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EVALUATION OF MORTALITY AND MORBIDITY IN EMERGENCY GASTROINTESTINAL SURGERY USING P-POSSUM SCORE IN SHEIKH ZAYED HOSPITAL

Usman Iqbal[1*], Muhammad Imran Anwar[2], Amir Jameel[3]

[1*]Post Graduate Trainee Registrar General Surgery and Surgical Oncology Unit-2, Shaikh Zayed Hospital, Lahore
[2]Professor & HOD General Surgery and Surgical Oncology Unit-2 Shaikh Zayed Hospital, Lahore
[3]Consultant General Surgery and Surgical Oncology Unit-2 Shaikh Zayed Hospital, Lahore

***Corresponding Author:** Dr. Usman Iqbal
*Email: osmaniqbal293742@gmail.com

ABSTRACT

Background: Emergency gastrointestinal surgeries are high-risk procedures with significant morbidity and mortality rates.

Objective: To evaluate the mortality and morbidity in emergency gastrointestinal surgery using p-possum score in Sheikh Zayed Hospital.

Methods: A descriptive cross-sectional study was conducted at Surgical Oncology Unit-2 Shaikh Zayed Hospital, Lahore from January 2023 to September 2023. Study included 120 patients undergoing emergency gastrointestinal surgery. P-POSSUM scores were calculated for each participant, and predicted mortality and morbidity rates were compared with observed outcomes. The data were analyzed using SPSS software version 25.

Results: The study included a total of 120 participants, with 38 (31.7%) females and 82 (68.3%) males. The age of participants ranged from 13 to 78 years, with the majority falling in the 41-60 years age group (n=64, 53.3%). The mean age was 48.4 ± 15.36 years. Based on P-POSSUM score, the predicted mortality rate was 9.2%, while the observed mortality rate was 10.8%. The observed/expected (O/E) ratios were calculated for different risk categories. For mortality, the O/E ratios ranged from 0 to 1.87, with the highest ratio observed in the 30.1-40% risk category. The overall O/E mortality rate ratio was 1.18. Hosmer and Lemeshow test found no significant lack of fit between the observed and predicted mortality (p=0.429). Postoperative complications were observed among the study participants. The most common complications included wound infections (n=11, 22.4%), chest infections (n=10, 20.4%), and hypotension (n=7, 14.3%). Other complications included septicemia, wound dehiscence, and urinary tract infections (UTI), among others.

Conclusion: This study demonstrates that the P-POSSUM score is a reliable tool for predicting mortality in emergency gastrointestinal surgery in a Pakistani population, with an observed/expected mortality ratio of 1.18 and no significant lack of fit. However, the model's predictive accuracy for morbidity was less robust, indicating the need for further refinement.

Keywords: Emergency gastrointestinal surgery, Mortality prediction, P-POSSUM score, Predictive accuracy, Risk assessment, Surgical outcomes

INTRODUCTION

Accurate prediction models are essential for preoperative assessment and postoperative management. The Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) and its Portsmouth modification (P-POSSUM) are widely used tools designed to predict the risk of mortality and morbidity in surgical patients. The POSSUM scoring system, introduced by Copeland et al., was initially developed as an audit tool to provide a standard method for comparing surgical outcomes by accounting for both the physiological status of the patient and the severity of the surgical procedure.[1] The Portsmouth modification (P-POSSUM) was later developed to address some limitations of the original POSSUM score, particularly its tendency to overpredict mortality in low-risk patients.[2] P-POSSUM incorporates modifications in the regression equations used to calculate the risk, making it more accurate for a broader range of patients.[3]

Emergency gastrointestinal surgeries are often associated with high morbidity and mortality due to the acute nature of the conditions treated, the urgency of the procedures, and the often compromised physiological state of the patients. Conditions such as perforated peptic ulcers, acute appendicitis, bowel obstruction, and gastrointestinal perforation are common emergencies that necessitate prompt surgical intervention. Accurate risk stratification in these scenarios is essential for optimizing patient management, guiding clinical decision-making, and improving overall outcomes.[4]

Several studies have compared the predictive accuracy of POSSUM and P-POSSUM with other scoring systems. For instance, a study by Kumar et al. evaluated the efficacy of P-POSSUM in predicting outcomes in patients undergoing emergency laparotomy and found that it provided reliable risk stratification, which was crucial for clinical decision-making and resource allocation in the intensive care setting.[5] Another study highlighted the comparative performance of P-POSSUM and the National Emergency Laparotomy Audit (NELA) score, noting that both scores were effective in predicting mortality but with varying degrees of accuracy depending on the specific patient population and surgical context.[6]

The utility of the P-POSSUM score extends beyond mortality prediction to include morbidity assessment. By evaluating both physiological and operative factors, the P-POSSUM score provides a comprehensive risk profile that can guide preoperative counseling, inform surgical planning, and facilitate postoperative care.[7] For instance, the score takes into account variables such as age, cardiac function, respiratory function, blood pressure, and the nature and urgency of the surgery, which collectively influence the patient's risk profile.[8]

Despite its widespread use, the P-POSSUM score is not without limitations. Some studies have pointed out its potential for overpredicting mortality in certain patient groups, necessitating ongoing refinement and validation to ensure its accuracy and applicability in diverse clinical settings.[9] Furthermore, the integration of P-POSSUM with other clinical parameters and emerging technologies, such as machine learning algorithms, holds promise for enhancing its predictive capability and tailoring it to individual patient needs.[10]

This study aims to evaluate the applicability and predictive accuracy of the P-POSSUM score for mortality and morbidity in emergency gastrointestinal surgeries in Pakistan. By doing so, it addresses the lack of region-specific validation studies and provides valuable data to improve surgical risk assessment in this context. This study will contribute new insights into the effectiveness of P-POSSUM in a Pakistani population, highlighting potential regional differences and filling an important research gap in the local healthcare literature.

MATERIALS AND METHODS

This cross-sectional study was conducted at Surgical Oncology Unit-2 Shaikh Zayed Hospital, Lahore from January 2023 to September 2023. A total of 120 patients who underwent emergency

laparotomy were included in the study. The inclusion criteria were patients of either gender age between 13 and 78 years. Patients undergoing emergency gastrointestinal surgery for various indications such as peptic perforation, blunt trauma abdomen, and acute intestinal obstruction were included. Patients with incomplete medical records, who declined to participate in the study were excluded.

Demographic data, including age and gender, were collected from all participants. Clinical data, including the primary indication for emergency laparotomy and postoperative complications, were also recorded. The primary indications for surgery were categorized into different groups, including peptic perforation, blunt trauma abdomen, and acute intestinal obstruction, among others. For each participant, the P-POSSUM score was calculated based on physiological and operative parameters. The physiological parameters included age, cardiac signs, respiratory signs, blood pressure, pulse rate, Glasgow Coma Score, serum sodium, serum potassium, urea, hemoglobin, white cell count, and electrocardiogram results. Operative parameters included the type of surgery, the severity of the procedure, the presence of malignancy, and the degree of peritoneal soiling. The predicted mortality and morbidity rates were calculated using the P-POSSUM equation, which combines the physiological and operative severity scores. The predicted rates were then compared with the observed outcomes.

The collected data were analyzed using IBM SPSS, version 27.0. Categorical variables are presented as frequency and percentage. Continuous variables are expressed as mean and standard deviation (SD). Mortality and morbidity rate of all the participants was calculated using the P-POSSUM equation. The equations used were: For mortality: Log (R1/1-R1) = (0.1692 x PS) +(0.155 x OS) - 9. 065, where R1 = risk of mortality. For morbidity: Log (R2/1-R2) = -5.91+(0.16xPS) +(0.19x OS), where R2 = risk of morbidity. Expected number of mortalities and morbidities was calculated by multiplying mean risk score of each group with number of patients in that group. Observed to expected number of mortalities and morbidities ratio was calculated. The Hosmer and Lemeshow goodness of fit test was used to evaluate the ability of P-POSSUM to assign the correct probabilities of outcome to patients. A higher value of chi-squared represented poorer model calibration, and $P < 0.05$ represented significant lack of fit between the predicted and observed results. The performance of P-POSSUM system also was assessed by receiver operator characteristic (ROC) curve analysis.

RESULTS

The study included a total of 120 participants, with 38 (31.7%) females and 82 (68.3%) males. The age of participants ranged from 13 to 78 years, with the majority falling in the 41-60 years age group (n=64, 53.3%). The mean age was 48.4 ± 15.36 years.

Table 1: Age and gender distribution of study participants

	n	**%**
Gender		
Female	38	31.7%
Male	82	68.3%
Age groups (years)		
11-20	3	2.5%
21-40	32	26.7%
41-60	64	53.3%
61-80	21	17.5%
Age (years), mean ± SD	48.4 ± 15.36	

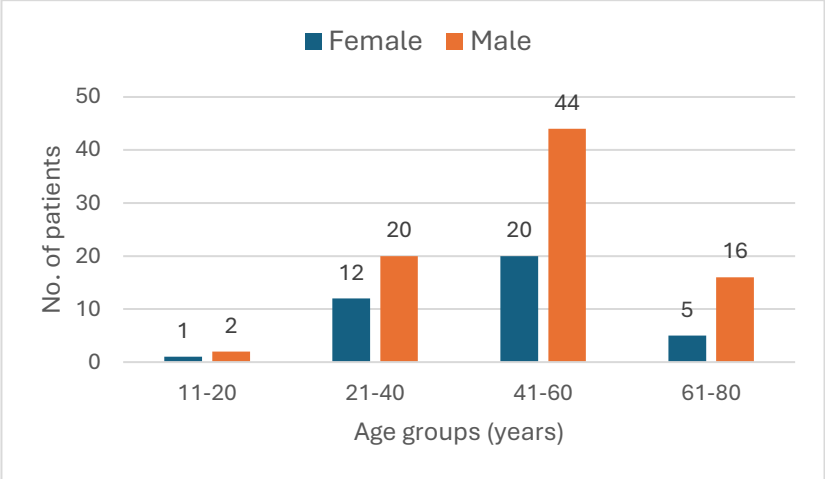

Figure 1: Age and gender wise distribution of study participants.

The primary indications for emergency laparotomy varied among the participants. The most common indication was peptic perforation (n=30, 25.0%), followed by blunt trauma abdomen (n=25, 20.8%) and acute intestinal obstruction (n=22, 18.3%). Other indications included appendicular mass, intestinal perforation, and sigmoid volvulus, among others as shown in Table 2.

Table 2: Indications for emergency laparotomy

Indications	n	%
Acute intestinal obstruction	22	18.3%
Appendicitis abscess	3	2.5%
Appendicitis with Meckel's diverticulitis	3	2.5%
Appendicular mass	7	5.8%
Biliary peritonitis	4	3.3%
Blunt trauma abdomen	25	20.8%
Gastric outlet obstruction	1	0.8%
Intestinal perforation	7	5.8%
Pelvic abscess	5	4.2%
Peptic perforation	30	25.0%
Ruptured liver abscess	2	1.7%
Sigmoid perforation	2	1.7%
Sigmoid volvulus	9	7.5%

Based on P-POSSUM score, the predicted mortality rate was 9.2%, while the observed mortality rate was 10.8% . The observed/expected (O/E) ratios were calculated for different risk categories. For mortality, the O/E ratios ranged from 0 to 1.87, with the highest ratio observed in the 30.1-40% risk category. The overall O/E mortality rate ratio was 1.18 (Table 3). Hosmer and Lemeshow test found no significant lack of fit between the observed and predicted mortality (p=0.429).

Table 3: Observed / Expected mortality ratio among study participants

Risk categories of predicted mortality rate (%)	No. of patients	Mean predicted probability of mortality	Mean mortality rate (%)	Expected mortality	Observed mortality	O/E ratio
≤ 10	96	0.024	2.44	2	3	1.28
10.1-20	7	0.122	12.2	1	0	0
20.1-30	5	0.245	24.5	1	2	1.63
30.1-40	3	0.357	35.7	1	2	1.87
40.1-50	2	0.468	46.8	1	0	0
50.1-60	2	0.549	54.9	1	1	0.91
60.1-70	2	0.648	64.8	1	2	1.54
70.1-80	1	0.778	77.8	1	1	1.29
80.1-90	1	0.852	85.2	1	1	1.17
90.1-100	1	0.929	92.9	1	1	1.08

Hosmer and Lemeshow test. Chi-square=8.047; df=8; p=0.429.

Similarly, based on P-POSSUM score, the predicted morbidity rate was 47.5%, while the observed mortality rate was 40.8% . For morbidity, the O/E ratios ranged from 0 to 1.89, with the highest ratio observed in the 30.1-40% risk category. The overall O/E morbidity rate ratio was 0.86 (Table 4). Hosmer and Lemeshow test found significant lack of fit between the observed and predicted mortality (p=0.014).

Table 4: Observed / Expected morbidity ratio among study participants

Risk categories of predicted morbidity rate (%)	No. of patients	Mean predicted probability of morbidity	Mean morbidity rate (%)	Expected morbidity	Observed morbidity	O/E ratio
≤ 10	3	0.093	9.30	0	0	0
10.1-20	32	0.148	14.8	5	4	0.84
20.1-30	10	0.264	26.4	3	2	0.76
30.1-40	8	0.330	33.0	3	5	1.89
40.1-50	16	0.458	45.8	7	8	1.09
50.1-60	8	0.538	53.8	4	6	1.4
60.1-70	12	0.637	63.7	8	7	0.92
70.1-80	8	0.727	72.7	6	7	1.2
80.1-90	7	0.834	83.4	6	6	1.02
90.1-100	16	0.960	96.0	15	4	0.26

Hosmer and Lemeshow test. Chi-square=19.074; df=8; p=0.014.

Predicted mortality rate taking into consideration, true positive fraction (sensitivity) & false positive fraction (1 - specificity) values suggests it was highly reliable to predict morality among study participants (AUC = 0.942; p < 0.001) as shown in Figure 2.

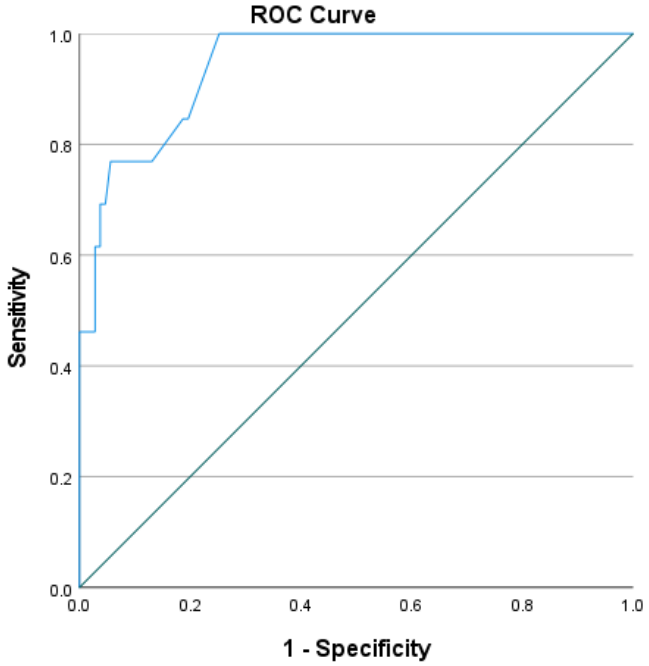

Figure 2: Predicted mortality rate predicting mortality among study participants.

Predicted morbidity rate taking into consideration, true positive fraction (sensitivity) & false positive fraction (1 - specificity) values suggests it was highly reliable to predict morbidity among study participants (AUC = 0.709; P < 0.001) as shown in Figure 3.

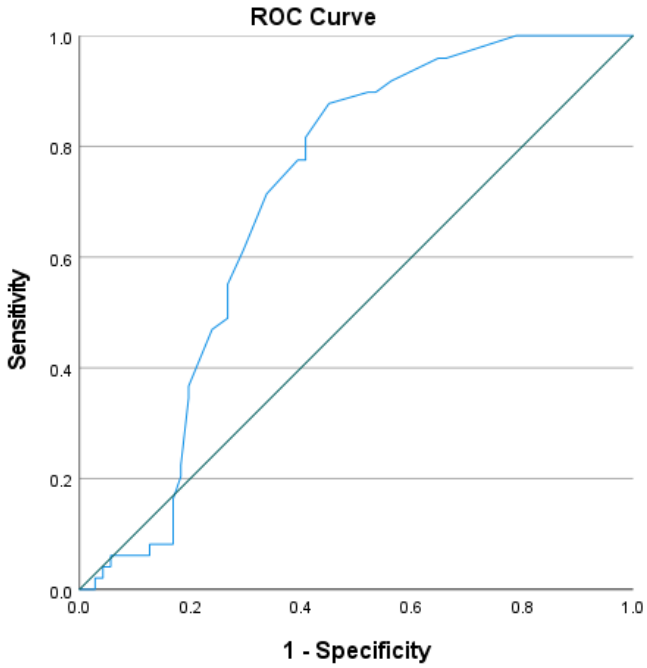

Figure 3: Predicted morbidity rate predicting morbidity among study participants.

Postoperative complications were observed among the study participants. The most common complications included wound infections (n=11, 22.4%), chest infections (n=10, 20.4%), and hypotension (n=7, 14.3%). Other complications included septicemia, wound dehiscence, and urinary tract infections (UTI), among others.

Table 5: Complications among study participants

Complications	n	%
Anastomotic leak	3	6.1%
Chest infection	10	20.4%
Hypotension	7	14.3%
Renal failure	2	4.1%
Septicemia	6	12.2%
UTI	3	6.1%
Wound dehiscence	5	10.2%
Wound hemorrhage	2	4.1%
Wound infections	11	22.4%

DISCUSSION

Surgeons care deeply about their patients' outcome after surgery. An ideal system for assessing risk before surgery should be easy to understand, consistent, based on facts, and work for all surgery patients. The ASA scoring system is popular because it's straightforward and easy to use.[11] However, it doesn't consider complications and anesthesia or surgical management of the patients. Additionally, the ASA score can be biased and isn't very accurate at predicting mortality on individual basis.[12] Therefore, to evaluate the quality of care in general surgery, the POSSUM scoring system was introduced in 1991.[13] However, subsequent reports indicated that it tended to overestimate outcomes.[14] As a result, the P-POSSUM system was developed with a revised equation. This equation has since been further refined for improved accuracy in predictions.[15] Our study aimed to evaluation of mortality and morbidity in emergency gastrointestinal surgery using P-POSSUM scoring system.

In our study, the proportion of males (68.3%) was higher compared to female patients (31.7%) undergoing gastrointestinal surgery. These results were in agreement with the study conducted by Mundu et al. (2020) who reported higher proportion of males (68%) compared to females (32%).[16] In another study carried out by Maitra et al. (2022) also showed that males (72%) are more compared to females (28%).[17] Study conducted by Garg et al. (2021) also reported higher proportion of males (82%), bit I was higher than our study.[18]

In this study, the most common indications for emergency laparotomy was peptic perforation (25.0%), followed by blunt trauma abdomen (20.8%) and acute intestinal obstruction (18.3%). Mundu et al. (2020) reported that among cases of emergency GI surgery, 28% cases were of intestinal perforation, 16% cases were of duodenal perforation while 14% cases were of intestinal obstruction, which was comparable to our study.[16] Tonape et al. (2022) showed that acute intestinal obstruction & colon cancer was most common diagnosis for patients undergoing abdominal surgery (11% each) followed by duodenal perforation in 10% patients. Pseudocyst of pancreas (8%), SMA thrombosis (6%), Ileal perforation (8%) etc. were also reported.[19]

Our study showed a significant difference between the observed and expected morbidity rates (p=0.014), whereas there was no considerable difference between the observed and expected mortality rates (p=0.429) using P-POSSUM scoring system. Thus, the scoring system appears to be accurate in predicting the mortality of a particular scenario, while the same accuracy is not achieved with respect to morbidity. The O: E ratio for mortality was 1.18 and that for morbidity was 0.86. These findings were in line with the study conducted Tonape et al. (2022) who used P-POSSUM score to evaluate mortality and morbidity in 100 patients undergoing abdominal surgery.[19]

Garg et al. (2021) evaluated P-POSSUM scores in predicting postoperative morbidity and mortality in patients undergoing emergency laparotomy. A total of 100 patients were included in this study. The O:E ratio was 0.88 : 1.00 for mortality at admission and pre-operatively, and 0.85 : 0.87 for morbidity respectively.[18] No statistically significant difference was found in the O:E ratios in both morbidity and mortality. Maitra et al. (2022) mentioned that the overall O:E ratio for mortality was 1.4 and that for morbidity was 1.137 and showed a significant difference between the observed and expected morbidity rates, while the observed and expected mortality rates show no significant difference.[17]

Echara et al. (2019) assessed the effectiveness of the POSSUM and P-POSSUM scores in predicting postoperative morbidity and mortality for 100 patients undergoing emergency laparotomy.[20] The actual observed mortality was 12%, while POSSUM predicted a mortality rate of 40% and P-POSSUM predicted 27%. Statistical test indicated no significant correlation between the observed and expected mortality rates. The observed morbidity was 69%, whereas POSSUM predicted a morbidity rate of 79%, demonstrating an overestimation of morbidity. The test for correlation showed no significance with a p-value of 0.75. Overall, both POSSUM and P-POSSUM were found to overestimate mortality and morbidity rates. Jain et al. (2016) found that POSSUM over predict both mortality and morbidity (O: E = 0.44 and 0.66 respectively). PPOSSUM accurately predicted mortality (O: E = 0.98), but over predicted morbidity.[21]

The limitation of this study is that it only included patients undergoing emergency gastrointestinal surgery. Additionally, the sample size was small, and the study was conducted at a single center. Conducting a multicenter study with a larger and more diverse sample population could yield different outcomes and allow for a more thorough analysis of the model's predictive accuracy and validity.

Conclusion:

This study demonstrates that the P-POSSUM score is a reliable tool for predicting mortality in emergency gastrointestinal surgery in a Pakistani population, with an observed/expected mortality ratio of 1.18 and no significant lack of fit. However, the model's predictive accuracy for morbidity was less robust, indicating the need for further refinement.

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