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ORIGINAL ARTICLE

A Prospective Observational Study on Efficacy of Possum Scoring System in Predicting Morbidity and Mortality for Patients Undergoing Emergency Laparotomy

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Abstract
Introduction: Emergency laparotomy is usually linked with considerable postoperative morbidity and mortality due to the critical condition of patients and the emergency nature of intervention. Accurate prediction of adverse outcomes is important for optimising the resource allocation and the perioperative care. The Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) was initiated to offer an objective method for risk stratification. This study assessed the effectiveness of the POSSUM scoring system in predicting the postoperative morbidity and mortality among patients who undergo the emergency laparotomy. **Materials and Methods:** This is a prospective observational study which included 129 patients who underwent emergency laparotomy in a tertiary care hospital. Demographic details, laboratory investigations, clinical parameters, operative findings, and postoperative outcomes were recorded by using a structured proforma. The POSSUM scores were recorded for all the participants based on the physiological and operative severity parameters. Institutional Ethical Committee approval was obtained and the written informed consent was obtained from all the participants. Data were analysed using the SPSS software version 21. Descriptive data were expressed as percentages and frequencies. The predictive performance of POSSUM was evaluated by finding the sensitivity, specificity, negative predictive value and positive predictive value for both the morbidity and mortality. **Results:** POSSUM predicted 111 patients for morbidity, whereas 61 cases developed the postoperative complication, indicating an overestimation of morbidity by this scores. Specificity and sensitivity for morbidity prediction were 25% and 98.4% respectively. For mortality, the POSSUM scoring predicted 67 persons mortality compared to 29 observed deaths, with specificity and sensitivity and of 62% and 100% respectively. The high negative predictive value for mortality had explained its reliability in identifying the low-risk patients. Overall, POSSUM had showed the sensitivity but it had tendency to overpredict the adverse outcomes, particularly the morbidity. **Conclusion:** POSSUM had proved to be a reliable risk stratification tool for predicting the postoperative mortality and it is a sensitive indicator for morbidity in patients undergoing emergency laparotomy, though it had tendency to overestimate the complications. This scoring system can facilitate early identification of high-risk patients, enabling the clinical decision-making and better perioperative management.

Keywords: POSSUM score, Emergency laparotomy, morbidity, mortality, risk prediction

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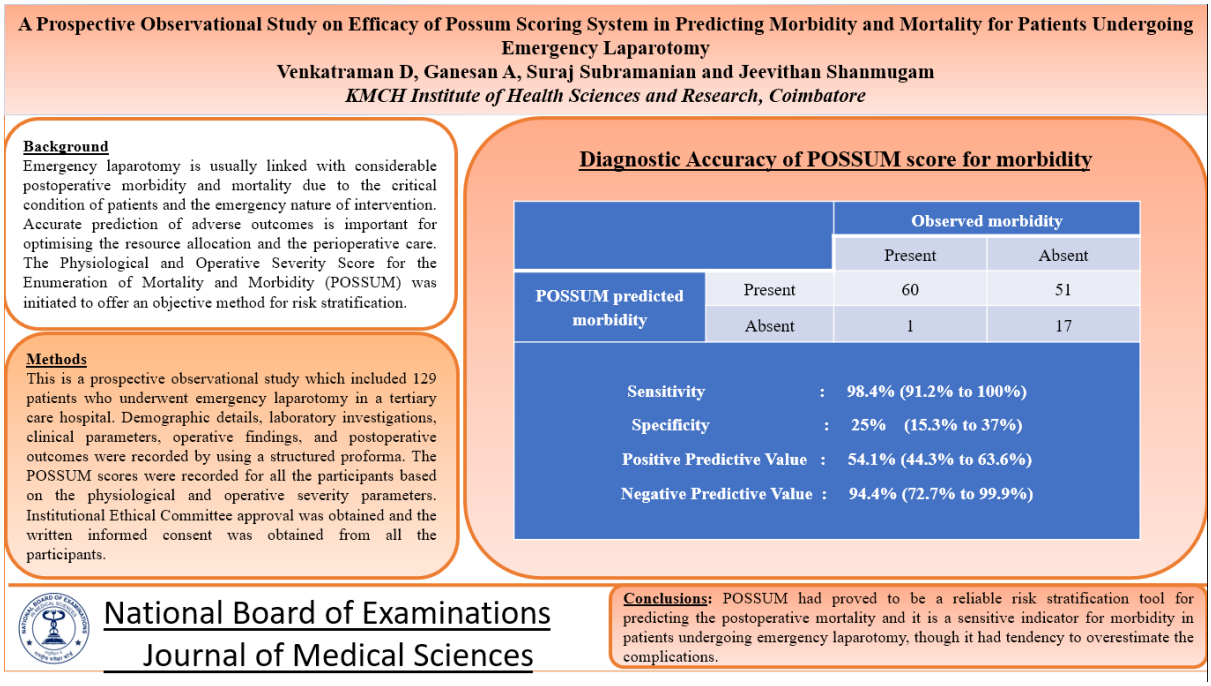
Graphical Abstract



Introduction

Risk management remains as a remarkable aspect of healthcare, particularly in the surgical domain, where early identification of the patients at risk of complications increases the quality of care while decreasing the overall costs. The ability to predict the adverse outcomes enables the surgeons to make informed decisions and perform timely interventions, ultimately improving the overall surgical results. The Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity (POSSUM) was created to offer a numerical estimate of expected postoperative morbidity and mortality across various surgical procedures, serving as a improved tool for the prediction of outcome. [1,2].

POSSUM consists of a two-part scoring mechanism that includes physiological assessment and the evaluation of operative severity. The physiological component has12 variables graded using an exponentially increasing scoring system, incorporating various clinical signs, haematological and biochemical investigations, and electrocardiographic findings. In cases where data are unavailable, a minimum score is used, allowing practicality and flexibility in routine clinical use. The total physiological score ranging from 12 to 88, which ensures the comprehensive assessment of the patient's preoperative condition [3].

The operative severity component assesses six intraoperative variables and it follows a similar exponential grading scale. This scoring system integrates into the existing hospital workflows and it can be used without disturbing the routine clinical and activity. Several comparative studies have demonstrated that POSSUM is more efficient than several other scoring systems in predicting the emergency surgical outcomes, reinforcing its relevance in perioperative risk assessment [4].

Multiple studies conducted across different healthcare systems and countries have consistently proved the accurate reliability of POSSUM in predicting the surgical outcomes. Its performance across varied populations highlights its adaptability and clinical significance, although the variations in predictive accuracy have been recorded depending on the institutional and regional practices [5,6].

Emergency laparotomy is a high-risk surgical procedure, which is commonly performed on the critically ill patients, and is linked with significant morbidity and mortality due to the urgent nature of such intervention. Accurate outcome prediction in such cases is very important for guiding the preoperative discussions, perioperative monitoring, and for optimizing the postoperative management. The use of POSSUM, a dependable scoring system can therefore remarkably contribute to enhance the patient care in emergency surgical settings [7].

Furthermore, emergency laparotomy cases often demand a quick clinical decision-making within limited time and resources. Effective predictive scoring systems like POSSUM allow better identification of high-risk patients, aiding in improved resource allocation and targeted interventions in those patients. This becomes very essential in emergency scenarios where the patient instability and surgical urgency, both coexist [8].

The physiological component of POSSUM considers the vital aspects of a patient's health such as respiratory, cardiovascular, renal, and metabolic status, while the operative severity component considers the procedural complexity and the urgency for intervention. Together, these components offer a holistic evaluation of surgical risk and assess the postoperative complications [9].

Therefore, the current study was undertaken to assess the efficacy of the POSSUM scoring system in evaluating the postoperative morbidity and mortality among the patients who undergo emergency laparotomy.

Aim and objectives

1. To assess the efficacy of the POSSUM scoring system in evaluating the postoperative morbidity and mortality among the patients undergoing emergency laparotomy.
2. To compare the observed surgical outcomes with those predicted outcome and complications by the POSSUM scores.

Materials and Methods

This is a prospective observational study which included 129 patients who underwent emergency laparotomy in a tertiary care hospital. Institutional Ethical Committee approval was obtained and the written informed consent was obtained from all the participants.

The participants who fulfilled the inclusion criteria and provided consent were enrolled in the study. The data were collected using a well-structured proforma that recorded demographic details, operative parameters, clinical findings, and postoperative outcomes. The POSSUM scoring system was applied to all the patients using pre-validated data collection forms recording both the physiological and operative severity components. All the parameter measurements and clinical assessments were done by the principal investigator to reduce the inter-observer variability, and all the values were recorded using standard SI units.

All the patients were provided with a Participant Information Sheet explaining the purpose of the study, procedures involved, potential risks and benefits, and their right to withdraw from the research at any stage without affecting their medical care. Written informed consent was obtained from all the patients or their legally authorised representatives, in both the regional language and English. Confidentiality of patient information was strictly maintained throughout the research period.

Preoperative evaluation includes recording of vital parameters such as blood pressure, pulse rate, respiratory rate, Glasgow Coma Scale, and routine laboratory investigations including total leukocyte count, hemoglobin, serum urea, and electrolytes. Intraoperative details such as number of procedures, blood loss, operative severity, degree of peritoneal contamination, and presence of malignancy were monitored. Postoperative outcomes were recorded until the discharge or death, and the occurrence of morbidity and mortality was recorded accordingly.

Data were entered into Microsoft Excel and analysed using the SPSS software (version 21). The descriptive data were expressed as frequencies and percentages (F and %). Diagnostic accuracy of the POSSUM scoring system was evaluated by comparing the predicted outcomes with observed morbidity and mortality. Specificity, sensitivity, positive predictive value (PPV), and negative predictive value (NPV) were measured to evaluate its performance in predicting the postoperative morbidity and mortality.

Results

Most of the patients undergoing emergency laparotomy were elderly, with the highest proportion (34.9%) belonging to the age group ≥ 61 years, followed by the even representation across the remaining age groups. This highlights the more susceptibility of elderly patients to acute abdominal emergencies requiring surgical intervention. The pronounced male predominance (68.99%) suggests that the older males were more frequently affected in this cohort, possibly correlating the gender-related differences in exposure to the risk factors or healthcare utilisation patterns. Procedural characteristics further indicate that most of the surgeries were classified as major procedures (98.4%), with majority of patients undergoing a single operative intervention (86%), reflecting a relatively uniform surgical severity profile. Complications like blood loss was predominantly seen between 101–500 ml in 63.5% of cases, while peritoneal soiling was not seen in 36.3% but it is present in the remaining patients in various forms, suggesting significant intra-abdominal contamination in them. The low prevalence of malignancy (12.4%) proves that most emergency laparotomies were done for non-malignant acute conditions (Table 1).

Table 1. Socio Demographic and Clinical Characteristics of the study participants

Category	Sub classification	Number	%
Age	≤30 years	23	17.80
	31-30 years	21	16.30
	41-50 years	19	14.70
	51-60 years	21	16.30
	≥61 years	45	34.90
Sex	Males	89	68.99
	Females	40	30.01
Procedural Details			
Operative severity	Major	127	98.4
	Major +	2	1.6
Number of procedures	1	111	86
	2	14	10.9
	3	4	3.1
Blood loss	<100 ml	21	16.3
	101-500 ml	82	63.5
	501-1000 ml	13	10.1
	>1000 ml	13	10.1
Peritonieal Soiling	None	47	36.3
	Local pus	12	9.2
	Bowel contents	32	24.8
	Blood	18	13.9
Malignancy	None	113	87.6
	Primary alone	15	11.6
	Nodal spread	1	0.8

POSSUM scoring system had demonstrated very high sensitivity (98.4%) in predicting the postoperative morbidity, indicating that it was highly efficient in identifying patients who may develop complications following emergency laparotomy. However, the specificity was low (25%), indicating that the system tended to overpredict the morbidity by incorrectly classifying many of the patients as high risk who did not develop the complications. The positive predictive value of 54.1% indicating moderate accuracy in confirming the morbidity when predicted, while the high negative predictive value of 94.4% correctly

reassures that patients identified as low risk were unlikely to experience postoperative complications. Thus, these findings suggest that POSSUM scoring system is more effective as a sensitive screening tool for morbidity risk assessment rather than a precise predictor of complication occurrence (Table 2).

Table 2. Diagnostic Accuracy of POSSUM score for morbidity.

		Observed morbidity	
		Present	**Absent**
POSSUM predicted morbidity	Present	60	51
	Absent	1	17
Sensitivity : 98.4% (91.2% to 100%)			
Specificity : 25% (15.3% to 37%)			
Positive Predictive Value : 54.1% (44.3% to 63.6%)			
Negative Predictive Value : 94.4% (72.7% to 99.9%)			

POSSUM demonstrated excellent predictive performance for mortality assessment, with a sensitivity of 100%, indicating that all patients who died postoperatively had been correctly identified as high risk. The specificity of 62% shows moderate accuracy in identifying patients who would survive. The positive predictive value of 43.3% reflects some degree of overprediction, while the negative predictive value of 100% confirms that no patient predicted as low risk died during the study period. These findings highlight the strong reliability of the POSSUM scoring system in predicting the mortality following emergency laparotomy (Table 3).

Table 3. Diagnostic Accuracy of POSSUM score for mortality.

Variable		**Observed mortality**	
		Present	**Absent**
POSSUM predicted mortality	Present	29	38
	Absent	0	62
Sensitivity : 100% (82.8% to 100%)			
Specificity : 62% (51.7% to 71.5%)			
Positive Predictive Value : 43.3% (31.2% to 56%)			
Negative Predictive Value : 100% (91.5% to 100%)			

Discussion

The POSSUM (Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity) and its variants such as P-POSSUM are the effective tools for predicting postoperative morbidity and mortality worldwide. In the current study, the POSSUM scoring system was applied to evaluate its predictive accuracy among the participants undergoing the emergency laparotomy. The findings confirm its relevance as a risk stratification tool, particularly in high-risk surgeries where the accurate prediction of outcomes can significantly influence the perioperative decision-making and patient management.

The participants predominantly comprised of elderly patients for with emergency laparotomy, consistent with the demographic profile. Similar age distributions were reported by Mzoughi et al. [10] and Cao et al. [11], highlighted on geriatric populations undergoing emergency laparotomy. Imaoka Y et al. [12] also reported the vulnerability of very elderly patients to emergency abdominal conditions, reinforcing the observed age-related susceptibility noted in the present study.

A male predominance was observed clearly in the present cohort, with a male-to-female ratio of 2:1 approximately. This finding was consistent with Simpson et al. [13] who reported a similar pattern in an older population undergoing the emergency laparotomy, and Chen et al. [14] who reported comparable male predominance in hepatobiliary surgical patients. These trends may suggest the gender-based differences in disease burden and healthcare utilisation of the society.

The prevalence of comorbidities such as diabetes mellitus and hypertension played an essential role in influencing the postoperative outcomes. Wang et al. [15] proved the preoperative biochemical parameters as key predictors of adverse outcomes, while Imaoka et al. [12] and Mzoughi et al. [10] proved that the increased physiological scores correlated strongly with the increased morbidity and mortality. This reflects the current study's observation that underlying systemic illnesses contribute to the postoperative complications and poor outcomes significantly.

POSSUM scoring system demonstrated high sensitivity for both morbidity and mortality prediction, though it tended to overestimate the outcomes, particularly morbidity This pattern aligns with various other studies worldwide that have highlighted POSSUM’s tendency to overpredict complications while maintaining the strong ability to point the high-risk patients. Despite this limitation, its application remains clinically valuable for finding the patients requiring continuous monitoring and preoperative optimisation, thus supporting its continued use in emergency surgical laparotomy settings

Conclusion

This study highlighted that the POSSUM scoring system is an essential, valuable, and sensitive tool for predicting the postoperative outcomes in patients undergoing emergency laparotomy, particularly in identifying the patients at risk of mortality. While POSSUM showed good sensitivity and negative predictive value for mortality prediction, its lower specificity and tendency to overestimate the morbidity reflects that it may overpredict the complications, especially in high-risk patients. Despite this limitation, POSSUM

remains clinically significant as a risk stratification tool that aids in early identification of vulnerable patients, aids in informed clinical decision-making, and supports appropriate allocation of perioperative resources. The findings demonstrates the importance of combining POSSUM scoring with clinical assessment to optimise the patient care and improve surgical outcomes in emergency settings.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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