



PREDICTIVE ACCURACY OF POSSUM IN ASSESSING MORBIDITY AND MORTALITY AFTER EMERGENCY LAPAROTOMY

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ABSTRACT

Objective: To assess the predictive accuracy of the Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) for the prediction of 30-day morbidity and mortality in patients undergoing emergency laparotomy.

Study Design: Prospective cross-sectional study.

Place and Duration: This study was carried out at Indus Medical College Tando Muhammad Khan Pakistan, from April 2025 to April 2026

Methods: The study included patients aged 15–75 years who underwent emergency laparotomy, excluding polytrauma and immunocompromising disease, including chronic liver disease, chronic renal failure, COPD, asthma, HIV, malignancy, and genetic diseases. A total of 146 consecutive patients were entered. Demographic and clinical data were obtained, POSS physiological and operative scores were computed, and a 30-day follow-up was conducted to assess morbidity and mortality. Data were summarized by mean \pm SD or median and IQR, frequencies were used for qualitative data, and discrimination was assessed using ROC curves.

Results: The cohort included 88 males (60.3%), with a mean age of 46.8 ± 14.5 years. The most common indications were perforation peritonitis (42.5%) and intestinal obstruction (31.5%). Thirty-day mortality was 18 patients (12.3%), and morbidity was 72 patients (49.3%). The ROC curve demonstrated satisfactory discrimination for mortality (AUC 0.782, $p < 0.001$) and moderate prediction for morbidity (AUC 0.618, $p = 0.092$).

Conclusion: POSSUM is a useful predictor of 30-day mortality but not morbidity in the emergency laparotomy population. Although useful for mortality risk stratification, greater sophistication or localization of models is necessary to predict morbidity.

Keywords: Emergency Laparotomy, POSSUM Scoring, Morbidity, Mortality, Risk Prediction.

INTRODUCTION

Emergency laparotomy, an urgent surgical opening of the abdomen to resolve life-threatening intra-abdominal disease, is one of the most common, most complex, and highest-risk general surgical procedures performed globally [1].

These operations are characterized by derangement of physiology, septic conditions, and poor preoperative optimization, leading to significant post-operative morbidity and mortality [2]. The 30-day mortality rates after an emergency laparotomy vary widely worldwide, but are consistently higher than the benchmarks for elective surgery, with several studies reporting 30-day mortality of around 13% to 18% and major complication rates of up to 50% [3]. These rates are likely even higher in lower and middle-income countries, with variable peri-operative optimization processes, limited resources



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and delayed presentation [2, 3]. A 30-day mortality rate of 9.5–15.2% is observed in Pakistan, as indicated by institutional data, which share similar challenges as delayed presentation and limited critical-care capacity [4].

Given its high-risk profile, risk stratification, both pre- and post-surgery, is crucial for guiding clinical decision-making, counselling patients and families, allocating resources, and comparing outcomes between institutions. The Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) is one of the surgical scoring systems used widely, and it was originally developed to facilitate risk-adjusted audit of surgical outcomes [5]. POSSUM includes 18 variables (12 physiological and six operative parameters), each weighted and fitted together using logistic regression to predict 30-day postoperative morbidity and mortality [5]. Although widely used, POSSUM has been criticized for overpredicting mortality and morbidity, especially in low-risk patients, and has since been modified, e.g. Portsmouth-POSSUM (P-POSSUM), which was developed to better calibrate the prediction of mortality [6, 7].

The POSSUM scoring system has been evaluated in the setting of emergency laparotomy. In Pakistan, a cross-sectional study reported a 34.5% 30-day morbidity and 7% mortality, with the POSSUM mortality score showing acceptable discrimination and poor discrimination for morbidity prediction [8]. Likewise, a prospective study conducted in India demonstrated that a combination of POSSUM and P-POSSUM was a sensitive predictor of mortality but overestimated events, especially in lower-risk groups [9].

While POSSUM is internationally validated, its specific effectiveness in emergency laparotomy in different healthcare settings must be continually assessed. The study is important to assist in the early identification of high-risk patients, to optimize care and to guide quality improvement and/or to allocate ICU resources efficiently. This study, therefore, aims to compare the predictive value of the POSSUM score for 30-day morbidity and mortality in patients undergoing emergency laparotomy.

METHODOLOGY

This is a prospective cross-sectional study assessing the predictive accuracy of the POSSUM scoring system for outcome after emergency laparotomy. Patients aged 15 to 75 years with any ASA classification who had undergone an emergency laparotomy were eligible for inclusion. Patients who suffered from polytrauma and immunocompromised diseases (including chronic obstructive pulmonary

disease, asthma, chronic liver disease, chronic kidney disease, HIV, malignancy, any genetic disorder) were excluded. Written informed consent was obtained from every patient or, in cases where there was a legally authorized representative. A non-probability consecutive sampling technique was adopted, with a sample size of 146 patients.

Patients who fulfilled the inclusion criteria were recognized and recruited for the study at the emergency department. A detailed demographic and clinical profile were obtained in all patients. A structured questionnaire was designed to collect data prospectively based on the POSSUM scoring system parameters. Preoperative clinical and laboratory scores were used to generate each patient's physiological score, and the operative severity score was assigned by the operating surgeon.

All patients were monitored during the hospital stay to detect postoperative morbidity and mortality. They were discharged when clinically stable. Follow-up continued for up to 30 days after surgery to determine if any complications or mortality occurred after hospital discharge.

IBM SPSS version 25.0 was used for statistical analysis. Quantitative variables (patient age, duration of surgery, POSSUM score) were summarized as mean \pm standard deviation or median (interquartile range) as appropriate for distribution. Qualitative variables (gender, residential status, comorbidities, smoking history, ASA grade, indication for laparotomy and previous surgical history) were displayed as frequencies and percentages. Receiver operating characteristic (ROC) curves were used to evaluate the discriminatory power of the POSSUM scoring system in predicting morbidity and mortality. Effect modifiers, including age and gender, were controlled using stratification analysis.

RESULTS

146 patients, who had undergone emergency laparotomy, were included in this study. The majority were male (n=88, 60.3%) with a mean age of 46.8 ± 14.5 years. Most patients were non-smokers (n=96, 65.8%) and not from rural areas (n=92, 63.0%). Comorbid conditions were present in 64 patients (43.8%), while the largest proportion belonged to ASA class III (n=60, 41.1%), indicating moderate to severe systemic disease. The most common indications for surgery were perforation peritonitis (n=62, 42.5%) and intestinal obstruction (n=46, 31.5%). A history of prior major abdominal surgery was noted in 38 patients (26.0%), and the mean operative duration was 102.5 ± 28.7 minutes (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n = 146)

Variable	Value
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Age (Years)	27.3 ± 14.3
Gender	
• Male	88 (60.3%)
• Female	58 (39.7%)
Place Of Residence	
• Urban	92 (63.0%)
• Rural	54 (37.0%)
Smoking Status	
• Smoker	50 (34.2%)
• Non-Smoker	96 (65.8%)
Comorbid Conditions	
• Present	64 (43.8%)
• Absent	82 (56.2%)
ASA Physical Status Class	
• I	20 (13.7%)
• II	52 (35.6%)
• III	60 (41.1%)
• IV	14 (9.6%)
Indication For Laparotomy	
• Perforation Peritonitis	62 (42.5%)
• Intestinal Obstruction	46 (31.5%)
• Mesenteric Ischemia/Gangrene	18 (12.3%)
• Other (Specify)	20 (13.7%)
Previous History Of Major Abdominal Surgery	
• Yes	38 (26.0%)
• No	108 (74.0%)
Duration Of Surgery (Minutes)	102.5 ± 28.7

The 30-day mortality occurred in 18 patients (12.3%), while 30-day morbidity was reported in 72 patients (49.3%). The ROC analysis demonstrated that the POSSUM mortality score had reasonable

discriminative ability with an AUC of 0.782 (95% CI 0.692–0.872, $p < 0.001$), indicating it reliably predicts death following emergency laparotomy (Figure 1).

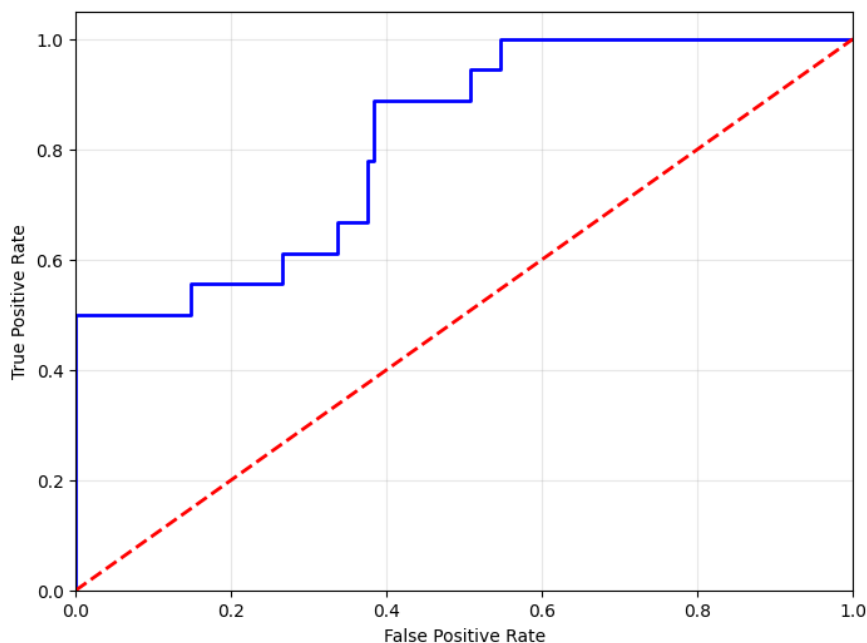


Figure 1: ROC Curve for POSSUM Mortality Score (30-day mortality)

The 30-day morbidity occurred in 72 patients (49.3%). The ROC analysis showed that the

POSSUM morbidity score had limited predictive ability, with an AUC of 0.618 (95% CI 0.523–0.713, $p = 0.092$) (Figure 2).

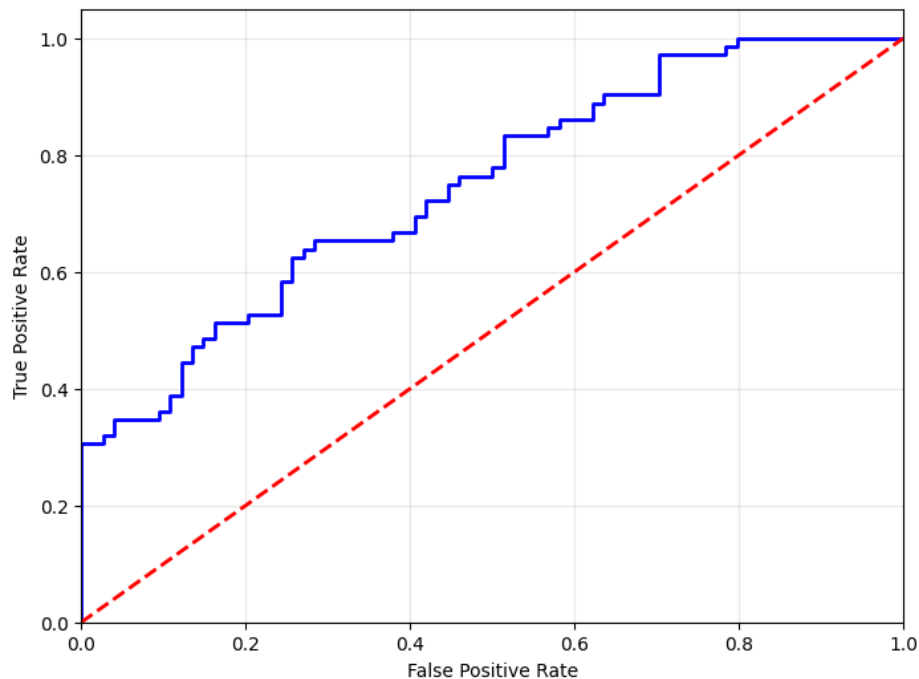


Figure 2: ROC Curve for POSSUM Morbidity Score (30-day morbidity)

DISCUSSION

The present study assessed the predictive accuracy of the POSSUM system for the 30-day postoperative morbidity and mortality in emergency laparotomy patients. In our study population of 146 patients, baseline characteristics showed that most were male, and their mean age was in the mid-forties, with almost half having moderate or severe systemic disease (ASA class III or IV) before surgery. This result is similar to that of a Swedish study of >700 patients undergoing emergency surgery, in which >50% of patients undergoing surgery had at least one comorbidity, and a higher ASA classification was strongly associated with increased 30-day mortality [10]. Perforation peritonitis and intestinal obstruction accounted for the majority of cases in our study, which is essentially the common surgical pathology seen in emergency abdominal surgery all over the world. Kyaruzi et al. reported similar primary pathologies, where obstruction and contamination of the peritoneum were often mentioned as complications occurring after surgery and leading to longer hospitalization [11].

Our results indicate a 30-day mortality rate of 12.3% and a morbidity rate 49.3%, with the mortality score providing reasonable discrimination and the morbidity score providing limited discrimination. In a similar clinical context, Gul et al. found that while POSSUM demonstrated reasonable discrimination for mortality (AUC ~0.796), it showed poor predictive performance for morbidity, reinforcing

our findings [8]. Maitra et al. have also reported that P-POSSUM was very good at predicting mortality but somewhat less good at predicting morbidity, indicating the multifactorial nature of complications that are difficult to predict [12].

Various scoring systems have been evaluated and compared with POSSUM and its adapted score (P-POSSUM). In the study by Barghash et al., the discrimination of the P-POSSUM score for predicting 30-day mortality was also acceptable (~0.784), very similar to that of other scores, such as the National Emergency Laparotomy Audit (NELA) score [13]. Further, Ali et al. compared P-POSSUM with other risk scoring systems, such as the Emergency Surgery Acuity Score (ESAS), and found that the latter had better discrimination for mortality in emergency laparotomy, suggesting the potential use of other or additional scoring tools [14].

In our study, the morbidity score had limited predictive value. This poor discrimination is consistent with the results of Maitra et al., who noted that P-POSSUM was a good predictor of mortality but less so of morbidity in emergency exploratory laparotomy [12]. Alabbasy et al. similarly noted underestimation of risk with both NELA and P-POSSUM for morbidity endpoints [15]. Cao et al. emphasized the usefulness of P-POSSUM with regard to 90-day mortality (key predictor in logistic models) while recognizing less robust morbidity calibration [6]. Ishfaq Khan et al. reported over-

prediction of in-hospital mortality, which is consistent with a moderate over-estimation pattern in the high-risk ASA III/IV cases [16]. Eswaravaka et al. validated POSSUM/P-POSSUM in ileal perforation, which was a frequent indication in our cohort (42.5% perforation peritonitis), and found it to be reasonably accurate in predicting mortality, but recommended local recalibration [17].

This study has implications for clinical and research practice. The reasonable discrimination of POSSUM for mortality is a testament to its value as a preoperative risk stratification tool to aid clinical decision-making and counselling the patient and family regarding prognosis. Furthermore, the poor prediction of morbidity indicates a need for more predictive models or for local recalibration using more dynamic postoperative parameters or institution-specific care pathways.

There are some limitations to this study. First, the results of this single-center study may not be generalizable to other centers with different case mixes and perioperative management. Second, the study did not compare its results with other scoring systems, such as P-POSSUM or newer risk models, that may provide further insight into relative performance.

CONCLUSION

The POSSUM scoring system demonstrated good discriminatory ability for 30-day mortality and poor discriminatory ability for 30-day morbidity. The high prevalence of comorbidities, moderate to severe ASA classes and common indications such as perforation, peritonitis, and obstructions were associated with a high postoperative risk. Our findings suggest that risk prediction tools can be useful, though they have low predictive value for morbidity. This highlights the importance of improved models and standardized perioperative care pathways in emergency surgical settings.

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