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The value of the revised trauma score and shock index in patients admitted to the emergency department after an earthquake

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Abstract

During events like earthquakes that exceed hospital capacities, scoring systems are crucial for prioritizing the injured. This study assessed the predictive accuracy of the Revised Trauma Score (RTS), Shock Index (SI), Modified Shock Index (MSI), and Age-Specific Shock Index (ASI) for crush syndrome, blood transfusion need, intensive care requirement, and mortality in trauma patients post-earthquake. Data from 878 trauma patients (aged >18) admitted between February 6-20, 2023, were analyzed retrospectively. Outcomes included crush syndrome, blood transfusion need, hospitalization, intensive care requirement, and mortality. The SI and MSI strongly predicted crush syndrome (AUC=0.873; AUC=0.840). Both indices also accurately predicted blood transfusion need (AUC=0.831; AUC=0.794), mortality (AUC=0.930; AUC=0.908), intensive care requirement (AUC=0.889; AUC=0.874), and hospitalization

(AUC=0.838; AUC=0.797). Across all outcomes, MSI and SI demonstrated better discriminatory performance than ASI and RTS. MSI outperformed SI statistically only for the prediction of crush syndrome and blood transfusion requirement. RTS may serve more to exclude than predict the adverse clinical outcomes analyzed.

Introduction

Appropriate scoring systems are essential to prioritize the injured by efficiently assessing the mass of patients in sudden events, such as earthquakes, that may exceed hospital care capacities.[1] Thus, the Revised Trauma Score (RTS), Shock Index (SI), Modified Shock Index (MSI), and Age-Adjusted Shock Index (ASI) have become widely used in emergency departments.[2]

To some extent, RTS can predict mortality risk and prognosis in acute trauma patients. The SI, which uses the ratio of pulse rate to systolic blood pressure, is a key indicator of blood loss severity. Recent studies have shown that SI measured in emergency departments yields better mortality predictions than prehospital measurements do.[3] However, trauma severity assessments generally depend on multiple variables, including diastolic blood pressure, body temperature, age, and trauma type. The MSI, calculated as the ratio of heart rate to mean blood pressure, offers a more objective measure of blood loss severity and is a significant predictor of mortality.[4] The ASI, obtained by multiplying the SI by age, may be useful in predicting blood transfusion needs in severely injured pediatric and elderly patients after blunt trauma.[5,6]

Crush syndrome, one of the leading causes of mortality following earthquakes, is defined by systemic symptoms resulting from ischemia–reperfusion injuries due to trauma or prolonged compression of various body parts.[7,8]

This study aims to evaluate the ability of RTS, SI, MSI, and ASI to predict crush syndrome, the need for blood transfusion, intensive care, and mortality in trauma patients. The findings are intended to guide the approach to trauma patients admitted to emergency departments following major devastations such as earthquakes.

Materials and Methods

This study included patients over 18 years of age who were admitted to the emergency department for trauma between February 6, 2023, and February 20, 2023, following a major earthquake. Among the 892 patients initially assessed, 14 with incomplete data were excluded, resulting in a final sample of 878 patients (354 males, 524 females). Patient data were collected retrospectively from medical records. The recorded variables included age, sex, admission vital signs, crush syndrome development, blood transfusion requirements, length of hospital stay, need for intensive care, mortality, and scores such as the GCS, RTS, SI, MSI, and ASI. The study outcomes included crush syndrome development, the need for blood transfusion, hospitalization, the need for intensive care, and mortality.

The ‘STROBE Statement’ guidelines were used to ensure proper reporting of methods, results, and discussion (*Supplementary materials*).

For continuous variables, arithmetic means and standard deviations were used for normally distributed data, whereas medians and quartiles were used for nonnormally distributed data. Categorical variables are expressed as counts and percentages. Relationships between score groups and categorical variables were analyzed via the chi-square test. Student's t test and the Mann–Whitney U test were used for two-group comparisons on the basis of distribution. Correlation coefficients were used to test the relationships between scores, and Receiver Operating Characteristic (ROC) analysis was used to assess the predictive value of the scores. A multivariate logistic regression analysis was conducted to identify the independent variables associated with the development of crush syndrome. Statistical significance was set at $p<0.05$.

For human trials, informed consent has been obtained from each subjects.

Ethical approval was obtained from the Clinical Research Ethics Committee (Date: 04/09/2024; Number: 2024/812).

Results

The mean age of the patients was 45.57 years. In terms of trauma location, 131 patients (14.92%) had lower extremity fractures, 89 (9.11%) had upper extremity fractures, and 7 (0.8%) had pelvic fractures. Crush syndrome developed in 166 patients (18.91%).

Interventions included central venous catheter insertion in 171 patients (19.48%), amputation in 37 patients (4.21%), fasciotomy in 12 patients (1.37%), and dialysis in 11 patients (1.25%). Hospitalization was required for 237 patients (26.99%), and death occurred in 5 patients (0.57%). The demographic and medical information of the study patients is shown in Table 1.

The means of SI, MSI, and ASI were greater in patients with crush syndrome, those requiring blood transfusions, hospitalization, or intensive care than in patients without these outcomes. Conversely, RTS was greater in patients without these outcomes. This difference was statistically significant ($p<0.001$; Table 2).

The SI and MSI were significantly greater in patients who required surgery than in those who did not ($p=0.002$; Table 2).

In nonsurviving patients, the means of the SI ($p=0.002$), MSI ($p=0.001$), and ASI ($p=0.001$) were greater than those in surviving patients. RTS was significantly greater in the surviving group ($p<0.001$; Table 2).

When the mean shock indices and RTSs were compared across patients with and without crush syndrome and those who needed surgery, blood transfusion, intensive care, or mechanical ventilation, no differences were found in terms of age or sex ($p>0.05$; Table 2).

All the variables successfully predicted the need for blood transfusion at the cutoff values ($p<0.05$). The MSI and SI displayed particularly high predictive performance for blood transfusion needs (AUC=0.831; AUC=0.794). RTS also had a specificity of 98.47% and a high NPV of 97.4% for predicting the need for transfusion. The ASI demonstrated a specificity of 86.32% and an NPV of 98% for blood transfusion prediction (Table 3, Figure 1).

All variables except RTS successfully predicted mortality at the cutoff values ($p<0.05$). The MSI, SI, and ASI showed especially high performance in predicting mortality (AUC=0.930 [0.911–0.946]; AUC=0.908 [0.887–0.927]; AUC=0.861 [0.836–0.883]), with the SI and MSI exhibiting high sensitivity, specificity, and NPV (Table 4, Figure 2).

At the cutoff values, all variables were also successful in predicting the need for intensive care ($p<0.05$). MSI and the SI had particularly high performance in predicting intensive care requirements (AUC=0.889 [0.866–0.909]; AUC=0.874 [0.851–0.896]). Although RTS had a lower predictive performance for intensive care needs (AUC=0.648 [0.616–0.680]), its specificity (98.74 [97.6–99.4]) and NPV (97.7 [97–98.2]) were high (Table 4, Figure 2).

All variables effectively predicted the need for hospitalization at the cutoff values ($p<0.05$). MSI and the SI again demonstrated particularly high performance in predicting the need for hospitalization (AUC=0.838 [0.812–0.861]; AUC=0.797 [0.769–0.823]).

All variables successfully predicted crush syndrome at the designated cutoff values ($p<0.05$). The MSI and SI demonstrated especially high performance in detecting crush syndrome (AUC=0.873 [0.849–0.894]; AUC=0.840 [0.814–0.863]), and RTS showed high specificity (98.74%) for predicting crush syndrome (Table 3, Figure 1). Due to potential multicollinearity between SI and MSI in the multiple logistic regression analysis, these variables were evaluated in separate models (Model 1 and Model 2). In the multivariate logistic regression analysis, when examined in Model 1 using cutoff values of ASI > 36, RTS < 12, and MSI > 1.3, the presence of crush syndrome was found to be independently associated. In Model 2, RTS < 12 and SI > 0.9 were identified as independent predictors, while ASI lost its statistical significance. In particular, the high OR value obtained for the SI > 0.9 cutoff value indicates strong discriminatory performance in determining the presence of crush syndrome. (Table 5)

A pairwise comparison of ROC curves was performed to evaluate whether the differences between the AUC values of the scoring systems were statistically significant. The results of this analysis are presented in Table 6. MSI demonstrated statistically significantly higher AUC values than the other evaluated scoring systems for the prediction of crush syndrome and blood transfusion requirement. For mortality and intensive care unit admission, MSI yielded AUC values comparable to those of SI. Overall, based on the analyzed outcomes, MSI and SI showed statistically superior discriminatory performance compared with ASI and RTS.

Spearman's correlation analysis revealed that the duration of hospitalization was positively correlated with shock indices and negatively correlated with the GCS and RTS ($p<0.05$), with the MSI having the highest positive correlation with hospital stay length (correlation coefficient=0.524, $p<0.001$).

Discussion

In our study, MSI and SI demonstrated superior predictive performance compared with ASI and RTS across all analyzed outcomes. However, MSI was statistically superior to SI only in predicting crush syndrome and blood transfusion requirement. Given that RTS shows very high specificity (>98%) for the study outcomes, it is appropriate to use it as a predictive parameter for adverse clinical outcomes in trauma patients. Although we did not categorize patients by age, we found that the ASI successfully predicted adverse clinical outcomes.

Earthquakes are major social events that occur suddenly, leading to significant morbidity and mortality. Prioritizing patients' use of scores and shock indices is therefore critical. In a study by Hossenpour *et al.*, where shock indices were analyzed in approximately 750,000 patients, the SI measured in the emergency department was more effective in predicting mortality and length of hospital stay than were the prehospital SI and delta SI (the difference between prehospital and emergency department SI).[3] Thus, shock indices and trauma scores measured in the emergency department are useful for patient management. Many studies have evaluated pulse rate, systolic and diastolic blood pressure, and the SI, with findings showing that a pulse rate above 120 and a blood pressure below 90/60 are effective in predicting hospital stay and mortality, particularly where a systolic blood pressure under 90 is the most critical component.[4,9] However, recent studies have highlighted the importance of diastolic blood pressure in assessing trauma severity. Accordingly, the MSI, which was developed to include this component, has been found to be superior in predicting mortality.[10] MSI is the most important tool for identifying critically ill trauma patients in the emergency department.[4,10] In our study, MSI emerged as the best predictor of blood transfusion requirement. While RTS is commonly used to assess trauma severity, particularly in younger patients and head trauma patients, its predictive power decreases in cases of blunt or penetrating injuries.[11] As most patients in our study experienced blunt trauma, the predictive performance of RTS may have been lower than that of other indices.

The incidence of crush syndrome has been reported to range from 2% to 15% in all trauma patients, potentially increasing to 30% among earthquake victims.[12] In our study, crush syndrome was observed in 166 patients (18.9%). Typically, the lower extremities are the most frequently affected areas, followed by the upper extremities and trunk.[13] Similarly, in our study, the lower extremities were most commonly traumatized, followed by the upper extremities and pelvis. All three shock indices were significantly greater in patients with crush syndrome than in those without crush syndrome, whereas RTS was lower in patients with crush syndrome. As the severity of blunt trauma increases, so does the likelihood of crush syndrome, and the predictive performance of MSI and the SI is particularly high in detecting this condition. We found that an SI cutoff value of 0.655 and an MSI cutoff value of 0.879 can predict crush syndrome in trauma patients. After adjustment for other variables in the multivariate logistic regression model, SI > 0.9 was independently associated with markedly increased odds of crush syndrome (OR: 56.82). Given its high Negative Predictive Value (NPV) and specificity, MSI can be used to exclude crush syndrome. Our study is the first to compare the utility of RTS and these three shock indices in predicting postearthquake crush syndrome.

Two large studies revealed that the need for massive transfusion in patients with an SI > 0.9 was twice as high as that in normal patients and approximately seven times greater in patients with an SI > 1.3.[14,15] In a study by Rau et al. involving 20,000 patients, the systolic blood pressure, SI, and MSI moderately predicted massive transfusion, whereas the heart rate and ASI were less effective.[16] Conversely, Zarzaur *et al.* reported that the ASI alone could predict the need for more than four units of red blood cell transfusion within 48 hours.[6] In our study, shock index averages were significantly greater in patients who required transfusion, and RTS was greater in the group without transfusion. In particular, the predictive performance of MSI and the SI for transfusion needs was high, and the ASI could also predict this need. Although RTS had a lower predictive performance for transfusion need, it had high specificity (98.47%) and NPV (97.4%) at a cutoff value of ≤11, indicating a very low transfusion likelihood in patients with an RTS above 11.

Jouini *et al.* reported that an SI ≥1 could serve as an independent predictor of mortality on days 7 and 30.[17] While Singh et al. noted that systolic blood pressure was most predictive of mortality, their study also revealed that MSI alone effectively predicted mortality.[4] Zarzaur *et al.* reported that the ASI is superior to heart rate, systolic blood pressure, and the SI in predicting 48-hour mortality.[6] In a study of 45,000 trauma patients aged over 65 years, the ASI was better at predicting mortality than the SI or MSI was.[18] Similarly, our study revealed that nonsurvivors had higher shock index means, whereas the group without mortality had higher RTS means. MSI, the SI, and the ASI showed very high performance in predicting mortality, although RTS was not a successful predictor. We believe this was due to the limited number of patients with GCS values below 15, with most RTS values being 12 or near 12.

Grimme et al. reported that the SI can predict hospitalization duration, intensive care stay, and mechanical ventilation needs in trauma patients.[14] Kim *et al.* reported that the ASI is superior to the SI and MSI in predicting hospitalization needs in geriatric trauma patients.[18] In our study, the shock index means were greater in patients requiring hospitalization, intensive care, and mechanical ventilation. Hospitalized patients were also older on average. All the variables successfully predicted hospitalization and intensive care needs, with MSI and SI being particularly strong in detecting these requirements. Although we did not separately evaluate patients over 65 years of age, the MSI and SI were valuable in both predicting and excluding hospitalization.

In our study, we observed a positive correlation between the GCS score and RTS and a negative correlation between the GCS score and shock indices. Despite only six patients having a GCS score less than 15, these statistically significant correlations underscore the importance of GCS monitoring and follow-up, offering a straightforward method to track trauma scores and shock indices.

Conclusions

Across all outcomes, MSI and SI demonstrated better discriminatory performance than ASI and RTS. MSI outperformed SI statistically only for the prediction of crush syndrome and blood transfusion requirement. RTS may serve more to exclude than predict the adverse clinical outcomes analyzed.

Limitations

Our study has several limitations. The cases were collected from a single center over a relatively short period, which may limit the generalizability of the findings. Data acquisition occurred during a catastrophic mass-casualty event characterized by a sudden patient surge and high clinical workload. In this setting, rapid triage and urgent management priorities may have resulted in incomplete documentation, missing data, or inaccuracies in the collection of clinical and laboratory parameters. Although the records were reviewed carefully, potential errors in data completeness and parameter recording cannot be fully excluded. We lacked RTS and shock indices measured at the time of the earthquake; only those taken upon emergency department admission were available. Therefore, we could not evaluate differences between measurements over time. The predictive abilities of shock indices and RTS according to patient age, especially the ASI, were not assessed. The predominance of patients with GCS values of 15 and RTS values of 12 may have limited our evaluation of GCS and RTS in terms of the outcomes examined.

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Table 1. Demographic and medical information of the patients included in the study

		N (%)
Age, Years, Mean ± SD	Female	46,655 ± 17,2875 (mean ± sd)
	Male	43,969 ± 16,5295 (mean ± sd)
Gender	Female	524 (59.7%)

	Male	354 (40.3%)
Crush Syndrome		166 (18.9%)
Acute Kidney Injury at Admission		29 (3.3%)
Hemodialysis		11 (1.3%)
Fasciotomy		12 (1.4%)
Surgery		7 (0.8%)
Clinical Outcome	Discharged without hospitalization	641 (73.0%)
	Discharged with Recovery	232 (26.4%)
	Exitus	5 (0.6%)
Hospitalization		237 (27.0%)
Length of Stay, Days, Mean		8 (4-13)
Need for Intensive Care Unit (NfICU)		29 (%3,30)
Need for Blood transfusion (NfBT)		30 (%3,42)
Need for Mechanical Ventilator (NfMV)		9 (%1,03)

Table 2. Comparison of the mean RTS and shock indices in terms of presence of Crush, NfBT, NfICU and mortality.

		N	RTS Median (25-75%)	SI Median (25-75%)	MSI Median (25-75%)	ASI Median (25-75%)
Crush Syndrome	Absent	712	12 (12-12)	0.5625 (0.5267-0.5925)	0.7070 (0.6491-0.7594)	25.6761 (17.8184-33.2358)
	Present	166	12 (12-12)	0.7955 (0.6048-0.9304)	1.0510 (0.7993-1.1185)	33.5580 (23.2550-45.7068)
	P		**<0.001**	**<0.001**	**<0.001**	**<0.001**

NfBT	Absent	848	12 (12-12)	0.5625 (0.5340-0.6250)	0.7438 (0.6596-0.8201)	26.6329 (18.2000-34.9408)
	Present	30	12 (11-12)	0.7325 (0.6267-0.9713)	1.0053 (0.8889-1.3328)	36.5155 (23.0550-51.7415)
	P		**<0.001**	**<0.001**	**<0.001**	**0.001**
NfICU	Absent	849	12 (12-12)	0.5625 (0.5333-0.6246)	0.7438 (0.6593-0.8201)	26.6240 (18.2000-34.9210)
	Present	29	12 (11-12)	0.8839 (0.7099-1.0212)	1.1185 (0.9691-1.3480)	40.3065 (24.2113-54.5127)
	P		**<0.001**	**<0.001**	**<0.001**	**<0.001**
Mortality	Absent	873	12 (12-12)	0.5625 (0.5344-0.6324)	0.7438 (0.6605-0.8416)	26.7273 (18.2951-35.3362)
	Present	5	12 (9.5-12)	1.0139 (0.7756-1.2966)	1.3354 (1.0571-1.4936)	46.0532 (34.4175-104.8361)
	P		**<0.001**	**0.002**	**0.001**	**0.005**

Table 3. ROC analysis for crush syndrome and NfBT.

		Cut-off	**AUC 95% [CI] (p)**	**Sensitivity % [CI]**	**Specificity % [CI]**	**PPV % [CI]**	**NPV % [CI]**
	RTS	≤11	0.530 [0.496-0.53] 0.0038	7.23 [3.8-12.3]	98.74 [97.6-99.4]	57.1 [36.4-75.7]	82 [81.4-82.7]
	SI	>0,655	0.840	70.48	87.92	57.6	92.7

Crush Syndrome			[0.814-0.863] <0.0001	[62.9-77.3]	[85.3-90.2]	[52.2-62.9]	[91-94.2]
	ASI	>32,782	0.667 [0.634-0.698] <0.0001	53.61 [45.7-61.4]	74.02 [70.6-77.2]	32.5 [28.5-36.7]	87.3 [85.2-89]
	MSI	>0,879	0.873 [0.849-0.894] <0.0001	71.69 [64.2-78.4]	88.48 [85.9-90.7]	59.2 [53.7-64.5]	93.1 [91.3-94.5]
NfBT	RTS	≤11	0.626 [0.594-0.659] 0.0022	26.67 [12.3-45.9]	98.47 [97.4-99.2]	38.1 [21.6-57.8]	97.4 [96.8-97.9]
	SI	>0,608	0.794 [0.766-0.820] <0.0001	86.67 [69.3-96.2]	71.11 [67.9-74.1]	9.6 [8.2-11.2]	99.3 [98.4-99.7]
	ASI	>40	0.672 [0.640-0.703] 0.0034	50 [31.3-68.7]	86.32 [83.8-88.6]	11.5 [8-16.1]	98 [97.1-98.6]
	MSI	>0,830	0.831 [0.804-0.855] <0.0001	83.33 [65.3-94.4]	76.53 [73.5-79.3]	11.2 [9.3-13.3]	99.2 [98.3-99.7]

AUC (Area Under Curve); CI (Confidence Interval); PPV (Positive Predictive Value); NPV (Negative Predictive Value).

Table 4. ROC analysis for mortality and need for intensive care.

		Cut-off	**AUC 95% [CI] p**	**Sensitivity % [CI]**	**Specificity % [CI]**	**PPV % [CI]**	**NPV % [CI]**
	RTS	≤10	0.692 [0.661-0.723] 0.122	40 [5.3-85.3]	99.66 [99-99.9]	40 [12.3-76]	99.7 [99.3-99.8]
	SI	>0,95	0.908	80	97.94	18.2	99.9

Mortality			[0.887-0.927] <0.0001	[28.4-99.5]	[96.8-98.8]	[10.6-29.5]	[99.3-100]
	ASI	>42,03	0.861 [0.836-0.883] 0.0002	80 [28.4-99.5]	89.12 [86.9-91.1]	4 [2.5-6.4]	99.9 [99.3-100]
	MSI	>1,305	0.930 [0.911-0.946] <0.0001	80 [28.4-99.5]	98.28 [97.2-99]	21.1 [12-34.2]	99.9 [99.3-100]
Need for ICU	RTS	≤11	0.648 [0.616-0.680] 0.0007	31.03 [15.3-50.8]	98.59 [97.5-99.3]	42.9 [25.6-62.1]	97.7 [97-98.2]
	SI	>0,704	0.874 [0.851-0.896] <0.0001	79.31 [60.3-92]	82.92 [80.2-85.4]	13.7 [11.1-16.7]	99.2 [98.3-99.6]
	ASI	>38,25	0.701 [0.670-0.731] 0.0006	55.17 [35.7-73.6]	83.39 [80.7-85.8]	10.2 [7.3-14]	98.2 [97.3-98.8]
	MSI	>0,968	0.889 [0.866-0.909] <0.0001	79.31 [60.3-92]	84.69 [82.1-87]	15 [12.2-18.4]	99.2 [98.3-99.6]

AUC: Area Under Curve; CI: Confidence Interval; PPV: Positive Predictive Value; NPV: Negative Predictive Value.

Table 5. Multivariate logistic regression models evaluating the independent predictors of crush syndrome.

	Scores (with cut-off value)	OR [CI]	p
Model 1	ASI>36	2.65 [1.83-3.84]	**<0.001**
	RTS<12	3.47 [1.30-9.29]	**0.013**
	MSI>1.3	4.53 [1.64-12.22]	**0.004**
Model 2	ASI>36	1.02 [0.61-1.71]	0.930
	RTS<12	5.40 [1.91-15.23]	**0.001**

	SI>0.9	56.82 [26.24-123.05]	**<0.001**

RTS: Revised Trauma Score, SI: Shock Index, ASI: Age-adjusted Shock Index, MSI: Modified Shock Index, OR [CI]: Odds Ratio [Confidence Interval]

Table 6. Pairwise comparisons of risk scores for study outcomes.

Outcome	Scores	RTS Dba (p)	SI Dba (p)	ASI Dba (p)	MSI Dba (p)
Crush Syndrome	RTS	-	0.310 **< 0.0001**	0.137 **< 0.0001**	0.343 **< 0.0001**
	SI	0.310 **< 0.0001**	-	0.173 **< 0.0001**	0.033 **< 0.0001**
	ASI	0.137 **< 0.0001**	0.173 **< 0.0001**	-	0.206 **< 0.0001**
	MSI	0.343 **< 0.0001**	0.033 **< 0.0001**	0.206 **< 0.0001**	-
NfBT	RTS	-	0.168 **0.002**	0.046 0.4693	0.204 **< 0.0001**
	SI	0.168 **0.002**	-	0.122 **0.0485**	0.036 **0.0259**
	ASI	0.046 0.4693	0.122 **0.0485**	-	0.159 **0.003**
	MSI	0.204 **< 0.0001**	0.036 **0.0259**	0.159 **0.003**	-
Mortality	RTS	-	0.216 0.0645	0.168 0.1007	0.237 **0.0369**
	SI	0.216 0.0645	-	0.0475 **0.0483**	0.021 0.3344
	ASI	0.168	0.0475	-	0.069

		0.1007	**0.0483**		0.0875
	MSI	0.237 **0.0369**	0.021 0.3344	0.069 0.0875	-
NfICU	RTS	-	0.226 **< 0.0001**	0.053 0.4728	0.241 **< 0.0001**
	SI	0.226 **< 0.0001**	-	0.173 **0.0011**	0.015 0.0760
	ASI	0.053 0.4728	0.173 **0.0011**	-	0.188 **0.0002**
	MSI	0.241 **< 0.0001**	0.015 0.0760	0.188 **0.0002**	-

Dba: difference between areas, RTS: Revised Trauma Score, SI: Shock Index, ASI: Age-adjusted Shock Index, MSI: Modified Shock Index, NfBT: need for Blood Transfussion, NfICU: Need for Intensive Care Unit.

Figure 1. ROC analysis for Crush syndrome (1a) and need for blood transfusion (1b).

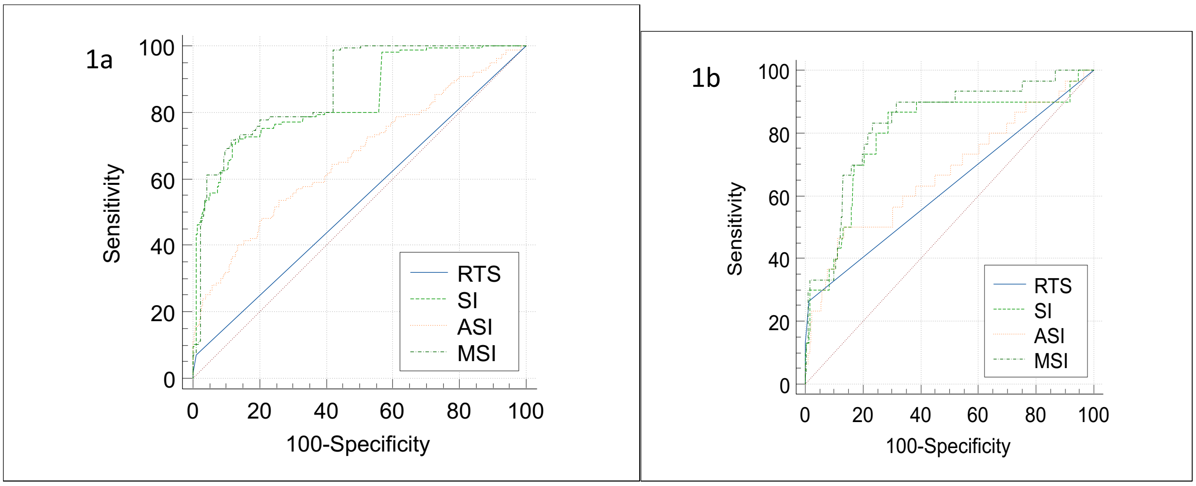
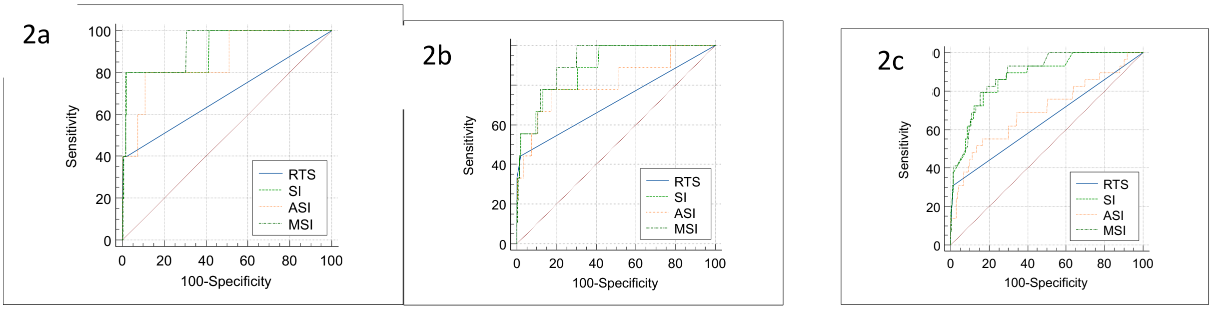


Figure 2. ROC analysis for mortality (2a), need for hospitalization (2b) and need for intensive care (2c)



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Conflict of interest: the authors declare no potential conflict of interest, and all authors confirm accuracy.

Ethics approval: ethical approval was obtained from the Clinical Research Ethics Committee (Date: 04/09/2024; Number: 2024/812). The study is conformed with the Helsinki Declaration of 1964, as revised in 2013, concerning human and animal rights.

Informed consent: all patients participating in this study signed a written informed consent form for participating in this study. Written informed consent was obtained from a legally authorized representative(s) for anonymized patient information to be published in this article.

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Supplementary materials

STROBE Statement (checklist of items that should be included in reports of observational studies)

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