ORIGINAL ARTICLE

Predicting mortality in severe polytrauma with limited resources

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ABSTRACT

BACKGROUND: Objective evaluation of the severity of injured patients is crucial for the adequate triage, decision-making, operative and intensive care management, prevention, outcome studies, and system quality assessment. This study aimed to compare six, widely-used, trauma scores as predictors of mortality, and to identify the most powerful among them in limited-resources settin.

METHODS: Seventy-five polytraumatized patients, admitted to the Intensive care unit (ICU) of the Clinic for Emergency Surgery (Level I trauma center, CSS Belgrade) from June 2018 to August 2020, were included in the study. The inclusion criteria were age ≥16, Injury Severity Score (ISS) ≥16, and Sequential Organ Failure Assessment (SOFA) ≥5 points. Scores were evaluated using logistic regression model and analysis of areas under the receiver operating characteristic curve (AUC).

RESULTS: During the 26 months period, highly selected cases, mostly of blunt trauma (97.3%), due to a road traffic accident (68%) and free-falls (25.3%), were included in the study. Surgery was indicated in 56 (74.7%) and non-operative treatment in 19 (25.3%) cases, with overall mortality rate at 36%. Logistic regression analysis demonstrated that all six trauma scores (ISS, NISS, Acute Physiologic Assessment and Chronic Health Evaluation [APACHE 2], SOFA, Trauma ISS [TRISS], and Kampala Trauma Score [KTS]) were significant mortality predictors ($p<0.001$). Observed cutoff values for ISS: 39.5, NISS: 42, APACHE 2: 25, SOFA 6.5 points are predictive for mortality in non-survivors. A multivariate analysis showed that the most powerful mortality predictors are TRISS and APACHE 2 with AUCs: 0.9 and 0.866.

CONCLUSION: According to our study, the most powerful mortality predictors are APACHE 2 and TRISS, even in limited-resources hospital settings, while statistically significant KTS did not perform as expected. We propose the appliance of the KTS, as the tool for exploiting "golden hour," ISS or NISS during admission stage and APACHE 2 or TRISS for use in the first 24 h after admission to ICU.

Keywords: Limited resources healthcare; mortality predictors; polytrauma; trauma scores.

INTRODUCTION

Severe and multiple trauma patients represent clinical challenge for surgeons and intensivists, with the ultimate goal of preventing mortality.[1,2] Polytrauma is a widely used entity for spectrum of severely injured patients with "multiple" trauma and high injury severity score (ISS) values.[3,4] Widely accepted threshold value for severe trauma that predicts mortality above 10% is ISS≥16.[4] Various study groups defined polytrauma with different ISS values, with the range: 15–25.[4,5] The Berlin definition of polytrauma, based on concepts of severity, number of injured regions, and indicators of pathophysiological response, is universally accepted by the international consensus.[4,5] Objective evaluation of the severity of injured patients is crucial for the adequate triage, decision-making, operative and intensive care management, prevention, outcome studies, and system quality assessment.[6–8] At present, three groups of scoring systems are used in surgical Intensive care unit (ICU): anatomical, physiological, and combined. The relationship between score values and the out-

Cite this article as: Mijaljica DR, Gregoric P, Ivancevic N, Pavlovic V, Jovanovic B, Djukic V. Predicting mortality in severe polytrauma with limited resources. Ulus Travma Acil Cerrahi Derg 2022;28:1404-1411.

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Ulus Travma Acil Cerrahi Derg 2022;28(10):1404-1411 DOI: 10.14744/tjtes.2021.70138 Submitted: 29.04.2021 Accepted: 24.07.2021

come of polytrauma is very complex.[9,10] Their performances and limitations as predictors are still matter of debate. Which of them is the most powerful independent predictor of mortality in polytrauma?

Trauma Score Systems

Anatomical

The ISS and the New ISS (NISS) are scores of "tissue destruction," as they estimate the severity of pathoanatomical tissue injuries.[11] They are defined with the same scoring system (AIS), based on anatomical region and injury pattern. While the ISS scores with six-points in six-body regions (AIS 90/2005) algorithm,[11] the NISS is modified, and scores with six-points but in nine-body regions (AIS 2015), without regional limit in number of the most severe injuries.[12]

Physiological

These score systems estimate the functional aspect of trauma – the severity of post-traumatic systemic response.[13] The Acute Physiologic Assessment and Chronic Health Evaluation (APACHE 2) score is widely used to evaluate the general physiological state and the level of dysfunction due to an injury.[13] It calculates the worst values of twelve parameters, measured in the first 24 h after admission to ICU. It reflects the intensity and dynamic of post-traumatic response syndrome and presence of trauma-related complications,[13] while predicting ICU mortality in critically ill and traumatized patients. The Sequential Organ Failure Assessment (SOFA) is another widely used score and ICU mortality predictor, measuring the level of dysfunction of six vital organ systems. The worst values measured in the first 24 h, after admission, are calculated.[14,15] The Revised Trauma Score (RTS) is a simple physiological score that calculates three basic, vital parameters (GCS, systolic BP, and respiratory rate), easy to assess in prehospital, and ambulatory settings. The RTS is a component of the composite Trauma ISS (TRISS) score.[16,17]

Combined

The TRISS system consists of three crucial components: anatomical (ISS), physiological (RTS), and pre-traumatic health capacity (age), together calculated make combined score system.[17] The coefficients used in logistic regression analysis are based on MTOS study, with several revisions.[16,17] It calculates probability of survival of the injured patients. The Kampala Trauma Score (KTS) developed by Kobusingye and Lett in 2000,[18] is a simple and combined score, for resource-limited health systems that require minimal data. The original KTS between few modifications was presented as "robust" mortality predictor, comparable to ISS and TRISS.[19,20]

The Aim of the Study

This study aimed to compare six, widely used, trauma scores as predictors of mortality, and to identify the most powerful among them in the settings of limited resources surgical ICU application.

MATERIALS AND METHODS

Study Design

This study is designed as prospective outcome study. We included only severely injured – polytraumatized patients, with combined thoracic-abdominal, orthopedic, and neurotrauma, mostly of a blunt type, as a study subjects.

Definition

We accepted and implemented the Berlin definition of polytrauma, based on both anatomical and pathophysiological concepts.

Patients

Seventy-five severely injured – polytraumatized patients, admitted to the ICU department of the University Clinic for emergency surgery (Clinical Center of Serbia, Belgrade; Level I trauma center) from June 2018 to August 2020, were included in a study sample. The inclusion criteria were age ≥16 years, ISS ≥16 points, and SOFA ≥5 points. The exclusion criteria were presence of any inflammatory, infectious, degenerative, malignant, or other pathology including the SARS-2 CoV-19 patients. The follow-up of the workgroup was during the period of 4 weeks.

Surgical Management of Polytrauma

The surgical management of all patients followed the ATLS guidelines, an institutionally established trauma protocol and "damage control" resuscitation and surgery principles.[21–24] After establishing vital functions, volume resuscitation, the life-saving surgery was performed when indicated. Damage control surgery procedures included decompression of the body cavities, hemorrhage control, removal of contamination, necrosectomy, followed by stabilization of major fractures. In selected cases, life-saving hemostasis was achieved by interventional radiology: TEVAR/EVAR, selective arterial embolization or stenting. Early enteral nutrition was mandatory, by nasogastric, nasojejunal or gastrostomy/PEG tube, to suppress catabolism and transmigration of enterobioma to the peritoneal cavity, due to enterocytes impairment.[24] Early tracheostomies were performed for severe neuro- and maxillofacial traumas. After stabilization, patients underwent definitive surgical treatment or management of the complications.

Data Collection

All routine laboratory parameters, X-ray, FAST, CT scan, and other morphological diagnostic procedures were obtained, during clinical follow-up, following trauma protocol.[24] All the data were collected with written consent of the patients or its relatives.

Laboratory Parameters

Blood sampling from trauma patients was done after admission to the ICU or OR (Day 0), and repeatedly on day 1, 3, and 7.

Scoring the Trauma

The ISS and NISS were used to determine the severity of the trauma, based on AIS 2005/2015 modifications. They were calculated on admission to ICU, after completion of the diagnostic trauma algorhythm or after establishing definitive intraoperative diagnosis.

The APACHE 2 and SOFA were used to evaluate the physiological dysfunction of the polytraumatized. They were scored on admission to ICU (the worst values within first 24 h) and on day 1, 3, and 7. The triage RTS (RTS-T) was calculated for the outcome RTS (RTS-O) and the TRISS calculation. The value of TRISS score (p-TRISS) is the probability of survival of polytrauma patient, which defined with original formula:

$P = 1/(1+e^{-b})$, $b = B0 + B1(RTS) + B2(ISS) + B3(Age\ index)$

The KTS score as simplified TRISS was calculated, using AIS 2005 and quick neurological test (AVPU status). Combined scores were calculated on admission to ICU (Day 0).

Statistical Analysis

The descriptive statistics were used to characterize the study sample. Associations between categorical data were evaluated using Pearson X^2-test or Fisher exact-test. Student's t-test or the Mann–Whitney U test were used for numerical data to evaluate the differences between survivors and non-survivors. Univariate and multivariate logistic regression analyses were used to determine factors related overall trauma mortality. Significant variables from univariate analysis were included in multivariate regressions, with overall mortality as outcome. Results were expressed as relative risk and corresponding 95% confidence intervals (CI). Trauma scores were evaluated as predictors of mortality using logistic regression models and analysis of areas under the receiver operating characteristic (ROC) curve (AUC). ROC curves demonstrated the overall discriminatory performance of a score. The results were expressed as continuous variable, assuming the equal importance of sensitivity and specificity.[25] The AUCs of all six trauma scores were compared to determine the highest predictive power among them.[26] In all analyses, the level of statistical significance was set at p≤0.05. Continuous variables were expressed as median and categorical variables as n (%). The statistical analysis was performed using IBM SPSS 21 (Chicago, IL, 2012).

The study was conducted in collaboration with the Serbian Ministry of Health, approved by the Ethical Board of Medical Faculty, University of Belgrade, according to the Declaration of Helsinki (approval: 29/VI-17, 15.06.2016.).

RESULTS

Patient Sample

Study cohort consisted of 75 severe polytrauma patients (ISS ≥16, SOFA ≥5, age ≥16 y.o.) that met inclusion criteria and were admitted to surgical ICU of the level I trauma center, during the study time period. The median age was 40.5 (range 16–65) years; 55 (73.3%) were male and 20 (26.7%) were female. Road traffic trauma was present in 51 (68%) cases, of which Automotive 27 (36%), pedestrian 13 (17.3%), and motorcyclist 11 (14.7%) cases in our chort. We found free fall trauma in 19 (25.3%) cases. Blunt trauma occurred in 73 (97.3%) cases compared to only 2 (2.7%) cases of penetrating trauma (Table 1). The operative management was indicated in 56 (74.7%) and non-operative in 19 (25.3%) cases. Overall mortality rate was 36% (27 of 75 cases). Non-survivors were more aged than survivors (45.1±16.5 y.o. vs. 40.1±13.3 y.o.). Most of the non-survivors were pedestrians (33.3%) and free fall victims (29.6%), necessitating emergency operation in (21 cases, 77.8%) (Table 1).

Distribution of the Score Values

ISS and NISS

The mean ISS in our cohort was 38.9±11.8 (median 39.9, range 22–75), while the NISS was 42.5±12.7 (median 41, range 22–75) points. The ISS (33.9±8.6, median 34.0, range 22–57 vs. 47.7±9.9, median 45.0, range 34–75, survivors vs. non-survivors) and NISS (37.0±9.4, median 34.0, range 22–57 vs. 52.2±10.9, median 48.0, range 34–75, survivors vs. non-survivors) values were significantly higher in non-survivors (p<0.001), as shown in Table 2. Comparing ISS and NISS, we observed the discrete difference, with higher NISS values in non-survivors, without significant difference (p>0.05).

APACHE 2 and SOFA

Comparing the admission (Day 0) and the worst values for (Day 0–7), we found consistently more representative results within the worst. The mean worst APACHE 2 was 19.3±8.3 (median 18, range 4–40) points. The worst APACHE 2 values (15.5±5.2, median 15.5, range 4–28 vs. 25.9±7.8, median 26.0, range 10–40, survivors vs. non-survivors) were significantly higher in non-survivors (p<0.001).

The mean worst SOFA was 7.7±3.5 (median 7, range 2–16) points. The worst SOFA values (6.3±2.5, median 5.00, range 2–11 vs. 10.2±3.3, median 10.0, range 5–16, survivors vs. non-survivors) were significantly higher in non-survivors (p<0.001) as in Table 2.

TRISS and KTS

The mean TRISS value was 68.0±30.7 (median 81.4, range 98.3–0.7) percent's. The TRISS values – survival probability (83.7±16.6, median 88.6, range 98.3–30.6 vs. 40.2±29.2, median 44.9, range 92.2–0.7, survivors vs. non-survivors) were significantly lower in non-survivors (p<0.001).

Table 1. Characteristics of the patient cohort

Variables	Total (n=75)	Survivors (n=48)	Non-survivors (n=27)	p-value
Gender, n (%)				0.663
Male	55 (73.3)	36 (75.0)	19 (70.4)	
Female	20 (26.7)	12 (25.0)	8 (29.6)	
Age, Mean±SD	41.9±14.6	40.1±13.3	45.1±16.5	0.181
Mechanism of injury, n (%)				
Automotive injury	27 (36.0)	21 (43.8)	6 (22.2)	
Pedestrian	13 (17.3)	4 (8.3)	9 (33.3)	
Motorcycle	11 (14.7)	8 (16.7)	3 (11.1)	
Fall	19 (25.3)	11 (22.9)	8 (29.6)	
Blunt trauma (other causes)*	3 (4.0)	2 (4.2)	1 (3.7)	
Penetrating trauma	2 (2.7)	2 (4.2)	0 (0)	
Blood transfusion, median (range)	4 (0–16)	4 (0–16)	7 (2–15)	**0.001**
Vasopressors, n (%)	39 (52.0)	18 (37.5)	21 (77.8)	**0.001**
Severe sepsis, n (%)	17 (22.7)	4 (8.3)	13 (48.1)	**<0.001**
Respiratory failure, n (%)	58 (77.3)	32 (66.7)	26 (96.3)	**0.003**
Acute renal failure, n (%)	46 (61.3)	25 (52.1)	21 (77.8)	**0.028**
Operative treatment	56 (74.7)	35 (72.9)	21 (77.8)	0.642
Non-operative treatment	19 (25.3)	13 (27.1)	6 (22.2)	
Overall mortality			27(36)	

*Other non-specified blunt trauma victims. SD: Standard deviation.

Table 2. Distribution of the six trauma score values

Score: [median] [range]	Total	Survivors	Non-survivors	p-value
ISS [points]	39.9 (22–75)	34 (22–57)	45 (34–75)	<0.001
NISS [points]	41 (22–75)	34 (22–57)	48 (34–75)	<0.001
APACHE 2 [points]	18 (4–40)	15.5 (4–28)	26 (10–40)	<0.001
SOFA [points]	7 (2–16)	5 (2–11)	10 (5–16)	<0.001
TRISS [p-survival,%]	81.4 (98.3–0.7)	88.6 (98.3–30.6)	44.9 (92.2–0.7)	<0.001
KTS [points]	11 (13–8)	11 (13–9)	9 (12–8)	<0.001

ISS: Injury Severity Score; NISS: New Injury Severity Score; APACHE 2: Acute Physiologic Assessment and Chronic Health Evaluation (the worst values); SOFA: Sequential Organ Failure Assessment (the worst values); TRISS: Trauma Injury Severity Score (probability of survival); KTS: Kampala Trauma Score; all scores are numerically represented with mean values and range.

The mean KTS was 10.7±1.4 (median 11, range 13–8) points. The KTS values (11.3±1.0, median 11.00, range 13–9 vs. 9.6±1.2, median 9.00, range 12–8, survivors vs. non-survivors) were significantly lower in non-survivors (p<0.001).

We found that all evaluated trauma score values for non-survivors were statistically highly significant for mortality (p<0.001) (Table 2).

Predictive Power of Trauma Scores

Logistic regression analysis demonstrated that all six evaluated trauma scores were significant predictors of mortality (p<0.001), as shown in Table 3. As a result of the multivariate analysis, APACHE 2 and TRISS emerged as striking predictors of mortality among others.

The logistic regression derived, ROC curves, was constructed and the values of AUC, for all six trauma scores, were above 0.836, distributed in relatively narrow interval (0.836–0.900), showing discrete difference in mortality prediction power between them (Table 4). The highest AUC value demonstrated TRISS with AUC: 0.900 (95% CI 0.826–0.974). The

Table 3. Logistic regression analysis of trauma scores

Score	Univariate			Multivariate		
	OR	95% CI	p-value	OR	95% CI	p-value
ISS	1.18	1.09–1.27	<0.001			
NISS	1.16	1.08–1.24	<0.001			
APACHE 2	1.29	1.15–1.45	<0.001	1.15	1.01–1.31	<0.001
SOFA	1.56	1.27–1.92	<0.001			
TRISS	0.932	0.90–0.96	<0.001	0.95	0.91–0.98	<0.001
KTS	0.26	0.14–0.50	<0.001			

OR: Odds of death per unit change in score (odds ratio); CI: Confidence interval; p: Statistical significance; ISS: Injury Severity Score; NISS: New Injury Severity Score: APACHE: Acute Physiologic Assessment and Chronic Health Evaluation; SOFA: Sequential Organ Failure Assessment; TRISS: Trauma Injury Severity Score; KTS: Kampala Trauma Score.

Table 4. Analysis of areas under ROC curves (AUCs)

Score	AUC	95% CI	p-value
ISS	0.860	0.779–0.941	<0.001
NISS	0.853	0.769–0.938	<0.001
APACHE 2	0.866	0.773–0.959	<0.001
SOFA	0.836	0.746–0.926	<0.001
TRISS	0.9	0.826–0.974	<0.001
KTS	0.849	0.755–0.943	<0.001

AUC: Area under receiver operating characteristic curve; CI: Confidence interval; p: Statistical significance; ISS: Injury Severity Score; NISS: New Injury Severity Score: APACHE: Acute Physiologic Assessment and Chronic Health Evaluation; SOFA: Sequential Organ Failure Assessment; TRISS: Trauma Injury Severity Score; KTS: Kampala Trauma Score.

second highest AUC value showed APACHE 2 with AUC: 0.866 (95% CI 0.733–0.959). The ISS and NISS showed AUCs: 0.860 (95% CI 0.779–0.941) and 0.853 (95% CI 0.769–0.938), respectively. At the bottom of the interval was KTS values with AUC: 0.849 (95% CI 0.755–0.943) and SOFA with AUC: 0.836 (95% CI 0.746–0.926).

We found no significant pairwise difference between AUCs of these six trauma scores and no significant difference in mortality predictive power between them. Still, they are all, highly predictive for mortality in severe trauma, with TRISS and APACHE 2 demonstrating the highest predictive power (Fig. 1).

Calculated cutoff values are, for ISS: 39.5, NISS: 42, APACHE 2: 25, SOFA: 6.5 and KTS: 8 points.

DISCUSSION

Tissue destruction, massive bleeding, and insufficient tissue oxygenation are crucial surgical problems in severe trauma.[22,23] Polytrauma patients admitted to level I trauma center, even with emergency transport within golden hour,[24] suffer the threatening mortal triad. Time matters. The early diagnosis is of the utmost importance.[24–28] The evaluation of the predictive power of trauma scores, as tools for decision-making, is resource-sparing in limited-resources health-care settings.

ISS and NISS: Tissue Destruction is Bleeder

The ISS and NISS directly reflect injured tissue mass and in-

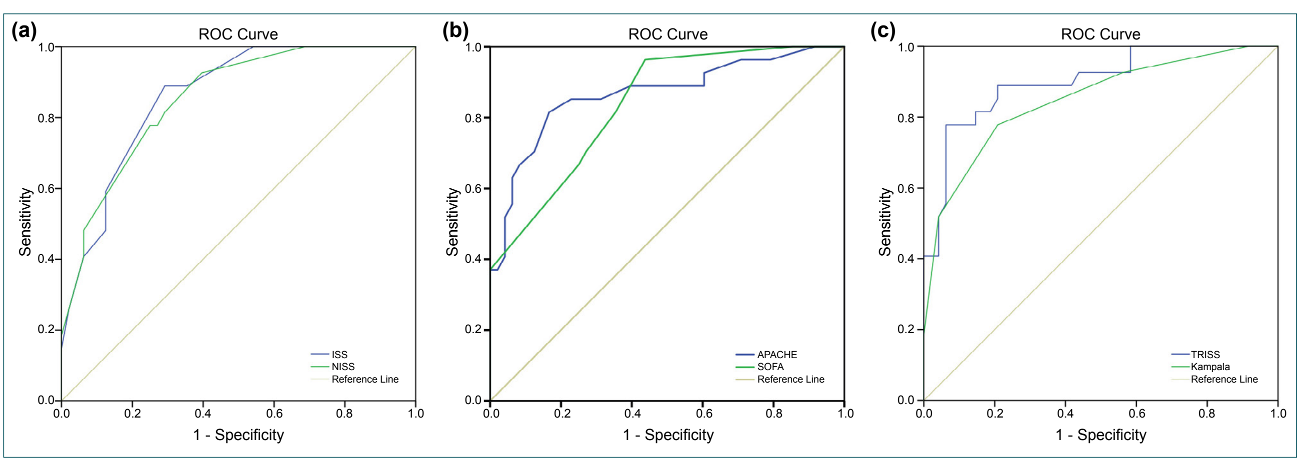

Figure 1. Pair-wise comparison of trauma scores by mortality ROC curves: (a) ISS versus NISS, (b) APACHE2 versus SOFA, and (c) TRISS versus KTS.

directly reflect the post-traumatic response syndrome and mortal triad. As stated before, coagulopathy develops in 98% of all trauma patients with an ISS >25, arterial blood pH <7.1, and a core temperature <34°C or a systolic blood pressure <70 mmHg.[21–23] The early recognition of these imminent threats, facilitates trauma management and lower mortality. The values of ISS and NISS in our study (non-survivors: 45 vs. 48; survivors: 34 vs. 34) are expected (Table 2). The difference between values is discrete and non-significant, which is in contrast to the results of Mica et al.[23] with striking difference (ISS vs. NISS: non-survivors: 41.0 vs. 50.0 and survivors: 29.0 vs. 41.0). It is observed that NISS has discrete bias for over-scoring the trauma, even though it is updated, trauma score.[6,12,28] We intended to be critical and not to over-score the trauma when using NISS (bias was partially corrected). Our data suggest that in severely traumatized patients with multisystemic injuries and high ISS and NISS, the values will differ less as they approach the 75 points maximum. The more severe the trauma, the less difference between ISS and NISS value there is. We recommend the ISS and NISS as predictors of mortality, based on logistic regression: AUC and ROC-A values (Table 4 and Fig. 1a).

The cutoff values for non-survivors in our study (ISS: 40, NISS: 42 points) are comparable to Mica et al.[6,23] (ISS: 40, NISS: 50 points), reported earlier. They indicate high risk of the negative outcome for trauma patients at admission and could be used as threshold values for presumed non-survivors.

APACHE 2 and SOFA: Connecting Tissue Destruction with Mortal Triad

These physiological scores were used as indicators of post-traumatic response syndrome in injured.[13–15] Parameters used to calculate these scores reflect ventilation/oxygenation, acid-base equilibrium, coagulation, renal function, and connect tissue destruction more directly with shock and mortal triad, than previous.[21–23] The APACHE 2 values for non-survivors, in our study, (non-survivors: 26 points; (Table 2) correlate good with mortality (Table 3) and with AUC: 0.866 (second highest) prove powerful mortality prediction (p<0.001) (Table 4). Comparing the APACHE 2 values in our study with Mica et al.[6,23] (non-survivors 25.0–30.0 points), we can confirm those findings. The SOFA values for non-survivors (non-survivors: 10.0 points), in our study, were significantly higher (p<0.001). Overall, SOFA is good mortality predictor, with sufficient predictive power (AUC 0.836) (Tables 3 and 4), which is consistent with the previously presented data (non-survivors: eight points; Antonelli et al.).[14] Comparing predictive power of APACHE 2 and SOFA, in our study (AUCs: 0.866 vs. 0.836), we showed that the APACHE 2 outperformed the SOFA. It is due to the complexity of SOFA calculation and the need for highly skilled clinicians, to perform it. Our findings suggest that APACHE 2 score is more robust, versatile, and easier to apply. The cutoff values for non-survivors, in our study, for APACHE 2 >25 and for SOFA >9 points are indicative for mortality. In our opinion, APACHE 2 is better mortality predictor and all the trauma patients with APACHE 2 >25 points should be considered at high risk for negative outcome.

TRISS and KTS: Combined Scores-the Complete and Most Powerful

The combined score systems incorporate three crucial components in calculation which is the relevant etiopathological factors. The KTS is simplified, for limited-resources healthcare systems application and the TRISS is the complex one, with coefficients derived from the fundamental MTOS study. Our results showed that even with evident differences concerning study samples and epidemiological characteristics, TRISS performed as the most powerful mortality predictor with AUC: 0.9. TRISS survival probability in non-survivors is significantly lower (p<0.001), as shown in Table 2. This finding is compliant with all recent studies.[29,30,31] The original TRISS coefficients are based on the patient population with specific demographic and ethnic characteristics in high-income healthcare system and is in contrast to ours.[16] Nevertheless, these differences did not interfere decisively, with our study results, making the appliance of the TRISS on our sample-unique approximation. It is our intention to create specific coefficient-based trauma score system, appropriate for our patient population. Interestingly, in contrast with the previous studies,[7,8,19,20] KTS performed less capable then expected but, sufficiently good, to confirm its mortality prediction capability (AUC: 0.849). The KTS score is simple and easy-to-use and can be incorporated in emergency room protocols as the first step in injury-severity measurement and mortality prediction.[20]

According to our study, the most powerful mortality predictors are TRISS and APACHE 2 scores (Table 4), even in limited-resources health-care system settings.

Problems and Limitations of Our Study

From the point of defining polytrauma, to the execution of our study, we experienced various problems of limited-resources health-care system. The loss of the most severely traumatized patients, deceased during transport or at the site of injury, due to a “prolonged” golden hour and recognized prehospital, emergency service problems, resulted in dispersal of cases, and smaller sample size. We present this as a pilot study of our continuous research, with intention to report new results on extensive sample, in the future. Other identified problems are incomplete digitalization of the trauma records and hospital data, problem of long-term follow-up, and necessity of creating specific coefficient-based trauma score for our patient population. The creation of advanced hospital database system and electronic trauma records are of the paramount importance.[27–31] Experiencing all of the previous, we tried to give our contribution in this field of research.

Conclusion

We can state that all evaluated trauma scores proved as capable mortality predictors (p<0.001). All the limitations derived from the lack of unified trauma registry and limited funds, as well as differences between samples, did not interfere decisively with the mortality prediction power of the tested scores. The most powerful mortality predictors according to our study are APACHE 2 and TRISS, while statistically significant KTS, did not perform as well as expected. The APACHE 2 and TRISS, as most powerful predictors of mortality, should be used to facilitate surgeon's decision-making, in the first 24 h, of trauma management. To achieve early, adequate treatment, and better outcome of severe trauma, we propose KTS as tool for exploiting the "golden hour," application of ISS or NISS on admission and APACHE 2 or TRISS for use in the first 24 h after admission. The presented cutoff values of trauma scores could be applied as orientation in directing early resuscitation and damage-control surgery. The implementation of scoring, even when the clinical settings are not ideal, is imperative for treating the severe trauma.

Acknowledgment

We would like to thank all the staff from our Surgical and CICU department (Central ICU), who have made a valiant effort to do everything possible in providing care of our trauma patients, from a health professional and a human perspective, in such a difficult circumstance of the SARS-2-CoV-19 threat.

Ethics Committee Approval: The study was conducted in collaboration with the Serbian Ministry of Health, approved by the Ethical Board of Medical Faculty, University of Belgrade and executed according to the Declaration of Helsinki (Date: 15.06.2016; Approval: 29/VI-17).

Peer-review: Internally peer-reviewed.

Authorship Contributions: Concept: D.R.M., V.Dj., P.G.; Design: D.R.M.; Supervision: V.Dj., P.G., N.I.; Resource: V.Dj.; Materials: D.R.M., P.G.; Data: D.R.M.; Analysis: D.R.M., V.P.; Literature search: D.R.M., N.I.; Writing: D.R.M.; Critical revision: V.Dj., P.G., N.I., B.J.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study has received no financial support.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Sınırlı kaynaklarla şiddetli çoklu travmada mortaliteyi tahmin etmek

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AMAÇ: Yaralı hastaların durumlarının ciddiyetinin objektif olarak değerlendirilmesi, yeterli triyaj, karar verme, operasyon ve yoğun bakım yönetimi, önlem ve koruma, sonuç çalışmaları ve sistem kalite değerlendirmesi açısından çok önemlidir. Bu çalışma, yaygın olarak kullanılan altı travma skorla-ma sistemini mortalitenin öngörücüleri olarak karşılaştırmayı ve sınırlı kaynaklara sahip ortamlarda aralarında en güçlü olanı belirlemeyi amaçlamıştır. GEREÇ VE YÖNTEM: Haziran 2018–Ağustos 2020 tarihleri arasında Acil Cerrahi Kliniği yoğun bakım ünitesine (Birinci basamak travma merkezi, CSS Belgrad) başvuran yetmiş beş çoklu travmalı hasta çalışmaya dahil edildi. Dahil edilme kriterleri; yaş ≥16, ISS ≥16 ve SOFA ≥5 idi. Puanlar, lojistik regresyon modeli ve alıcı işletim karakteristiği (ROC) eğrisi altındaki alanların (AUC) analizi kullanılarak değerlendirildi.
BULGULAR: Yirmi altı aylık süre boyunca, çoğunlukla künt travma (%97.3), trafik kazası (%68) ve serbest düşme (%25.3) olmak üzere yüksek seviyede seçilmiş vakalar dahil edildi. Toplam mortalite oranı %36 ile, 56 (%74.7) olguda cerrahi ve 19 (%25.3) olguda nonoperatif tedavi indikasyonu verildi. Lojistik regresyon analizi, altı travma skorunun tamamının (ISS, NISS, APACHE2, SOFA, TRISS, KTS) anlamlı mortalite öngörücüleri olduğunu göstermiştir (p<0.001). Gözlemlenen eşik değerleri olan ISS: 39.5, NISS: 42, APACHE 2: 25, SOFA: 6.5 puanları, hayatta kalamayanlarda mortalite için öngörücü değerlerdir. Çok değişkenli bir analiz, en güçlü mortalite öngörücülerinin TRISS ve APACHE 2 olduğunu ve sırasıyla AUC'le-rin 0.9 ve 0.866 olduğunu göstermiştir.
TARTIŞMA: Çalışmamıza göre, en güçlü mortalite öngörücüleri APACHE 2 ve TRISS'dir; sınırlı kaynaklara sahip hastane ortamlarında bile istatistik-sel olarak anlamlı olan KTS, beklendiği gibi performans göstermemiştir. "Altın saat"ten faydalanma aracı olarak KTS'yi, kabul aşamasında ISS veya NISS kullanımını, ve yoğun bakım ünitesine kabulden sonraki ilk 24 saatte kullanım için APACHE 2 veya TRISS'i önermekteyiz.
Anahtar sözcükler: Çoklu travma; mortalite öngörücüleri; sınırlı kaynaklara sahip sağlık hizmetleri; travma skorları.

Ulus Travma Acil Cerrahi Derg 2022;28(10):1404-1411 doi: 10.14744/tjtes.2021.70138