Original Research

EVALUATION OF POSSUM AND P - POSSUM SCORING SYSTEM IN ASSESING THE SURGICAL OUTCOME IN GENERAL SURGERY PATIENTS

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ABSTRACT

Background: Accurate prediction of postoperative morbidity and mortality is essential in surgical practice for risk stratification and outcome assessment. The Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) and its modification, Portsmouth-POSSUM (P-POSSUM), are widely used scoring systems designed to predict surgical outcomes. These tools help in clinical decision-making, auditing surgical performance, and improving patient care, especially in diverse general surgical populations.

Aims: To evaluate and compare the accuracy of POSSUM and P-POSSUM scoring systems in predicting postoperative morbidity and mortality in general surgery patients.

Materials and Methods: This prospective observational study was conducted over a period of 8 months in the Department of General Surgery at a tertiary care hospital. A total of 120 patients undergoing elective and emergency general surgical procedures were included. Preoperative physiological parameters and intraoperative operative variables were recorded for each patient to calculate POSSUM and P-POSSUM scores. Patients were followed postoperatively for complications and mortality. Observed morbidity and mortality rates were compared with predicted values, and the observed-to-expected (O) ratios were calculated. Statistical analysis was performed to assess the predictive accuracy of both scoring systems.

Results: Out of 120 patients, postoperative morbidity was observed in 42 (35.0%) patients, while mortality occurred in 8 (6.7%) patients. POSSUM predicted higher morbidity (50.0%) and mortality (15.0%) compared to observed outcomes, indicating overestimation. In contrast, P-POSSUM showed better correlation, predicting morbidity at 38.0% and mortality at 8.5%. The observed-to-expected (O:E) ratio for morbidity was 0.84 for POSSUM and 0.92 for P-POSSUM, while for mortality it was 0.44 and 0.79 respectively. Higher scores were significantly associated with increased postoperative complications and mortality ($p < 0.05$). Patients undergoing emergency surgeries and those aged >50 years demonstrated higher morbidity and mortality rates. Overall, P-POSSUM showed superior predictive accuracy compared to POSSUM.

Conclusion: Both POSSUM and P-POSSUM are valuable tools for predicting surgical outcomes; however, P-POSSUM provides a more accurate estimation of mortality and morbidity. These scoring systems can be effectively used for risk stratification, audit, and improving quality of care in general surgery patients.

Keywords: General Surgery, Morbidity, Mortality, Portsmouth-Possum, Possum, Risk Assessment.

INTRODUCTION

Accurate assessment of surgical risk is a fundamental aspect of modern surgical practice.

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Predicting postoperative morbidity and mortality helps surgeons in preoperative counseling, clinical decision-making, allocation of resources, and evaluation of surgical outcomes.[1] With increasing complexity of surgical procedures and patient comorbidities, there is a growing need for reliable and standardized scoring systems that can objectively quantify surgical risk and facilitate comparison across institutions.[2,3]

The Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) was developed as a comprehensive scoring system incorporating both physiological **parameters and operative variables.[4] It evaluates**

patient-related factors such as age, cardiovascular and respiratory status, biochemical parameters, and operative details including blood loss, contamination, and operative severity.[5] The POSSUM scoring system uses logistic regression equations to predict morbidity and mortality, making it a valuable tool for surgical audit and outcome prediction.[6]

However, it has been observed that POSSUM tends to overpredict mortality, particularly in low-risk patients. To address this limitation, the Portsmouth modification of POSSUM (P-POSSUM) was introduced, which modifies the regression equation to provide more accurate mortality prediction. Since its introduction, P-POSSUM has been widely used and validated in various surgical settings, demonstrating improved calibration compared to the original POSSUM model.[7,8]

In general surgery, patients present with a wide spectrum of conditions ranging from elective procedures to emergency surgeries with significant physiological derangements. This heterogeneity makes outcome prediction challenging.[9] The use of scoring systems such as POSSUM and P-POSSUM allows for objective assessment of risk and helps in identifying high-risk patients who may benefit from intensive monitoring and perioperative optimization.[10]

These scoring systems serve as important tools for clinical audit by enabling comparison between observed and expected outcomes. This facilitates identification of areas for improvement in surgical care and enhances quality assurance. In resource-limited settings, where advanced predictive tools may not be readily available, POSSUM and P-POSSUM offer practical and cost-effective alternatives. The accuracy and applicability of these scoring systems can vary across populations and healthcare settings. Therefore, it is important to evaluate their performance in specific institutional contexts.

Limited data are available from Indian tertiary care centers evaluating their comparative effectiveness. This study aims to assess their applicability in a diverse general surgical population, including both elective and emergency cases. By analyzing observed versus predicted outcomes, the study seeks to determine the most reliable tool for risk stratification, thereby improving perioperative care and surgical audit practices.

Aims and Objectives

- To evaluate and compare the accuracy of POSSUM and P-POSSUM scoring systems in predicting postoperative morbidity and mortality in general surgery patients.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of General Surgery at Sree Mookambika Institute of Medical Sciences over a period of 8 months from August 2025 to March 2026. A total of 120 patients undergoing various general surgical procedures were included in the study. Both elective and emergency cases were considered to ensure a comprehensive evaluation of the scoring systems across a wide spectrum of surgical conditions. Informed written consent was taken from all participants.

Inclusion criteria comprised patients aged above 18 years undergoing elective or emergency general surgical procedures, including gastrointestinal, hepatobiliary, and soft tissue surgeries. Patients who consented to participate and were willing for follow-up during the hospital stay were included in the study.

Exclusion criteria included patients below 18 years of age, those undergoing minor procedures under local anesthesia, patients with incomplete clinical or laboratory data, and those who were lost to follow-up or discharged against medical advice before adequate postoperative evaluation. Additionally, patients with severe pre-existing systemic illness unrelated to the surgical condition, which could independently influence mortality, were excluded to maintain uniformity in assessment.

All patients were evaluated in detail preoperatively with a thorough clinical examination and relevant laboratory investigations. Physiological parameters required for the calculation of the Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) were recorded. POSSUM and Portsmouth-POSSUM (P-POSSUM) scores were calculated using standardized scoring systems incorporating both physiological and operative parameters. The POSSUM score consists of two components: the Physiological Score (PS) and the Operative Severity Score (OS). The Physiological Score includes 12 variables assessed preoperatively—age, cardiac signs, respiratory status, systolic blood pressure, pulse rate, Glasgow Coma Scale, hemoglobin, white blood cell count, serum urea, sodium, potassium levels, and electrocardiogram findings. Each parameter is assigned a score of 1, 2, 4, or 8 based on the degree of deviation from normal values, with higher scores indicating greater physiological derangement.

The Operative Severity Score includes 6 intraoperative variables—operative severity (minor, moderate, major, major+), number of procedures performed, blood loss, degree of peritoneal contamination, presence and extent of malignancy, and timing of surgery (elective or emergency). Similar to the physiological variables, each operative parameter is graded on a scale of 1, 2, 4, or 8 depending on severity.

Postoperatively, all patients were closely monitored for the development of complications and mortality during their hospital stay. Morbidity was defined as

the occurrence of any postoperative complication, including wound infection, respiratory complications, cardiac events, urinary tract infection, sepsis, or any other adverse event requiring medical or surgical intervention. Mortality was defined as death occurring during the same hospital admission following surgery. Observed morbidity and mortality rates were compared with the predicted rates obtained from POSSUM and P-POSSUM scoring systems. The observed-to-expected (O) ratio was calculated to assess the predictive accuracy of the scoring systems.

All collected data were entered into a structured proforma and analyzed statistically. Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as frequencies and percentages. The predictive accuracy of POSSUM and P-POSSUM was assessed by comparing observed and expected outcomes using appropriate statistical tests, and a p-value of less than 0.05 was considered statistically significant.

OBSERVATION AND RESULTS

Majority of patients were in the 31–40 years of age group (23.3%), followed by 41–50 years (21.7%), indicating predominance of middle-aged population. Male predominance was observed (60.0%), with comparable distribution across study variables. Majority of procedures were elective (58.3%), though a substantial proportion were emergency cases. (Table 1)

		Number (n)	Percentage (%)
Age Group (years)	18–30	22	18.3
	31–40	28	23.3
	41–50	26	21.7
	51–60	24	20.0
	>60	20	16.7
Gender	Male	72	60.0
	Female	48	40.0
Type of Surgery	Elective	70	58.3
	Emergency	50	41.7

Table 1: Distribution of age, gender and type of surgery

Postoperative complications occurred in 35.0% of patients, while mortality was relatively low at 6.7%. (Table 2)

Outcome	Number (n)	Percentage (%)
Morbidity (Complications)	42	35.0
No morbidity	78	65.0
Mortality	8	6.7
Survival	112	93.3

Table 2: Postoperative Outcomes

POSSUM overestimated both morbidity and mortality, whereas P-POSSUM showed closer approximation to observed outcomes. (Table 3) P-POSSUM demonstrated better predictive accuracy with O: E ratios. (Table 4)

Outcome	Observed (%)	POSSUM Predicted (%)	P-POSSUM Predicted (%)
Morbidity	35.0	50.0	38.0
Mortality	6.7	15.0	8.5

Table 3: Observed vs Predicted Outcomes

Outcome	POSSUM	P-POSSUM
Morbidity	0.84	0.92
Mortality	0.44	0.79

Table 4: Observed-to-Expected (O: E) Ratio

Older age (>50 years) showed a statistically significant association with increased morbidity and mortality. Emergency procedures were significantly associated with higher morbidity and mortality. (Table 5)

		Morbidity n (%)	Mortality n (%)	p-value
Age Group	≤50 years (76)	20 (26.3%)	2 (2.6%)	0.02*

	>50 years (44)	22 (50.0%)	6 (13.6%)	
Type of Surgery	Elective (70)	18 (25.7%)	2 (2.9%)	0.01*
	Emergency (50)	24 (48.0%)	6 (12.0%)	

Table 7: Correlation of age and type of surgery with Outcomes

Higher POSSUM scores were strongly associated with increased postoperative complications. Mortality increased significantly with higher POSSUM scores. (Table 8)

Score Category	Morbidity Present n (%)	Morbidity Absent n (%)	p-value	Mortality n (%)	Survival n (%)	p-value
Low	6 (15.0%)	34 (85.0%)	<0.001*	0 (0%)	40 (100%)	<0.001*
Moderate	18 (45.0%)	22 (55.0%)		2 (5.0%)	38 (95.0%)	
High	18 (75.0%)	6 (25.0%)		6 (25.0%)	18 (75.0%)	

Table 8: Correlation of POSSUM Score with Morbidity and Mortality

Increasing P-POSSUM scores showed a statistically significant association with morbidity. Higher P-POSSUM scores were significantly associated with increased mortality. (Table 9)

Score Category	Morbidity Present n (%)	Morbidity Absent n (%)	p-value	Mortality n (%)	Survival n (%)	p-value
Low	5 (12.5%)	35 (87.5%)	<0.001*	0 (0%)	40 (100%)	<0.001*
Moderate	17 (42.5%)	23 (57.5%)		2 (5.0%)	38 (95.0%)	
High	20 (50.0%)	20 (50.0%)		6 (15.0%)	34 (85.0%)	

Table 9: Correlation of P-POSSUM Score with Morbidity and Mortality

DISCUSSION

The present study evaluated 120 patients undergoing general surgical procedures using the POSSUM (Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity) and P-POSSUM (Portsmouth POSSUM) scoring systems to assess their utility in predicting postoperative outcomes. The majority of patients were in the middle-aged group, particularly between 31–40 years (23.3%) and 41–50 years (21.7%), indicating that surgical conditions requiring operative intervention are more common in this economically productive age group. A male predominance (60.0%) was observed, which is consistent with patterns reported in surgical literature and may reflect increased exposure to risk factors and healthcare utilization among males.

These demographic findings are comparable with previous studies. Das DK et al.[11] reported a mean age of 40.6 years with 63.3% male patients, closely aligning with the present study. Similarly, Bullagan A et al.[12] observed a mean age of 37.9 years and a male-to-female ratio of 1.5:1, further supporting the predominance of middle-aged males in surgical cohorts. In contrast, Johns WL et al.[13] reported a significantly older population (median age 88 years) in hip fracture patients, highlighting that demographic characteristics vary depending on the surgical population studied.

In the present study, elective surgeries constituted 58.3% of cases, while 41.7% were emergency procedures, indicating a substantial burden of acute surgical conditions. Postoperative morbidity was observed in 35.0% of patients, and mortality occurred in 6.7%. These findings are comparable with Echara ML et al.[14] who reported a morbidity rate of 69% and mortality of 12%, although their higher rates may be attributed to differences in case severity and study population. Similarly, Hu ZW et al.[15] reported an observed complication rate of 17.88% and mortality of 1.09%, which were lower than predicted values, reflecting variability in outcomes across settings.

Age was identified as a significant determinant of postoperative outcomes in the present study. Patients aged above 50 years demonstrated higher morbidity (50.0%) and mortality (13.6%) compared to younger patients. This is consistent with findings by Jain AK et al.[16] who noted increased mortality associated with delayed presentation and deranged physiological parameters, which are more common in elderly patients. Additionally, emergency surgeries were associated with significantly worse outcomes, with higher morbidity (48.0%) and mortality (12.0%) compared to elective procedures. This observation is in agreement with Jain AK et al.[16] and Das DK et al.[11] who emphasized the impact of delayed presentation and emergency surgical conditions on adverse outcomes.

The predictive performance of POSSUM and P-POSSUM scoring systems in the present study showed that both scores correlated well with increasing morbidity and mortality. Higher scores were associated with significantly increased

complications and deaths, confirming their role in risk stratification. However, POSSUM tended to overpredict outcomes, with predicted morbidity (50.0%) and mortality (15.0%) exceeding observed values (35.0% and 6.7%, respectively). In contrast, P-POSSUM demonstrated better calibration, with predicted morbidity (38.0%) and mortality (8.5%) closer to observed rates.

These findings are consistent with multiple comparative studies. Shekar N et al.[17] reported that both POSSUM and P-POSSUM overpredicted morbidity and mortality, although the difference between predicted and observed values was statistically significant. Echara ML et al.[14] also demonstrated overestimation by both models, with O:E ratios of 0.29 for POSSUM and 0.44 for P-POSSUM, indicating overprediction, particularly by POSSUM. Similarly, Jain AK et al.[16] found that POSSUM overpredicted both morbidity and mortality, whereas P-POSSUM provided a more accurate estimation of mortality (O:E ratio ~1).

Meta-analytical evidence by Wanjiang F et al.[18] further supports these observations, demonstrating that POSSUM tends to overestimate mortality (RR 1.93), whereas P-POSSUM provides a more accurate prediction (RR 1.15). Additionally, Hu ZW et al.[15] reported that POSSUM overpredicted complication and mortality rates, while P-POSSUM showed better agreement with observed mortality, reinforcing its superior calibration.

The diagnostic accuracy of these scoring systems has also been supported by Bullagan A et al.[12] who demonstrated high sensitivity and specificity for both POSSUM and P-POSSUM in predicting morbidity and mortality, with slightly better performance by P-POSSUM. However, Johns WL et al.[13] highlighted poor agreement between predicted and observed mortality in certain subgroups, suggesting that these scoring systems may have limitations in specific populations, particularly elderly patients or specialized surgical cohorts.

CONCLUSION

The present study demonstrates that both POSSUM and P-POSSUM scoring systems are effective tools for predicting postoperative morbidity and mortality in general surgical patients. Increasing scores were significantly associated with higher rates of complications and mortality, highlighting their value in risk stratification. However, POSSUM was found to overpredict outcomes, whereas P-POSSUM showed better accuracy and closer correlation with observed results. Factors such as advanced age and emergency surgery were associated with poorer outcomes. Thus, P-POSSUM is a more reliable scoring system for assessing surgical risk and can be effectively utilized for clinical decision-making, audit, and improving patient care.

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Conflicts of Interest

There are no conflicts of interest

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