https://archtrauma.kaums.ac.ir/
Archives of Trauma Research. 2023; 12(4): 179-185
https://doi.org/10.48307/ATR.2023.410476.1027

Research Article Open Access

Comparison of revised trauma score with MGAP score in determining clinical outcomes of multiple trauma patients hospitalized in trauma center

Majid Pourshaikhian [1], **Ehsan Kazemnezhad** [2], **Ehsan Azizi** [3], **Iraj Aghaei** [4] *

[1] Associate Professor, Department of Medical Surgical Nursing, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran
[2] Associate Professor, Department of Biostatistics, Social Determinants of Health Research Center, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran
[3] MSc in ICU Nursing, Student Research Committee, School of Nursing and Midwifery, Guilan University of Medical Sciences Rasht, Iran
[4] Associate Professor, Neuroscience Research Center, School of Nursing and Midwifery, Guilan University of Medical Sciences Rasht, Iran

* **Corresponding author:** Iraj Aghaei- School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran
E-mail: iraj_8383@yahoo.com, aghaei@gums.ac.ir

Received: 9 August 2023 **Revised:** 30 November 2023 **Accepted:** 5 November 2023 **e-Published:** 1 December 2023

Abstract

Background: Trauma is one of the important causes of disability, death and major health problem in the world. Various instruments are used to assess the clinical outcomes of trauma patients.

Objectives: The aim of this study was to compare the Revised Trauma Score (RTS) with the MGAP score in determining the clinical outcomes.

Methods: A retrospective cross-sectional analytical study was conducted on 1000 multiple trauma patients admitted to Poursina Hospital in Rasht. The data collection instruments included a three-part checklist of demographic and clinical characteristics, RTS and MGAP scores, and clinical outcomes (length of hospitalization and mortality). Data were analyzed using descriptive and non-parametric statistical tests by SPSS 21 software. To determine the predictive power of RTS and MGAP mortality using the ROC test, in addition to obtaining the area under the curve (AUC), the cut-off point, sensitivity, specificity, positive and negative predictive values (PPV and NPV) were obtained.

Results: The findings showed that 3% of patients (CI: 95%) died and the length of hospitalization was 3.7±2 days. The mortality prediction level of RTS and MGAP instruments for trauma patients was significant (P<0.001) according to AUCs of 97.9% and 98.3%, respectively. Correlation between MGAP and RTS for the length of hospitalization were significant (r=-0.267and r=-0.274, p<0.001), but the intensity of correlation between MGAP and RTS was not significant. The best cut-off points for RTS and MGAP were equal to 7 and 22.5, respectively, with sensitivity rates of 98.1% and 92.3%., specificity rates of 96.7%, and 92.3%., PPV values of 97.7% and 92.3% and NPV values of 92.3% and 98.1%, respectively.

Conclusion: MAGP and RTS instruments can predict the clinical outcomes of trauma patients well, but they did not have a significant superiority over each other. Therefore, the preferred choice of one of these agents requires multicenter studies.

Keywords: Revised Trauma Score, MGAP, Clinical outcomes, Trauma.

Introduction

Trauma is a major health problem worldwide and it is one of the important causes of disability and death, especially in the first four decades of life.[1, 2] In Iran, road traffic injury (RTI) is the most important cause of injuries, and trauma is the second cause of death in the country and the biggest cause of years of life lost.[3] Guilan Province, which is one of the first three provinces of Iran in terms of RTI,[4] has a high number of victims due to its high population density and geographical location.[5] Evidence shows that improving care measures can reduce the rate of trauma-related complications and mortality in patients.[6]

Estimating the severity of injury and stability of the patient plays an important role in determining the type of care and reducing mortality rate.[7] Twenty percent of deaths from trauma are preventable. Accurate prediction of the outcome based on the appropriate triage of patients helps to provide effective treatments and reduce the risk of mortality.[8] Therefore, efforts should be directed towards the early identification of critically injured patients which can increase the chances of survival.[9] Therefore, it is very important to use the right instruments to measure the outcomes of trauma patients.

The modified Revised Trauma Score (RTS) and MGAP (Mechanism of injury, Glasgow Coma Scale (GCS), Age, Blood pressure) trauma score instruments are easy for use in pre-hospital and hospital emergency areas and can be used to diagnose the severity of trauma.[10] RTS has been widely used to evaluate the patient prognosis. This is suitable for triage and initial severity assessment because it does not require complex medical tests or devices, so it is very useful in emergency care.[11,12] Some studies indicate that this scale is useful for predicting mortality rate.[7,13] MGAP also plays an important role in determining the clinical outcomes of trauma patients. It was reported that the MGAP with a sensitivity of 97.6% and a specificity of 80% in predicting short-term death can be used as one of the accurate instruments in the correct triage of patients and predicting the severity of injury and death,[14] but limited studies have compared the RTS and MGAP scores.

Another study showed that the MGAP scoring tool has higher sensitivity and specificity for mortality, but compared to RTS, it is not superior for predicting the severity of anatomic injury.[15] The results of other studies showed that RTS can be used as an accurate tool to predict the mortality rate of injured patients.[16,17] In a study, no significant difference was observed between RTS and MGAP in terms of predicting mortality rate, while RTS is the most applicable trauma scoring system in the hospital.[18] But, Selim et al., and Llompart-Pou et al., showed that MGAP was better than RTS for predicting the mortality rate.[9,19]

Objectives

Considering the high statistics of accidents and deaths in Iran and the preventability of most of the deaths caused by accidents, the use of suitable triage instruments in the pre-hospital and hospital areas is unavoidable. RTS and MGAP instruments can be easily used to diagnose the severity of trauma, therefore, considering the limitedness of comparative studies and the contradiction in the results of the studies, this study was designed to compare the RTS tool score with the MGAP score to determine the clinical outcomes in hospitalized trauma patients.

Methods

In this retrospective cross-sectional analytical study, the score of the RTS tool has been compared with the MGAP for clinical outcomes (hospitalization length and mortality) in trauma patients admitted to Poursina Research, Treatment and Training Center in Rasht north of Iran. The files of trauma patients aged 18 years and over who were admitted to Poursina Hospital in Rasht in Summer 2021 and were recorded in Hospital Information System (HIS) of the hospital were collected.

The inclusion criteria included the cases of patients hospitalized with moderate and severe trauma based on the emergency severity index (ESI) and the exclusion criteria were cases with incomplete report forms. The sample size required to compare MGAP with RTS in predicting the outcomes of trauma patients referred to Poursina Hospital with 95% confidence and 80% test power in a two-domain test based on the results of Galvagno et al.'s study[15] based on the correlation of MGAP with RTS is equal to r = 0.372 was determined for the number of 1188 cases of trauma patients. Finally, 1000 cases were considered as the study sample.

The data collection tool consisted of three parts. The first part included demographic characteristics (age, sex, type of trauma), GCS, systolic blood pressure, accident mechanism, heart rate, respiration rate, SPO_2, how to transfer to the hospital, anatomical area of injury, alcohol consumption, and underlying diseases, the second part included clinical outcomes, and the third part included two scoring instruments, including RTS and MGAP.

MGAP score includes 4 variables: age, GCS, mechanism of injury and systolic blood pressure and score ranges from 3 to 29 points. Based on this tool, patients with closed and penetrating trauma are scored 4 and 0, respectively, based on the level of consciousness one of the scores 3 to 15, based on patient age is less than or over than 60 years that are scored 5 and 0, respectively, also in case of systolic blood pressure above 120 mmHg score 5, pressure 60 to 120 score 3, pressure less than 60 score 0. Finally, scores of 3-14, 15-22, and 23-29 were classified as high, medium and low risk, respectively.[20]

The RTS score, which includes 3 GCS variables, respiration rates and systolic blood pressure, was calculated in five states between zero (the worst state) and four (the best state), and the final score is in the range of 0-12.[21] A score of less than 3 has a very low chance of survival, a score of 3-10 requires immediate intervention, a score of 11 requires therapeutic intervention, but the patient can wait for a while, and a score of 12 includes delayed care. According to the recorded information in the HIS, the scores of the patients were calculated based on the RTS and MGAP tools and the clinical outcomes (hospitalization period and mortality) were compared.

A 33-year-old Caucasian man was working on a roof in December 2016 when a pole he was carrying came into contact with a 33-kilovolt overhead cable. The incidence of non- fatal electrical injuries of the severity described in this case (resulting in amputations) is difficult to estimate world-wide. The incidence of non- fatal electrical injuries of the severity described in this in this case (resulting in amputations) is difficult to estimate world-wide. The incidence of non- fatal electrical injuries of the severity described in this case (resulting in amputations) is difficult to estimate world-wide.

Statistical analysis

Descriptive statistics (range, frequency, percentage and mean±SD) and non-parametric tests (Mann-Whitney, Kruskal-Wallis and Spearman's correlation coefficient) were used to evaluate the relationship between study variables. All statistical analyses were performed with SPSS (version 21.0, SPSS Inc, Chicago, IL, USA). P<0.05 was considered statistically significant. To determine the predictive power of RTS and MGAP mortality using the ROC test, in addition to obtaining the area under the curve (AUC), the cut-off point, their sensitivity and specificity, and positive predictive values (PPV) and negative predictive values (NPV) were calculated.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval (code: IR.GUMS.REC.1400.295) was obtained.

Results

The frequency distribution of the samples according to individual characteristics showed that the average and standard deviation of the age of the samples was 39.5±18, the youngest and oldest were 18 and 97 years old, respectively. Moreover, 37.4% of the patients were under 30 years old, 71.6% were male and 60.9% were married. Majority of the patients (78%) were city residents and 47.4% were self-employed. The findings of the study in terms of clinical characteristics related to trauma and the type of inpatient department showed that 38.1% of the patients were hospitalized due to road accidents and the type of trauma was closed trauma in most cases (63.5%), while the location of the lesions was upper limb in more than half of the cases (51.6%) [Table 1].

Table 1. Frequency distribution of research samples according to factors related to trauma and type of inpatient department

Variables		Number (percentage)
Type of inpatient ward	Emergency	756 (75.6)
	Orthopedic	166 (16.6)
	ICU	51 (5.1)
	CPR	17 (1.7)
	Surgery	10 (1)
	Sum	1000 (100)
Cause of trauma	Accidents	381 (38.1)
	Fall	335 (33.5)
	Incidents	209 (20.9)
	Strife	75 (7.5)
	Sum	1000 (100)
Type of trauma	Penetrating	365 (36.5)
	Blunt	635 (63.5)
	Sum	1000 (100)
Area of trauma	Upper limbs	596 (59.6)
	Lower limbs	169(16.9)
	Multiple trauma	235(23.5)
	Sum	1000(100)

Based on RTS risk severity classification, the majority of samples (99.8%) were in the medium category, but based on MGAP, the majority of samples (89.7%) were considered low risk. The Kappa coefficient of agreement is very low (0.02) [Table 2]. The findings of the study showed that the predictive levels of RTS and MGAP for the mortality of trauma patients were 97.9 and 98.3%, respectively, which was statistically significant with reference line by Z test (P<0.001), [Figure 2].

Comparison of RTS and MGAP predictive levels based on the z test showed that the difference in their area under the curve (AUC) was 0.005, which means that the predictive level of these two scales together is no significant. In examining the cut-off point, the best separation point for RTS was equal to 7 with a sensitivity of 98.1% and a specificity of 96.7%, and the best cut-off point for MGAP was 22.5% with a sensitivity of 92.3% and a specificity of 92.3% [Table 3].

Table 2. Severity of risk based on MGAP and RTS

			Severity risk based on RTS		Total	P
			High risk	**Moderate**		
Severity risk based on MGAP	High risk	No	2_a	15_b	17	Kappa= 0.02 P<0.001
		Percent	0.2%	1.5%	1.7%	
	Moderate	Count	0_a	86_a	86	
		% of Total	0.0%	8.6%	8.6%	
	Low risk	Count	0_a	897_b	897	
		% of Total	0.0%	89.7%	89.7%	
Total		Count	2	998	1000	
		No	0.2%	99.8%	100.0%	

Table 3. Comparison of mortality prediction level based on MGAP and RTS scores

Instrument	Cut-off point	Area Under the Curve						Sensitivity	Specificity	PPV	NPV
		AUC	SE	CI 95%		Difference of AUC	P*				
				Lower	Upper						
RTS	7	0.979	0.019	0.941	1.000	0.005	0.795	98.1%	97.7%	97.7%	98.1%
MGAP	22.5	0.983	0.007	0.970	0.996			92.3%	92.3%	92.3%	92.3%

PPV: positive predictive values, NPV: negative predictive values. * Z Test

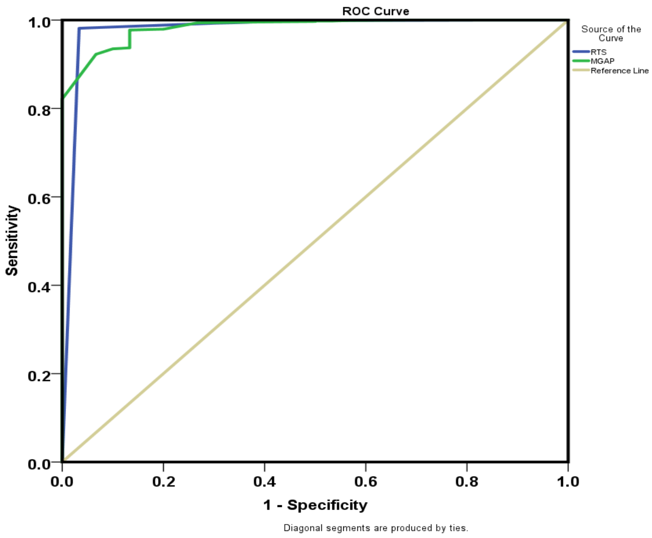

Figure 2. Mortality predictive level based on MGAP and RTS scores

Comparison of the levels of correlation between MGAP and RTS instruments for the length of hospitalization showed that MGAP with r=-0.267 and p<0.001 was the same scale as RTS with r=-0.274 and p<0.001 and had a significant correlation (p<0.001). However, comparison of the intensity of correlation between MGAP and RTS with the length of hospitalization based on Z test was not significant, which means that the intensity of correlation of these two scales with length of hospitalization was almost the same [Table 4].

Table 4. Spearman's correlation coefficient between the length of hospitalization with MGAP and RTS

Instruments		RTS	MGAP	P*
Length of hospitalization	Spearman	- 0.274	- 0.276	0.9
	P-Value	<0.001	<0.001	

*Z Test

Discussion

The present study was conducted with the aim of comparing the scores of RTS and MGAP instruments in determining the clinical outcomes (hospitalization length and mortality) of trauma patients. The demographic characteristics of the patients from an individual and clinical point of view showed that the mean and standard deviation of the age of the samples was 39.5±18 years, 37.4% were less than 30 years old, 71.6% were male and about 60.9% were married. Furthermore, the most common cause of trauma was accidents, falls and accidents, respectively, and 63.5% of the samples had closed trauma. Moreover, 51.6% had upper limb trauma, 16.9% lower limb trauma and 23.9% had multiple traumas.

The findings of the present study show that the predictive level of RTS clinical outcomes had a sensitivity of 97.9% and was significant. This finding was consistent with the findings of Jeong et al.'s study, who reported a sensitivity of 97%.[22] However, Galvagno et al.,[15] and Mohammed et al.,[23] reported that the sensitivity values of RTS for mortality of trauma patients were 95% and 83%, respectively. The differences in the sensitivity of the tool can be due to the characteristics of the populations investigated in different studies. In addition, the results of this study showed that the predictive level of hospitalization length and mortality of MGAP had a sensitivity of 98.3% and was significant. In the present study, the RTS and MGAP instruments performed well in predicting the mortality outcome of trauma patients, so that there was no significant difference between the sensitivity and specificity of the two scoring instruments, although according to the area under the curve, the RTS score performed slightly better than the MGAP. In line with the above-mentioned results, Rahmani et al.'s study showed to be more acceptable due to the ease of calculating MGAP.[24] Our results were not in line with the results of separate studies conducted by Llompart-Pou et al., and Ahun et al., in which MGAP performed slightly better than RTS due to a level under its curve.[8,9]

The appropriate cut-off points for RTS in predicting the mortality of trauma patients was 7 with sensitivity, specificity, PPV, and NPV of 98.1%, 96.7%, 97.7% and 98.1%, respectively. Moreover, the best cut-off point for MGAP was 22.5% with sensitivity, specificity, PPV and NPV of 92.3% for all parameter. These results are in line with the study of Baghi et al., which was conducted with the aim of determining the MGAP scoring tool in predicting the mortality, and the score was 22 as the cut-off point with sensitivity and specificity of 93.7% and 91.3%, respectively.[25] Mohammed et al.,[23] reported that cut-off points for RTS and MGAP were 7 and 26 with a sensitivity of 83% and 94%, specificity of 85% and 61% and PPV of 56% and 35% and NPV 96% and 98%. In the study of Sartorius et al., which was conducted with the aim of developing a triage tool in predicting the mortality of trauma patients for easy and objective implementation in the pre-hospital emergency, a score of 23 was also reported as a suitable cut-off point for the MGAP tool.[26] Additionally, in Ahun et al.'s study, the best cut-off points in mortality for GAP and MGAP instruments were 19 and 23, which were associated with 83.33% and 100% sensitivity and 87.50% and 89.77% specificity, respectively.[8] The limited sample size of 100 people in Ahun's study and the lower frequency of penetrating traumas compared to the present study can be the reasons for the difference in the results.

The mortality rate of the studied trauma patients was 30 (3%) with a 95% confidence interval of 2.1%-4.2%. However, in Sartorius et al. study, the mortality rate was 163 (16%) out of 1003 patients. In our study, prediction was assessed according to in-hospital mortality rate but in Sartorius et al. study, the prediction was calculated based on follow-ups during 3 years, which can lead to different mortality rates in two studies. Additionally, the present study was conducted on all patients admitted to all wards of the hospital but in Sartorius's study, patients selected from a pre-hospital mobile intensive care unit in 22 centers in France during 2002-2003.

The AUC prediction levels of RTS and MGAP for the mortality rate of patients were 97.9% and 98.3%, respectively, and it was significant, which was opposite with the results of Sartorius et al., that AUC for RTS and MGAP were 0.90; (95% CI ,0.88–0.92) and 0.90; (95% CI, 0.88–0.92) respectively.[26] In line with the finding of the present study, Galvagno et al.'s study reported that the predictive levels of RTS and MGAP for the mortality rate were 92.7% and 95.8%, respectively, which was not significant.[15] Among the causes of this difference in studies, we can point to things such as the type and location of trauma, the severity of the injury, and the different prognosis of patients in different studies.

This study showed that the mean and standard deviation of the hospitalization length of trauma patients was 3.7±2 days. Comparing the correlation level of MGAP and RTS with the length of hospitalization, the correlation coefficient of MGAP ($r=-267$ and $p<0.001$) and RTS ($r=-274$ and $p<0.001$) had a significant correlation with the length of hospitalization. However, comparing the correlation between MGAP and RTS with length of hospitalization based on Z test, there was no significant difference, which indicates that the intensity of correlation of these two scales with length of hospitalization was almost the same. This finding was consistent with the study of Huang et al., from South Korea.[27] The differences between those studies and the current study can be due to the characteristics of the samples and the severity of trauma, which can be directly related to the length of hospitalization

Study data were collected from the records of hospitalized trauma patients registered in the hospital information system, which may affect the study results. Although the incomplete study sheets were removed, it was inevitable to rely on the data recorded in the file.

Conclusions

There is a slight difference between MAGP and RTS instruments for predicting mortality rate and length of hospitalization in trauma patients, and no significant superiority was seen in any of these two instruments over the other. However, RTS scores demonstrated efficacy in ruling out mortality upon presentation with negative predictive values > 95%. Therefore, although the use of these instruments may help in better diagnosis of patients at risk and better prediction of mortality, it is suggested to conduct multicenter studies in this field to choose the best tool, so that the current study can be generalized to larger populations.

Acknowledgment

This article is extracted from the Master's thesis of Nursing intensive care (Ehsan Azizi), and we are grateful to Guilan University of Medical Sciences for assigning the code of ethics and the necessary platform to conduct the research.

Competing interests

The authors declare that they have no competing interests.

Abbreviations

RTS: Revised Trauma Score;
AUC: Area Under the Curve;
GCS: Glasgow Coma Scale;
MGAP: Mechanism of injury, GCS, Age, Blood pressure;
PPV: Positive predictive values;
NPV: Negative predictive values.

Authors' contributions

IA contributed to writing introduction, writing methodology, writing findings and design. MP had a substantial role in design and content and writing discussion. EK contributed to writing methodology, writing findings and data analysis. EA contributed to writing and coordinating with Hospital Information System for collecting data. All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

Funding

None.

Role of the funding source

None.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval (code: IR.GUMS.REC.1400.295) was obtained. The present study did not interfere with the process of diagnosis and treatment of patients and all participants signed an informed consent form.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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How to Cite this Article:
Pourshaikhian M, Kazemnezhad E, Azizi E, Aghaei I. Comparison of revised trauma score with MGAP score in determining clinical outcomes of multiple trauma patients hospitalized in trauma center. Arch Trauma Res. 2023; 12 (4): 179-185. doi:10.48307/ATR.2023.410476.1027