0.72) and thorax Abbreviated Injury Score (0.73, 95% CI = 0.72–0.74) performed worse ($P < 0.001$) and Trauma and Injury Severity Score (0.88, 95% CI = 0.87–0.88) performed equivocally ($P = 0.51$) in comparison to ISS. Using a cutoff point ISS ≥16, sensitivity and specificity were 84.9% (95% CI = 83.0%–86.6%) and 75.6% (95% CI = 75.1%–76.2%), respectively.

Conclusions: Among commonly used trauma indices, ISS has superior or equivocal discriminative ability for development of ARDS. A cutoff point of ISS ≥16 provided good sensitivity and specificity. The use of ISS ≥16 is a simple method to evaluate ARDS in trauma epidemiology and outcomes research.

Institution where work was performed: University of Maryland Shock Trauma Center.
No reprints will be ordered. Work was performed at University of Maryland.
No conflicts of interest to disclose among the authors. M.A. and G.S. had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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0022-4804/$ – see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jss.2015.11.050

1. Introduction

Traditional prediction models for death after injury have incorporated injury severity using anatomic scores such as the abbreviated injury score (AIS) and injury severity score (ISS) [1,2]. Criticisms of these trauma scoring systems include the inability to account for multiple injuries and the underscoring of certain body regions [3]. Subsequently, composite indices have been designed, incorporating physiologic parameters to injury severity, such as the Glasgow Coma Score (GCS) [4]. Trauma and injury severity score (TRISS) and A Severity Characterization of Trauma (ASCOT) are among these and are able to produce reproducible results that are superior to scores solely based on injury in predicting probability of survival after trauma [5,6].

Acute respiratory distress syndrome (ARDS) is an organ dysfunction occurring after severe trauma, which is associated with increased morbidity and mortality [7]. Case rates for ARDS development have ranged between 5%–10% [7–10] for all trauma patients, risk increasing with higher ISS score [11]. Prediction models for ARDS have been evaluated in medical patients [12], but few studies stratified by blunt injuries have been investigated in the prediction of ARDS in injured patients [8,11,13]. These trauma prediction models were performed in single-center cohorts, incorporating multiple clinical risk factors and anatomic trauma scores. Most require chronic health measurements rarely performed at the bedside in addition to blood transfusion data [14]. Previously validated prediction models for in-hospital death after trauma such as ISS, Revised Trauma Score (RTS), TRISS, and ASCOT have not been evaluated in the context of ARDS development [5].

We aimed to compare the performance of commonly used anatomic, physiologic, and composite indices for the development of ARDS. In a large cohort of patients from a statewide referral trauma center with a detailed registry, we identified ARDS patients in accordance with the Berlin Definition [15]. We hypothesized that trauma indices possess discriminative ability for predicting development of ARDS, similar to their performance in predicting death.

2. Materials and methods

2.1. Setting and design

The R. Adams Cowley Shock Trauma Center (STC) at the University of Maryland Medical is a free-standing, adult trauma center and a major health care resource in the State of Maryland for over 3 decades [16]. The center has over 5000 trauma encounters annually with coverage of over 6 million people from urban to rural regions. All patients admitted to the trauma center are recorded in the institution's trauma registry. Trauma indices listed in Table 1 are routinely calculated and recorded into the registry by dedicated and trained injury coders.

2.2. Population

Chest radiographs were completed in over 92% of the trauma encounters during initial evaluation at STC. Chest radiograph reports were retrieved in 28,682 of 38,609 (74.2%) patients through an electronic query using medical record numbers (MRNs) from the trauma registry matched with the University of Maryland Clinical Data Repository. Patients without chest radiograph reports were excluded because this precluded ARDS evaluation. These unlinked records resulting from inconsistencies between administrative databases and trauma registries have been previously described [17]. Patients missing any of the trauma indices listed in Table 1 accounted for 3.0% (1297) and were also excluded from analysis. The final analysis cohort consisted of 27,385 patients. Characteristics (demographics, injury mechanism, and outcomes) of the excluded cohort are found in Supplemental A.

2.3. Acute respiratory distress syndrome definition

An internally and externally validated automated electronic screening tool [18,19] was adapted to identify patients with ARDS [15]. In the study of level I trauma patients, the screening tool demonstrated 87% sensitivity (95% confidence interval [CI], 82%–92%) and 89% specificity (95% CI, 85%–93%) [18]. In our cohort, ARDS was identified using the Berlin

Table 1 – Trauma outcome scores.

Name of score	Range	Type of scoring system	Parameter
Glasgow coma score	Ordinal scale: 3–15	Physiologic	Best verbal, motor, eye response on admission to trauma center
Revised trauma score	Ordinal scale: 0–7.84	Physiologic	First set of respiratory rate, systolic blood pressure, glasgow coma score
Abbreviated injury score of thorax	Ordinal scale: 1–6	Anatomic	Threat to life associated with chest injury using ICD-9 coding
Injury severity score	Ordinal scale: 0–75	Anatomic	Three most severely injured body regions squared
Trauma injury severity score	Interval probability of survival: 0%–100%	Combined (anatomic + physiologic)	Revised trauma score, age, age units, injury mechanism
A severity characterization of trauma	Interval probability of survival: 0%–100%	Combined (anatomic + physiologic)	Abbreviated injury score, revised trauma score, age, age units, injury mechanism