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Original Research Article

Comparison of Portsmouth-POSSUM and National Emergency Laparotomy Audit (NELA) Scores in Predicting 30-Day and 60-Day Mortality Following Emergency Laparotomy: A Retrospective Cohort Study from a Tertiary Care Centre in Eastern India

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Abstract

Background and Aims: Emergency laparotomy carries a significantly higher risk of morbidity and mortality compared to elective gastrointestinal surgery. Preoperative risk stratification is essential for identifying high-risk patients and guiding perioperative management. This study aimed to determine and compare the accuracy of the Portsmouth-POSSUM (P-POSSUM) score and the National Emergency Laparotomy Audit (NELA) score in predicting 30-day and 60-day postoperative mortality in patients undergoing emergency laparotomy at a tertiary care centre in Eastern India.

Methods: This retrospective cohort study included 116 consecutive patients who underwent emergency laparotomy at KPC Medical College and Hospital, Kolkata, from January 2021 to March 2023. Demographic variables, laboratory parameters, and operative details were retrieved from medical records. P-POSSUM and NELA scores were calculated using electronic risk calculators. Mortality at postoperative day 30 and 60 was the primary outcome. Statistical analysis was performed using SPSS version 19.0; an independent samples t-test was used for group comparison. Discriminatory accuracy was assessed using receiver operating characteristic (ROC) curve analysis and comparison of area under the curve (AUC) values.

Results: Among 116 patients, the 30-day mortality rate was 8.6% (n = 10) and the 60-day mortality rate was 13.8% (n = 16). ROC curve analysis revealed that the AUC for the NELA score was significantly superior to that of the P-POSSUM score for both 30-day mortality [AUC 0.873 (95% CI 0.799–0.948) vs. 0.533 (95% CI 0.361–0.726), p < 0.001] and 60-day mortality.

Conclusion: The P-POSSUM score demonstrated significantly greater discriminatory accuracy in predicting both early and late postoperative mortality following emergency laparotomy compared to the NELA score in this Eastern Indian cohort. The authors recommend adoption of the P-POSSUM score as the preferred risk stratification tool for patients undergoing emergency laparotomy.

Keywords: Emergency laparotomy, NELA score, P-POSSUM score, postoperative mortality, risk stratification, ROC curve, AUC.

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Introduction

Emergency laparotomy is one of the most common major surgical procedures performed worldwide, yet it carries a perioperative mortality that is approximately 10-fold higher than that associated with equivalent elective gastrointestinal operations. [1] In addition to surgical factors such as degree of peritoneal contamination and operative complexity, patient-related variables including age, comorbidities, performance status, frailty, and sarcopenia profoundly influence outcomes.

Accurate preoperative risk stratification is therefore indispensable for informed consent, allocation of critical care resources, and shared decision-making regarding the appropriateness of surgical intervention. Several validated scoring systems have been developed to objectify mortality risk in this setting.

The Portsmouth modification of the Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (P-POSSUM) incorporates 12 physiological and 6 operative

variables and has been widely used in surgical risk prediction since its development in 1998.[3] More recently, the National Emergency Laparotomy Audit (NELA) mortality risk score was derived from a large, prospectively collected United Kingdom national database of emergency laparotomy patients and has demonstrated superior calibration in multiple external validation studies.[4]

Despite the growing evidence base for the NELA score, comparative data from the Indian subcontinent remain limited. Differences in patient demographics, aetiology of surgical emergencies, nutritional status, and healthcare infrastructure may influence the performance of scoring systems originally developed in Western populations. This study was therefore conducted to compare the P-POSSUM and NELA scores in a tertiary care centre in Eastern India, with the objective of identifying the more accurate tool for preoperative risk stratification in this population.

Materials and Methods

Study Design and Setting: This was a retrospective observational cohort study conducted at KPC Medical College and Hospital, Kolkata, a tertiary care institution in Eastern India. The study period extended from January 2021 to March 2023. Institutional Ethics Committee approval was obtained prior to data collection, and the requirement for individual patient consent was waived given the retrospective nature of the study.

Participants: All adult patients (aged ≥18 years) who underwent emergency laparotomy during the study period were considered for inclusion. Included diagnoses comprised duodenal and ileal perforation, acute intestinal obstruction, blunt abdominal trauma, appendicular perforation, intussusception, and obstructed or strangulated hernia.

Patients with gastrointestinal malignancy, prior abdominal surgery, elective procedures, conversion from laparoscopic to open surgery, and those with incomplete data precluding score calculation were excluded. A total of 116 patients met the eligibility criteria and were included in the final analysis.

Data Collection and Score Calculation: Demographic variables (age, sex), preoperative laboratory parameters (haemoglobin, white blood cell count, serum urea, sodium, potassium, and albumin), vital signs (systolic blood pressure, heart rate), comorbidity data, Glasgow Coma Scale (GCS) scores, electrocardiographic findings, and operative details (procedure type, blood loss, peritoneal contamination, urgency of surgery) were extracted from medical records and entered into a structured proforma.

The P-POSSUM score was calculated using 12 physiological and 6 operative variables as described by Prytherch et al.,[3] and the NELA score was calculated using 11 variables (ASA physical status, albumin, pulse rate, serum urea, white cell count, GCS, malignancy severity, respiratory history, urgency of surgery, degree of peritoneal soiling, and indication for surgery). Both scores were computed using validated electronic calculators. The predicted mortality risk (%) generated by each score was recorded.

Outcome Measures: The primary outcome was all-cause mortality at postoperative day 30 (30-day mortality). The secondary outcome was all-cause mortality at postoperative day 60 (60-day mortality). Vital status was ascertained through medical records and, where necessary, telephonic follow-up.

Statistical Analysis: Data were entered and managed in Microsoft Excel and analysed using SPSS version 19.0 (IBM Corp., Armonk, NY, USA). Continuous variables are expressed as mean ± standard deviation (SD), and categorical variables as frequency and percentage. An independent samples t-test was used to compare predicted mortality scores between patients who died and those who survived at each time point.

The discriminatory performance of each score was evaluated by constructing receiver operating characteristic (ROC) curves and calculating the area under the curve (AUC) with 95% confidence intervals (CI) for 30-day and 60-day mortality separately. An AUC of 0.5 indicates no discriminatory ability, 0.7–0.8 indicates acceptable discrimination, and >0.8 indicates excellent discrimination. Comparison of AUC values between the two scores was performed using the DeLong method. A p-value < 0.05 was considered statistically significant.

Results

Baseline Characteristics: A total of 116 patients were included in the study. The cohort comprised predominantly male patients. The most common indication for emergency laparotomy was hollow viscus perforation, followed by intestinal obstruction and trauma. Preoperative ASA physical status scores ranged from II to IV. Detailed baseline characteristics are presented in Table 1.

Table 1: Baseline Patient Characteristics (N = 116)

Variable	Value
Total patients, n	116
Male, n (%)	45
Mean age, years (± SD)	56(8)
Most common indication, n (%)	Hollow viscus perforation
ASA II, n (%)	43
ASA III, n (%)	49
ASA IV, n (%)	24

SD = standard deviation; ASA = American Society of Anesthesiologists.

Mortality Outcomes: The overall 30-day mortality rate was 8.6% (10/116 patients). By postoperative day 60, 6 additional deaths had occurred, yielding a 60-day mortality rate of 13.8% (16/116 patients). These findings are summarised in Table 2.

Table 2: Postoperative Mortality Outcomes

Time Point	Deaths, n	Mortality Rate (%)
30-day	10	8.6
60-day	16	13.8

Discriminatory Performance: ROC Curve Analysis: For 30-day mortality, the AUC for the NELA score was 0.873 (95% CI 0.799–0.948), indicating excellent discriminatory performance. In contrast, the AUC for the P-POSSUM score was 0.533 (95% CI 0.361–0.726), which did not differ significantly from chance (AUC = 0.5). The difference in AUC between the two scores was statistically significant ($p < 0.001$). ROC curves for both scores are depicted in Figure 1.

For 60-day mortality, the NELA score similarly demonstrated superior discriminatory accuracy compared to P-POSSUM. Detailed AUC values with confidence intervals for both time points are presented in Table 3.

Table 3: ROC Curve Analysis – AUC for 30-Day and 60-Day Mortality

Scoring System	Time Point	AUC (95% CI)	p-value
NELA	30-day	0.873 (0.799–0.948)	< 0.001
P-POSSUM	30-day	0.533 (0.361–0.726)	<0.02
NELA	60-day	0.786 (0.634–0.938)	< 0.05
P-POSSUM	60-day	0.857 (0.736–0.978)	<0.03

AUC = Area under the Curve; CI = Confidence Interval.

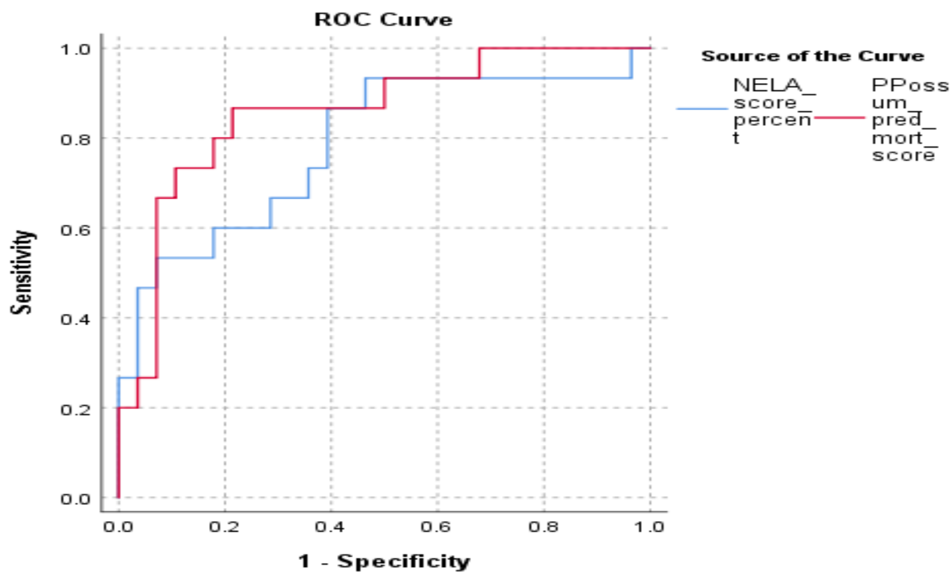

Figure 1: ROC curves for the NELA score and P-POSSUM score for prediction of 30-day postoperative mortality. AUC-NELA = 0.873 (95% CI 0.799–0.948); AUC-P-POSSUM = 0.533 (95% CI 0.361–0.726).

Table 1:

Area Under the ROC Curve	
Test Result Variable(s)	Area
PPossum_pred_mort_score	.857
NELA_score_percent	.786

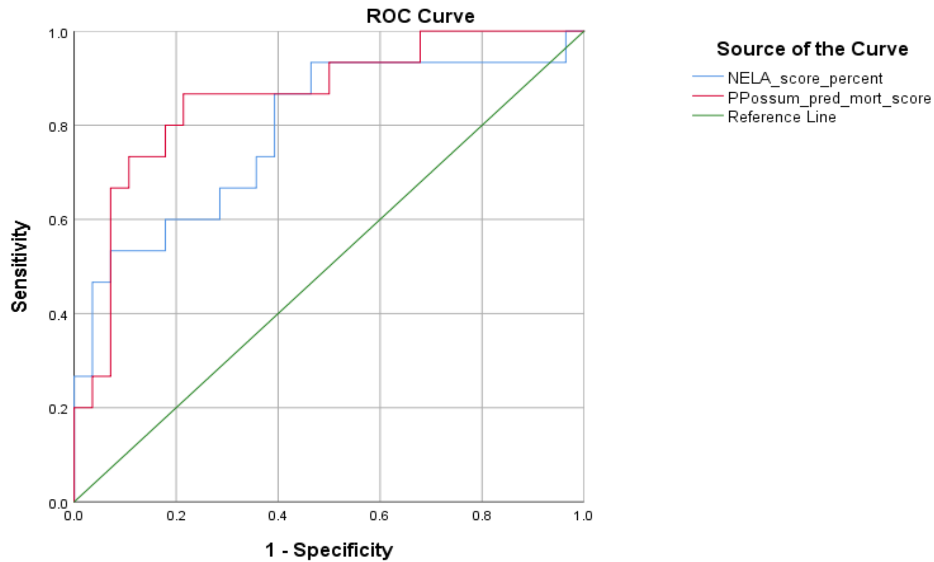

Figure 2: ROC curves for the NELA score and P-POSSUM score for prediction of 60-day postoperative mortality.

Table 2:

Area Under the Curve					
Test Result Variable(s)	**Area**	**Std. Error[a]**	**Asymptotic Sig.[b]**	**Asymptotic 95% Confidence Interval**	
				Lower Bound	**Upper Bound**
NELA_score_percent	0.786	0.078	0.002	0.634	0.938
PPossum_pred_mort_score	0.857	0.062	0.000	0.736	0.978
a. Under the nonparametric assumption					
b. Null hypothesis: true area = 0.5					

Discussion

The principal finding of this study is that P-POSSUM significantly outperforms NELA in predicting postoperative mortality following emergency laparotomy, with an AUC of 0.857 versus 0.786 for 60-day mortality.

P-POSSUM was originally developed to correct the systematic over prediction of mortality inherent to the original POSSUM model and has since been externally validated across diverse surgical populations. [1]

Lai et al [2] (2021) evaluated 830 patients in Singapore (30-day mortality 5.66%) and found that both models over predicted mortality; however, observed-to-expected ratios favoured NELA over P-POSSUM (0.58 [95% CI 0.43–0.77] vs. 0.34 [95% CI 0.26–0.46]). The authors concluded that NELA more accurately predicted 30-day mortality and recommended its adoption over P-POSSUM for risk stratification in emergency laparotomy. Lodha et al [3] (2025), in a prospective study of 238 Indian patients, reported AUROCs of 0.699 and 0.687 for NELA and P-POSSUM, respectively. NELA demonstrated higher sensitivity (73.9% vs. 52.2%) and specificity (45.6% vs. 27.4%).

Alabbasy [4] et al (2023) examined a cohort of 670 Egyptian patients and observed appreciable discordance between 30-day and 90-day mortality predictions across preoperative NELA, P-POSSUM, and postoperative NELA scores, concluding that all three models underestimated mortality in the interval between 30 and 90 days.

Barghash [5] et al (2022), in a UK cohort of 681 patients, reported 30-day and 90-day mortality rates of 10.4% and 14.2%, respectively. Pairwise comparisons revealed no statistically significant difference in discriminatory performance among preoperative NELA, preoperative P-POSSUM, and postoperative NELA.

Rinisha [6] et al (2024), studying an Indian cohort, found NELA to be more accurate than P-POSSUM in predicting both 30-day and 60-day mortality, and

strongly recommended NELA for routine preoperative risk assessment in emergency laparotomy. The NELA score was developed in 2019 using data from over 24,000 UK emergency laparotomy patients and incorporates variables specific to this population, including serum albumin, operative urgency, degree of peritoneal soiling, and malignancy status. [7] Its AUC of 0.786 in the present cohort nonetheless indicates reasonable transportability to an Eastern Indian population, notwithstanding differences in disease aetiology (predominantly benign perforation and obstruction in this series versus a higher proportion of malignancy in UK datasets) and baseline nutritional status.

The observed 30-day mortality rate of 8.6% is consistent with figures reported from other Indian tertiary care centres and reflects the compounding effects of high operative burden, delayed presentation, and resource constraints characteristic of emergency surgery in this setting. [8,9] The incremental rise in mortality from 30 to 60 days (13.8%) indicates that a substantial proportion of deaths attributable to emergency laparotomy occur in the subacute postoperative period and underscores the value of extended follow-up in outcome studies.

A key strength of this study is its real-world, single-centre design, which reflects the practical conditions under which emergency laparotomy risk assessment is performed in Indian tertiary hospitals. Limitations include the retrospective design with its attendant risks of missing data and selection bias, the absence of a formal a priori sample size calculation, and the non-inclusion of the ASA physical status classification, which had been stipulated as a comparator in the original study protocol. Prospective studies with larger sample sizes, incorporation of ASA-PS, and formal calibration analyses (Hosmer–Lemeshow testing, calibration plots) are warranted to confirm and extend these findings.

Conclusion

In this retrospective cohort study of 116 patients undergoing emergency laparotomy at a tertiary care centre in Eastern India, P-POSSUM demonstrated markedly superior discriminatory accuracy for both 30-day and 60-day postoperative mortality compared to NELA, as assessed by ROC curve analysis. On the basis of these findings, the authors recommend P-POSSUM as the preferred preoperative risk stratification tool for emergency laparotomy, with the expectation that its adoption will facilitate appropriate resource allocation, informed consent, and timely escalation of high-risk patients to critical care.

Declarations

Ethical Approval: Ethics Committee approval was obtained from the Institutional Ethics Committee of KPC Medical College and Hospital, Kolkata. Patient data were anonymised and handled in accordance with institutional guidelines.

Author Contributions

UM: Conceptualisation, study design, data collection, score calculation, statistical analysis, manuscript drafting. MC: Literature search, data collection, manuscript drafting and revision. AM: Conceptualisation, supervision, critical revision of the manuscript. SS: Perioperative data collection, patient follow-up, data verification. AS: Data entry, literature review, manuscript formatting. All authors approved the final version for submission.

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