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Comparing the predictive values of GAP, NTS, RTS, and KTS indicators in determining the hospital outcome of multi-trauma patients admitted to Imam Khomeini hospital in Urmia, Iran

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Abstract

Background: Trauma is one of the main causes of premature deaths worldwide. Improvements in hospital and pre-hospital care and procedures can reduce trauma-related deaths. Easy trauma scoring systems can help the doctors to adopt a specific and appropriate method of managing trauma patients.

Objectives: This study aimed to compare the degree to which indicators of GCS, Age, and systolic blood pressure (GAP), New trauma score (NTS), Revised trauma score (RTS), and Kampala trauma score (KTS) predicted the hospital outcome of the multi-trauma patients.

Methods: This descriptive-analytical study was conducted on 385 multi-trauma patients referred to the emergency department of Imam Khomeini hospital in Urmia (Iran). The data related to GAP, NTS, RTS, and KTS were collected using a checklist and then were analyzed using descriptive and analytical statistics by SPSS 18.

Results: The mean RTS, NTS, KTS, GAP and GCS values were 6.71±0.47, 6.06±0.34, 8.25±0.96, 77.77±0.96, 22.20±2 and 13.90±1.8, respectively. Moreover, the deceased patients' averages of RTS, NTS and GAP were significantly lower than these averages in the discharged patients. Nonetheless, there was no significant difference between deceased and discharged patients in terms of their average KTS. Moreover, there was no statistically significant difference between the average RTS, NTS, KTS and GAP of the patients who needed surgery and the patients who did not need surgery. In addition, the averages RTS, NTS and GAP of the patients who needed ICU were significantly lower than these averages in patients who did not need ICU. However, there was no significant difference between the average KTS of the patients who needed ICU and the patients who did not need ICU.

Conclusion: The findings of the study show that the deceased trauma patients' RTS, NTS, KTS and GAP were lower than the recovered patients' RTS, NTS, KTS and GAP. This problem can be a risk factor and shows that there is a need for faster treatment of these patients.

Keywords: New trauma score (NTS), Revised trauma score (RTS), Kampala trauma score (KTS), GCS, Age, and systolic blood pressure (GAP), Glasgow Coma Scale (GCS), Trauma.

Introduction

Trauma is an important health problem and is considered to be the main cause of death, especially in adults and adolescents. The reported mortality rate for severely injured patients is still significant and ranges from 7% to 45%.[1] The observed variability in mortality and durability of this health problem among different centers and countries may reflect differences in quality. According to a 20-year study of patients who had a history of multiple trauma, more than half of the patients with multiple trauma suffered from psychiatric complications. These results highlight the importance of this issue.[2] Describing injury severity is very important to the scientific study of trauma. Nonetheless, measuring injury severity dates back to 50 years ago. In 1969, researchers developed the Abbreviated Injury Scale (AIS) to rate the severity of

individual injuries. AIS was revised in 2005. It is based on the Injury Severity Score (ISS), which is the most widely used injury severity score in trauma patients. Attempting to summarize the severity of injury in multiple trauma patients with a single number is difficult. Therefore, several alternative scoring systems have been proposed which have their own problems and limitations.[3,4]

Injury severity scoring may be objectively associated with resource use measures such as length of stay and treatment costs. Moreover, it informs the clinical decisions about the management of injuries with specific severity.[5] However, prediction of trauma mortality in different patients using different scoring systems is limited. That is, in general, this kind of prediction is not better than good clinical judgment. Therefore, decisions on individual patients should never be based solely on the statistical injury severity score. More specifically, the scoring systems are able to quantitatively estimate the level of severity of injured patients. This kind of estimation adjusts the evaluation of hospital results.[6,7]

The Revised Trauma Score (RTS) is one of the most common scores, which are used to measure the functional consequences of an injury. It determines three specific physiological parameters, including Glasgow Coma Scale (GCS), systemic blood pressure, and the number of breaths per minute.[8] The amount of difference in each parameter is obtained from 0-4. RTS has 2 forms based on its applications. That is, when it is used for true triage, the RTS is determined by adding each of the encoded values together. Therefore, RTS ranges from 0 to 12.[9] The calculation of this value is complex. This issue limits its usefulness in this context. The main advantage of the coded RTS is that the weighting of the individual components emphasizes the significant effect of TBI on the outcome. This scale has various limitations that affect its usefulness, and most of these limitations are related to GCS. As mentioned previously, the purpose of GCS was to measure the functional state of the central nervous system.[10] Furthermore, GCS is used by many researchers as a component of trauma severity scoring due to the importance of head injury in determining trauma outcome. One of the inherent problems is inability to accurately score patients who are intubated and receive mechanical ventilation. This kind of scoring is possible in triage. The new trauma score (NTS) is based on revised parameters, including the actual GCS score which is used instead of the GCS code, modified systolic blood pressure that is used for code value, and combination of ambient oxygen saturation (SpO_2) which is used instead of respiratory rate. According to the previous findings, NTS predicts hospital mortality much better than RTS.[11] The GCS, Age, and systolic blood pressure (GAP) scale is another scoring system based on GCS, age, and systolic arterial pressure. If the mechanism criterion is added to it, it can establish the MGAP criterion. The previous results indicate that this criterion predicts trauma patients' mortality more accurately in comparison with the scales.[12] Prediction of mortality in trauma patients has been based on injury severity scoring tool, which focuses on anatomical injury. The review of Kampala trauma score (KTS) criteria shows that injury severity scoring includes physiological information as well as anatomical injury scores which are used for predicting mortality. In this case, the criteria include age, systolic blood pressure upon arrival, respiratory rate upon arrival, level of consciousness, and severity of injury. The comparison between KTS and the other scores has shown that this criterion is much more useful for triage and prioritization under limited-facility conditions. Moreover, it has indicated that KTS is as effective as the other scoring systems for predicting patient mortality.[13]

The successful treatment of severely injured patients depends on the use of techniques for predicting deterioration as well as the grading of patients who suffer from energy deficiency. All of the calculated trauma scoring systems showed significant mortality prediction power in the similar studies that examined 100 multiple trauma patients. GAP score was statistically and significantly selective and sensitive regarding hospital and patient mortality prediction.[14] The results of a study that focused on 285 injured people indicated that the KTS was more effective in predicting patient mortality than the other scoring systems.[15] The results of another study showed that the GAP score was preferable to the previous trauma scoring systems.[16] The importance of time regarding the emergency patients' life preservation, highlights the necessity of developing a scale for identifying the best measures. This study intended to evaluate the RTS, NTS, GAP, and KTS criteria in the case of patients with multiple traumas. Moreover, it aimed to examine the relationships between the above-mentioned criteria and the patients' clinical outcome which includes the need for surgery, mortality in the emergency department, or mortality in the ward. This outcome is determined based on the sensitivity and specificity of these criteria.

Objectives

This study aimed to compare the predictive power of GAP, NTS, RTS, and KTS in the process of hospital

outcome specification of multi-trauma patients who were admitted to Imam Khomeini Hospital in Urmia, Iran.

Methods

In this descriptive-analytical cross-sectional study, 385 patients referred to Imam Khomeini Hospital in Urmia were selected using simple random sampling, like a similar study,[17] in 2023. Moreover, it used an error level of 5%, accuracy of 5% and specificity of 49%, and a sample size of 385 people. In fact, the study was carried out at three stages. The first stage involved stating the entry and exit criteria. Moreover, the second stage encompassed collecting information and calculating the indices (the data were entered into SPSS for calculating the indices). Lastly, the third stage involved comparing the final result with the expected result.

At the beginning of the study, a number of entry and exit criteria were established. The inclusion criteria involved: 1) being a multiple-trauma patient over 18 who was primarily referred to the emergency department by the pre-hospital emergency system or by family members; and 2) being a patient whose GCS and systolic blood pressure were recorded. The exclusion criteria included: 1) being a patient who suffered cardiac arrest when he/she arrived at the emergency room; and 2) being a patient who took anti-hypertensive and anti-depressant drugs.

The data were collected using a checklist that involved information about: 1) GAP criteria which focused on three parameters including Glasgow coma scale, systemic blood pressure, and the number of breaths per minute, 2) RTS criteria [Table 1] which used GCS parameters, systolic blood pressure, and breathing rate; 3) NTS criteria [Table 2] which were based on GCS, systolic blood pressure, and peripheral blood oxygen saturation percentage, and 4) KTS criteria that were calculated based on age, systolic blood pressure, respiratory rate, state of consciousness, and number of injuries.

Table 1. Revised trauma score (RTS) criterion

Coded value	Respiratory rate	Systolic BP (mm hg)	Glasgow coma scale
4	10-29	>89	13-15
3	>29	76-89	9-12
2	6-9	50-75	6-8
1	1-5	1-49	4-5
0	0	0	3

The NTS criterion was determined as follows:

NTS=(0.4006xGCS)+(0.2983xBPNTS)+(0.8709xSpO2NTS)

Table 2. NTS criterion

Coded value	Glasgow coma scale	New trauma scores systolic blood pressure	Oxygen saturation
4	3-15	110-149	94≥
3		150≥	80-93
2		90-109	60-79
1		70-89	40-59
0		<90	<40

GAP was calculated based on the following Table 3. Its maximum score was 25. That is, the lower scores indicated the more adverse patient conditions.

Table 3. GCS, Age, and systolic blood pressure (GAP) criteria

Variable	Scores
Age	
<60	+5
>60	0
Mechanism of trauma	
Blunt trauma	+4
Penetrating trauma	0
Systolic blood pressure	
>120	5
60-120	3

The maximum KTS score was 10, and the higher scores indicated the deterioration of the patient's condition. That is, the scores which were less than 6 showed the severe patient condition. (In fact, this score was determined based on the sum of the scores of age, blood pressure, breathing, state of consciousness, and the number of injuries. It is explained at the bottom of the Table 4.

Table 4. Kampala trauma score (KTS) score

Description	Score
Age (years)	
5-55	1
<5 or >55	0
Systolic blood pressure on admission	
More than 89 mm Hg	2
Between 89 and 50 mm Hg	1
Equal or below 49 mm Hg	0
Respiratory rate on admission	
0-29/min	2
30+	1
<or=9/min	0
Neurological status	
Alert	3
Responds to verbal stimuli	2

Responds to painful stimuli	1
Unresponsive	0
Score for serious injuries	
None	2
One injury	1
More than one	0

Kampala trauma score total=A+B+C+D (Mild: 9-10, Moderate:7-8, Severe:<6)

Statistical analysis

The scores were analyzed based on the clinical outcome of trauma patients that included the need for surgery, mortality in the emergency room, and mortality in the ward. Moreover, descriptive statistics (prevalence, percentage, mean and standard deviation) and analytical statistics (regression, rock curve calculated by this curve, sensitivity, specificity, and area under the curve) were used to analyze the data. All statistical analyses were performed with SPSS (version 18.0, SPSS Inc, Chicago, IL, USA). A "P-value" less than 0.05 was considered significant.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval (code: IR.UMSU.HIMAM.REC.1401.020) was obtained. That is, the Vice-Chancellor for Research of Urmia University of Medical Sciences contacted Imam Khomeini Hospital (RA) and provided the relevant officials with information about the aim and procedure of the study. These officials were assured that the information on the checklists would be confidential. The present study did not interfere with the process of diagnosis and treatment of patients and all participants signed an informed consent form.

Results

The results of this study showed that 323 (83.9%) of the 385 patients who took part in this study were men and 62 (16.1%) of them were women. Moreover, the mean age of the patients was 39.95±17.31 years. The mean number of respiratory movements, systolic blood pressure, diastolic blood pressure, and SPO_2 were 16.65±2.28, 125.4±17.02 mm Hg, 79.8±11.71 mm Hg, and 96.3±2.3 percent, respectively. Furthermore, the mean RTS, NTS, KTS, GAP and GCS were 6.71±0.47, 6.06±0.34, 8.25±0.96, 22.20±2.77 and 13.90±1.8, respectively. The mean lengths of hospitalization in ICU, ward and emergency department were 1.2±0.2, 2.91±2.82 and 1.04±0.25, respectively. Lastly, 58 patients (15.1%) needed surgery, 13 patients (3.4%) died) and 37 patients (9.6%) needed hospitalization in ICU [Table 5].

Table 5. Hospital characteristics of the participants of the study (n=323)

Variable	subgroup	Mean±standard deviation	Minimum	Maximum
Vital Signs	The number of respiratory movements	16.65±2.28	11	20
	Systolic blood pressure	125.4±17.02	50	18
	Diastolic blood pressure	79.8±11.71	40	116
	SPO2	96.3±2.3	85	99
The soothsayers	RTS	6.71±0.47	5.08	6.94
	NTS	6.06±0.34	5.01	6.28
	KTS	8.25±0.96	7	10
	GAP	22.20±2.77	13	25
	GCS	13.90±1.8	3	15
Hospitalization period	Hospitalized in ICU (n=37)	1.2±0.2	1	6
	Hospitalized in ward (n=156)	2.91±2.82	1	13
	Hospitalized in the emergency room (n=385)	1.04±0.25	1	2

Kampala trauma score: KTS; Revised trauma score: RTS; New trauma score: NTS; Glasgow Coma Scale: GCS; GCS, Age, and systolic blood pressure: GAP.

The results showed that there was not a statistically significant difference between the mean RTS, NTS, KTS and GAP of the patients who needed surgery and the patients who did not need surgery. The deceased patients' means of RTS, NTS and GAP were significantly lower than discharged patients' RTS, NTS and GAP means. Nonetheless, there was not a statistically significant difference between the mean KTS of the patients who died and the patients who were discharged. The mean RTS, NTS, and GAP of the patients who needed ICU were significantly lower than the mean RTS, NTS, and GAP of the patients who did not need ICU. Furthermore, there was no statistically significant difference between the mean KTS of the patients who needed ICU and the patients who did not need ICU [Table 6].

Table 6. Correlations between GAP, KTS, RTS, NTS criteria scores and mortality, need for surgery, and hospitalization in ICU

Variable	Subgroup (mean±standard deviation)			
	RTS	NTS	KTS	GAP
In need of surgery	6.73±0.52	6.05±0.35	8.13±0.82	22.46±2.63
Not in need of surgery	6.71±0.46	6.07±0.34	8.27±0.99	22.15±2.8
p-value	0.74	0.71	0.30	0.43
Deceased	5.65±0.47	5.18±0.23	8.07±0.86	15.76±4.32
discharged	6.75±0.43	6.09±0.3	8.26±0.97	22.42±2.42
p-value	<0.001	<0.001	0.49	<0.001
In need of ICU	6.46±0.67	6.46±0.67	8.56±0.95	20.37±4.67
Not in need of ICU	6.74±0.44	6.74±0.44	8.22±0.96	22.39±2.42
P value	<0.001	<0.001	0.06	<0.001

Kampala trauma score: KTS; Revised trauma score: RTS; New trauma score: NTS; Glasgow Coma Scale: GCS; GCS, Age, and systolic blood pressure: GAP.

The areas under the curve (AUC) for the RTS, NTS, KIS and GAP scoring criteria were 0.06, 0.036, 0.47 and 0.102, respectively. The low level under the curve for scoring criteria indicated that these criteria were not able to predict the multiple trauma patients' mortality [Table 7].

The AUC of the RTS, NTS, KTS and GAP scoring criteria were 0.52, 0.49, 0.47, and 0.53, respectively. The low level under the curve for scoring criteria indicated that these criteria were not able to predict the multiple trauma patients' need for surgery [Table 8].

The AUC for the RTS, NTS, KIS and GAP scoring criteria were 0.52, 0.49, 0.47 and 0.53, respectively. The low level under the curve for scoring criteria showed that these criteria were not able to predict the multiple trauma patients' need for ICU [Table 9].

Table 7. Determining the diagnostic values of NTS, RTS, KTS, GAP for determining multiple trauma patients' mortality

Criterion	Statistics				
	AUC	Cut of point	Sensitivity	Specificity	P-Value
RTS	0.06	5.27	0.61	0.97	<0.001
NTS	0.036	5.09	0.38	0.98	<0.001
KTS	0.47	7.5	0.69	0.83	0.73
GAP	0.102	16.5	0.30	0.97	<0.001

Kampala trauma score: KTS; Revised trauma score: RTS; New trauma score: NTS; Glasgow Coma Scale: GCS; GCS, Age, and systolic blood pressure: GAP.

Table 8. Determining the diagnostic value of NTS, RTS, KTS, GAP for determining multiple trauma patients' need for surgery

Criterion	Statistics				
	AUC	Cut of point	Sensitivity	Specificity	P-Value
RTS	0.52	5.27	0.93	0.97	0.55
NTS	0.49	5.04	0.98	0.93	0.84
KTS	0.47	7.5	0.82	0.86	0.50
GAP	0.53	16.5	0.95	0.94	0.44

Kampala trauma score: KTS; Revised trauma score: RTS; New trauma score: NTS; Glasgow Coma Scale: GCS; GCS, Age, and systolic blood pressure: GAP.

Table 9. Determining the diagnostic values of GAP, KTS, RTS, NTS for determining multiple trauma patients' need for ICU

Criterion	Statistics				
	AUC	Cut of point	Sensitivity	Specificity	P-Value
RTS	0.52	5.27	0.93	0.97	0.55
NTS	0.49	5.04	0.98	0.97	0.84
KTS	0.47	7.5	0.86	0.82	0.5
GAP	0.53	16.5	0.94	0.95	0.44

Kampala trauma score: KTS; Revised trauma score: RTS; New trauma score: NTS; Glasgow Coma Scale: GCS; GCS, Age, and systolic blood pressure: GAP.

Discussion

Trauma is one of the main causes of premature deaths worldwide. Improvements in hospital and pre-hospital care and procedures can reduce trauma-related deaths.[18] Trauma is a time-dependent condition. The management, resuscitation, and examination of the patients' condition in the early hours of trauma are very important. Examining the severity of patients' trauma includes the scrutiny of the clinical findings, previous anatomical problems, mechanism of injury, and the patients' health level before the accident.[17,19] Easy trauma scoring systems can help the doctor to use a specific and appropriate method of managing trauma patients. These scoring systems can help the treatment staff at two stages. First, they can help the staff to decide on patient transfers before sending the patients to the trauma center. Second, they can assist the staff to make clinical decisions immediately after the patients' arrival at the trauma center. Moreover, these systems can help the staff to prepare patients in the emergency department for transfer to the operating room or to inform the patients' families about the severity of the injury.[20]

This study was conducted to determine the predictive values of GAP, NTS, RTS, and KTS indicators for determining the hospital outcome of multi-trauma patients who were admitted to Imam Khomeini Hospital in Urmia. Based on the results, the deceased patients' diagnostic criteria scores were lower that the recovered patients' diagnostic criteria scores.

In our study, the mean age of patients was 39.95 ± 17.31 years. Moreover, 83.9% of the participants were men. Mohammadian et al.,[21] conducted a cross-sectional study in 2013 in Iran in order to compare RTS and ISS ratings in multi-trauma patients for predicting their chances of survival. The patients' mean age was 23.5 years. Furthermore, 81.4% of patients were male. The mean age of patients in the above-mentioned study was lower than the mean age of the participants in our study. Nonetheless, similar to the results of our study, most of the patients were male. Khosravi et al., carried out a study,[22] in order to investigate the outcome of trauma. The study used the Trauma and Injury Severity Score (TRISS) criteria. Similar to our study, the number of men was more than the number of women. The results of this study were in line with the results of our study and showed that proper planning was necessary to prevent injuries and to treat them quickly.

Farzad Rahmani et al.,[17] conducted a study to compare MGAP and GAP for predicting multiple-trauma patients' prognosis. The mean age of the examined population was 40.42 years. Men and women constituted 82.1% and 17.9% of the population, respectively. The mean age of the participants of their study was close to the mean age of the participants of the present study. Furthermore, similar to our study, the majority of patients with multiple-trauma were male. Kondo et al.,[20] conducted a study in 2011 for examining the ease of use of the new scoring criteria compared to the scoring criteria in multiple-trauma patients. The mean age of the patients was 51.2 years. Moreover, in this study, 68.9% of patients were male. The reasons behind the higher mean age and the lower percentage of men (despite being more than women) in this study compared to our study, may stem from the difference in their examined populations. Moreover, Imam Khomeini hospital in Urmia is the trauma center of West Azarbaijan Province in Iran and all of the patients are referred to this hospital under random conditions.

In the present study, the mean numbers of respiratory movements, systolic blood pressure, diastolic blood pressure and SPO_2 were 16.65±2.28, 125.4±17.02 mmHg, 79.8±11.71 mm and 96.3 ± 2.3%, respectively. Moreover, 58 patients (15.1%) needed surgery, 13 patients (3.4%) died, and 37 patients (9.6%) needed hospitalization in ICU. In Rahmani et al.'s study[17] the mean GCS was equal to 12. Furthermore, the mortality rate in the ward and emergency department was 17.1%. This rate was higher than the rate which was obtained in our study. In Akhavan and Mohammadian's study,[21] the mortality rate was 15.17%. This rate is higher than the rate in the present study. Moreover, in Kondo et al.'s study,[20] the patients' mortality rate in the emergency department was equal to 5.4%. This rate is close to the relevant rate in our study. Furthermore, in the above-mentioned study, the examination of the vital signs showed that the mean systolic blood pressure was 125.3 mmHg. The systolic blood pressure in this study was close to the systolic blood pressure in our study. The main reason behind the difference between the results of our study and the results of the other studies may be the difference in their population characteristics (e.g., age, gender, and number of injuries) and their location.

In the present study, the mean RTS, NTS, KTS, GAP and GCS were 6.71±0.47, 6.06±0.34, 8.25±0.96, 22.20±2.77, 22.20±0.96 and 13.90±1.8, respectively. Moreover, the deceased patients' mean RTS, NTS and GAP were significantly lower than the discharged patients' RTS, NTS and GAP. Nonetheless, there was not a statistically significant difference between the deceased and discharged patients' mean of KTS. Furthermore, there was not a statistically significant difference between the mean

RTS, NTS, KTS and GAP of the patients who needed surgery and the patients who did not need surgery. In addition, the mean RTS, NTS and GAP of the patients who needed ICU were significantly lower than the mean RTS, NTS and GAP of the patients who did not need ICU. However, there was not a significant difference between the mean KTS of the patients who needed ICU and the patients who did not need ICU. Finally, based on the results, none of the criteria was effective in evaluating the trauma patients' outcome.

Based on the results of the study that was conducted by Weeks et al., anatomy-based ISS, NISS, and scores calculated based on KTS were the predictors of mortality.[13] In Kondo et al.'s study,[20] the mean GAP and RTS were 23.5 and 6.9, respectively. These results are almost the same as the results of our study. In Khosravi et al.'s study,[22] the patients' mean RTS was 6.7. This score was lower than the score in our study. Khosravi et al.'s study was similar to our study and showed that there was a significant difference between the deceased and discharged people' RTS. Garkaz et al., carried out a study to determine the hospitalized traffic accident victims' survival and to evaluate the quality of hospital care using the TRISS method. Based on the results, living people's mean RTS was 7.67. On the other hand, the deceased people's mean RTS was 6.000. These results are similar to the results of the present study.[23] These issues highlight the need to pay attention to deceased patients more quickly, because their diagnostic indicators were lower than the other patients' indicators.

One of the strengths of this study was its setting and its population. More specifically, it was not conducted at the university setting, and did not focus on trauma patients whose treatment was necessary and vital due to their high probability of death in untreated cases. On the other hand, one of the limitations of this study was its data source since some files were incomplete and illegible and were removed from the study. Moreover, most of the files were examined by the emergency medicine specialists to ensure the accuracy of their registration. The future studies should have larger samples and need to focus on the other diagnostic criteria. Moreover, they have to be conducted in other settings. Furthermore, they should be carried out in big cities and in several hospitals. That is, they should compare their data on all of the hospitals with each other to achieve better results.

Conclusions

The findings of the present study showed that the deceased patients had a lower score on the diagnostic criteria. Therefore, we should use these criteria to diagnose the patients' condition in a faster way and to prioritize their care. Moreover, the emergency personnel should be provided with the necessary training.

Acknowledgment

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Competing interests

The authors declare that they have no competing interests.

Abbreviations

Injury severity scores: ISS;
New injury severity scores: NISS;
Areas under the curve: AUC;
Abbreviated Injury Scale: AIS;
Trauma and Injury Severity Score: TRISS;
Kampala trauma score: KTS;
Revised trauma score: RTS;
New trauma score: NTS;
Glasgow Coma Scale: GCS;
GCS, Age, and systolic blood pressure: GAP.

Authors' contributions

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.

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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.UMSU.HIMAM.REC.1401.020) 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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