



Increased nutritional risk in major trauma: correlation with complications and prolonged length of stay

Majör travmada artan nutrisyonel risk:
Komplikasyon ve yatış süresinde uzama ile korelasyon

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BACKGROUND

Acute Physiology and Chronic Health Evaluation II (APACHE II) and the Trauma Injury Severity Score (TRISS) are physiological and anatomical severity scores to predict trauma outcome. Nutritional Risk Screening (NRS-2002) is used for the screening of nutritional risk, which can affect outcome adversely. The objective of this study was to determine the reliability of these scales to predict disease severity, complications and mortality, and to compare the reliability of the NRS-2002 in predicting outcome with different scoring systems in trauma-intensive care unit (ICU) patients.

METHODS

The study enrolled 100 consecutive patients who were admitted to the ICU in a training hospital due to trauma in the six-month study period (1 July 2008 and 1 January 2009). Discrimination characteristics of the scoring systems were evaluated using receiver operating characteristic (ROC) curves.

RESULTS

Overall mortality was 14%, and the complication rate was 22%. Nutritional risk at admission was found to be increased in 58% of the patients. The NRS-2002 score was increased in patients with complication. ISS, TRISS and APACHE II at admission had a reliable power of discrimination (AUC>0.8) for mortality and complication prediction. The NRS-2002 score had moderate discrimination power for complication prediction (AUC=0.708) but showed high correlation with increased length of stay (LOS).

CONCLUSION

A significant percent of trauma patients are at nutritional risk. The NRS-2002 score can be useful in predicting complication and prolonged LOS in trauma patients.

Key Words: Nutritional Risk Screening (NRS)-2002; trauma score/outcome; critical care; nutritional risk.

AMAÇ

Akut Fizyoloji ve Kronik Sağlık Değerlendirmesi II (APACHE II) ve Travma Yaralanma Şiddet Skoru (TRISS), travma sonucunu tahmin etmek için kullanılan fizyolojik ve anatomik şiddet skorlama skalalarıdır. Nutrisyonel Risk Skorlaması (NRS-2002), nutrisyonel riskin taraması için kullanılır. Bu çalışmanın amacı, hastalığın şiddetini, komplikasyonları ve mortalite tahmini için bu skorlama sistemlerinin güvenilirliğini belirlemek ve travma yoğun bakım hastaları için sonuçların tahmininde farklı skorlama sistemleri ile NRS-2002'nin güvenilirliğini karşılaştırmaktır.

GEREÇ VE YÖNTEM

Bu çalışmaya altı aylık çalışma süresinde (1 Temmuz 2008 ile 1 Ocak 2009) travma sonrasında bir eğitim hastanesi yoğun bakım ünitesine (YBÜ) kabul edilen 100 ardışık hasta dahil edildi. Skorlama sistemlerinin diskriminasyon özellikleri alıcı işletim karakteristiği (receiver operating characteristic-ROC) eğrileri kullanılarak değerlendirildi.

BULGULAR

Genel mortalite %14 ve komplikasyon oranı %22 idi. Hastaneye başvuru sırasında hastaların %58'inde nutrisyonel riskin artmış olduğu saptandı. Komplikasyon gelişen hastalarda NRS-2002 skorunun artışı saptandı. Başvurudaki ISS, TRISS ve APACHE II skorlarının mortalite ve komplikasyon tahmini için diskriminasyon gücü güvenilir seviyede (AUC >0,8) idi. NRS-2002 skorunun komplikasyon tahmini için orta derecede diskriminasyon gücü (AUC=0,708) olduğu saptandı. NRS-2002 skoru ile hastanede kalış süresi arasında yüksek korelasyon mevcuttu.

SONUÇ

Travma hastalarının önemli bir yüzdesi nutrisyonel risk altındadır. NRS-2002 skoru travma hastalarında komplikasyon artışı ve yatış süresinde uzama tahmininde yararlı olabilir.

Anahtar Sözcükler: Beslenme Risk Taraması (NRS) -2002; travma skoru/sonucu; yoğun bakım; beslenme riski.

There are several scoring systems in general use for outcome prediction in hospitalized patients. The rationale behind the common use of these scales is to score illness severity to yield comparisons between patient groups, intensive care units (ICUs) or interventions.^[1,2] However, they have also been used to assess or to predict the risk in specific patient groups for mortality, complication and length of hospital stay (LOS).

In the context of trauma patients, there are three main groups of scoring systems for risk prediction. 1: Anatomical scores, which provide an overall score based on grades of multiple injuries. The most commonly used anatomical score is the Injury Severity Score (ISS). 2: Physiological scores are calculated by evaluating the physiological variables of the patient without taking the anatomical injuries into account. One of the most widely used physiological prognostic models in the ICU is the Acute Physiology and Chronic Health Evaluation II (APACHE II) system. It incorporates the chronic health evaluation (e.g. diabetes mellitus, cirrhosis) with the acute physiological status of the patient. 3: Combined anatomical and physiological scores assess both anatomical injury variables and physiological parameters to increase the predictive power. The Trauma Injury Severity Score (TRISS) method, the most widely used combined system, provided improvements in the ability to predict outcome after trauma.^[3]

As expressed by Osler,^[4] the outcome prediction algorithm can be usefully summarized as follows:

Outcome = anatomical injury + physiological injury + patient reserve.

Nutritional status is one of the most important components of the patient's reserve. Of note, one of the drawbacks of all the above-mentioned systems is that they all ignore the nutritional status. They do not take the nutritional risk into account as an independent predictive variable. However, malnutrition at admission has been known to be associated with increased rates of complications, LOS and mortality.^[5,6]

The Nutritional Risk Screening 2002 (NRS-2002) score was introduced by the European Society for Clinical Nutrition and Metabolism (ESPEN) as a useful method for the screening of nutritional risk in hospitalized patients.^[7] It consists of a nutritional score, a disease severity score and an age adjustment for patients aged >70 years. The total score is calculated and patients are classified as being at no risk to high risk. When the NRS-2002 score is ≥ 3 , patients are accepted as under risk from a nutritional point of view.

The primary aim of the present study was to investigate the reliability of systems designed to predict disease severity and the probability of mortality and

complications, and to compare the reliability of NRS-2002 in predicting outcome with different scoring systems in trauma - ICU patients.

To our knowledge, the present study is the first study in the English literature comparing the reliability of a nutritional risk screening index with that of prognostic trauma scores. The secondary aim was to determine the nutritional risk of trauma patients in the region at the time of hospital admission.

MATERIALS AND METHODS

The study enrolled 100 consecutive patients who were admitted to the ICU due to trauma between 1 June 2008 and 1 January 2009 in the Training and Research Hospital, which is a 910-bed tertiary care hospital with an annual census of 330,000 patients (only emergency department [ED]). The hospital is a tertiary care referral center for a hinterland in the north-eastern Mediterranean region populated by around 6 million people.

The main outcome measures were mortality, complications and LOS. Complications that were taken into the analysis included: wound-related (surgical site infection, evisceration, and dehiscence), cardiac (arrhythmias, ischemic events), pulmonary (atelectasis, respiratory failure, adult respiratory distress syndrome, and pneumonia), and gastrointestinal (leaks, fistulas, and intraabdominal abscesses) complications and other events (acute renal failure, acalculous cholecystitis, and pressure ulcer).

Records of the Prehospital Emergency Medical Service, hospital emergency department and trauma-ICU were reviewed. Radiological and operative findings were evaluated. APACHE II, ISS and NRS-2002 scores were calculated. APACHE II score and the predicted mortality rates according to TRISS methodology were calculated using open-access web sites (<http://www.akademikcerrahi.com/apache.html> and <http://www.sfar.org/scores2/triss2.html>).

Data Analysis

The term "discrimination" refers to the ability of a model to distinguish patients who experienced an event from those who did not. Therefore, it defines the overall predictive power of a model. Discrimination was measured by the receiver operating characteristic (ROC) curves. The area under the curve (AUC) represents the probability that a patient who experienced the event had a higher predicted probability of having that event than a patient who did not.^[8] The higher the true-positive rate is compared to the false-positive rate, the greater the AUC. The discrimination power of a model is considered perfect if AUC=1, good if AUC>0.8, moderate if AUC is between 0.6 and 0.8, and poor if AUC<0.6.

Table 1. Patient information (age and LOS are presented as mean \pm SD)

	Total	Survivors	Non-survivors	p
Number	100	86	14	–
Age	32.88 \pm 12.44	33.10 \pm 12.99	31.50 \pm 8.53	NS
ICU LOS (day)	2.71 \pm 2.39	2.91 \pm 2.51	1.50 \pm 0.76	0.04
Hospital LOS (day)	5.02 \pm 3.06	5.59 \pm 2.90	1.50 \pm 0.76	0.0001
Patients with complications	22	14	8	0.002
Reoperation	5	–	5	NS

NS: Nonsignificant; ICU: Intensive care unit; LOS: Length of stay.

Continuous variables were presented as means \pm SD and were compared using ANOVA. Categorical values were analyzed using the chi-square test. Correlations were evaluated by Pearson's correlation. A value of $p < 0.05$ was considered as statistically significant. Statistical evaluation was performed by using the Statistical Package for the Social Sciences (SPSS) 11.0 statistical package.

RESULTS

Data on survivors and non-survivors are presented in Table 1. A total of 100 patients (41 penetrating, 59 blunt trauma patients), with a mean age of 32.88 \pm 12.44 years (range: 15-65) were included in the study. Overall mortality was 14%, and at least one complication was observed in 22% of the patients. When the NRS-2002 score is ≥ 3 , patients are accepted as at risk from a nutritional point of view. In the present study, the NRS-2002 score was found to be ≥ 3 in 58% of the patients.

Table 2 shows overall scores and the differences between survivors and non-survivors and patients with or without complications. Increased ISS and APACHE II scores and the predicted mortality rate with the TRISS method were found to be significantly associated with both mortality and complication development. The NRS-2002 score was significantly increased in patients with complication; however, no association was found between the NRS-2002 and mortality.

Discrimination values of the scoring systems revealed findings consistent with the statistical evaluation. ISS, TRISS and APACHE II scores recorded on admission had a reliable power of discrimination

(AUC > 0.8) for mortality and complication prediction. The NRS-2002 score was found to be insufficient for mortality prediction (AUC=0.504). However, the NRS-2002 score had acceptable discrimination power for complication prediction (AUC=0.708) (Table 3). The NRS-2002 score showed a correlation with both increased intensive care and hospital LOS (Table 4).

DISCUSSION

Published research showed that nearly one-third of hospitalized patients suffer from malnutrition.^[9,10] There are few reports about the incidence of malnutrition in trauma patients. The findings in the present study pointed out that more than half of the patients are subject to increased nutritional risk at trauma-ICU admission. In accordance with this finding, a recent study demonstrated that 40% of trauma patients had moderate malnutrition at hospital admission according to the Subjective Global Assessment (SGA) model.^[11] These observations are important since trauma pa-

Table 3. Discrimination and calibration statistics of the evaluated scoring systems for outcome variables*

	Mortality AUC (p)	Complication AUC (p)
ISS	0.878 (<0.001)	0.861 (<0.001)
TRISS	0.926 (<0.001)	0.902 (<0.001)
APACHE II	0.920 (<0.001)	0.867 (<0.001)
NRS-2002	0.504 (0.920)	0.708 (=0.001)

ISS: Injury Severity Score; TRISS: Trauma Injury Severity Score; APACHE II: Acute Physiology and Chronic Health Evaluation II; NRS: Nutritional Risk Screening. *(The areas under the ROC curves [AUC] for outcome variables and their significance)

Table 2. The relation between scores and mortality and complication development (mean \pm SD)

	Total	Survivors	Non-survivors	p	Patients without complication	Patients with complication	p
ISS	15.85 \pm 13.07	12.63 \pm 8.76	35.64 \pm 17.54	<0.001	12.46 \pm 10.50	27.86 \pm 14.38	<0.001
TRISS	9.32 \pm 21.88	2.25 \pm 3.00	52.75 \pm 35.01	<0.001	6.66 \pm 20.11	18.76 \pm 25.58	0.021
APACHE II	6.48 \pm 5.01	5.0 \pm 2.95	15.64 \pm 5.43	<0.001	5.14 \pm 4.18	11.23 \pm 4.92	<0.001
NRS-2002	2.55 \pm 1.57	2.53 \pm 1.65	2.64 \pm 1.01	0.813	2.28 \pm 1.56	3.5 \pm 1.23	0.001

ISS: Injury Severity Score; TRISS: Trauma Injury Severity Score; APACHE II: Acute Physiology and Chronic Health Evaluation II; NRS: Nutritional Risk Screening.

Table 4. Correlations between scoring systems and LOS (Pearson correlation)

	ISS	TRISS	APACHE II	NRS-2002	Hospital LOS (day)	ICU LOS (day)
ISS	1	.772*	.743*	.183	.000	.081
TRISS	.772*	1	.755*	-.012	-.348*	-.156
APACHE II	.743*	.755*	1	.126	-.132	.076
NRS-2002	.183	-.012	.126	1	.542*	.527*
Hospital LOS (day)	.000	-.348*	-.132	.542*	1	.752*
ICU LOS (day)	.081	-.156	.076	.527*	.752*	1

ISS: Injury Severity Score; TRISS: Trauma Injury Severity Score; APACHE II: Acute Physiology and Chronic Health Evaluation II; NRS: Nutritional Risk Screening; LOS: Length of stay; ICU: Intensive care unit. * Correlation is significant at 0.01 level (2-tailed).

tients are usually young and productive persons.

Although the NRS-2002 has not been specifically devised for use in trauma and surgical patients, it was found as an accurate screening tool in patients undergoing major elective surgery, and a high NRS-2002 score is associated with an increased complication rate and prolonged LOS.^[12,13] The purpose of nutritional screening is to predict the probability of a better or worse outcome due to nutritional factors and whether nutritional treatment is likely to be influential.^[7] Therefore, an ideal nutritional screening tool is supposed to predict postoperative mortality and complication rates in surgical patients, so that nutritional intervention can be provided in high-risk patients. To our knowledge, this is the first study in the English literature comparing the reliability of a nutritional risk screening index with that of prognostic trauma scores and severity of illness scores. The present data indicate sufficient discrimination statistics and predictive power of the NRS-2002 for complication and prolonged LOS prediction in trauma-ICU patients.

The predictive powers of anatomical, physiological and combined trauma scoring systems for mortality and prediction differ. It appears that currently there is no ideal and universally applicable scoring system.^[3] An ideal scoring system should incorporate all variables of anatomical injury, physiological derangement and patient reserve into an outcome prediction score. "Patient reserve" plays a very important role in outcome, and this concept includes age, comorbidities, immunological and genetic properties, and the nutritional status of the patient. None of the currently available systems takes the nutritional risk into account as an independent predictive variable.

As demonstrated before,^[3] the ISS, APACHE II and TRISS systems were found to have sufficient predictive power for mortality and complication in the present study. Although the NRS-2002 score incorporates age, nutritional status and preexisting comorbidities, ROC analysis indicated that it has inadequate predictive power for mortality.

Although trauma is a disease of the young and

healthy population, a significant percent of trauma patients in our region are at nutritional risk. The NRS-2002 score can be useful and practical in predicting complication risk and prolonged hospital stay in trauma patients.

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