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RESEARCH ARTICLE

COMPARATIVE ANALYSIS OF SOFA VS. SAPS-II SCORE IN ASSESSING MORTALITY IN POLYTRAUMA PATIENTS FOR QUALITY MANAGEMENT

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Abstract

Background: The rise in severe combined traumas, underscores the need for accurate trauma assessment. The urgency to determine diagnoses and treatments for a variety of bodily injuries and disorders in polytrauma cases highlights the necessity for a robust classification system to evaluate trauma severity. Thus, the study aimed to assess the predictive value of the SOFA and SAPS II systems in evaluating mortality among polytrauma patients.

Materials and Methodology: In this single centre prospective study, a total of 200 patients with injuries in at least two regions and an ISS > 16 were included. Demographic information and variables for SOFA and SAPS II calculations were recorded upon admission. SOFA scores were applied to evaluate organ failure, with variables assessed at different time points to provide comprehensive insights. SAPS II scores were derived using established procedures, considering vital signs, blood tests, and Glasgow Coma Scale (GCS) values. Mortality outcomes were monitored for up to 30 days post-admission.

Result: The relationship between SOFA and SAPS II scores was significant, with a Chi-square value and p-value less than 0.001. Notably, elevated SOFA scores were linked to reduced survival rates, as affirmed by a substantial Chi-square association between SOFA scores and survival outcomes (Chi-square: 116.80, $p < 0.001$). The ROC Curve analysis with SOFA's AUROC at 0.924 and SAPS II\\\'s AUROC at 0.99. SAPS II exhibited superior sensitivity and a lower false negative rate compared to SOFA.

Conclusion: SOFA score effectively assesses organ dysfunction over time, while SAPS II excel in prognostic accuracy with an AUROC of 0.99, superior sensitivity, and reduced false negatives. SAPS II emerge as the more precise outcome predictor, aiding clinical decisions for enhanced patient care and improved outcomes in critical settings.

Introduction:-

Over the past few decades, there has been a notable rise in the occurrence of severe combined traumas in thefield of trauma care. This increase is particularly significant in the working-age population. Treating these injuries requires substantial financial resources, with mortality rates ranging from 30% to 80%[1,2]. The range of different

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combinations of bodily injuries and disorders that happen in cases of polytrauma, alongwith the urgency to swiftly determine diagnoses and treatments, emphasizes the requirement for aclassification system to assess the severity of trauma [3]. Severely injured multiple-trauma patients typicallytransition to the intensive care unit (ICU) following initial emergency care [4].

Numerous scoring systems are designed for critically ill patients. Various trauma scoring systems haveemerged, relying on anatomical injury details and physiological factors to quantify injury severity. Widelyused examples include the injured severity score (ISS), an all-encompassing anatomical score; and theRevised Trauma Score (RTS). The polytrauma score (PTS) and the Trauma and Injury Severity Score (TRISS) merge both anatomical and physiological aspects. However, each of these trauma scores has distinct constraints [5]. Prominent ones include sequential organ failure assessment (SOFA) for organ dysfunctionand simplified acute physiology score II (SAPS II) for disease severity. Organ dysfunction and failure greatlyinfluence outcomes in multiple-trauma cases [6].

The SOFA score quantifies dysfunction severity across six organ systems in critically ill patients throughregularly measured routine variables. This score involves fewer parameters compared to other systems, offering a morestraightforward morbidity assessment. Furthermore, recent studies suggest a potentialassociation between the SOFA score and mortality [7,8].

SAPS II calculates the likelihood of mortality using patient data within the initial 24 hours of hospitaladmission [9]. While SAPS II has demonstrated effectiveness as a severity assessment tool, a study using asizable global ICU patient dataset revealed its mortality prediction was not precise. On the other hand, in case of general trauma patients, a combined approach of the TRISS score with SAPS II resulted inenhanced risk adjustment [10].

As of now, there is significant lack of data comparing scores used to assess injuries with scores meant for critically ill patients. This comparison hasn't been studied in a group of people who have experienced multiple injuries and were brought to the emergency room of a trauma center. Additionally, a single hospital examined whether combining different types of scores could improve predictions about the likelihood of death in casesof multiple injuries. Their findings suggested that using a combination of scores meant for both critically illpatients and trauma cases might enhance the accuracy of predicting mortality in individuals with multiple traumatic injuries [11]. Thus, the aim of the study was to compare the effectiveness of the SOFA and SAPS IIscoring systems in predicting mortality among polytrauma patients.

MaterialsAndMethods:-

This prospective study was conducted in the Department of General Surgery, of a Tertiary Referral hospital located in South India from January 2021 to November 2022. The study focused on all instances of emergencies related to trauma. The study received the approval from the ethical committee.

InclusionCriteria:

The study included patients who were undergoing treatment in the surgical casualty and presented with polytrauma, which encompasses a range of injuries such as road traffic accidents, fall from height and assault were included in the study.

ExclusionCriteria:

Patients with mono-traumatic injuries, ISS less than or equal to 16 and patients who were transferred to hospital from another facility more than 24 hours after the injury occurred were excluded from the study.

Methodology:-

This study involved a total of 200 patients, and it aimed to prospectively evaluate consecutive patients withpolytrauma admitted to the Department of General Surgery in a Tertiary referral hospital in south India.

Based on the criteria set by the German Society of Trauma Surgeons, we defined multiple-trauma patients as those who had injuries in at least two regions, resulting in ISS greater than 16.

The process of data collection was thorough, encompassing all multiple-trauma patients selected in theEmergency room (ER). Even if a patient did not proceed to the ICU or hospital wards due to early death in theER or during surgery, their data from the ER were still included in the present study. Patient demographic information and the necessary variables for calculating the SOFA and SAPS II scores were collected upon their admission to the hospital.

For the SOFA scores, organ failure evaluation was based on the criteria defined by Vincent et al. Organ failure was considered present when the SOFA score reached or exceeded 3. The variables required for calculating the SOFA score were collected at various time points: upon ER admission, on days 3 and 10 following a set protocol, and on the day of ICU discharge if it occurred before day 10. The calculation used the highest value for each variable, and the initial SOFA score upon ER admission included scores for all six organ components.

For SAPS II scores, established procedures outlined in the literature to calculate the probability of mortality was followed. This calculation considered vital signs, blood test results, and the patient's Glasgow Coma Scale (GCS) value at the time of measurement, even if the patient was sedated or intubated. Mortality outcomes were tracked up to 30 days after admission, and in cases of earlier discharge, we reached out to patients or their next of kin for relevant information. The analysis focused on how accurately the scores predicted survival after 30 days.

StatisticalAnalysis:

Data was analyzed using the SPSS Version 20.0. The Chi-square test was assessed for the statistical associations. Multivariate Pearson correlation analysis was utilized to study relationships between various parameters. Receiver Operating Characteristics (ROC) analysis determined the cut-off values, with statistical significance of $p<0.05$.

Results:-

Table 1:- a.GENDERdistribution.

	Frequency	Percent	Cumulative Percent
Male	167	83.5	83.5
Female	33	16.5	100.0
Total	200	100.0	

b. Age Distribution

Age	Frequency	Percent	Cumulative Percent
<30	56	28.0	28.0
30-39	25	12.5	40.5
40-49	43	21.5	62.0
50-59	46	23.0	85.0
60-69	18	9.0	94.0
>70	12	6.0	100.0
Total	200	100.0	

The data set reveals the distribution of gender and age among a group of 200 individuals. In terms of gender,167 individuals, or 83.5% of the total, are identified as male, while 33 individuals, constituting 16.5% of the group are female.

Regarding age distribution, among the 200 individuals, a breakdown by age groups was observed. Notably, 28% of the total group consists of individuals under the age of 30. The age group between 30 and 39 comprises 25 individuals, making up 12.5% of the total. In the age bracket of 40 to 49 years old, there were 43 individuals, contributing to 21.5% of the group. Moreover, the age range of 50 to 59 includes 46 individuals, representing 23% of the total count. The demographic of individuals aged between 60 and 69 accounts for 18 individuals, or 9% of the group. Lastly,12 individuals, which were 6% of the total, are over the age of 70.

Table2:- Distribution of SAPS-II score and SOFAonday-1.

SAPSIIscore	**Frequency**	**Percent**	**ValidPercent**	**CumulativePercent**
Normal	92	46	46	46
Mild	100	50	50	96
Moderate	8	4	4	100
Total	200	100	100	
SOFADay-1				

Normal	53	26.5	26.5	26.5
Mild	66	33	33	59.5
Moderate	60	30	30	89.5
Severe	16	8	8	97.5
Critical	5	2.5	2.5	100
Total	200	100	100	

The SAPS II scores, reflective of illness severity, exhibit a breakdown asfollows: 46% of patients possess anormal SAPS II score (92 patients), signifying a baseline health state. Meanwhile, 50% of the patients present a mild SAPS II score (100 patients), denoting relatively manageable illness severity. Asmaller segment, constituting 4% of the sample (8patients), displays a moderate SAPS II score, indicating a middle-tier level of illness severity. This cumulative distribution highlights that all recorded SAPS II scores fall within the range of 0 to100%.

The SOFA scores which gauge the degree of organ dysfunction, manifest in varying degrees: 26.5% of patients exhibit a normal SOFA score, suggesting minimal or no organ impairment. Approximately one-third of the patients, accounting for 33%, demonstrate a mild SOFA score, implying slight dysfunction across specific organ systems. Moreover, 30% of the sample was categorized under the moderate SOFA score, indicating a more notable level of organ dysfunction. A smaller proportion, constituting 8% of the assigned severe SOFA score, indicative of substantial organ dysfunction. The most severe level of dysfunction, designated as the critical SOFA score, was observed in 2.5% of the patients. The collective distribution of SOFA scores spans from 0% to 100%, progressively encompassing the spectrum of organ impairment.

SOFAScore	**Day1**	**Day3**	**Day10**
Normal	53(26.5)	52(26%)	52(26%)
Mild	66(33%)	67(33.50%)	59(29.5%)
Moderate	60(30%)	59(29.50%)	60(30%)
Severe	16(8%)	21(10.50%)	18(9%)
Critical	5(2.5%)	1(0.50%)	11(5.50%)
Chi Square116.806;p<0.05			

Table 2:- SOFA score calculated on specified days.

During the initial assessment on Day 1, SOFA scores revealed varying levels of organ dysfunction among critically ill patients. Approximately a quarter of the patients (26.5%) demonstrated no organ dysfunction, while 33% had mild impairment and 30% exhibited moderate dysfunction. A smaller portion constituting 8%, had severe organ dysfunction, and the critical SOFA score was present in 2.5% of patients.

As the evaluation continued to Day 3, the distribution of SOFA scores showed consistency, with 26%maintaining normal scores, 33.50% having mild dysfunction, and 29.50% falling within the moderate category. Severe scores were observed in 10.50 % of patients, while the critical score appeared in only 0.50% of patients. On Day10, a similar pattern emerged, with 26% having normal scores, 29.50% showing mild dysfunction, and 30% falling under the moderate category. A reduced 9% displayed severe organ dysfunction and notably, the critical SOFA score was observed in 5.50% of patients.

Table 3:- SAPS II compared with SOFA score.

	SOFA DAY 1					
SAPS- II	**NORMAL**	**MILD**	**MODERATE**	**SEVERE**	**CRITICAL**	**TOTAL**
NORMAL	37(69.8%)	36(54.5%)	17(28.3%)	1(6.2%)	1(20%)	92(46%)
MILD	16(30.2%)	30(45.501%)	43(71.7%)	11(68.8%)	0	100(50%)
MODERATE	0	0	0	4(25%)	4(80%)	8(4%)
	p value :128.57 ,<0.001					

For patients categorized as having a "Normal"SAPS-II score, themajority, approximately69.80%, show "Normal" SOFA Day1 scores, while 30.20% display "Mild" SOFA scores. A much smaller proportion, 0%,fall into the "Severe" and "Critical" SOFA categories. The cumulative total of patients in the "Normal" SAPS-II group was 92, accounting for 46% of the total sample.
Patients with a "Mild" SAPS-II score reveal a different distribution in SOFA Day 1 scores. Around 45.50% fallunder the "Mild" SOFA category, 28.30% exhibit "Moderate" dysfunction, and 6.20% have "Severe"dysfunction. No patients with a "Mild" SAPS-II score were categorized as having "Normal" or "Critical" SOFA scores. The total count of patients in the "Mild" SAPS-II group was100, constituting 50% of the total.

Interestingly, the "Moderate" SAPS-II category has no representation in the provided data for SOFA Day 1 scores. There are no patients in this group with recorded SOFA scores.

Table 4:- Survival in SOFA Score.

			SOFA DAY 1					Total
			Normal	Mild	Moderate	Severe	Critical	
SURVIVAL SOFA	Dead	Count	1	1	5	14	4	25
		% within SOFA DAY 1	1.9%	1.5%	8.3%	87.5%	80.0%	12.5%
	Survived	Count	52	65	55	2	1	175
		% within SOFA DAY 1	98.1%	98.5%	91.7%	12.5%	20.0%	87.5%
Total		Count	53	66	60	16	5	200
		% within SOFA DAY 1	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	116.806[a]	4	.000
Likelihood Ratio	78.941	4	.000
Linear-by-Linear Association	60.856	1	.000
N of Valid Cases	200		
a. 3 cells (30.0%) have expected count less than 5. The minimum expected count is .63.			

Among the "Dead" group, 1.9% of patients with "Normal" SOFA scores, 1.5% with "Mild" scores, and 8.3%with "Moderate" scores did not survive. A significant 57.5% of patients with "Severe" SOFA scores and 80.0%with "Critical" scores did not survive. The cumulative total of deceased patients was 25, constituting 12.5%oftheentiresample.

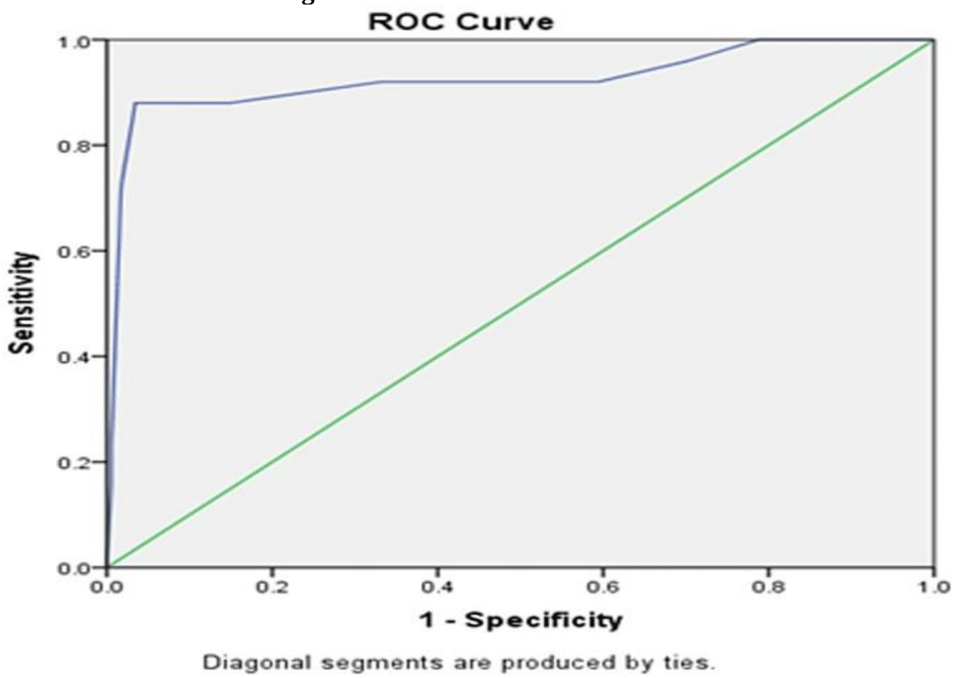
In contrast, amongthe "Survived"group, asubstantial 98.1%of patientswith "Normal"SOFA scores,98.5%with "Mild" scores, and 91.7% with "Moderate" scores survived. However, only 12.5% of patients with"Severe" scores and 20.0% with "Critical" scores managed to survive. The cumulative total of surviving patients is 175, making up 87.5%of the total sample.

AChi-square test was conducted to ascertain the statistical significance of these observed relationships. The computed Chi-square value was 116.80, and the corresponding P value less than 0.001.

In the evaluation of the SOFA score's performance, the area under the receiver operating characteristic curve (AUROC) was determined to be 0.924, accompanied by a standard error of 0.039. This value was notably significant, demonstrated by a p-value of less than 0.01. Similarly, the AUROC for SAPS II was calculated to be 0.99, with a small standard error of +/-0.001.

When considering sensitivity and false negativity, SAPS II emerge as particularly effective. It achieves the highest sensitivity while maintaining the lowest false negative rate, notably at a SAPS II score of 53.5. Incomparison, the SOFA score, with a sensitivity of 88% and false negative rate of 3.4%, performs less optimally at a score of 8.5. This underscores SAPS II superiority in correctly identifying true positive cases and minimizing instances of false negative outcomes

Figure1:-ROC CurveforSOFAscore.



Discussion:-

The preferred method for impartially evaluating the extent of polytrauma severity is widely recognized to involve a quantitative approach that relies on predictive scoring systems. Nonetheless, crafting a universally applicable scale is complex due to the broad spectrum of injuries and associated complications stemming from polytrauma. This complexity is compounded by the scarcity of comprehensive studies investigating factors that predict the outcomes of such injuries. The proposed survival estimates and prognostic indicators are intricately tied to specific polytrauma databases, each marked by disparities in mortality rates and the caliber of medical care administered [12].

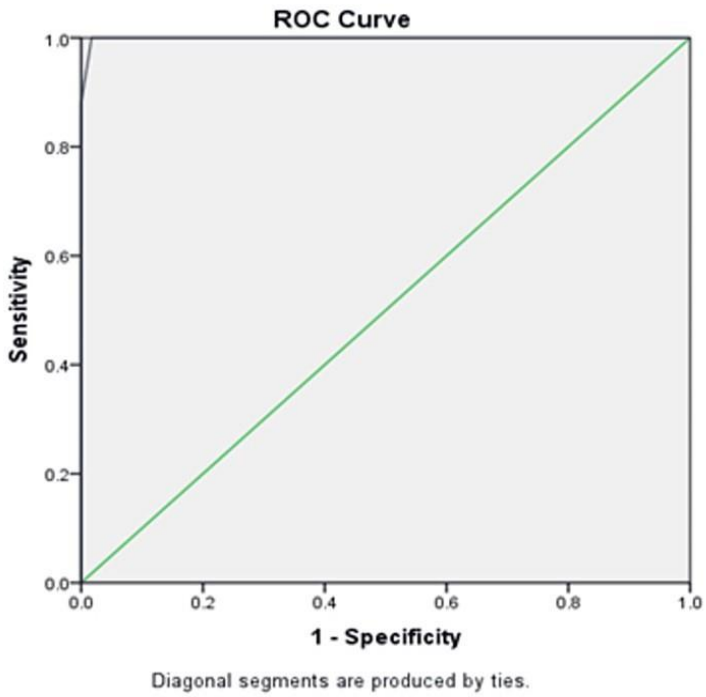


FIGURE2: ROC curve for SAPS II score

In the present study the demographic data clearly indicates a substantial predominance of males within the examined group of 200 individuals. Notably, 83.5% of the total population was identified as male, underscoring a significant numerical advantage of males over females. Also, It is evident that the age group with the highest percentage representation was above 30 years old. The cumulative percentage of these age groups above 30 was 28%, indicating that the majority of the individuals within this range. Furthermore, among these age groups, the 50-59 age range holds a prominent position, constituting of 23% of a significant portion of the data set. In the study conducted by Hariprasad K V out of the 80 patients admitted, 68.8% were male, while 31.3% were female. The highest frequency of was observed in the 31-40 years age group among male patients which was similar to the present study [13].

The examination of SOFA score, during Day 1 assessment revealed varying organ dysfunction levels:26.5% no dysfunction, 33%mild, 30%moderate, 8%severe and 2.5% critical. Day 3 had consistent distribution: 26% normal, 29.50% mild, 30% moderate, 9% severe, 5.50% critical. Patterns highlight SOFA's relevance in predicting patient prognosis over time. Silakhori S. et al. in their study reported, during the first day of admission, SOFA scores demonstrated a predictive accuracy of 72.1%. On the second day, SOFA scores achieved a forecast accuracy of 67.8%, and on the third day, SOFA scores attained a notably higher predictive accuracy of 72.2% [14]. These findings highlight SOFA's effectiveness as a reliable tool for anticipatingpatients' prognoses. When comparing these findings, which indicate that the precision of SOFA scores forpredicting patient prognosis, notable correlations and implications arise. The distribution of SOFA scores across the assessment days reflects the progression and persistence of organ dysfunction levels, providing a comprehensive view of patient conditions overtime.

In the present study, a clear pattern emerges, linking SOFA scores with patient survival. Higher SOFA scores, escalating from normal to critical, correspond to increased mortality rates. Notably, patients with normal and mild SOFA scores show strong survival rates (98.1% and 98.5% respectively), indicative of milder cases. However, at the critical level, only20% survive, underlining its severe impact. The Chi-square test confirms a strong connection. Singh et al. reported the lower survival (1.3%) for rising

SOFA scores and higher survival (24.7% and 74%) for steady or decreasing scores. The Chi-square outcomes further strengthen thisassociation. These findings are parallel with present study highlights that SOFA scores' clinical significance as prognostic indicators, reinforcing the importance of vigilant patient management [15].

Based on the AUROC measures, in present study, the AUROC for SAPS II was calculated to be 0.99, which signifies an exceptionally high discriminatory power. The associated small standard error of +/- 0.001. AnAUROC value close to 1 suggests that the SAPS II score is excellent at distinguishing between individuals with different outcomes. In the assessment of the performance of the SOFA score, using AUROC, which yields a value of 0.924 which was accompanied by a standard error of 0.039. The statistical significance by p-value of less than 0.01, signifying a strong indication of its predictive accuracy. Contrasting this with the finding of another study, the AUROC values for SAPS II and SOFA scores were reported as 0.76 and 0.72 respectively [14]. Both scores demonstrate moderate discriminatory abilities, although the SAPS II scores how a reatively stronger performance compared to the SOFA score.

While in another study the SOFA score exhibited the AUROC value of 0.895 was specifically focused on its performance in predicting mortality in trauma patients [16]. Similarly, the AUROC value of 0.72 for the SOFA score suggests a reasonable capacity to predict outcomes, but it is somewhat lower than the AUROC of SAPS II in the same study. Comparing these AUROC values across studies, it's evident that the predictive performance of these scoring systems can vary based on the specific patient population, data quality, and other factors. The higher AUROC value for SAPS II in the present study indicates its exceptional accuracy in prognostication.

The SOFA score demonstrated its efficacy as a tool for assessing organ dysfunction over time. On the otherhand, SAPS II exhibited remarkable performance in terms of prognostic accuracy. The AUROC value of 0.99 signified its exceptional capability in predicting patient outcomes. The sensitivity and false negative rates of SAPS II further emphasized its ability to correctly identify true positive cases while minimizing the risk of overlooking critical conditions.

Conclusions:-

In conclusion, both SOFA and SAPS II are invaluable tools for assessing patients in critical care settings, SAPS II standsout as the more accurate predictor of patient outcomes. Its exceptional performance in terms of AUROC, sensitivity, and false negative rates attests to its potential to enhance clinical decision-makingand patient management. The findings of this study underscore the significance of employing predictivescoring systems in critical care, enabling healthcare providers to make informed decisions that optimize patient care and ultimately contribute to improved outcomes.

Additional Information

Disclosures

Human subjects:

Consent was obtained from all participants in this study, no active participation of the subjects as it was purely observational study based on routine investigations.

Animal subjects:

All authors have confirmed that this study did not involve animal subjects or tissue.

Conflicts of interest:

Incompliance with the ICMJE uniform disclosure form, all authors declare the following:

Payment/servicesinfo:

All authors have declared that no financial support was received from any organization for thesubmitted work.

Financial relationships:

All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other relationships:
All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References:-

1. Von Rüden C., Woltmann A., Röse M., Wurm S., Rüger M., Hierholzer C., Bühren V:Outcome after severemultiple trauma: aretrospective analysis. JTrauma ManagOutcomes. 2013, 7:4-10.10.1186/1752-2897-7-4
2. PaffrathT.,LeferingR.,FlohéS:TraumaRegisterDGU.Howtodefineseverelyinjuredpatients?—AnInjurySeverityScore(ISS)basedapproachaloneisnotsufficient.Injury.2014,45:3.10.1016/j.injury.2014.08.020.
3. Berezka N.I., Litovchenko V.A., Garyachiy Y.V., Lapshin D.V., Morozova U.V:Optimization of surgicaltreatmentpatientswithpolytraumausingascaleevaluationofthedamageseverityandvictimsstatus.NauchnyevedomostiBelGU.Meditsina.Farmatsiya.2014,25:116-119.
4. Fueglistaler P, Amsler F, Schüepp M, et al.:Prognostic value of Sequential Organ Failure Assessment andSimplified Acute Physiology II Score compared with trauma scores in the outcome of multiple-traumapatients.The.AmericanJournalofSurgery.20101,200:204-14.10.1016/j.amjsurg.2009.08.035
5. Javali RH, Krishnamoorthy, Patil A, Srinivasarangan M, Suraj, Sriharsha:Comparison of Injury SeverityScore,NewInjurySeverityScore,RevisedTraumaScoreandTraumaandInjurySeverityScoreforMortalityPrediction in Elderly Trauma Patients. Indian J Crit Care Med. 2019, 23:73-77.10.5005/jp-journals-10071-23120
6. Tran D: Scoring systems for prediction of mortality in critical trauma . Am J Surg. 1994, 167:622-3.10.1016/0002-9610(94)90115-5
7. Antonelli M, Moreno R, Vincent J, et al.:Application of SOFA score to trauma patients. Intensive Care Med.1999,25:389-94.10.1007/s001340050863
8. Ferreira F, Bota D, Bross A, et al.:Serial evaluation of the SOFA score to predict outcome in critically illpatients.JAmMedAssoc.2001,286:1754-8.10.1001/jama.286.14.1754
9. Le Gall J, Lemeshow S, Saulnier F:A new simplified acute physiology score (SAPS II) based on aEuropean/NorthAmericanmulticenterstudy.JAmMedAssoc.1993,270:63.10.1001/jama.270.24.2957
10. Moreno R, Miranda D, Fidler V, et al.:Evaluation of two outcome prediction models on an independentdatabase.CritCareMed.1998,26:50-61.10.1097/00003246-199801000-00016
11. Philipp Fueglistaler, Hans Pargger , Augustinus Ludwig Jacob:Thomas Gross, Department of Surgery,UniversityHospitalBasel,Spitalstrase21,CH-4031Basel,Switzerland;The.AmericanJournalofSurgery.2010:204-214.
12. Seliverstov PA, Shapkin YG:Assessment of severity and prognosis of polytrauma outcome: the current stateoftheproblem.Современныетехнологиивмедицине.2017,9:207-16.10.17691/stm2017.9.2.25
13. Hariprasad KV, Ravikanti K, Murali MN, et al.:Comparison of Acute Physiology and Chronic HealthAssessmentII(APACHEII)ScoreandSequentialOrganFailureAssessment(SOFA)ScoreasaMortalityPredictorinED-ICUPatients.IndianJEmergMed.2019,5:225-232.10.21088/ijem.2395.311X.5419.2
14. SilakhoriS,DadpourB,Khadem-RezaiyanM,SedaghatA,MirzakhaniF:ComparingAPACHEII,APACHEIV, SAPS II, and SOFA Predictive Power in Poisoned Patients Admitted to the Intensive Care Unit.InternationalJournalofMedicalToxicologyandForensicMedicine.2020,10:28814.
15. SinghM,PalnatiV,RamakrishnanSR:ComparisonofMortalityPredictionofAPACHEII,SAPSIIandSOFAICU Scoring Systems in Patients with Severe Sepsis and Septic Shock in ICU of A Tertiary Care Hospital. JMedSciClinRes.November.2019,7:619-627.10.18535/jmscr/v7i11.108
16. Karami Niaz M, Fard Moghadam N, Aghaei A, Mardokhi S, Sobhani S:Evaluation of mortality predictionusingSOFAandAPACHEIVtoolsintraumaandnon-traumapatientsadmittedtotheICU.EurJMedRes.2022271,188-2022.10.1186/s40001-022-00822-9.