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Original Research

Comparison Of Acute Physiology And Chronic Health Evaluation(Apache) II Score With Sequential Organ Failure Assessment Score(Sofa) To Predict Morbidity and Mortality in a Tertiary Care Hospital

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Abstract

Backgroud: Scoring systems have been developed in response to an increasing emphasis on the evaluation and monitoring of health services. These systems enable comparative audit and evaluative research of intensive care. The Present study conducted to assess the presenting APACHE II score and SOFA score of patients admitted in ICU with sepsis.

Materials and Methods: This prospective study was undertaken over an 18-month period and included all the admissions which fit the inclusion criteria. APACHE II Score was calculated at 24 hours of admission to ICU using the worst value of 12 variables. SOFA Score was calculated on admission, at 48 hours and at 72 hours. **Result:** 60.1% study participants survived after 30 days.The patients who survived had a SOFA score at admission ranging from 2.70 to 8.09, which was statistically significant (P<0.01*). After 48 hours of admission, the SOFA score was 2.94 among survivors and 8.47 among non-survivors, which was also statistically significant (P<0.01*). After 72 hours of admission, the SOFA score was 2.94 among survivors and 8.40 among non-survivors, with a statistically significant difference (P<0.01*). On the other hand, the APACHE II Score ranged from 4.00 to 17.20 among survivors and non-survivors, with a statistically significant difference (P<0.01*). **Conclusion:** In conclusion, the study found that both SOFA and APACHE II scores effectively predict morbidity and mortality in critically ill patients, but SOFA scores showed a more pronounced difference between survivors and non-survivors. Using SOFA scores in conjunction with APACHE II scores may provide a more comprehensive assessment of patient severity and prognosis, highlighting the importance of validated scoring systems in informing clinical decision-making in intensive care units.

Keywords: APACHE II; SOFA; Scoring system; Acute Organ Dysfunction.

Introduction

Multiple organ failure is prevalent in patients hospitalized to the intensive care unit (ICU) and is a major cause of death in severely ill individuals. Efforts have been made to measure organ failure by creating a scoring system that uses repeated assessments of the number and degree of organ failure during the patient's time in the intensive care unit (ICU) to predict the outcome.[1-2]

Scoring systems have been created in order to address the growing focus on assessing and overseeing healthcare services. These systems facilitate the comparison and evaluation of critical care through audit and research.[3] Several grading systems have been devised for intensive care units.[4] Scoring systems in the ICU (intensive care unit) serve multiple functions. They help describe ICU patient groups for management and clinical trial recruitment, allowing

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quality control comparisons between ICUs or within the same ICU. Predicting outcomes is crucial for managing both the clinical and administrative aspects of intensive care unit (ICU) operations. The administration of both clinical and administrative aspects of intensive care units (ICUs) relies on the prediction of outcomes for critically ill patients.[5]

The APACHE II scoring system utilizes a point-based assessment that takes into account 12 normal physiological parameters, age, and pre-existing health condition to determine the overall severity of an illness.[6] The APACHE II score is calculated by considering the lowest values of 12 physiological variables, including blood pressure, heart rate, and body temperature, within the first 24 hours after admission to the intensive care unit (ICU). Additionally, the patient's chronic health, age, and type of ICU admission are taken into account. Nevertheless, the APACHE II score's validity has been questioned due to its failure to consider the medical treatment provided to the patient or the progression of the disease beyond the initial 24 hours in the intensive care unit.[7] Sepsis continues to be one of the primary causes of Multiple Organ Dysfunction Syndrome (MODS) globally. Sepsis is a potentially fatal condition where the body's response to infection becomes uncontrolled, leading to organ malfunction.

Therefore, in this observational study, we selected to evaluate the initial APACHE II score and SOFA score of patients admitted to the ICU with sepsis, septic shock, or acute organ failure. We aimed to compare these scores as predictors of morbidity and death, as well as the prognosis of the patient.

Material and Method

A Prospective Cross- Sectional study was undertaken among all patients who were critically ill and were admitted to RAMA MEDICAL COLLEGE AND HOSPITAL, HAPUR, UP during the study period, after receiving approval from the Human Research Ethics Committee, were included in the study if they met the eligibility requirements. The study was conducted over a duration of 1.5 years, with a total of 138 patients involved in the trial. The study included patients who met the following criteria: all patients admitted to the Intensive Care Unit (ICU) with evidence of sepsis, patients with septic shock, and post-operative patients in any surgery ICU, aged 16 years or older. However, patients who were discharged against medical advice, which would prevent follow-up on outcomes, were excluded. Additionally, patients under the age of 16, those with a duration of stay less than 24 hours, pregnant patients, patients with missing physiological variables, and patients on immunosuppressive drugs were also excluded from the study. A comprehensive evaluation was conducted, encompassing a thorough review of the patient's medical history, physical examination, and pertinent laboratory tests, which included a blood culture. The prognosis of all sepsis patients admitted to the Intensive Care Unit (ICU) was determined using the APACHE II and SOFA scores. The APACHE II score was computed on the day the patient was admitted to the intensive care unit (ICU). The APACHE II Score was computed after 24 hours of admission to the Intensive Care Unit (ICU) by considering the most severe value among 12 factors. The death rate forecast was computed based on this score. The progressive involvement of individual organs or multiple organs was evaluated by calculating the SOFA score at 48 hours and 72 hours. The mean and maximum scores are computed to determine whether the participation of several organs is rising or decreasing, and to assess whether the severity of organ involvement is increasing or decreasing. The lowest recorded SOFA score was 0, while the highest recorded score was 24. The parameter with the most unfavorable outcome was evaluated at both the 48-hour and 72-hour marks, and a score was computed. We conducted an analysis of different characteristics within two groups: the survivor group, consisting of patients who were discharged after recovering, and the non-survivor group, consisting of patients who died. We also determined if there were any significant statistical differences in the aforementioned profiles between the survivor group and the non-survivor group. Patients were monitored to determine their fate, either in terms of recovery or fatality, after a period of 30 days.

The data was presented as mean ± standard deviation (SD) or median, range, and percentage as applicable. Statistical analysis was performed using SPSS 21.0 software, with post hoc tests used for multiple variables. A p-value < 0.05 was considered statistically significant. Data was expressed as percentages and displayed as mean ± SD.

Results

Table 1: Age group wise distribution of study subjects

Age Groups(Years)	Frequency	Percent
<20	1	.7
21-30	20	14.5
31-40	47	34.1
41-50	28	20.3
51-60	26	18.8
>60	16	11.6
Total	138	100.0

Table 1 shows age group wise distribution of study subjects results revealed that maximum 34.1% study

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subjects belonged to age group of 31-40 years ,20.3% subjects belonged to 41-50 years, 18.8% study subjects belonged to51-60 years, 11.6% study subjects belonged to >60 years and one subject belonged to age group<20years

Table 2: Distribution of study participants according to presence ofsymptoms

Symptoms	Yes		No	
	Frequency	Percent	Frequency	Percent
Fever	44	31.9	94	68.1
Altered sensorium	49	35.5	89	64.5
respiratory distress	32	23.2	106	76.8
jaundice	24	17.4	114	82.6
bleeding manifestation	9	6.5	129	93.5
reduced urine output	0	0.0	138	100.0
cold clammy extremities	0	0.0	138	100.0

Table 2 shows distribution of study participants according to presence of symptoms results revealed that 31.9% study participants had fever, 35.5% participants had altered sensorium , 23.2% had respiratory distress, 17.4% subjects had jaundice and 6.5% participants had bleeding manifestations.

Table 3: Descriptive statistics for general examination parametersamong study participants

	Minimum	Maximum	Mean	Std. Deviation
Pulse	68	152	95.70	17.90
SBP	94	160	127.09	17.11
DBP	60	110	81.20	7.17
Respiratory rate	12	40	20.36	6.61
Temperature	98.10	103.00	99.40	1.40

Table 3 shows general examination parameters among study participants, Among participants mean pulse rate was found to be 95.70, mean SBP was 127.09, mean DBP was 81.20, mean respiratory was 20.36 and mean temperature of 99.40 was noted.

Table 4: Comparison of SOFA scores at different time intervals among study participants

Time Interval	Mean	Std. Deviation	F value	p value
Admission	4.91	3.20		
48Hrs	5.19	3.51		
72Hrs	5.25	3.62		
Mean	5.12	3.40	9.63	0.002*

*P<0.5 considered as statistically significant

Table 4 shows comparison of SOFA scores at different time intervals among study participants it revealed that mean SOFA score of 4.91 at the time admission, 5.91 after 48 hours and 5.25 after 72 hours which was statistically significant (p<0.002*). Table 5 shows descriptive statistics for APACHE II score among study participants.

Table 5: Descriptive statistics for APACHEII score among studyparticipants

Minimum	Maximum	Mean	Std. Deviation
0.00	24.00	9.41	7.87

Table 6: Comparison of SOFA scores at various time intervals and APACHE II scores according to survival status of study participantsafter 30 days

Parameter andtime interval	Survivedafter 30 days	Mean	Std. Deviation	t value	p value
SOFA_Admission	**No**	8.09	2.09	16.106	<0.01*
	Yes	2.70	1.62		
SOFA_48Hrs	**No**	8.47	2.07	14.483	<0.01*
	Yes	2.94	2.35		
SOFA_72Hrs	**No**	8.64	2.27	14.163	<0.01*
	Yes	2.94	2.35		
SOFA_Mean	**No**	8.40	2.08	15.321	<0.01*
	Yes	2.86	2.06		
APACHEII Score	**No**	17.20	4.79	16.6	<0.01*
	Yes	4.00	4.18		

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*P<0.5 considered as statistically significant

Table 6 shows comparison of SOFA scores at various time intervals and APACHE II scores according to survival status of study participants after 30 days. The results revealed that mean SOFA score was 2.70 among survived participant at the time of admission which was statistically significant (P<0.01*). 2.94 among survived participant after 48 hours of admission which was statistically significant (P<0.01*), 2.94 among survived participant after72 hours of admission which was statistically significant (P<0.01*).

Table 7: Distribution of study participants according to survival after 30days

Survival	Frequency	Percent
No	55	39.9
Yes	83	60.1
Total	138	100.0

Table 7 shows percentage of study participants who survived after 30 days results revealed 60.1% participants survived.

Discussion

Sepsis, accompanied by multiple organ dysfunction syndrome (MODS), is a prevalent factor contributing to mortality and morbidity in Intensive Care Units (ICUs). Prompt commencement of suitable and potent antimicrobial treatment is crucial for achieving a positive result in patients with sepsis. Both cultures and serology tests require a minimum of 24 to 48 hours to obtain results. During the critical hours that decide the patient's prognosis, the physician must rely on clinical symptoms and demographic data to assist in diagnosis and treatment.[8] Performing an early assessment of severity upon admission would allow physicians to categorize patients into appropriate levels of care and facilitate improved communication with family and caretakers regarding expected outcomes.[9] Utilizing scoring systems such as APACHE II upon admission and SOFA both upon admission and during the patient's treatment can aid in forecasting the prognosis.[8]Hence, the objective of this study was to compare the acute physiology and chronic health evaluation (APACHE) II score with the sequential organ failure assessment score (SOFA) in order to predict the occurrence of illness and death in a tertiary care hospital.

The current study conducted a comparison between the performance of the APACHE II score and the SOFA score for the same patient, while also evaluating the morbidity and death rates of these patients. The patients who survived had a SOFA score at admission ranging from 2.70 to 8.09, which was statistically significant (P<0.01*). After 48 hours of admission, the SOFA score was 2.94 among survivors and 8.47 among non-survivors, which was also statistically significant (P<0.01*). After 72 hours of admission, the SOFA score was 2.94 among survivors and 8.40 among non-survivors, with a statistically significant difference (P<0.01*). On the other hand, the APACHEII Score ranged from 4.00 to 17.20 among survivors and non-survivors, with a statistically significant difference (P<0.01*). In a separate study conducted by Abhinandan KS et al,[8] the prognostication of sepsis patients admitted to ICUs and emergency rooms was determined using APACHE II and SOFA scores. Although the APACHE II scores were higher in non-survivors compared to survivors (23.28 vs 18.75), this difference was not statistically significant (P=0.068). The analysis of SOFA scores on the first day showed that both individuals who did not survive and those who did had elevated scores, which had a significant statistical difference (10.17 versus 7.94, p=0.014). However, on the third day, the most notable distinction was observed. Non-survivors exhibited a considerably elevated SOFA score (13.42 compared to 6.84) in comparison to survivors, with statistical significance.

The results of this study can be compared to a similar study conducted by Beigmohammadi MT.[10] In that study, the predictive value of APACHE II and SOFA scores in COVID-19 patients in the intensive care unit was compared. The study found that the average APACHE II and SOFA scores were significantly higher in patients who did not survive compared to those who did survive (14.4 ± 5.7 vs. 9.5 ± 5.1, 7.3 ± 3.1 vs. 3.1 ± 1.1, respectively). The integral of the curve was 89.5% for the SOFA score and 73% for the APACHEII score.

In line with our research, Lee MA et al[11] found that in intensive care unit (ICU) patients, both the Sequential Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores were reliable indicators of prognosis, with the SOFA score being the most accurate. This study assessed the predictive ability of APACHE II score and SOFA score in determining the outcome of patients in the intensive care unit (ICU). At admission, the non-survival group had a considerably higher APACHE II score (24.1 ± 8.1 vs. 12.3 ± 7.2, $P < 0.001$) and SOFA score (7.7 ± 1.7 vs. 4.3 ± 1.9,

$P < 0.001$). The SOFA score exhibited the greatest values for the areas under the curve (0.904). Over the initial three days, the non-survival group maintained a consistently high SOFA score. In a study conducted by Hosseini M et al,[12] the ability of APACHE II and SOFA scores to predict outcomes (survivors, nonsurvivors) in surgical and medical Intensive Care Units (ICUs) was evaluated. The data analysis revealed a significant statistical difference in

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APACHE II and SOFA scores between survivor and nonsurvivor patients (P < 0.0001, P = 0.001; respectively). Both APACHE II and SOFA showed good predictive accuracy for results in surgical and medical ICUs. However, SOFA is the preferred choice due to its simplicity and ease of data recording. In a study conducted by Bale C et al[13], the correlation between SOFA and mean SOFA scores and the outcome of sepsis patients was examined. The findings revealed that when the SOFA score was less than 7, the mortality rate was 56%. When the score was within the range of 8 and 15 (P = 0.0989, t value: 1.69, Mean difference: 2.12, 95% CI: 0.41-4.665), it increased to 70%. Within a span of 48 hours, a total of 52% of patients who had a Sequential Organ Failure Assessment (SOFA) score below 7 experienced mortality, whereas 88% of patients with a score ranging from 8 to 15 faced the same outcome. The patients who showed improvement had an average SOFA score of 2.5 after 48 hours, while those who died had an average score of 6.96. The statistical analysis showed a significant difference between the two groups, with a p-value of less than 0.001, a t-value of 4.332, a mean difference of 4.39, and a 95% confidence interval ranging from 2.34 to 6.44. 48 hours following the presentation, the predictive value of the SOFA score for mortality was increased. Evaluating organ failure in the intensive care unit (ICU) both upon admission and 48 hours thereafter is a valuable prognostic instrument. Irrespective of the initial score, the average and maximum SOFA values are highly useful markers of the outcome. A high SOFA score 48 hours after presentation is indicative of an elevated mortality rate. In their study, Qiao Q et al.[61] evaluated the effectiveness of the Acute Physiology and Chronic Health Evaluation II (APACHE II) score and the Sequential Organ Failure Assessment (SOFA) score in predicting mortality in elderly patients who were critically ill. They found that the average APACHE II and SOFA scores were lower in patients who survived compared to those who did not.

A constraint of the current investigation was its exclusive focus on a particular medical facility, which raises concerns about the applicability of these findings to other intensive care units. Sepsis is a significant contributor to death in the intensive care unit. A reliable prognostic indicator for sepsis is necessary to evaluate the morbidity and mortality associated with this illness.

Conclusion

In conclusion, the current study demonstrated that both the SOFA and APACHE II scores are effective predictors of morbidity and mortality in critically ill patients. However, the SOFA score showed a more pronounced difference between survivors and non-survivors, with statistically significant differences observed at admission, 48 hours, and 72 hours. These findings suggest that the SOFA score may be a more sensitive indicator of patient outcomes, and its use in conjunction with the APACHE II score may provide a more comprehensive assessment of patient severity and prognosis. Overall, the study highlights the importance of using validated scoring systems to predict patient outcomes and inform clinical decision-making in the intensive care unit.

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