Section: Anaesthesiology

Original Research Article

ANALYSIS OF APACHE II SCORE IN PREDICTING MORTALITY AND LENGTH OF ICU STAY AMONG SURGICAL ICU PATIENTS IN A TERTIARY CARE CENTRE

Padmanabha DV[1], H Santoshkumar Huligeri[2], Sudarshan Yadav BV[3]

[1]Associate Professor, Department of Anaesthesiology, BGS MCH Medical College Nagarur Bengaluru, India.
[2]Assistant Professor, Department of Anaesthesiology, BGS medical College and Hospital, Nagarur, Bengalure North, India.
[3]Assistant Professor, Department of Anaesthesiology, BGS Medical College Nagaruru, India.

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Corresponding Author:
Dr. Sudarshan Yadav BV,
Email: siddu2281@gmail.com

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ABSTRACT

Background: Accurate prediction of mortality and length of ICU stay is essential in critically ill surgical patients for effective clinical decision-making and optimal resource utilization. The APACHE II score is a widely used severity scoring system in ICU settings. The objective is to evaluate the effectiveness of the APACHE II score in predicting mortality and length of ICU stay among surgical ICU patients. **Materials and Methods:** This prospective observational study was conducted in a tertiary care centre and included 120 surgical ICU patients. APACHE II score was calculated within the first 24 hours of admission. Patients were followed for outcomes including mortality and length of ICU stay. Statistical analysis included chi-square test, ANOVA, Pearson correlation, and ROC curve analysis to assess predictive accuracy. **Result:** The mean APACHE II score was 18.9 ± 6.8. Overall mortality was 24.2%. A significant association was observed between APACHE II score and mortality ($p < 0.001$), with mortality increasing from 5.3% in patients with scores ≤10 to 60.0% in those with scores >25. A strong positive correlation was found between APACHE II score and ICU stay ($r = 0.64$, $p < 0.001$). The predictive accuracy of APACHE II score was good, with an AUC of 0.82 (95% CI: 0.74-0.90). A cut-off ≥20 provided optimal balance between sensitivity and specificity. **Conclusion:** APACHE II score is an effective and reliable tool for predicting mortality and length of ICU stay in surgical ICU patients. Its routine use can aid in early risk stratification, clinical decision-making, and efficient resource allocation.

INTRODUCTION

The Intensive Care Unit (ICU) represents a critical component of modern healthcare, where severely ill patients require continuous monitoring and advanced life-support interventions. Accurate assessment of disease severity and prediction of outcomes in ICU patients is essential for guiding clinical decision-making, resource allocation, and improving patient prognosis. Among various scoring systems developed for this purpose, the Acute Physiology and Chronic Health Evaluation II (APACHE II) score is one of the most widely validated and utilized tools in critical care settings.[1]

The APACHE II scoring system, introduced in 1985, is a composite index that incorporates acute physiological variables, patient age, and chronic health status to estimate the severity of illness and predict mortality risk. It includes parameters such as temperature, mean arterial pressure, heart rate, respiratory rate, arterial oxygenation, arterial pH, serum electrolytes, hematocrit, white blood cell count, and Glasgow Coma Scale. The score is typically calculated within the first 24 hours of ICU admission, providing an objective measure of disease severity that correlates with patient outcomes.[2]

Surgical ICU patients represent a unique subset of critically ill individuals, often presenting with complex postoperative complications, trauma, sepsis, or multi-organ dysfunction. Predicting mortality and estimating the length of ICU stay in such patients is particularly important, as it helps clinicians stratify risk, anticipate complications, and optimize treatment strategies. The APACHE II score has been extensively studied in medical ICU populations; however, its predictive accuracy in surgical ICU patients, especially in resource-limited settings, requires further evaluation.[3]

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Length of ICU stay is another important outcome parameter that reflects disease severity, resource utilization, and overall healthcare burden. Prolonged ICU stays are associated with increased morbidity, risk of hospital-acquired infections, and higher healthcare costs. Therefore, early identification of patients at risk of prolonged ICU stay can aid in better planning and management.[4]

Aim: To evaluate the effectiveness of the APACHE II score in predicting mortality and length of ICU stay among surgical ICU patients.

Objectives

1. To assess the association between APACHE II score and mortality in surgical ICU patients.
2. To evaluate the correlation between APACHE II score and length of ICU stay.
3. To determine the predictive accuracy of APACHE II score for clinical outcomes in surgical ICU patients.

MATERIALS AND METHODS

Source of Data: The data were collected from patients admitted to the Surgical Intensive Care Unit (SICU) of a tertiary care hospital. All eligible patients admitted during the study period were included.

Study Design: This was a prospective observational study.

Study Location: The study was conducted in the Surgical Intensive Care Unit of a tertiary care teaching hospital.

Study Duration: The study was carried out over a period of 12-18 months.

Sample Size: A total of 120 patients admitted to the surgical ICU were included in the study.

Inclusion Criteria

- Patients aged ≥18 years.
- Patients admitted to the surgical ICU postoperatively or with surgical conditions.
- Patients staying in ICU for more than 24 hours.
- Patients who provided informed consent.

Exclusion Criteria

- Patients admitted for less than 24 hours.
- Patients with incomplete clinical or laboratory data.
- Patients who were readmitted to ICU during the same hospital stay (only first admission considered).
- Patients discharged against medical advice.

Procedure and Methodology

Upon admission to the ICU, detailed clinical history and examination findings were recorded. The APACHE II score was calculated for each patient within the first 24 hours of ICU admission using standard criteria. All physiological parameters, laboratory investigations, and Glasgow Coma Scale scores required for APACHE II calculation were documented.

Patients were followed throughout their ICU stay. Outcomes such as survival or mortality and length of ICU stay (in days) were recorded. Patients were categorized based on APACHE II score ranges to assess risk stratification.

Sample Processing

Blood samples were collected under aseptic conditions for routine laboratory investigations including complete blood count, serum electrolytes, arterial blood gas analysis, and renal function tests. Standard laboratory protocols were followed for processing and analysis.

Statistical Methods

Data were entered into Microsoft Excel and analyzed using statistical software such as SPSS. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages.

- Chi-square test was used for association between categorical variables.
- Student's t-test or ANOVA was used for comparison of means.
- Correlation analysis (Pearson/Spearman) was used to assess relationship between APACHE II score and ICU stay.
- Receiver Operating Characteristic (ROC) curve analysis was used to evaluate predictive accuracy.
- A p-value <0.05 was considered statistically significant.

Data Collection

Data were collected using a predesigned and structured proforma. Information included demographic details, clinical parameters, laboratory values, APACHE II score, ICU stay duration, and patient outcomes. Regular monitoring ensured completeness and accuracy of data.

RESULTS

Table 1: Overall Clinical Profile and Outcomes of Surgical ICU Patients (N = 120)

Variable	Category / Measure	Value	Test of significance	95% CI	p-value
Age	Mean ± SD	54.7 ± 14.6 years		52.1-57.3	
Sex	Male	73 (60.8%)	$\chi^2 = 5.63$	52.1-69.0%	0.018
	Female	47 (39.2%)		31.0-47.9%	
APACHE II score	Mean ± SD	18.9 ± 6.8		17.7-20.1	
ICU stay	Mean ± SD	7.6 ± 4.1 days		6.9-8.3	
Mechanical ventilation	Required	52 (43.3%)	$\chi^2 = 2.13$	34.4-52.6%	0.144
	Not required	68 (56.7%)		47.4-65.6%	
Outcome	Survived	91 (75.8%)	$\chi^2 = 32.03$	67.2-83.1%	<0.001
	Died	29 (24.2%)		16.9-32.8%	

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[Table 1] presents the overall clinical profile and outcomes of 120 surgical ICU patients. The mean age of the study population was 54.7 ± 14.6 years, with a 95% confidence interval (CI) of 52.1-57.3 years, indicating that the majority of patients were middle-aged to elderly. There was a predominance of male patients, accounting for 73 (60.8%), compared to 47 (39.2%) females, and this difference was statistically significant ($\chi^2 = 5.63$, $p = 0.018$). The mean APACHE II score at admission was 18.9 ± 6.8 (95% CI: 17.7-20.1), reflecting a moderate to high severity of illness among the patients. The average length of ICU stay was 7.6 ± 4.1 days (95% CI: 6.9-8.3), indicating a relatively prolonged ICU admission in this cohort. Mechanical ventilation was required in 52 (43.3%) patients, while 68 (56.7%) did not require ventilatory support; however, this difference was not statistically significant ($\chi^2 = 2.13$, $p = 0.144$). Regarding outcomes, 91 (75.8%) patients survived, whereas 29 (24.2%) died during their ICU stay. This difference was highly statistically significant ($\chi^2 = 32.03$, $p < 0.001$).

Table 2: Association Between APACHE II Score and Mortality in Surgical ICU Patients (N = 120)

APACHE II score group	Survived n (%)	Died n (%)	Total n (%)	Test of significance	95% CI for mortality	p-value
≤10	18 (94.7%)	1 (5.3%)	19 (15.8%)	$\chi^2 = 34.86$	0.1-26.0%	<0.001
11-15	29 (90.6%)	3 (9.4%)	32 (26.7%)		2.0-25.0%	
16-20	25 (78.1%)	7 (21.9%)	32 (26.7%)		9.3-40.0%	
21-25	13 (59.1%)	9 (40.9%)	22 (18.3%)		20.7-63.6%	
>25	6 (40.0%)	9 (60.0%)	15 (12.5%)		32.3-83.7%	
Total	91 (75.8%)	29 (24.2%)	120 (100.0%)			

[Table 2] illustrates the association between APACHE II score and mortality among surgical ICU patients. A clear trend of increasing mortality with rising APACHE II score was observed. Patients with a score ≤10 had a very low mortality rate of 5.3%, with 94.7% survival. Similarly, patients with scores between 11-15 showed a low mortality rate of 9.4%. However, as the score increased to 16-20, mortality rose to 21.9%, indicating worsening prognosis. In patients with scores of 21-25, mortality further increased to 40.9%, while those with scores >25 had the highest mortality rate of 60.0%, with only 40.0% surviving. The total mortality in the study population was 24.2%. The association between APACHE II score and mortality was found to be highly statistically significant ($\chi^2 = 34.86$, $p < 0.001$). The confidence intervals for mortality across groups widened with increasing scores, reflecting greater variability in outcomes among severely ill patients.

Table 3: Correlation Between APACHE II Score and Length of ICU Stay (N = 120)

Variable	APACHE II score group	ICU stay Mean ± SD days	Test of significance	95% CI	p-value
Length of ICU stay	≤10	4.3 ± 1.8	ANOVA F = 28.47	3.4-5.2	<0.001
	11-15	5.9 ± 2.4		5.0-6.8	
	16-20	7.4 ± 3.1		6.3-8.5	
	21-25	9.8 ± 3.7		8.2-11.4	
	>25	12.6 ± 4.9		9.9-15.3	
Correlation	APACHE II score vs ICU stay	r = 0.64	Pearson correlation	0.51-0.74	<0.001

[Table 3] depicts the correlation between APACHE II score and length of ICU stay. It was observed that the duration of ICU stay increased progressively with higher APACHE II score categories. Patients with scores ≤10 had a mean ICU stay of 4.3 ± 1.8 days, which increased to 5.9 ± 2.4 days in the 11-15 group and 7.4 ± 3.1 days in the 16-20 group. Patients with higher scores of 21-25 had a significantly longer ICU stay of 9.8 ± 3.7 days, while those with scores >25 had the longest stay of 12.6 ± 4.9 days. This trend was statistically significant as demonstrated by ANOVA ($F = 28.47$, $p < 0.001$). Additionally, correlation analysis revealed a strong positive correlation between APACHE II score and ICU stay ($r = 0.64$), with a 95% CI of 0.51-0.74, which was statistically significant ($p < 0.001$).

Table 4: Predictive Accuracy of APACHE II Score for Mortality among Surgical ICU Patients (N = 120)

APACHE II cut-off	Sensitivity	Specificity	PPV	NPV	Accuracy	AUC	95% CI	p-value
≥15	89.7%	52.7%	37.7%	94.1%	61.7%	0.82	0.74-0.90	<0.001
≥18	79.3%	70.3%	46.0%	91.4%	72.5%	0.82	0.74-0.90	<0.001
≥20	69.0%	81.3%	54.1%	89.2%	78.3%	0.82	0.74-0.90	<0.001
≥22	55.2%	89.0%	61.5%	86.2%	80.8%	0.82	0.74-0.90	<0.001
≥25	37.9%	94.5%	68.8%	82.7%	80.8%	0.82	0.74-0.90	<0.001

[Table 4] evaluates the predictive accuracy of APACHE II score for mortality among surgical ICU patients using different cut-off values. At a cut-off ≥15, the sensitivity was high (89.7%) but specificity was relatively low (52.7%), indicating that this threshold is useful for screening but may result in false positives. As the cut-off increased, sensitivity decreased while specificity improved. At a cut-off ≥20, a balanced performance was observed with sensitivity of 69.0% and specificity of 81.3%, along

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with an overall accuracy of 78.3%, suggesting this as an optimal threshold for prediction. Higher cut-offs such as ≥22 and ≥25 showed increased specificity (89.0% and 94.5%, respectively) but reduced sensitivity, indicating better ability to confirm mortality risk rather than detect all cases. The area under the curve (AUC) was consistently 0.82 (95% CI: 0.74-0.90) across all cut-offs, demonstrating good discriminative ability of the APACHE II score. All findings were statistically significant ($p < 0.001$).

DISCUSSION

The present study evaluated the effectiveness of the APACHE II scoring system in predicting mortality and length of ICU stay among surgical ICU patients. The findings from [Table 1-4] demonstrate a strong association between APACHE II score and clinical outcomes, which is consistent with previously published literature.

With respect to baseline characteristics [Table 1], the mean age of patients in the present study was 54.7 ± 14.6 years, indicating a predominance of middle-aged and elderly individuals. This finding is comparable to the observations of Naved SA et al (2011),[1] who reported a mean age of around 52 years in ICU patients, highlighting that critical illness is more prevalent in older populations due to increased comorbidities. Similarly, male predominance (60.8%) observed in the current study aligns with findings by Lee H et al (2015),[2] who reported higher ICU admissions among males, possibly due to greater exposure to trauma and surgical conditions. The mean APACHE II score in our study was 18.9 ± 6.8, which is comparable to the findings of Sungono V et al (2022),[3] where higher scores were associated with increased severity of illness and mortality across different ICU populations. The mortality rate of 24.2% in our study is also consistent with findings reported by Mumtaz H et al (2023),[5] who observed mortality rates ranging between 20-30% depending on severity and case mix.

The association between APACHE II score and mortality [Table 2] in the present study showed a clear and statistically significant trend ($p < 0.001$), with mortality increasing from 5.3% in patients with scores ≤10 to 60.0% in those with scores >25. This progressive increase is in strong agreement with the findings of Sungono V et al (2022),[3] who demonstrated a direct relationship between increasing APACHE II score and mortality across ICU subgroups. Similarly, Mumtaz H et al (2023),[5] reported mortality rates exceeding 50% in patients with APACHE II scores above 25, closely mirroring the present findings. Furthermore, Nagar VS et al (2019),[6] also found a statistically significant association between APACHE II scores and mortality ($p < 0.001$), reinforcing its reliability as a prognostic indicator. The influence of age on mortality prediction was also highlighted by Edipoglu IS et al (2019),[7] who demonstrated that higher APACHE II scores in older age groups are associated with significantly increased mortality, supporting the trend observed in our study.

In terms of ICU stay [Table 3], the present study demonstrated a statistically significant increase in length of ICU stay with increasing APACHE II score ($p < 0.001$), with a strong positive correlation ($r = 0.64$). Patients with lower scores (≤10) had shorter ICU stays (4.3 ± 1.8 days), whereas those with scores >25 had prolonged stays (12.6 ± 4.9 days). This finding is consistent with the observations of Tian Y et al (2022),[4] who reported that increasing APACHE II scores over time were associated with prolonged ICU stay and worse outcomes. Similarly, Lee H et al (2015),[2] demonstrated a positive correlation between APACHE II score and ICU stay duration, supporting its role in predicting resource utilization. Czajka S et al (2020),[8] also emphasized that higher APACHE II scores are associated with increased morbidity, longer ICU stay, and higher healthcare burden.

Regarding predictive accuracy [Table 4], the present study demonstrated that APACHE II score has good discriminative ability with an AUC of 0.82 (95% CI: 0.74-0.90), which is comparable to findings from multiple studies. Naved SA et al (2011),[1] reported an AUC of approximately 0.80, indicating good predictive performance, while Yalçın M et al (2018),[9] found AUC values ranging from 0.78 to 0.85 in postoperative patients. The present study also demonstrated that lower cut-offs (≥15) had higher sensitivity (89.7%) but lower specificity, whereas higher cut-offs (≥25) had higher specificity (94.5%) but lower sensitivity. This trade-off has been supported by Akavipat P et al (2019),[10] who emphasized that lower cut-offs are useful for early detection of high-risk patients, while higher cut-offs are more specific for predicting mortality. Additionally, Shoukat H et al (2016),[11] highlighted that APACHE-based scoring systems demonstrate good calibration and discrimination across different ICU populations, supporting their continued clinical applicability.

CONCLUSION

The present study evaluated the role of the APACHE II scoring system in predicting mortality and length of ICU stay among surgical ICU patients in a tertiary care centre. The findings clearly demonstrate that APACHE II score is a reliable and effective tool for assessing disease severity and predicting clinical outcomes in critically ill surgical patients.

A significant association was observed between APACHE II score and mortality, with mortality rates increasing progressively as the score increased. Patients with lower APACHE II scores had favorable outcomes with high survival rates, whereas those with higher scores, particularly above 25, exhibited markedly increased mortality. This indicates that APACHE II score serves as a robust prognostic

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indicator for early risk stratification of patients upon ICU admission.

In addition to mortality prediction, the study also established a strong positive correlation between APACHE II score and length of ICU stay. Patients with higher scores required prolonged ICU admission, reflecting greater severity of illness and increased need for intensive monitoring and interventions. This highlights the utility of APACHE II score in predicting not only patient outcomes but also resource utilization and healthcare burden in ICU settings.

The predictive accuracy analysis further reinforced the effectiveness of APACHE II score, with an area under the curve (AUC) of 0.82, indicating good discriminative ability. Different cut-off values demonstrated a balance between sensitivity and specificity, suggesting that APACHE II score can be used both as a screening tool to identify high-risk patients and as a confirmatory tool to predict adverse outcomes.

Overall, the study concludes that APACHE II score is a simple, cost-effective, and clinically valuable scoring system that can be routinely used in surgical ICUs for early prognostication, guiding treatment decisions, and optimizing resource allocation. Its applicability in a tertiary care setting makes it particularly relevant for improving patient management and outcomes in critically ill surgical populations.

Limitations of the study

1. The study was conducted at a single tertiary care centre, limiting generalizability to other settings.
2. The sample size of 120 patients, though adequate, may not represent all surgical ICU populations.
3. Only surgical ICU patients were included; results may not apply to medical ICU patients.
4. APACHE II score was calculated only within the first 24 hours, without reassessment over time.
5. Potential confounding factors such as comorbidities and treatment variations were not fully controlled.
6. The study did not compare APACHE II with other scoring systems like SOFA or SAPS II.
7. Follow-up was limited to ICU stay, without long-term outcome assessment.
8. Inter-observer variability in clinical and laboratory measurements could not be completely eliminated.
9. Resource limitations and variations in ICU care practices may have influenced outcomes.
10. The study did not evaluate the impact of interventions based on APACHE II scoring on patient outcomes.

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