Use of the Braden Scale to Predict Injury Severity in Mass Burn Casualties

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Background: Mass burn casualties impose an enormous burden on triage systems. The triage capacity of the Braden Scale for detecting injury severity has not been evaluated in mass burn casualties.

Material/Methods: The New Injury Severity Score (NISS) was used to dichotomize the injury severity of patients. The Braden Scale and other potentially indicative measurement tools were evaluated using univariate analysis and multivariate logistic regression. The relationships between the Braden Scale and other continuous variables with injury severity were further explored by correlation analysis and fitted with regression models. Receiver operating characteristic (ROC) curve analysis was used to validate triage capacity and compare prognostic accuracy.

Results: A total of 160 hospitalized patients were included in our study; 37 were severely injured, and 123 were not. Injury severity was independently associated with the Numerical Rating Scale (adjusted OR, 1.816; 95% CI, 1.035-3.187) and Braden Scale (adjusted OR, 0.693; 95% CI, 0.564-0.851). The ROC curve of the fitted quadratic model of the Braden Scale was 0.896 (0.840-0.953), and the cut-off value was 17. The sensitivity was 81.08% (64.29-91.44%) and the specificity was 82.93% (74.85-88.89%). Comparison of ROC curves demonstrated an infinitesimal difference between the Braden Scale and NISS for predicting 30-day hospital discharge (Z=0.291, P=0.771) and Intensive Care Unit admission (Z=2.016, P=0.044).

Conclusions: The Braden Scale is a suitable triage tool for predicting injury severity and forecasting disability-related outcomes in patients affected by mass burn casualty incidents.

Keywords: Abbreviated Injury Scale • Burns • Health Status Indicators • Regression Analysis

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Background

Unpredictable burn-related accidents, such as the Tianjin explosion on December 8, 2015 [1], and Hangzhou bus arson incident [2], account for hundreds of thousands of deaths annually [3] and impose enormous economic and medical burdens on developing and developed countries [4,5]. A previous study reported that more than 700 tanker truck explosions occurred in China from 2004 to 2011, resulting in numerous burn-related casualties [5]. The accidental explosions that happen casually worldwide also cause a mass of burn-related injury and death [6,7].

The injured patients who flood into the Emergency Departments (EDs) and overwhelm the local hospital resources are urgent cases that need to be directed appropriately and treated immediately. Several triage systems have been developed in the past several decades, including the Australasian Triage Scale [8], Canadian Triage and Acuity Scale [9], Manchester Triage System [10], Emergency Severity Index [11], and Simple Triage and Rapid Treatment (START) system [12]. Severely injured patients requiring urgent treatment are initially evaluated by medical personnel according to one of these triage systems, although concerns about insufficient evaluations of injury severity during mass burn casualty incidents have been raised [13,14]. Moreover, the accurate assessment of injury severity relies on the New Injury Severity Score (NISS) [15], in which higher scores reflect more severe injury [16,17]. The NISS can be used to predict mortality, length of hospital stay, and likelihood of functional recovery [18]. Early application of the NISS in EDs seems impossible because complete and detailed diagnoses are unavailable in the EDs at the early stage of an emergency. Furthermore, the prognostic indicators to predict injury severity of mass burn casualties have not been sufficiently evaluated [19].

The Braden Scale, developed by Barbara Braden and Nancy Bergstrom to evaluate the risk of pressure sores and ulcers [20], includes 6 dimensions: sensory perception, moisture, activity, nutrition, mobility, and friction and shear. As a rapid evaluation tool, the predictive application of the Braden Scale has already been widely extended in previous studies. Eschbach et al [21] applied the Braden Scale to predict pneumonia after acute ischemic stroke with a cut-off threshold of 18 points. The Braden Scale can also help surgeons predict the demand for postoperative rehabilitation after pancreatectomy [22] and the adverse outcomes of geriatric surgical patients [23]. The Braden Scale is considered an essential tool in China for assessing hospitalized patients before admission, particularly in burn and trauma wards [24]. In this study, we aimed to evaluate the predictive capacity of the Braden Scale for injury severity in mass burn casualties, thereby improving triage efficiency when EDs are at capacity.

Material and Methods

Data Resource, Patients Management, and Ethics

At 4: 46 PM on June 13, 2020, a tanker truck exploded on an off-ramp of the Shenyang-Haikou Expressway near Liangshan Village in Wenling City (Taizhou, Zhejiang Province, China). The explosion destroyed a building on the opposite side of the road, and a second explosion led to hundreds of injuries. Medical personnel were mobilized to transfer and treat those who were injured. Then, we collected the data of inpatients injured in the accident from the electronic medical records system and paper-based medical records of the Wenling First People's Hospital, Wenling Traditional Chinese Medicine Hospital, Taizhou Enze Hospital, Taizhou Integrated Medicine Hospital, Taizhou Orthopedics Hospital, and Wenling Oriental Hospital. Additional information was provided by 2 referral hospitals: the Second Affiliated Hospital of Zhejiang University and Zhejiang Children's Hospital of Zhejiang University.

This retrospective study included all patients admitted to the hospitals within 24 h after the accident. Emergency triage was first conducted by emergency physicians with the help of experienced senior nurses. After the initial assessment of vital signs and injury condition, the wounded were simply graded as minor, severe, or critical types and then immediately transferred to the corresponding department for specialized treatments by the professional medical teams [25].

This study was approved by the Health Department of Zhejiang Province and the Institutional Ethics Committee of the Second Affiliated Hospital of Zhejiang University, School of Medicine. Owing to the retrospective nature of the study, the need for informed consent was waived by the Ethics Committee.

Data Collection

Sample Size Calculation, and Inclusion and Exclusion Criteria

In the exploratory stages of univariate analysis and logistic regression analysis, the sample size was not overly restricted. While in receiver operating characteristic (ROC) curve analysis, we estimated that a sample size of 105 patients (21 positive and 84 negative) would be needed to achieve an 80% power and an area under the curve (AUC) of 0.70 with a 2-sided Z-test at a significance level of 0.05, estimating the allocation ratios (20% Braden Scale score <16) and effect sizes from previously published studies [26,27].

We established and used the same checklist to collect the information from the medical records of different hospitals. The inclusion criteria were as follows: (1) age ≥18 years; (2) patients injured in the explosion; and (3) inpatients with a complete

and detailed diagnosis. The exclusion criteria were as follows: (1) patients with incomplete records or who were treated as outpatients; (2) a history of serious cardiovascular, renal, pulmonary, or cerebral disease; (3) admission after 24 h [13]; and (4) death before admission or within 30 days thereafter.

Data Collection and Evaluation of Braden Scale and Other Scales

Two trained medical experts independently reviewed the medical records and collected data using a standardized reporting template with clear definitions and codes. The patients' vital signs evaluated at the time of admission to the hospitals were extracted [19], including systolic blood pressure (SBP), heart rate (HR), respiratory rate (RR), and body temperature. The shock index was calculated as the HR divided by SBP [16], and a high risk of shock was defined as a shock index ≥1. Abnormal vital signs were recorded, including HR >140 or <50 beats/min, RR >30 or <10/min, SBP >220 or <90 mm Hg, body temperature >40°C or <32°C, and oxygen saturation <90% [28]. We also extracted data on general demographic characteristics (age, sex, and occupation) and injury type (burn or inhalation injury). Burn size was assessed using the rule of nines [29]. Cases where >10% of the total body surface area (TBST) was affected by second-degree burns, or worse, were of special interest [30]. Inhalation injury was verified by a bronchoscopic examination and treated correspondingly [31]. A history of chronic diseases, such as diabetes or hypertension, was considered as a confounding factor.

The Braden Scale was measured before admission to the wards by the certified nurses and consisted of 6 subscales: sensory perception, skin moisture, activity, mobility, nutrition, and friction and shear. The minimum score for each item is 1 (worst), and the maximum score is 4 (best), which ranges from 1 to 3 (except for friction and shear). The summed scores range from 6 to 23, with lower scores related to a higher risk [21]. Furthermore, other associated scales, including the Numerical Rating Scale (NRS) [32] and Glasgow Coma Scale (GCS) [28], were collected as well.

Outcome Measures

Diagnoses of all inpatients were based on the Abbreviated Injury Scale (AIS) 2005, version updated in 2008 [33]. The AIS divides the human body into 6 regions, and injury severity in each region is rated on a 6-point scale: 1 (minimum) to 6 (maximum, theoretically untreatable). The NISS was calculated as the sum of the squares of the 3 highest AIS scores [15]. All scoring was independently performed by 2 highly qualified physicians, and their scores were then checked by a third physician.

Injury severity, based on the NISS, was the main outcome measure of this study. Patients with an NISS ≥16 were classified as severely injured, and those with scores below 16 were not. ICU admission and 30-day hospital discharge (discharge in 30 days after admission) were the secondary outcome measures. The times to recovery and discharge were confirmed by an official medical team (including at least 1 chief physician) in different departments.

Statistical Analysis

Categorical variables (presented as numbers and percentages) and continuous variables (presented as mean±SD) were compared between the severely and not severely injured. The Mann-Whitney U test or independent t test was used (depending on the homogeneity of variance) to test for differences in quantitative traits, and the chi-squared or Fisher exact test was used (depending on the theoretical frequency of each grid) to compare differences in categorical variables. We reported 2-tailed P values, and the variables with a P value <0.1 were entered into the multivariate logistic regression model. In multivariate analysis, the P value <0.05 was considered statistically significant. Next, to find an optimal quantitative predictor of injury severity, correlations between continuous variables and the NISS were further investigated using correlation analysis and linear and non-linear regression models. Prediction accuracy of severity and prognosis (ICU admission and 30-day hospital discharge) was compared with the NISS, based on ROC curve analysis and the DeLong test [34,35].

Sample size and power analysis was estimated with PASS software version 15.05 (NCSS, LLC, Kaysville, UT, USA). SPSS software version 20.0 (IBM Corp, Armonk, NY, USA) was used for univariate and multivariate logistic regression analyses. The correlation analysis and linear and non-linear regressions were performed using OriginPro 2019b (OriginLab Corp, Northampton, MA, USA). The ROC curve analysis was conducted with MedCalc software version 19.6.3 (MedCalc Software Ltd, Ostend, Belgium).

Results

Patients Characteristics

Our study extracted the data of 176 injured patients admitted to the hospitals within 24 h after the explosion. Among inpatients with complete medical records, only 3 patients had abnormal vital signs: 2 had a body temperature >40°C or <32°C, and 1 had an RR <10/min. Therefore, we excluded these vital signs from the potential indicative markers and calculated the shock index as an alternative variable. Oxygen saturation data were missing for 63 patients. No patient had a history of serious disease. Thirteen patients <18 years and 3 patients who died within 30 days after admission were excluded.

Ultimately, 160 patients were included in the analysis, 37 of whom were severely injured (NISS ≥16) (**Table 1**). Of the severe patients, 13 (35.14%) were admitted to the ICU for special care, while the number of patients with a 30-day hospital discharge was 11 (29.73%) (**Table 1**). Patient age ranged from 19 to 90 years, and the severely injured patients were older than the not severely injured patients (54.03±16.11 and 47.47±17.47 years, respectively, *P*<0.001). About 66% of patients (106/160) were men, most of whom were farmers and workers.

Exploring Confounders with Univariate Analysis and Logistic Regression Analysis

Univariate analysis revealed that the severely and non-severely injured groups differed significantly in terms of shock risk (*P*=0.001), second-degree burn covering >10% TBST (*P*<0.001), and inhalation injury (*P*<0.001) (**Table 1**). In addition, patients with severe injuries had worse NRS (3.73±2.51 vs 2.13±0.98, *P*=0.001), GCS (13.24±3.36 vs 14.99±0.09, *P*=0.003), and Braden Scale (14.43±3.88 vs 20.60±2.85, *P*<0.001) scores than did patients without severe injuries. All significant variables in the univariate analysis were entered into the multivariate logistic regression (**Table 2**). After adjusting for potential confounders, the NRS (adjusted odds ratio [OR], 1.816; 95% confidence interval [CI], 1.035-3.187), and Braden Scale (adjusted OR, 0.693; 95% CI, 0.564-0.851) scores were independently associated with injury severity.

Application of the Braden Scale to Predict Injury Severity

According to the correlation analysis, the Braden Scale and NISS were most strongly negatively correlated (Pearson correlation coefficient=-0.727, **Table 3**). Therefore, we fitted the Braden Scale with the NISS using a series of linear and non-linear regression models (**Table 4**) and thereafter chose the optimal fitting model, relying on the maximal coefficient of determination (R squared), and excluded the overfitted models with unjustified parameters (*P*>0.05). Finally, a quadratic equation with statistical significance and maximum correlation was established as follows: $Y=0.344X^2-15.094X+169.978$ (X=Braden Scale [range: 6-23]; R squared=0.632). As shown in **Figure 1**, most data points were around the 95% CI, showing a fitted prediction capacity of the Braden Scale to forecast injury severity.

ROC Analysis of Braden Scale for Predicting Injury Severity and Outcomes

Figure 2 shows the results of the ROC curve analysis of the ability of the Braden Scale to predict injury severity. The AUC was 0.896 (range: 0.840-0.953), and the cut-off value for severe injury was 17 (sensitivity=81.08% [range: 64.29-91.44%], specificity=82.93% [range: 74.85-88.89%]), depending on the

Youden index [34]. The accuracy of the Braden Scale-based injury scores for predicting ICU admission and 30-day discharge rates was compared with the NISS. No difference was found in predicting 30-day hospital discharge (Z=0.291, *P*=0.771) (**Figure 3**); however, the ICU admissions rate seemed to be better predicted by the Braden Scale (Z=2.016, *P*=0.044) (**Figure 4**).

Discussion

Hospital EDs can be overwhelmed by the presentation of many patients after an explosion. We prospectively analyzed the Braden Scale and other predictive indicators of injury severity in mass burn casualties. The Braden Scale and the NRS pain score showed potential utility for predicting injury severity. We also established the quadratic regression of the Braden Scale and NISS (Braden Scale-based injury score) and further conducted the ROC curve analysis and comparison, which demonstrated a wider application of the Braden Scale as a quantitative tool to predict the injury severity and prognosis of patients before admission in mass burn casualties.

Multivariate logistic regression indicated that some of the putative prognostic markers (vital signs, GCS, second-degree burns covering >10% TBST, and inhalation injury) validated in univariate analysis were not useful, while the NRS pain score and the Braden Scale were shown to be suitable predictive tools for injury severity. The NRS quantifies physical and psychological pain, and its scores were associated with injury severity (adjusted OR, 1.816; 95% CI, 1.035-3.187). Shafshak et al [36] found that a score of 6 in the NRS could predict severe disability in patients with low back pain by using the ROC curve. Nevertheless, the correlation coefficient between the NRS and NISS in our correlation analyses was 0.514, indicating a relatively weak association (**Table 3**). In addition, precise evaluation of pain in elderly people is difficult because of their reduced sensitivity to painful stimuli [32]. Thus, we excluded the NRS from the further analysis.

The Braden Scale, an available frailty assessment tool, was demonstrated to be useful for predicting severe injury of patients with burns. For the quadratic equation graphed in **Figure 1**, the parabolic curve tended to decrease gradually within the Braden Scales scores of 5 to 23. ROC analysis further validated that the Braden Scale had a prediction sensitivity of 81.58% (65.11-91.68%) and a specificity of 80.43% (72.63-86.50%). Predictive power seems lower than that of the Emergency Severity Index triage system (89% [range: 85-93%] and 97% [94-99%], respectively) [11] and the START algorithm (about 23.3% and 5.8% were over-and under-triaged) [37]. Nevertheless, as an assessment tool of pressure sores and ulcers, the Braden Scale was not designed specifically to evaluate injury severity [24]. With suitable sensitivity and specificity

Table 1. Patient characteristics and potential predictors of injury severity.

	Non-severe (NISS <16)	Severe (NISS ≥16)	T/χ^2 value	Sig. (2-tailed)
Gender			0.408**	0.523
Male	76 (61.79%)	25 (67.57%)		
Female	47 (38.21%)	12 (32.43%)		
Age (y)	47.47±17.47	54.03±16.11	-2.036*	0.043
Occupation			0.285**	0.867
Farmer	72 (58.54%)	21 (56.76%)		
Worker	44 (35.77%)	13 (35.14%)		
Other	7 (5.69%)	3 (8.11%)		
Hypertension			1.647**	0.249
Yes	16 (13.01%)	2 (5.41%)		
No	107 (86.99%)	35 (94.59%)		
Diabetes			0.535**	0.683
Yes	7 (5.69%)	1 (2.70%)		
No	116 (94.31%)	36 (97.30%)		
High risk of shock#			16.131**	0.001
Yes	1 (0.81%)	6 (16.22%)		
No	122 (99.19%)	31 (83.78%)		
>10% 2nd degree burns			42.069**	<0.001
Yes	5 (4.07%)	17 (45.95%)		
No	118 (95.93%)	20 (54.05%)		
Inhalation injury			27.501**	<0.001
Yes	5 (4.07%)	13 (34.21%)		
No	118 (95.93%)	24 (65.79%)		
NRS	2.13±0.98	3.73±2.51	-3.786*	0.001
GCS	14.99±0.09	13.24±3.36	3.164*	0.003
Braden Scale	20.60±2.85	14.43±3.88	8.965*	<0.001
ICU admission			69.113*	<0.001
Yes	2 (1.63%)	13 (35.14%)		
No	121 (98.37%)	24 (64.86%)		
30-day hospital discharge			37.592*	<0.001
Yes	115 (93.50%)	11 (29.73%)		
No	8 (6.50%)	26 (70.27%)		

NISS – New Injury Severity Score; NRS – numerical rating scale; GCS – Glasgow Coma Scale. Categorical variables are presented as numbers (%), and continuous variables as mean±SD. # High risk of shock is denoted by a value ≥1 for heart rate/systolic blood pressure. * Independent samples *t* test or Mann-Whitney U test, depending on the normality of the data distribution. ** Chi-squared or Fisher exact test, depending on the theoretical frequency of each grid.

Table 2. The multivariate logistic regression between potential predictor markers and injury severity.

	Severe patients (NISS ≥16)					
	Odds ratio (OR)	95% CI		Adjusted OR*	95% CI	
NRS	1.699	1.031	2.800	1.816	1.035	3.187
GCS	0.434	0.105	1.797	0.397	0.081	1.949
Braden scale	0.702	0.579	0.852	0.693	0.564	0.851
>10% 2nd degree burns	1.211	0.188	7.805	1.315	0.147	11.734
Inhalation injury	0.134	0.006	3.090	0.115	0.003	4.280
High risk of shock	14.946	0.208	1071.839	0.110	0.001	11.133

NISS – New Injury Severity Score; NRS – numerical rating scale; GCS – Glasgow Coma Scale. * Adjusted for age, gender, occupation, and chronic diseases (diabetes and hypertension).

Table 3. Correlation analysis of different variables with New Injury Severity Score.

Continuous variables	New Injury Severity Score (NISS)	
	Pearson's correlation	Sig. (2-tailed)
NRS	0.514*	<0.001
GCS	-0.511*	<0.001
Braden Scale	-0.727*	<0.001
Age	0.248*	0.002

NISS – New Injury Severity Score; NRS – numerical rating scale; CS – Glasgow Coma Scale. * Significant at the 0.01 level (2-tailed).

Table 4. Linear and non-linear fitting models of the Braden Scale with the New Injury Severity Score.

Equation	Model summary			Parameter estimates			
	R Square	F	Sig.	Constant	b1	B2	B3
Linear	0.529	177.121	<0.001	75.374**	-3.275**		
Logarithmic	0.585	222.961	<0.001	174.738**	-55.428**		
Inverse	0.603	240.349	<0.001	-32.476**	810.205**		
Quadratic	0.632	135.052	<0.001	169.978**	-15.094**	0.344**	
Cubic	0.633	89.631	<0.001	152.744	-11.472	0.107	0.005
Compound	0.469	139.567	<0.001	234.336*	0.828**		
Power	0.478	144.946	<0.001	49201.394	-3.064**		
S	0.449	128.550	<0.001	-0.535*	42.710**		
Growth	0.469	139.567	<0.001	5.457**	-0.189**		
Exponential	0.469	139.567	<0.001	234.336*	-0.189**		
Logistic	0.469	139.567	<0.001	0.004*	1.208**		

*Significant at the 0.05 level (2-tailed); ** significant at the 0.01 level (2-tailed).
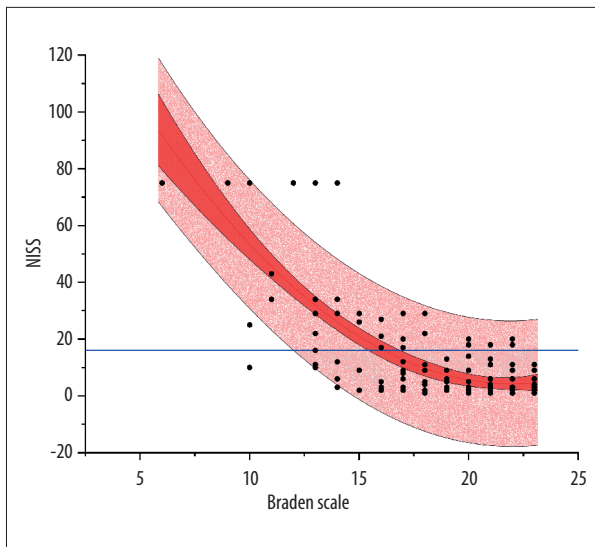
Figure 1. Quadratic fitting of the Braden Scale and New Injury Severity Score. NISS – New Injury Severity Score Black dots are individual patients, blue line is a reference line, red curve is the fitted quadratic curve, dark red area corresponds to the 95% confidence interval, and light red area corresponds to the 95% prediction interval. The figure was created with Origin Software (OriginPro 2019b, version 9.6.5.169, OriginLab Corp).
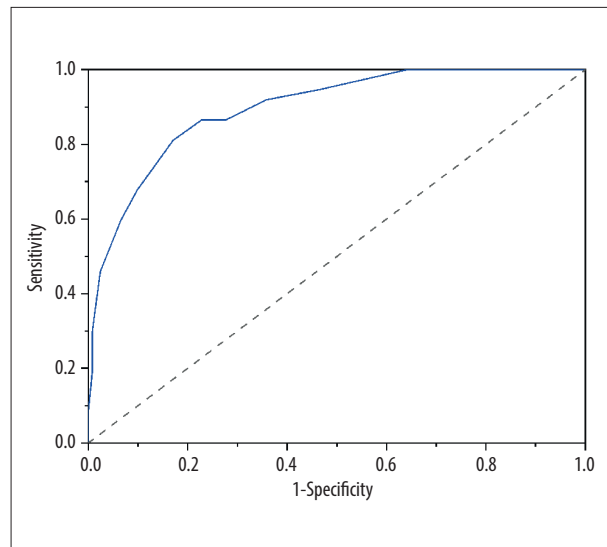

Figure 2. Receiver operating characteristic (ROC) curve analysis: Ability of the Braden Scale to predict injury severity. The area under the ROC curve (AUC) for predicting injury severity was 0.896 (0.840, 0.953). The cut-off value of the Braden Scale was 17 based on the Youden index, with a sensitivity of 81.08% (64.29%, 91.44%) and specificity of 82.93% (74.85%, 88.89%). The ROC curve analysis was conducted with MedCalc software (MedCalc, MedCalc Software Ltd).
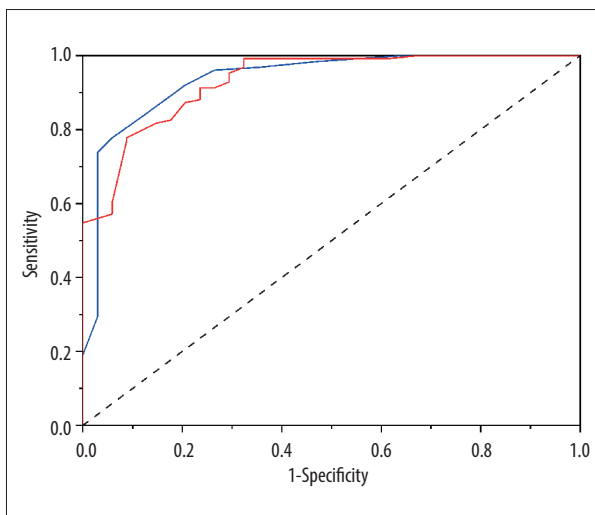

Figure 3. Comparison of Braden Scale-Based Injury Score and New Injury Severity Score for predicting 30-day hospital discharge. The area under the receiver operating characteristic (ROC) curve of 30-day hospital discharge was 0.931 (range: 0.880-0.965) for the New Injury Severity Score (red line) and 0.937 (0.888-0.970) for the Braden Scale-based injury score (blue line) (Z=0.291, *P*=0.771, Delong test). The ROC curve analysis was conducted with MedCalc software (MedCalc, MedCalc Software Ltd).
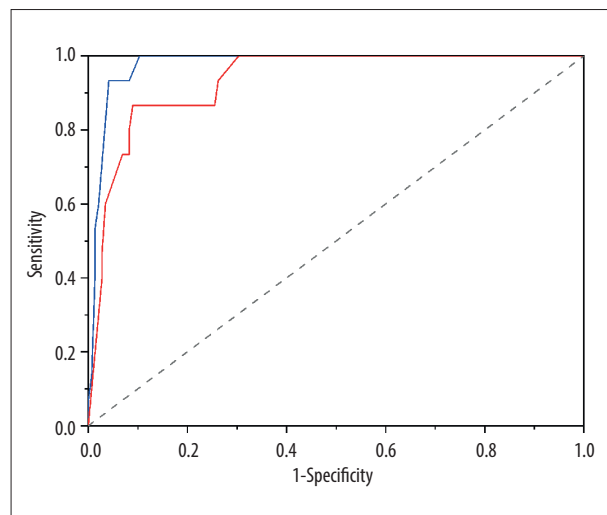

Figure 4. Comparison of Braden Scale-Based Injury Score and New Injury Severity Score for predicting and intensive care unit (ICU) admission rates. The area under the receiver operating characteristic (ROC) curve of the ICU admission was 0.977 (0.941-0.994) for the NISS (red line) and 0.977 (0.884-0.967) for the Braden Scale-based injury score (blue line) (Z=2.016, *P*=0.0438, Delong test). The ROC curve analysis was conducted with MedCalc software (MedCalc, MedCalc Software Ltd).

and relatively applicable confidence [21], the Braden Scale could be a fast assessment tool to rapidly sort the injured in mass burn casualty incidents before patient admission.

The Braden Scale assesses the vulnerability to stressors, including 6 different risk factors: sensory perception, ability to respond meaningfully to pressure-related discomfort; moisture, degree to which skin is exposed to moisture; activity, degree of physical activity; mobility, ability to control body position; nutrition, usual food intake pattern; and friction and shear [24]. A total score of 23 reveals no risk of developing a pressure ulcer, whereas a score of <16 indicates that there should be a recommendation for nutrition and/or physical therapy consultation [23,24]. It was reported that exposed body areas, such as the face and extremities, were most likely to be injured in an explosion [1,38]. Such injuries can restrict physical activity and damage free body control, which restricts patients' sensory and moisture perception, body activity, and mobility. Nutritional intake of severely injured patients, especially patients with extensive burns, is usually reduced, and therefore nutritional supplementation needs to be strengthened to maintain the intestinal function of these patients. Previous studies [39,40] revealed that burn patients tend to develop substantial energy and protein deficits, and optimized feeding had a strong impact on the outcome, especially for mechanically ventilated burn patients. It is feasible to use the Braden Scale to conveniently assess the impairments of these abilities in severely injured patients, which consolidates the application of the Braden Scale in injury severity assessment.

In addition, the Braden Scale could be a suitable predictor of patient outcomes. The predictive accuracy of the Braden Scale and NISS for 30-day hospital discharge and ICU admission rates was nearly identical, indicating that the Braden Scale might be adaptable as a simple and convenient instrument to assess disability-related outcomes. A retrospective cohort study of 341 patients found worse outcomes after liver transplantation in those with a lower Braden Scale score [27]. Multivariate regression modeling in that study revealed that a high Braden Scale score was associated with a longer hospital stay (incidence rate ratio, 1.56; 95% CI, 1.47-1.65), non-ambulatory status at discharge (OR, 4.15; 95% CI, 1.77-9.71), and discharge to a rehabilitation facility (OR, 5.51; 95% CI, 2.57-11.80). Another finding corroborated that the Braden Scale was an accurate predictor of postoperative outcomes in the geriatric population as well, with scores <18 predicting longer length of hospital stay. [23] To some extent, the results of these studies were consistent with our research. Therefore, what we assume is probably the predictive ability of the Braden Scale has been

extended to assess the injury severity and prognosis in mass burn casualty patients.

In addition, our research confirmed that the GCS, which principally assesses brain damage, might not be appropriate to assess trauma severity because of its poor correlation with the NISS (correlation coefficient was -0.511) [41]. A study of 939 burn patients showed that a deeper burn (OR=1.1, P<0.001) was a latent predictor of burn severity [19] but was less useful as a predictor of the outcomes of mass burn casualties because such incidents also involve many non-burn and non-inhalation injury patients. Other factors, such as vital signs [16], which previously had been considered relevant to burn and trauma, were shown to have no significant correlations with injury severity in our study. Overall, more research needs to be conducted to evaluate the capability of these indicators to predict injury severity in mass burn casualties.

Limitations

First, our data excluded the injured patients who were not admitted to the hospitals, which may have given rise to selection bias and reduced the effectiveness of prediction. However, the bias is comparatively low because most of the injured patients were admitted to the hospitals owing to the policy carried out by the local government. Second, the evaluation bias that differed between professionals and certified nurses might decrease the integrity of diverse scales and measurements, even though each one has anchoring statements for each of its aspects. Third, a larger sample is needed to validate the utility of the Braden Scale, NRS, and other measures for predicting the prognosis of mass burn casualties.

Conclusions

The Braden Scale is a suitable triage tool for predicting injury severity in mass burn casualties. The Braden Scale could also be used to predict disability-related outcomes (ICU admission and 30-day hospital discharge) for burn patients. Other potential prognostic markers, such as vital signs, GCS, and injury type (burn or inhalation injury), require further validation.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors, who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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