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Original Article

Surgery Section

Comparison of P-POSSUM Score and NELA Score as Prime Predictors of Mortality in Emergency Laparotomies at a Tertiary Care Centre: A Retrospective Cohort Study

A RINISHA[1], K ANUPAMA PUJAR[2], V KALAIVANI[3], SHUBHA DANDU[4]

ABSTRACT

Introduction: Emergency laparotomies carry significant morbidity and mortality. Preoperative risk assessment is the key part for all emergency laparotomies. Therefore, the use of Physiological and Operative Severity Score for the enumeration of Mortality and morbidity (POSSUM) and National Emergency Laparotomy Audit (NELA) scores helps stratify the risk and highlight the importance of high-risk patients, aiding in the provision of appropriate treatment plans and care.

Aim: To determine and compare the Portsmouth-POSSUM (P-POSSUM) score and NELA score in predicting mortality at 30 days and 60 days in patients undergoing emergency laparotomies.

Materials and Methods: This retrospective cohort study included all patients who underwent emergency laparotomy at a tertiary care centre from January 2021 to March 2023. A total of 116 patients were included, and demographic variables, laboratory values, and operative details were recorded. Mortality on postoperative day 30 and 60 was observed. All data were recorded in an MS excel spreadsheet, and statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 19.0. An independent sample t-test was used.

Results: Among the total study sample of 116 patients, the 30-day mortality rate was 8.6% (10 out of 116), and the 60-day mortality rate was 13.8% (16 out of 116). The area under the ROC curve (AUC) for mortality prediction was 0.533 (0.361-0.726) for the P-Possum score and 0.873 (0.799-0.948) for the NELA score, which was significantly higher.

Conclusion: The NELA Score demonstrated greater accuracy in predicting early and late mortality compared to the P-POSSUM score in this study. Therefore, the authors highly recommend the use of the NELA score for risk assessment in all emergency laparotomies.

Keywords: High risk, Preoperative, Risk assessment, Scoring

INTRODUCTION

There is a significant risk of morbidity and mortality associated with emergency laparotomy, almost ten times higher than the risk of mortality associated with major elective gastrointestinal procedures [1,2]. Several patient-related factors significantly impact the outcomes of emergency laparotomy, in addition to operation-related factors, such as age, concurrent medical conditions, performance status, frailty, sarcopenia, and the presence of peritoneal contamination [3-5]. When determining the probability of survival following an emergency laparotomy, these kinds of preoperative considerations need to be given great attention. Due to this, numerous scoring systems that aim to predict the results of surgical procedures have been established [6-9] to facilitate easier and objective decision-making.

Two of the most widely used methods for risk prediction are the P-POSSUM model and the NELA mortality risk score [7,8]. The former scoring system was developed as early as 1991 by Copeland GP et al., and it was further refined and improved by Prytherch DR et al., [6,7]. Despite providing insights into the patient's condition in various situations, P-POSSUM [Table/Fig-1] has shown several inconsistencies and a tendency for overestimation [10,11]. The P-POSSUM score consists of 18 variables, while NELA, a more recent development, is simpler.

On the other hand, the NELA [Table/Fig-2] team utilised a unique method of developing a score from an extensive database [8]. NELA showed promising performance in validation and categorisation [8], and it makes use of risk indicators that are commonly collected in clinical practice. Recent research [9] has shown an interest in comparing the predictive ability of the P-POSSUM model and the NELA mortality risk score in specific emergency conditions, especially gastrointestinal surgeries. Hence, the authors performed this retrospective study to analyse the P-POSSUM score and NELA score in predicting mortality and morbidity in patients undergoing emergency laparotomy.

Physiological	Operative
Age	Operative type (minor-complex major)
Cardiac co-morbidity	Number of procedures
Respiratory co-morbidity	Operative blood loss
Electrocardiogram changes	Peritoneal contamination
Systolic Blood Pressure	Malignancy status
Pulse rate	CEPOD (confidential inquiry into perioperative deaths)
Haemoglobin	
White Blood Cells (WBC)	
Urea	
Sodium	
Potassium	
Glasgow Coma Scale (GCS)	

[Table/Fig-1]: POSSUM Score (Predictor of mortality in patients undergoing emergency laparotomy).

MATERIALS AND METHODS

This was a retrospective cohort study that included the case records of 116 patients who underwent emergency laparotomy in a tertiary

Hospital number	
Age	
Hospital ward	
Consultant	
What was the ASA score?	1. No Systemic disease 2. Mild Systemic disease 3. Severe Systemic disease, not life-threatening 4. Severe, life-threatening 5. Moribund patient
Albumin (g/L)	
Pulse rate (bpm)	
Systolic blood pressure (mm Hg)	
S. Urea concentration (mmol/L)	
S. White cell count (x10^9/L)	
Glasgow coma scale	
What severity of malignancy is anticipated to be present?	1. None 2. Primary only 3. Nodal metastases 4. Distant metastases
Select option that best describes this patient's respiratory history and chest X-ray appearance?	1. No dyspnoea 2. Dyspnoea on exertion or CXR: mild COPD 3. Dyspnoea limiting exertion to <1 flight or CXR moderate COPD 4. Dyspnoea at rest/rate >30 at rest or CXR: fibrosis or consolidation
Please select the urgency of surgical intervention	3. Expedited (>18 hours) 2B. Urgent (6-18 hours) 2A. Urgent (2-6 hours) 1. Immediate (<2 hours)
Please select a value that best describes the likely degree of peritoneal soiling	1. None 2. Serous fluid 3. Localised pus 4. Free bowel content, pus or blood
Indications for surgery	1. Bleeding Haemorrhage 2. Other Abdominal wound dehiscence Abdominal compartment syndrome Planned relook Other 3. Obstruction Tender small bowel obstruction Non-tender small bowel obstruction Tender large bowel obstruction Non-tender large bowel obstruction Gastric outlet obstruction Incarcerated/strangulated hernia Hiatus Hernia/para-oesophageal hernia Volvulus Internal hernia Obstructing incisional hernia Intussusception Pseudo-obstruction Foreign body 4. Sepsis Phlegmon Pneumoperitoneum Sepsis Iatrogenic injury Anastomotic leak Peritonitis GI Perforation Abdominal abscess Intestinal fistula 5. Ischaemia Necrosis Ischaemia/infarction Colitis Acidosis

[Table/Fig-2]: National Emergency Laparotomy Audit (NELA) score.

care center from January 2021 to March 2023 and were included in the study. Data analysis was conducted between April 2023 and June 2023.

No formal sample size calculation was done and it included all patients who underwent emergent laparotomy, fulfilling all inclusion and exclusion criteria. The sampling technique used was convenience sampling.

Inclusion criteria: All patients between the age groups of 18-60 years diagnosed with acute gastrointestinal conditions, including duodenal/ileal perforations, acute intestinal obstruction, blunt trauma, appendicular perforation, intussusception, and obstructed or strangulated hernia, were included.

Exclusion criteria: The data of patients with malignancy of the gastrointestinal tract, previous abdominal surgery or elective surgeries, conversion of laparoscopic to open laparotomy, and patients who did not have relevant investigations to calculate the P-POSSUM score and NELA score were excluded from the study.

Procedure

The details of the patients, along with their demographic variables, laboratory values, and operative details, were documented. The P-POSSUM [6,7] and NELA [8] scores were calculated using an electronic risk calculator, and mortality was recorded. The outcomes measured were 30 and 60 days of mortality (postoperative death) that occurred due to any cause after emergency laparotomies.

STATISTICAL ANALYSIS

All the data were recorded in an MS excel spreadsheet, and statistical analysis was performed using SPSS version 19.0. Independent sample t-tests were used for the comparison of mortality between both groups at 30 and 60 days. Categorical variables were represented as percentages and frequencies, while continuous variables were recorded as means and standard deviations. The discrimination of mortality was assessed and compared by determining the Area Under the Curve (AUC). The ROC curve was plotted for the prognostic ability of the two scoring systems.

RESULTS

This entails all 116 patients who met the inclusion criteria and underwent emergency laparotomy and were identified retrospectively, with a mean age of 45.48±15.75 years. Of the study population, 91 (78.4%) patients were male, and 25 (21.6%) were female.

It was concluded that 45 patients (38.8%) did not have any peritoneal contamination, 37 patients (31.9%) had serous discharge, 32 patients (27.6%) had pus discharge, and two patients (1.7%) had bowel contents contaminating the peritoneum.

In this study, it was found that there was an elevated mean pulse rate (102.42±14.67 bpm), serum urea (45.24±5.09 mmol/L), and diminished serum albumin (2.97±0.74g/L), with diminished sodium levels [Table/Fig-3]. The mean operating time in the study population was 87.35±27.61 minutes. The mean ICU stay was 1.51±0.31 days [Table/Fig-3].

Vitals and laboratory parameters	Values (n=116) (Mean±Sd)
Haemoglobin (g/dL)	11.65±3.04
Systolic blood pressure (mm of Hg)	127.40±16.91
Pulse rate (beats/minute)	102.42±14.67
Glasgow Coma Scale	15.00±0.10
Serum urea (mg/dL)	45.24±5.09
Serum sodium (mg/dL)	132.27±7.97
Serum potassium (mg/dL)	4.25±0.71
White blood cell count (cu.mm)	10697±531.20
Serum albumin (mg/dL)	2.97±0.74

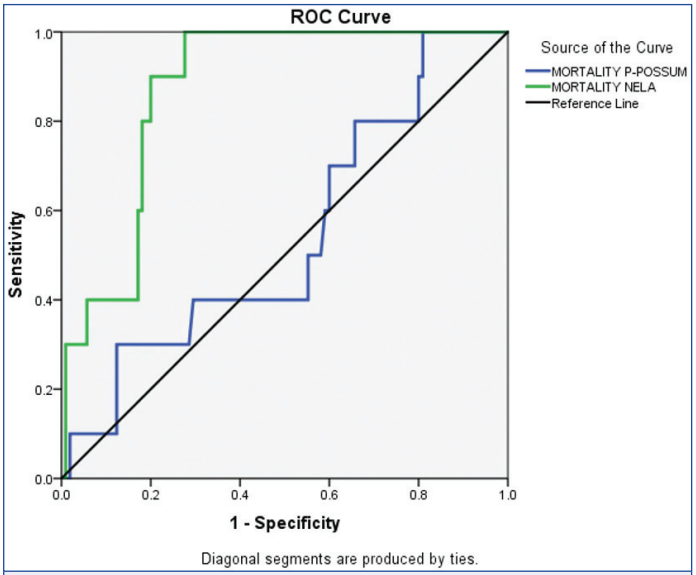
[Table/Fig-3]: Vitals and laboratory parameters of the study population.

It was observed that the 30-day mortality was 10 (8.6%), while the 60-day mortality was nearly double, i.e., 16 (13.8%). An observation was made that the prediction of mortality was more consistent with the observed mortality data using NELA scores rather than the P-POSSUM score at both 30 days (p-value <0.001) and 60 days (p-value 0.008) [Table/Fig-4].

Mortality		Mortality P-Possum	p-value	Mortality NELA	p-value
At 30 days	Death (n=10)	20.58±15.20	0.534	35.99±18.26	**0.001***
	Recovered (n=106)	17.35±10.15		13.40±14.68	
At 60 days	Death (n=16)	21.28±14.68	0.054	37.09±18.20	**0.008***
	Recovered (n=100)	17.04±11.68		11.85±8.91	

[Table/Fig-4]: Comparison of mortality P-POSSUM score and mortality NELA scores in predicting mortality at 30 and 60 days.
*p-value <0.05=Significant Independent sample t-test

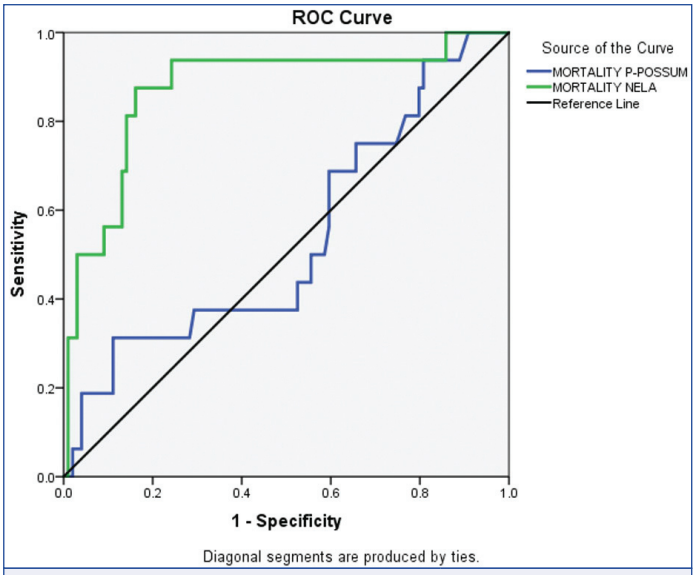
In the 30-day mortality analysis, the ROC suggested that the NELA score is more sensitive, specific, and has a better discriminative ability compared to the P-POSSUM score. The AUC of 0.873 revealed that the NELA score has a higher predictive value than the P-POSSUM score (0.544) in predicting mortality at 30 days [Table/Fig-5].



Area Under the Curve (AUC)	
Test Result Variable(s)	**Area**
Mortality P-POSSUM	0.544
Mortality NELA	0.873

[Table/Fig-5]: Receiver Operating Curve (ROC) comparing the prognostic ability of mortality P POSSUM and mortality NELA scores in predicting 30 day mortality.

Similarly, in the 60-day analysis, the ROC suggested that the NELA score is more sensitive, specific, and has a better discriminative ability than the P-POSSUM score. The NELA score had a high predictive value (AUC 0.872) compared to the P-POSSUM score (0.538) in predicting mortality at 60 days [Table/Fig-6].



Area Under the Curve (AUC)	
Test Result Variable(s)	**Area**
Mortality P-POSSUM	0.538
Mortality NELA	0.872

[Table/Fig-6]: Receiver Operating Curve (ROC) comparing the prognostic ability of mortality P POSSUM and mortality NELA scores in predicting 60 day mortality.

DISCUSSION

Mortality estimates based on risk models, such as the NELA and P-POSSUM scores, which use risk factors collected in clinical practice, can be used to identify high-risk patients after emergency laparotomies. These patients can then be enrolled in facilities that provide higher quality care, which can reduce and prevent mortality.

The present retrospective study noted that NELA performed better at 30 and 60 days, supporting other findings in the literature. Thahir A et al., found that the NELA model predicted 30-day mortality better than the P-POSSUM model in 650 emergency laparotomy patients (AUC= 0.82 vs. 0.77) [12]. Thahir A et al., found that the P-POSSUM overstated mortality risk, while the NELA mortality score understated it [12]. In another investigation, Lai CPT et al., studied 830 patients and found no difference in discriminative power between the NELA score and P-POSSUM model (AUC= 0.86 vs. 0.84) [13]. Lai CPT et al., found that both models underestimated 30 and 90-day mortality [13], which contradicts the findings of the present study as the authors did not study mortality on the 90th day.

A similar retrospective cohort study was performed by Barghash M et al., where NELA had a better predictive value in estimating mortality at 30 and 90 days [14]. Lai CPT et al., studied 830 individuals with 5.66% 30-day mortality [13]. The AUROC was similar for both the NELA (0.86, p<0.001, 95% CI 0.81-0.91) and P-POSSUM models (0.84, p <0.001, 95% CI 0.78-0.89). Although the models overpredicted death, the NELA model had a better O:E ratio than P-POSSUM {0.58 (95% CI 0.43-0.77) vs. 0.34 (95% CI 0.26-0.46)}. The NELA risk-prediction model surpasses the P-POSSUM model in predicting 30-day death in this large cohort of EL patients. We suggest replacing the P-POSSUM score with the NELA score to identify high- and low-risk EL patients.

Alabbasy MM et al., studied 670 patient data [15]. The risk of 30-day and 90-day mortality was 10.3% (69/670) and 13.13 % (88/670).

The AUC for 30-day mortality was 0.774, 0.763, and 0.780 for preoperative NELA, P-POSSUM, and postoperative NELA scores, respectively. For 90-day mortality, the AUCs were 0.649 (0.581-0.717), 0.782 (0.737-0.828), and 0.663 (0.608-0.718) for preoperative NELA, P-POSSUM, and postoperative NELA scores. Pairwise comparisons revealed differences in the discrimination abilities of the three models. Both the NELA and P-POSSUM scores underestimated the probability of death at 30 and 90 days in the population. The scores differed in their predictive performance.

Limitation(s)

Although the patient study group consisted of 116 patients, this study had several limitations. It was a retrospective design, conducted at a single centre, and had a short follow-up period, which limited our ability to assess mortality and morbidity on the 90th day.

CONCLUSION(S)

The present study indicates that the NELA score is a more sensitive and specific indicator of mortality at 30 and 60 days in patients undergoing emergency laparotomy compared to P-POSSUM. This shows that the NELA score can be routinely used in all patients undergoing emergency laparotomy to stratify risk. However, a large, randomised controlled trial would be preferable to confirm the findings of the present study. Nonetheless, the NELA score is an easy and accessible scoring system to implement in day-to-day surgical practice.

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PARTICULARS OF CONTRIBUTORS:

1. Postgraduate Resident, Department of General Surgery, Sapthagiri Institute of Medical Sciences and Research Centre, Bangalore, Karnataka, India.
2. Professor, Department of General Surgery, Sapthagiri Institute of Medical Sciences and Research Centre, Bangalore, Karnataka, India.
3. Professor, Department of General Surgery, Sapthagiri Institute of Medical Sciences and Research Centre, Bangalore, Karnataka, India.
4. Postgraduate Resident, Department of General Surgery, Sapthagiri Institute of Medical Sciences and Research Centre, Bangalore, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
K Anupama Pujar,
1181, 9th A Cross, 4th Block, HBR Layout, Bangalore-560043, Karnataka, India.
E-mail: anupamapujar@rediffmail.com

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