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Accuracy of Kampala Trauma Score as a Predictor in Assessing the Prognostic Value of Multiple Trauma

Nurhayat Usman,[1] Tommy Ruchimat,[1] Andhika Rahmawan[2]
[1]Division of Digestive Surgery, Department of General Surgery, Faculty of Medicine, Universitas Padjadjaran/ Dr. Hasan Sadikin General Hospital, Bandung, Indonesia
[2]General Surgery, Faculty of Medicine, Faculty of Medicine, Universitas Padjadjaran/Dr. Hasan Sadikin General Hospital, Bandung, Indonesia

Abstract

Determining a trauma scoring system appropriate for certain conditions will help in predicting mortality and morbidity, and can determine the need for treatment in patients. Kampala Trauma Score (KTS) is a trauma scoring system that uses a decent number of assessment variables and can be used in all general groups. This study was a retrospective prognostic test conducted in Dr. Hasan Sadikin Hospital Bandung, Indonesia, from December 2021 to July 2022. Data obtained was processed using Microsoft Excel and SPSS spreadsheets. The respondents were 66 people with multiple trauma. Results showed that this study was dominated by patients with blunt trauma (n=63, 95.45%). The mean KTS score in this study was 13.08±1.03. In 49 (74.24%) patients who survived, the mean KTS score was 13.41±0.89 and in 17 (25.76%) patients who died, the mean KTS score was 12.12±0.79. The greatest mortality accuracy was at the cutoff point of the KTS score >12 (81.82% accuracy; 70.59% sensitivity; 85.71% specificity). The accuracy value of the KTS score is in line with the ROC where the optimal KTS score is >12 (85.77%). In conclusion, the Kampala trauma score can be used as a predictor in assessing the prognostic value of multiple trauma patients with the obtained cut-point value as it has high accuracy, sensitivity, and specificity values.

Keywords: Accuracy, KTS, multiple traumas, trauma scoring

Introduction

Trauma is an important health problem in developing countries.[1] Deaths caused by trauma are still high and even increasing in the world.[2] The most common cause of trauma is traffic accidents.[3] It is estimated that the number of deaths from traffic accidents is one million deaths each year, with 20 to 50 million serious injuries annually. Trauma is the main cause of death in Indonesia in the age group of 15–24 years and the number two in the age group of 25–34 years.[4] According to data from Police Department of Indonesia, in 2015 there were 38,279 cases of road accidents with the most victims in the 15–55-year age group. The trauma that occurs often involves several regions of the body, which is referred to as multiple traumas.[5]

Multiple trauma is an injury to two or more organ systems with a fairly high degree of injury and is accompanied by a systemic reaction to life-threatening trauma.[6] The incidence of trauma is increasing along with the increasing number of motorized vehicle users who do not obey traffic signs and do not comply with the use of complete personal protective equipment.[6] Previous studies explained that there were 126 multiple trauma patients with a mortality of 16.6%.[6] The majority of trauma patients (50–60%) die on the way to the hospital.[3] Previous studies also explained deaths in trauma patients were divided into 3 categories, namely immediate death (45%), early death within 1–4 hours (34%), and late death over 1 week (20%). Each category has a different cause of death, namely trauma to the central nervous system and cardiovascular system in immediate and early death, then late death, mostly due to systemic complications such as sepsis or multiple organ failure.[7] Estimating the severity of trauma is a good strategy, not only for

Corresponding Author:
Andhika Rahmawan
General Surgery, Faculty of Medicine, Faculty of Medicine, Universitas Padjadjaran/Dr. Hasan Sadikin General Hospital, Bandung, Indonesia
Email: andhikarahmawan91@gmail.com

estimating mortality but also for determining the need for patient care on admission. Estimating the severity of this trauma, will not only reduce mortality and morbidity but can also reduce complications that can result from the trauma itself.[8]

To estimate the severity of the trauma, many studies have developed a scoring system or trauma assessment. This trauma scoring system has a significant function to predict prognosis and can determine the appropriate treatment.[2] Several scoring systems have been successfully developed in the last few decades. The trauma scoring system is divided into several types, including the anatomical trauma scoring system, such as the Injury Severity Score (ISS). Then the physiological trauma scoring system, such as the Revised Trauma Score (RTS), and the mixed trauma scoring system, namely the Trauma and Injury Severity Score (TRISS) and the Kampala Trauma Score (KTS).[9]

Kampala Trauma Score (KTS) is a trauma scoring system that focuses on assessing the patient's body physiology compared to the patient's anatomy. KTS was created and developed in a developing area, where access to technology is still limited to carry out an accurate evaluation of the patient's anatomical factors.[10] According to a study conducted by Manoochehry et al., This scoring system has a sensitivity of 88% and a specificity of 73%. the positive-likelihood ratio is 8.90, and the negative-likelihood ratio is 0.16.[11] Although the KTS was developed to simplify the way of predicting mortality in low-middle income countries, from the meta-analysis studies conducted, this scoring system has higher accuracy than the RTS scoring system.[11] The KTS scoring system is easy to use without the need for special needs, such as expertise, and injury flashbacks. So that KTS is very possible and can be used as a first line in triage, this scoring system can be used to predict mortality and the need for hospitalization.[11, 12]

Determining a trauma scoring system that is appropriate for certain conditions will help in predicting mortality and morbidity and can determine the need for treatment in patients.[12] Until now, there have been no studies assessing the prognostic ability of the KTS system in Dr. Hasan Sadikin General Hospital Bandung, so no data are showing the sensitivity, specificity, or ability to determine the prognosis of KTS in Dr. Hasan Sadikin General Hospital Bandung. therefore, this study was conducted. This study aims to determine the accuracy of KTS in assessing the prognostic value of multiple trauma patients at Hasan Sadikin Hospital Bandung.

Methods

This study is a prognostic study with a retrospective cohort design to determine the sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and mortality calculated from the KTS scoring system. The subject of the study was the medical records of multiple trauma patients who came to Dr. Hasan Sadikin General Hospital Bandung from 2017 to 2021 and who met the inclusion criteria.

The inclusion criteria in this study were the patient suffered from trauma to more than one organ, the wound was serious (reversible wound, but requires hospitalization), severe (life-threatening wound, and will not heal if not given treatment), critical (threatening mental health and not necessarily cured even though medical treatment is given), the patient is >18 years old, and the onset of trauma is less than 24 hours from the occurrence of the trauma. Exclusion criteria in this study were trauma patients who had a history of comorbid disease, patients in a triad of death condition when they arrived, including coagulopathy, hypothermia, and metabolic acidosis, patients who had been resuscitated in a previous health facility, and incomplete medical record data.

The sample size based on the rule of thumb in our study requires at least 60 medical records. The data taken are secondary data from patients with multiple trauma who come to Dr. Hasan Sadikin General Hospital Bandung, namely through medical records. Data taken in the form of age, gender, age, level of consciousness (GCS and AVPU), blood pressure, respiratory rate, and also the number of serious injuries assessed by several even numbered interterraters, at least 2 people. Furthermore, data on the comorbidities that exist in the patient is carried out, to reduce bias in the study. The data obtained was processed by editing, coding, data entry, and cleaning stages using Microsoft Excel spreadsheets and SPSS for Windows with a value < 0.05 showing a significant result.

The research was conducted at Dr. Hasan Sadikin General Hospital Bandung from December 2021 to July 2022. The research has received ethical clearance number: LB.02.01/X.6.5/46/2022 from the Health Research Ethics Committee of Dr. Hasan Sadikin General Hospital Bandung.

Results

The number of samples in this study was 66 patients who met the inclusion criteria. The sample consisted of 58 men (87.88%) and 8 women (12.12%). The average age in the study sample was 33.32±17.40 with the youngest age being 16 years old and the oldest being 93 years old. The largest age group is in the range of 16-25 years. The type of trauma was dominated by blunt trauma as many as 63 patients or 95.45%. The mean KTS score in this study was 13.08±1.03.

The number of samples with living outcomes of as many as 49 (74.24%) and dead outcomes of as many as 17 samples (25.76%). The male sex group consisted of 43 living outcomes (65.14%) and 15 dead outcomes (22.73%) while 6 samples (9.09%) were alive and 2 samples (3.03%) died. The living group had a mean age of 32.65±18.22 years and the dead group had a higher mean age of 35.24± 5.14 years. Out of life with blunt trauma as many as 46 samples (69.70%) and sharp trauma by 3 samples (4.55%) while the outcome of death all had blunt trauma type as many as 17 samples (100.00%). The KTS score on the live outcome had an average of 13.41±0.89 while the dead outcome had a KTS mean of 12.12±0.78.

The KTS score had a significant relationship with patient outcomes with $p < 0.001$ with a mean value of 13.41±0.89 on survival and 12.12±0.78 of death. The variable that has a significant relationship with patient outcomes is GCS/AVPU with $p<0.001$. The GCS score on the live outcome had a mean of 12.94±2.45 and that of the dead outcome had an average of 6.35±2.09. The AVPU variable had a mean outcome of 3.57±0.71 for living patients and 1.94±0.24 for dead patients. Other variables, namely age, systolic blood pressure, and respiratory rate were not significantly related to the patient's outcome in this study with p-values of 0.570, 0.851 and 0.249, respectively.

In the age variable, the sample with a live outcome had a mean age of 32.65±18.22, while the sample with a dead outcome had a mean age of 35.24±15.14. Systolic blood pressure in living patients had a mean of 112.24±22.104 while the mean of dead patients was 111.18±9.33. The respiratory rate in the living patients had a mean of 22.29±3.70 and in the dead patients it was 23.41±3.30.

The greatest accuracy is at the cut-off point of the KTS score > 12 with an accuracy of 81.82%, sensitivity 70.59%, specificity 85.71%, PPV 63.16%, NPV 89.63%, LR+ 4.94, and LR- of 0.34.

The greatest accuracy value is also in line with the ROC as shown in Figure 1, namely the most optimal cut-off point is in the KTS score > 12 with an AUC value of 85.77% which shows the KTS score has a high accuracy prediction on the mortality of multiple trauma patients.

The optimal cutoff value can be seen based on Figure 2, which is found that the cutoff value between sensitivity and specificity is at COV 12 and 13. respectively, by 100% and 55.10% so the optimal cut-off point for KTS is 12, which means that patients with KTS >12 have a good prognosis and KTS 12 have a poor prognosis.

On table 5 in the 2x2 chi-square calculation with COV KTS 13, the P value is <0.0001. This shows that there is a correlation between patient outcomes and the cutoff value of KTS 13.

Table 1 KTS Scoring

Description	Score
Age (in years)	
5–55	2
<5 or >55	1
Systolic blood pressure on admission (mmHg)	
>89	4
50–89	3
1–49	2
Undetectable	1
Respiratory rate (breath per minute)	
10–29	3
≥ 30	2
≤9	1
Neurological status (AVPU system)	
Alert	4
respond to Verbal	3
respond to Pain	2
Unresponsive	1
Number of serious injuries	
None	3
1	2
≥2	1

Table 2 Characteristics of Research Patients

Characteristics	Life	%	Death	%	Total	%
Gander						
Male	43	65.15	15	22.73	58	87.88
Female	6	9.09	2	3.03	8	12.12
Age (years)*	32.65 ± 18.22		35.24 ± 15.14		33.32 ± 17.40	
16–25	26	39.39	7	10.61	33	50.00
26–35	7	10.61	2	3.03	9	13.64
36–45	5	7.58	4	6.06	9	13.64
46–55	4	6.06	2	3.03	6	9.09
56–65	4	6.06	1	1.52	5	7.58
>65	3	4.55	1	1.52	4	6.06
Type of Trauma						
Blunt	46	69.70	17	25.76	63	95.45
Sharp	3	4.55	0	0.00	3	4.55
KTS Score*	13.41 ± 0.89		12.12 ± 0,78		13.08 ± 1.03	
Patient outcome						
Life					49	74.24
Death					17	25.76

*Average ± Standard Deviation

Discussion

All samples were grouped based on their prognoses, namely alive and dead to be tested for sensitivity, specificity, NPV, PPV, LR+, LR-, and cut-off value (COV) of KTS scores as predictors of the prognosis of multiple trauma patients. The KTS score was chosen because the trauma scoring system focuses on assessing the patient's body physiology compared to the patient's anatomy. KTS was created and developed in a developing area, with limited access to technology to carry out an accurate evaluation of the patient's anatomical factors.[2] KTS was developed to simplify the way of predicting mortality in low-middle income countries, but from the meta-analysis studies conducted, this scoring system has higher accuracy than the RTS scoring system, because KTS has a significantly higher sensitivity than RTS. The RTS also has a>

Table 3 The Relationship of the Composing Variables of KTS with Patient Outcomes

Variable	Life	Death	P value*
Age			
Average ± SD	32.65 ± 18.22	35.24 ± 15.14	0.570
Systolic BP			
Average ± SD	112.24 ± 22.104	111.18 ± 19.33	0.851
GCS			
Average ± SD	12.94 ± 2.45	6.35 ± 2.09	0.001
AVPU			
Average ± SD	3.57 ± 0.71	1.94 ± 0.24	0.001
RR			
Average ± SD	22.29 ± 3.70	23.41 ± 3.30	0.249
KTS			
Average ± SD	13.41 ± 0.89	12.12 ± 0.78	0.001

*T-test

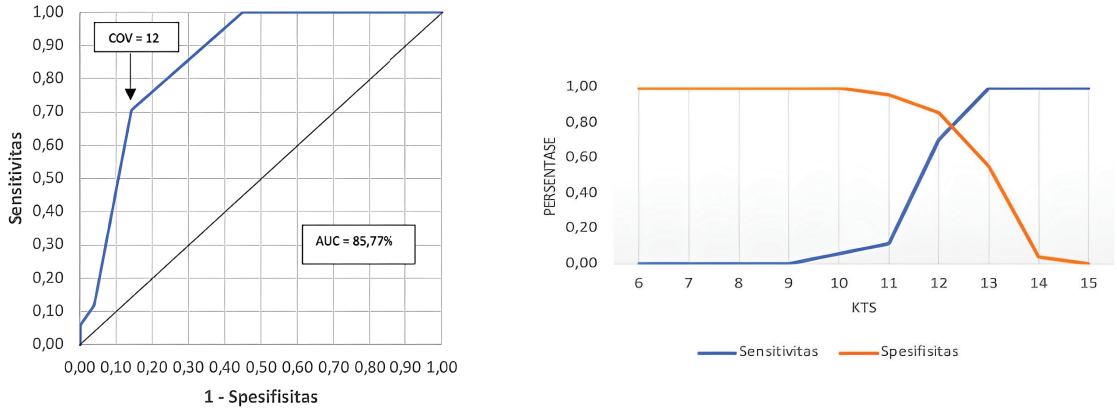

Figure 1 (a) ROC KT Score with Multiple Trauma Patient Outcomes (b) Optimal Cut-Off Point of KTS on Sensitivity and Specificity Of Outcome In Multiple Trauma Patients

Table 4 KTS scoring system diagnostic accuracy

KTS (Score)	Accuracy	Sensitivity	Specificity	PPV	NPV	LR+	LR-
>6	74.24%	0.00%	100.00%	-	74.24%	-	1.00
>7	74.24%	0.00%	100.00%	-	74.24%	-	1.00
>8	74.24%	0.00%	100.00%	-	74.24%	-	1.00
>9	74.24%	0.00%	100.00%	-	74.24%	-	1.00
>10	75.76%	5.88%	100.00%	100.00%	75.38%	-	0.94
>11	74.24%	11.76%	95.92%	50.00%	75.81%	2.88	0.92
>12	81.82%	70.59%	85.71%	63.16%	89.63%	4.94	0.34
>13	66.67%	100.00%	55.10%	43.59%	100.00%	2.23	0.00
>14	28.79%	100.00%	4.08%	26.56%	100.00%	1.04	0.00
>15	25.76%	100.00%	0.00%	25.76%	-	1.00	-

KTS: Kampala Trauma Score; PPV: Positive Predictive Value; NPV: Negative Predictive Value; LR: Likelihood Ratio

45-degree diversion from the calibration line on the comparison chart for trauma severity measurements.[9] This KTS scoring system is easy to use without requiring special needs, such as experts, injury flashbacks, so that KTS is very possible and can be used as a first line in triage, besides this scoring system can be used to predict mortality and the need for hospitalization.[9, 10]

A scoring system to predict mortality that is easy to do is needed because multiple trauma has a high mortality rate.[6] The multiple trauma mortality rate found in this study was 25.8% higher than that reported by the previous study by 16.6%. In the same previous study, there were more patients with multiple trauma who met the inclusion criteria than in this study, 126 patients

Table 5 Relationship between COV 12 KTS and Patient Outcome

Variable	Output		P value*
	Death	Alive	
KTS ≤ 12	12 (0.18%)	7 (0.11%)	
KTS > 12	5 (0.07 %)	42 (0.64%)	<0.0001
Total	17	49	

*Chi-Square Test

and 66 patients, respectively.[6]

The KTS score ranges from 5-16, with the most reported score being a perfect score of 16. In other words, the patient has normal physiological parameters, ages 5–50, and there are no serious injuries. KTS scores have a distribution that is generally skewed to the left (dominated by data that is closer to physiological normal than close to trauma classification) as in previous studies.[1] This also happened in the results of this study, the KTS score was distributed to the left with the highest score being at KTS 14 and followed by KTS 13 and 12.

In conducting the KTS score validation test, we first tested the sensitivity and specificity of the COV KTS scores ranging from 6 to 15. Then, this study also analyzed the sensitivity and specificity values in this study with those of previous studies. Based on research from Macleod et al. obtained COV 13 with sensitivity and specificity of 92.1% and 47.3% respectively, while in this study with COV 13 the sensitivity and specificity were 100% and 55.1%, respectively.[1] Then based on research from Oluwadiya et al. The optimal COV in this study was 12 with a sensitivity of 100% and a specificity of 70.7%, while with a COV of 12 in this study, a sensitivity of 70.59% and a specificity of 85.71% were obtained.[13] Previous study also obtained the most optimal COV value is 12 with a sensitivity of 90% and specificity of 88%.[10] In another previous study also obtained a sensitivity of 66.07% and a specificity of 77.55%.[14]

Then, we determine the most optimal COV in this study using the ROC curve. Analysis of the ROC curve shows that the optimal COV in this population is a KTS score > 12 and has an AUC of 85.77% with a sensitivity and specificity of 70.59% and 85.71%, respectively, and has an accuracy of 81.82%. When compared to the meta-analysis conducted by Manoochehry et al.[11] which has a sensitivity of 88% and a specificity of 73%, the sensitivity value in this study is lower and the specificity value is higher.The LR+ value in this study was strengthened compared to the meta-analysis from 3.30 to 4.94 even though both had a small increase in the output, while the LR- value was attenuated from 0.16 which was a moderate increase to 0.34 which is a small increase. The odds ratio (OR) obtained in this study shows that the group of patients with KTS > 12 will have a mortality rate of 14.4 times greater than that of patients with KTS 12. The odds ratio is smaller than the meta-analysis conducted by Manoochehry et al. with an OR value of 20.[11] The PPV value in this study with COV 12 was obtained at 63.16% so that it showed the ability of KTS in predicting the outcome of death when KTS >12 was 63.16% while the NPV value was obtained at 89.63% so that it showed the ability of KTS in predicting the outcome of life when KTS 12 of 89.63%. These results indicate that COV 12 has high accuracy, sensitivity, specificity, PPV, NPV, LR+, and LR- so it can be used as a predictor of prognosis for multiple trauma patients.

The advantage of this research is that it is carried out at the referral hospital of West Java Province so that it can describe the population in West Java and in the future the results of this study can also be used clinically West Java Province, especially in type C network hospitals because the Kampala trauma score is simple and easy to apply. However, this study has limitations, namely that the sample is not large enough to provide a possible mortality percentage that cannot describe the level of mortality in the population. The severity of the patients included in the study also did not vary as indicated by the sample that was only in the KTS range of 10 to 15 while the KTS with scores <10 and 16 had 0 samples which certainly affected the sensitivity, specificity, and accuracy of the research results.

The Kampala trauma score can be used as a predictor in assessing the prognostic value of multiple trauma patients with the cut-point value that has been obtained because it has high accuracy, sensitivity, specificity, PPV, NPV, and LR values. The KTS value with a cut-off point of 12 can be used as a reference for predicting patient mortality. Clinicians can use the Kampala trauma score in determining the prognosis of multiple trauma patients in areas with inadequate equipment. There is a need for further research with a larger number of samples and a more diverse population and a more proportional number of outcome samples, and the need for an assessment of critical and fatal injuries to Kampala's scoring.

References

1. MacLeod JBA, Kobusingye O, Frost C, Lett R, Kirya F, Shulman C. A comparison of the Kampala Trauma Score (KTS) with the revised trauma score (RTS), injury severity score (ISS) and the TRISS method in a Ugandan Trauma Registry. Eur J Trauma. 2003;29(6):392–8.
2. Banin SR, Yueniwati Y, Utami YW. comparison of trauma scoring ability to predict survival rate in countries with low to middle-income.

Int J Sci Society. 2020;2(4):194–206.
3. Bozorgi F, Mirabi A, Chabra A, Mirabi R, Hosseininejad S-M, Zaheri H. Mechanisms of traumatic injuries in multiple trauma patients. INTJMI. 2018;7(2):7–15.
4. Ramadiputra G, Ismiarto Y, Herman H. Survey penyebab kematian berdasarkan prosedur advance trauma life support (ATLS) pada pasien multiple trauma di instalasi gawat darurat (IGD) bedah rumah sakit Hasan Sadikin Bandung Periode Januari – Juli 2014. Syifa'MEDIKA:Jurnal Kedokteran dan Kesehatan. 2018;9:10.
5. Gaol HRJL, Wiargitha K, Widiana GR. Korelasi antara parameter faal hemostasis dan kadar serum laktat sebagai indikator mortalitas pada pasien multiple trauma di Rumah Sakit Umum Pusat Sanglah Denpasar, Bali-Indonesia. Intisari Sains Medis. 2020;11(2):429–33.
6. Setiawan G, Murni TW, Nusjirwan R, Sobarna R. Perbandingan sensitivitas dan spesifisitas lung organ failure score (LOFS) dan thoracic trauma severity score (TTSS) terhadap pemakaian ventilator pada pasien trauma multipel disertai trauma tumpul toraks. Jurnal llmu Bedah Indonesia. 2019;47(1):69–85.
7. Pfeifer R, Teuben M, Andruszkow H, Barkatali BM, Pape HC. Mortality patterns in patients with multiple trauma: a systematic review of autopsy studies. PLoS One. 2016;11(2):e0148844.
8. Valderrama-Molina CO, Giraldo N, Constain A, Puerta A, Restrepo C, León A, et al. Validation of trauma scales: ISS, NISS, RTS and TRISS for predicting mortality in a Colombian population. Eur J Orthop Surg Traumatol. 2017;27(2):213–20.
9. Hung YW, He H, Mehmood A, Botchey I, Saidi H, Hyder AA, et al. Exploring injury severity measures and in-hospital mortality: A multi-hospital study in Kenya. Injury. 2017;48(10):2112-8.
10. Weeks SR, Stevens KA, Haider AH, Efron DT, Haut ER, MacKenzie EJ, et al. A modified Kampala trauma score (KTS) effectively predicts mortality in trauma patients. Injury. 2016;47(1):125–9.
11. Manoochehry S, Vafabin M, Bitaraf S, Amiri A. A Comparison between the ability of Revised Trauma Score and Kampala Trauma Score in predicting mortality; a meta-analysis. Arch Acad Emerg Med. 2019;7(1):e6.
12. Mukonkole SN, Hunter L, Möller A, McCaul M, Lahri S, Van Hoving DJ. A comparison of trauma scoring systems for injuries presenting to a district-level urban public hospital in Western Cape. S Afr J Surg. 2020;58(1):37–42.
13. Gardner A, Forson PK, Oduro G, Stewart B, Dike N, Glover P, et al. Diagnostic accuracy of the Kampala Trauma Score using estimated Abbreviated Injury Scale scores and physician opinion. Injury. 2017;48(1):177–83.
14. Salim C. Sistem penilaian trauma. Cermin Dunia Kedokteran. 2015;42(9):702–9.