# Efficacy of Possum and P Possum Scoring System to Assess Outcomes in Emergency Gastrointestinal Surgeries

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## *Abstract*

**Objectives:** The aim of the study was to assess outcome in terms of morbidity and mortality using POSSUM and P-POSSUM scores in patients undergoing emergency gastrointestinal surgeries and also to compare POSSUM and P-POSSUM scores in predicting mortality and morbidity.

**Methods:** In this study, 45 patients presenting to general surgery emergency department and undergoing emergency gastrointestinal surgery were included in accordance with pre-defined inclusion and exclusion criteria.

**Results:** Among the patients included in the study 62.2% patients were of the age group of 18-40 years, 28.9% were of 41-60 years age group, 8.9% were of >60 years age group. The most common diagnosis for which patients underwent exploratory laparotomy in the study was intestinal perforation, 15 out of 45 patients presented with this diagnosis. Physiological component of POSSUM and P-POSSUM score was calculated pre-operatively and the operative component was calculated with the intra-op findings. Cutoff of POSSUM morbidity score was 87.5% with a sensitivity and specificity of 83.3 and 92.6% while cut off of P-POSSUM morbidity score was 88.6% with a sensitivity and specificity of 88.9 and 96.3%.Cut off of POSSUM mortality score in was 56.7% with a sensitivity and specificity of 87.5 and 94.6% while cut off of P-POSSUM mortality score was 22.7% with a sensitivity and specificity of 100 and 81.1% respectively.

**Conclusions:** Wecan conclude that both POSSUM and P-POSSUM scores can be used for prediction of morbidity and mortality in patients undergoing emergency gastrointestinal surgeries with significant sensitivity and specificity.

**Keywords:** Possum; P Possum; Mortality; Morbidity; Prediction; Score.

## Introduction

To audit the surgical intervention surgical risk prediction models have proven to be an invaluable tool for the surgeon. Appropriate risk-stratification can enable patients to be better informed, improve patient selection and make improved treatment plan; and therefore, improve overall outcomes.[1-3] In order to quantify the risk of perioperative morbidity and mortality different scoring systems have been developed which include Physiological and Operative Severity Score for the enumeration of Mortality and morbidity (POSSUM) and Portsmouth POSSUM(P POSSUM).[4] Early prognostic evaluation would aid in selection of high-risk patients for an aggressive treatment and optimum utilization of resources.[5]

Although surgeons remain the most relevant factor, other variables include previous health condition, underlying disease requiring surgical intervention and peri operative care. POSSUM scoring system was designed to combine the three aspects and predict the patient's outcome. The risk of a surgical procedure could be calculated based on a patient's physiological condition and operative findings and then pooled.[6]POSSUM

combines a physiological score with an operative severity score to give a risk of mortality and morbidity. It processes the clinical data in a logarithmic model that derives morbidity and mortality risk. Possum score includes 12 physiological parameters and 6 operative parameters. The mortality of all the patients can be calculated using the linear method of analysis as described by Copeland.[6] Later, a modification to the predictor equation was proposed as the P-POSSUM that claimed to produce a closer fit with the observed in hospital mortality in low-risk groups. In India, P-POSSUM has been verified among different population groups and possibly surgical practice.[7-9]

The studies mostly have been done in developed countries where patient characteristics, presentation and hospital resources differ from our setup. Hence, there is a need to validate POSSUM in Indian scenario, particularly lower socioeconomic group, where problems like delayed presentation and limited resources can affect the outcome even with adequate quality care. By using these scoring methods, we will be able to predict the risk of morbidity and mortality in a patient requiring surgical intervention at the time of presentation. This will help us to plan the management accordingly.

## Methods

This Prospective Observational study was carried out in the Department of General Surgery, ESIC PGIMSR & Hospital, New Delhi after obtaining clearance from the ethical and the scientific committee for a period of two years.Written and informed consent was taken from the enrolled patients.

Sample size for the study is being calculated using the formula-

$$N = \frac{Z^2_{1-\alpha/2} * [S_n(1-S_n)]}{L^2 (1-P)}$$

Where $Z_\alpha$ is 1.96 at a confidence level of 95%

$S_n$ is the sensitivity; L is margin of error and p is the mortality rate in patients with emergency laparotomy

The sensitivity of P-POSSUM score to predict mortality was found to be 91.3% by Deb Sanjay Nag et al.[5] So, taking 91.3% sensitivity with 10% margin of error the minimal required sample size required is 41. So, we took the sample size of 45 taking into account the attrition factor.

All patients above 18 years of age undergoing emergency gastrointestinal surgeries were included in the study.Patients with multiorgan failure, polytrauma and not willing to participate in study were excluded.Based on clinical examination and other investigations a diagnosis was made and decision for emergency gastrointestinal surgery was taken.

Physiologicalscore was calculated as per parameters and scoring in table 1 and operative score was calculated as per parameters and scoring in table 2. Then these scores were used in the equation given below to calculate the POSSUM score.

**Table 1:** Calculation of Physiological Score.

| **Score** | **1** | **2** | **4** | **8** |
|---|---|---|---|---|
| **Age(years)** | <60 | 61-70 | >=71 | |
| **Cardiac signs** | Normal | Diuretic,digoxin,antianginal or anti-hypertensive | Peripheral edema,warfarin therapy | Raised JVP |
| **Chest radiograph** | Normal | ____ | Borderline cardiomegaly | Cardiomegaly |

| | | | | |
|---|---|---|---|---|
| **Respiratory history** | Normal | Dyspnea on exertion | Limiting dyspnea(one flight of stairs) | Dyspnea at rest |
| **Chest radiograph** | Normal | Mild COPD | Moderate COPD | Fibrosis or consolidation |
| **Systolic BP** (mm Hg) | 110-130 | 131-170 or 100-109 | >=171 or 90-99 | =<89 |
| **Pulse** (beats/min) | 50-80 | 81-100 or 40-49 | 100-120 | >=121 or =<89 |
| **Glasgow coma score** | 15 | 12-14 | 9-11 | <9 |
| **Haemoglobin** (g/dl) | 13-16 | 11.5-12.9 or 16.1-17 | 10-11.4 or 17.1-18 | <10 |
| **White cell count**($x10^{12}$/l) | 4-10 | 10.1-20 or 3.1-4 | >20 or <4 | |
| **Bloodurea** (mmol/l) | <7.5 | 7.6-10 | 10.1-15 | >15 |
| **Sodium** (mmol/l) | >135 | 131-135 | 126-130 | <126 |
| **Potassium** (mmol/l) | 3.5-5.5 | 3.2-3.4 or 5.2-5.3 | 2.9-3.1 or 5.4-5.9 | <2.9 or >5.9 |
| **ECG** | Normal | | Atrial fibrillation | Any other change |

**Table 2:** Calculation of Operative score.

| **Score** | **1** | **2** | **4** | **8** |
|---|---|---|---|---|
| **Operative severity** | Minor | Intermediate | Major | Major |
| **No of operations within 30 days** | 1 | | 2 | >2 |
| **Blood loss per surgery (ml)** | <101 | 101-500 | 501-999 | >999 |
| **Peritoneal contamination** | None | Serous fluid | Local pus | Free bowel content/pus/blood |
| **Presence of malignancy** | None | Primary only | Nodal metastasis | Distant metastasis |
| **Mode of surgery** | Elective | | Emergency resuscitation of > 2 hours possible/ Surgery within 24 hours of admission | Emergency (within 2 hours of admission) |

## *POSSUM equation for Morbidity*

Logn R1/1-R1= -5.91 + (0.16 x Physiological score) + (0.19 x Operative severity score), where R1 is the predicted risk of morbidity.

## *POSSUM equation for Mortality*

Logn R2/1-R2 = -7.04 + (0.13 x Physiological score) + (0.16 x Operative severity score), where R2 is the predicted risk of mortality.

### *P POSSUM equation for mortality*

In [R / (1-R)] = −9.37 + (0.19 × physiological score) + (0.15 × operative severity score)

Where R is the predicted risk of mortality.

Each patient was followed up for a period of 30 days post-surgical intervention to look for post op morbidity and mortality.

Morbidity was assessed using the ClaveinDindo classification.[10]Outcome measures for morbidity were assessed as wound complications, local or systemic infections, organ dysfunction, shock, thromboembolism and anastomotic failure.

Statistical Evaluation was done using SPSS-20 version.Quantitative data was expressed by mean, standard deviation or median with interquartile range and depends on normality distribution, difference between two means was tested by student t test and Mann Whitney U test. Qualitative data was expressed in percentage and difference between the proportions were tested by chi square test and Fisher's exact test. Pearson correlation coefficient was used to see the correlation between two quantitative variables. The ROC curve was prepared using P-POSSUM score and POSSUM score to predict mortality and based on that optimum cut off value was calculated. Sensitivity, specificity, positive predictive value and negative predictive value of P-POSSUM score and POSSUM score was calculated. 'P' value less than 0.05 was considered statistically significant.

## Results

The mean (SD) of age (in years) was 37.87 (15.73). The median (IQR) of age was 32.00 (26-47). The age ranged from 18 - 72. 62.2% of the participants had age group: 18-40 years. 28.9% of the participants had age group: 41-60 Years. 8.9% of the participants had age group: > 60 years. [Table 3].

**Table 3:** Summary of All Parameters.

| All Parameters | Mean ± SD \|\| Median (IQR) \|\| Min-Max \|\| Frequency (%) |
|---|---|
| **Diagnosis** | |
| Acute Appendicitis | 8 (17.8%) |
| Abdominal Koch's | 1 (2.2%) |
| Acute necrotizing pancreatitis | 2 (4.4%) |
| SAIO | 7 (15.6%) |
| Liver Abscess | 3 (6.7%) |
| Intestinal Perforation | 15 (33.3%) |
| Blunt Trauma Abdomen | 1 (2.2%) |
| Pyoperitoneum | 3 (6.7%) |
| Sigmoid Volvulus | 1 (2.2%) |
| Strangulated Inguinal Hernias | 1 (2.2%) |
| Ruptured Hydatid Cyst | 1 (2.2%) |
| Gastrointestinal Malignancies | 2 (4.4%) |
| **Age (Years)** | 37.87 ± 15.73 \|\| 32.00 (26.00-47.00) \|\| 18.00 - 72.00 |
| **Age Group** | |
| 18-40 Years | 28 (62.2%) |
| 41-60 Years | 13 (28.9%) |
| > 60 Years | 4 (8.9%) |
| **Cardiac Signs (None)** | 45 (100.0%) |
| **Chest X-Ray** | |
| None | 31 (68.9%) |
| Normal | 6 (13.3%) |
| Cardiomegaly | 1 (2.2%) |
| Cavitary Lesion | 1 (2.2%) |
| Fibrosis | 1 (2.2%) |
| Pleural Effusion | 5 (11.1%) |
| **Respiratory History: None (Yes)** | 38 (84.4%) |
| **Respiratory History: Dyspnea (Yes)** | 5 (11.1%) |

| All Parameters | Mean ± SD \|\| Median (IQR) \|\| Min-Max \|\| Frequency (%) |
|---|---|
| **Respiratory History: Dyspnea at Rest (Yes)** | 3 (6.7%) |
| **Systolic BP (mmHg)** | 117.49 ± 16.32 \|\| 116.00 (106.00-130.00) \|\| 86.00 - 150.00 |
| **Pulse Rate (BPM)** | 105.82 ± 18.83 \|\| 105.00 (90.00-120.00) \|\| 78.00 - 140.00 |
| **GCS** | 14.98 ± 0.15 \|\| 15.00 (15.00-15.00) \|\| 14.00 - 15.00 |
| **Hemoglobin (gm/dL)** | 11.12 ± 2.06 \|\| 11.20 (9.70-12.30) \|\| 7.60 - 16.20 |
| **TLC (/mm$^3$)** | 12102.22 ± 7000.24 \|\| 9800.00 (7700.00-16000.00) \|\| 1900.00 - 36000.00 |
| **Blood Urea (mmol/L)** | 3.40 ± 1.46 \|\| 3.50 (2.50-4.30) \|\| 0.60 - 7.80 |
| **S. Sodium (mEq/L)** | 132.76 ± 5.33 \|\| 134.00 (128.00-136.00) \|\| 122.00 - 144.00 |
| **S. Potassium (mEq/L)** | 4.16 ± 0.73 \|\| 4.10 (3.80-4.60) \|\| 2.60 - 6.20 |
| **ECG** | |
| None | 1 (2.2%) |
| Normal | 17 (37.8%) |
| S. Tachycardia | 26 (57.8%) |
| Others | 1 (2.2%) |
| **Operative Severity** | |
| Minor | 0 (0.0%) |
| Intermediate | 12 (26.7%) |
| Major | 33 (73.3%) |
| **Number Of Operations (30 Days)** | |
| 1 | 44 (97.8%) |
| 2 | 1 (2.2%) |
| **Blood Loss** | 204.44 ± 147.64 \|\| 175.00 (50.00-300.00) \|\| 50.00 - 650.00 |
| **Peritoneal Contamination** | |
| None | 17 (37.8%) |
| Bowel Content | 14 (31.1%) |
| Local Pus | 2 (4.4%) |
| Blood | 1 (2.2%) |
| Pus | 11 (24.4%) |
| **Presence Of Malignancy** | |
| None | 40 (88.9%) |
| Primary Malignancy | 4 (8.9%) |
| Malignancy With Distant Mets | 1 (2.2%) |
| **Mode Of Surgery (Emergency)** | 45 (100.0%) |
| **Physiologic Score** | 24.00 ± 8.25 \|\| 23.00 (16.00-29.00) \|\| 13.00 - 49.00 |
| **Operative Score** | 17.42 ± 5.02 \|\| 20.00 (13.00-20.00) \|\| 10.00 - 27.00 |
| **POSSUM Mortality (%)** | 30.56 ± 24.35 \|\| 27.30 (6.20-45.00) \|\| 2.30 - 89.80 |
| **POSSUM Morbidity (%)** | 66.64 ± 31.06 \|\| 80.40 (34.30-91.50) \|\| 12.70 - 99.50 |
| **P POSSUM Morbidity (%)** | 67.26 ± 31.69 \|\| 82.80 (30.80-93.60) \|\| 12.70 - 99.70 |
| **P POSSUM Mortality (%)** | 18.68 ± 21.56 \|\| 12.20 (1.50-27.10) \|\| 0.50 - 92.30 |
| **ClaveinDindo Grade** | |
| 1 | 14 (31.1%) |
| 2 | 11 (24.4%) |
| 3 | 10 (22.2%) |
| 4 | 2 (4.4%) |
| 5 | 8 (17.8%) |
| **Mortality (Yes)** | 8 (17.8%) |
| **Major Complication (Yes)** | 18 (40.0%) |

The diagnosis with which different patients were treated is given in table 3. Intestinal Perforation (33.3%) was the most frequent one, followed by Acute Appendicitis (17.8%)and SAIO (15.6%).[Table 3]

The mean (SD) of blood loss in patients with major complication was 263.89ml. The mean (SD) of blood loss in patients without major complication was 164.81ml. The blood loss in patients with major complications ranged from 50 – 650ml. The blood loss in patients without major complications ranged from 50 – 500ml. [Table 3]

There was a significant difference between the 2 groups in terms of blood loss (W = 337.000, p = 0.028), with the median blood loss being highest in patients with major complications.

In this study, 37.8% of the participants had peritoneal contamination, 31.1% of the participants had feculent peritoneal contamination. 4.4% of the participants had local pus collection. 2.2% of the participants had haemoperitoneum. 24.4% of the participants had peritoneal contamination with pus. [Table 3]

88.9% of the participants had no malignancy. 8.9% of the participants had primary malignancy. 2.2% of the participants had malignancy with distant metastasis. [Table 3]

The mean (SD) of Physiologic Score was 24.00 (8.25). The median (IQR) of Physiologic Score was 23.00 (16-29). The Physiologic Score ranged from 13 - 49. [Table 3]

The mean (SD) of Operative Score was 17.42 (5.02). The median (IQR) of Operative Score was 20.00 (13-20). The Operative Score ranged from 10 - 27. [Table 3]

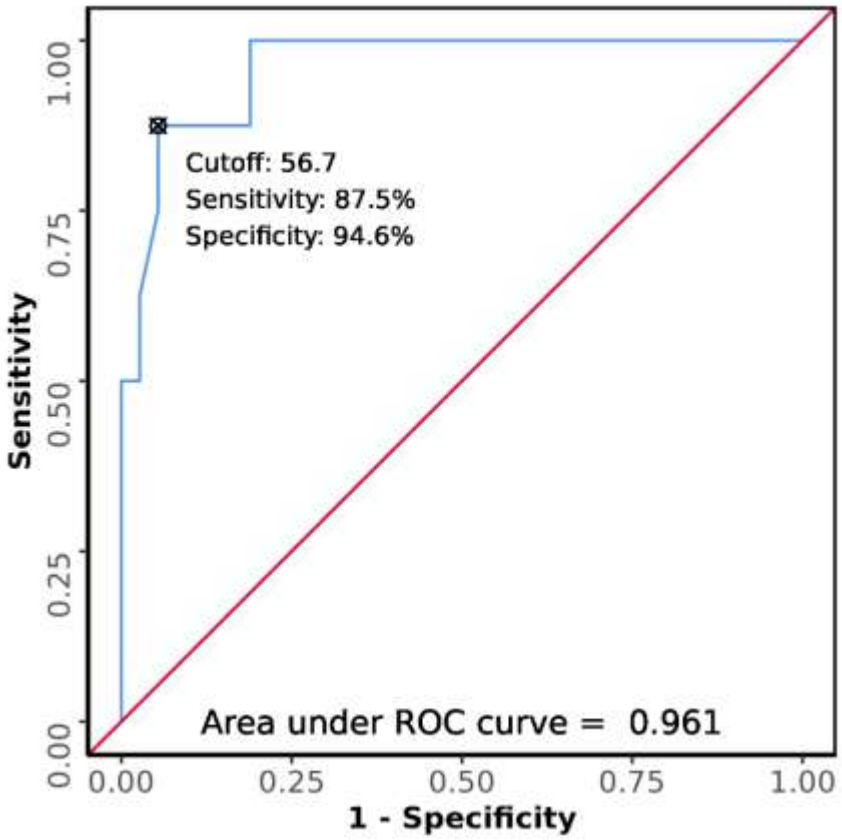
No study participants had cardiac pathology.Only 7 patients had history of some respiratory disease.3 patients had history of dyspnea at rest. 31 patients had normal chest x-Ray. 1 patient had cavitary lesion on chest x-ray. 1 patient had lung fibrosis on chest x-ray. 5 patients had pleural effusion on chest x-ray. [Table 3]

The vitals of patients recorded is shown in table 3, 31.1% of the participants had ClaveinDindo Grade: 1. 24.4% of the participants had ClaveinDindo Grade: 2. 22.2% of the participants had ClaveinDindo Grade: 3. 4.4% of the participants had ClaveinDindo Grade: 4. 17.8% of the participants had ClaveinDindo Grade: 5. [Table 3]

Mortality was seen in 17.8% of the patients and 40.0% of the participants had Major Complication. There was a significant difference between the various groups in terms of distribution of Peritoneal Contamination ($\chi 2$ = 9.814, p = 0.024).Patients without any major complications had the larger proportion of patients without any peritoneal Contamination. Most of the patients who developed major complications, had the larger proportion of peritoneal contamination with faecal matter. [Table 3]

The area under the ROC curve (AUROC) for POSSUM mortality risk (%) predicting Mortality was 0.961 (95% CI: 0.906 - 1), thus demonstrating excellent diagnostic performance. It was statistically significant (p = <0.001). At a cut-off of POSSUM Mortality risk (%) ≥56.7, it predicts mortality, with a sensitivity of 88%, and a specificity of 95%. [Table 4].

**Table 4:** ROC Curve Analysis Showing Diagnostic Performance of POSSUM Mortality (%) in Predicting Mortality (n = 45).

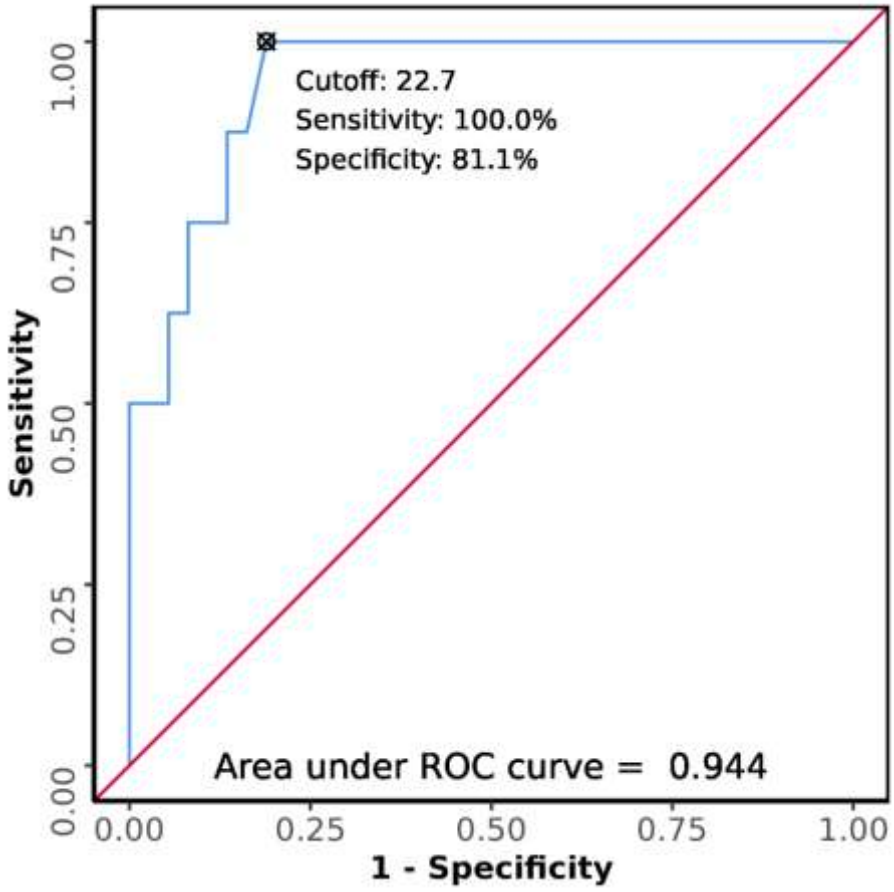



| Parameter | Value (95% CI) |
|---|---|
| Cut-off (p value) | ≥ 56.7 (<0.001) |
| AUROC | 0.961 (0.906 - 1) |
| Sensitivity | 87.5% (47-100) |
| Specificity | 94.6% (82-99) |
| Positive Predictive Value | 77.8% (40-97) |
| Negative Predictive Value | 97.2% (85-100) |
| Diagnostic Accuracy | 93.3% (82-99) |
| Positive Likelihood Ratio | 16.19 (4.1-63.9) |
| Negative Likelihood Ratio | 0.13 (0.02-0.83) |
| Diagnostic Odds Ratio | 122.5 (9.72-1543.84) |

The odds ratio (95% CI) for Mortality when POSSUM mortality risk (%) is ≥56.7 was 52.5 (6.16-447.46). The relative risk (95% CI) for mortality when POSSUM mortality risk (%) is ≥56.7 was 13.88 (3.77-52.19).

The area under the ROC curve (AUROC) for P POSSUM Mortality risk (%) predicting Mortality was 0.944 (95% CI: 0.879 - 1), thus demonstrating excellent diagnostic performance. It was statistically significant (p = <0.001). At a cut-off of P POSSUM Mortality risk (%) ≥22.7, it predicts Mortality with a sensitivity of 100%, and a specificity of 81%. [Table 5].

**Table 5:** ROC Curve Analysis Showing Diagnostic Performance of P POSSUM Mortality (%) in Predicting Mortality (n = 45).

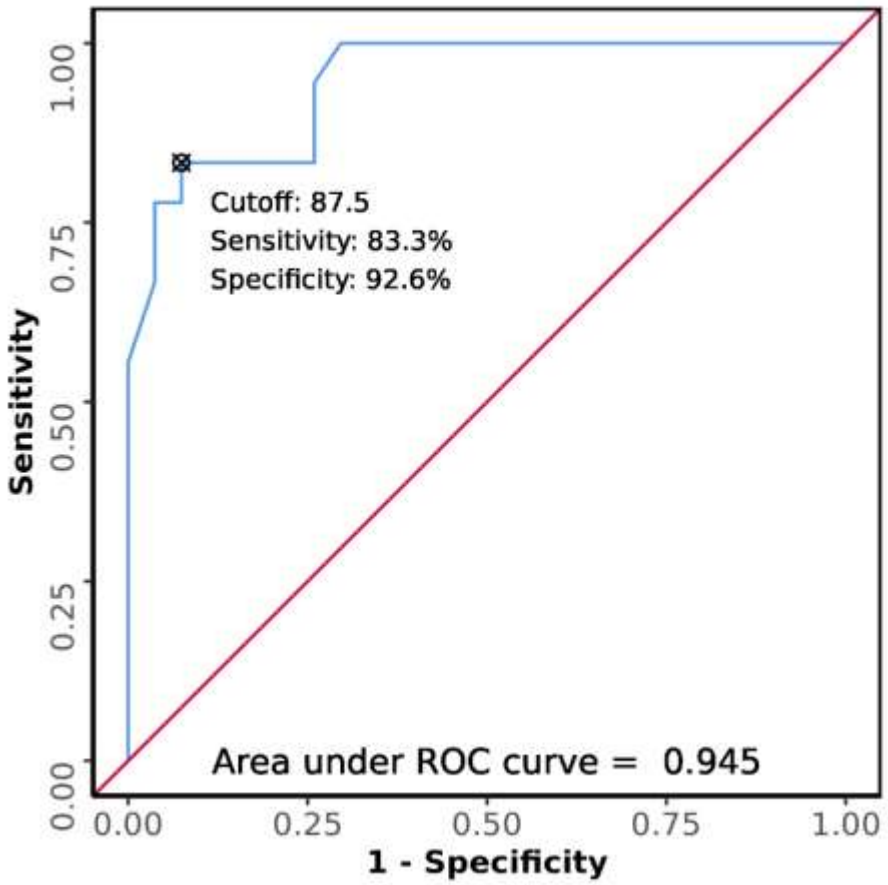



| Parameter | Value (95% CI) |
|---|---|
| Cut-off (p value) | ≥ 22.7 (<0.001) |
| AUROC | 0.944 (0.879 - 1) |
| Sensitivity | 100.0% (63-100) |
| Specificity | 81.1% (65-92) |
| Positive Predictive Value | 53.3% (27-79) |
| Negative Predictive Value | 100.0% (88-100) |
| Diagnostic Accuracy | 84.4% (71-94) |
| Positive Likelihood Ratio | 5.29 (2.71-10.3) |
| Negative Likelihood Ratio | 0 (0-NaN) |
| Diagnostic Odds Ratio | Inf (NaN-Inf) |

The odds ratio (95% CI) for Mortality, when P POSSUM Mortality risk (%) is ≥22.7 was 36.17 (3.74-350.19). The relative risk (95% CI) for Mortality, when P POSSUM Mortality risk (%) is ≥22.7 was 17.23 (3.12-101.46).

The area under the ROC curve (AUROC) for POSSUM morbidity risk (%) predicting major complications was 0.945 (95% CI: 0.886 - 1), thus demonstrating excellent diagnostic performance. It was statistically significant (p = <0.001). [Table 6].

**Table 6:** ROC Curve Analysis Showing Diagnostic Performance of POSSUM Morbidity (%) in Predicting Major Complications (n = 45).

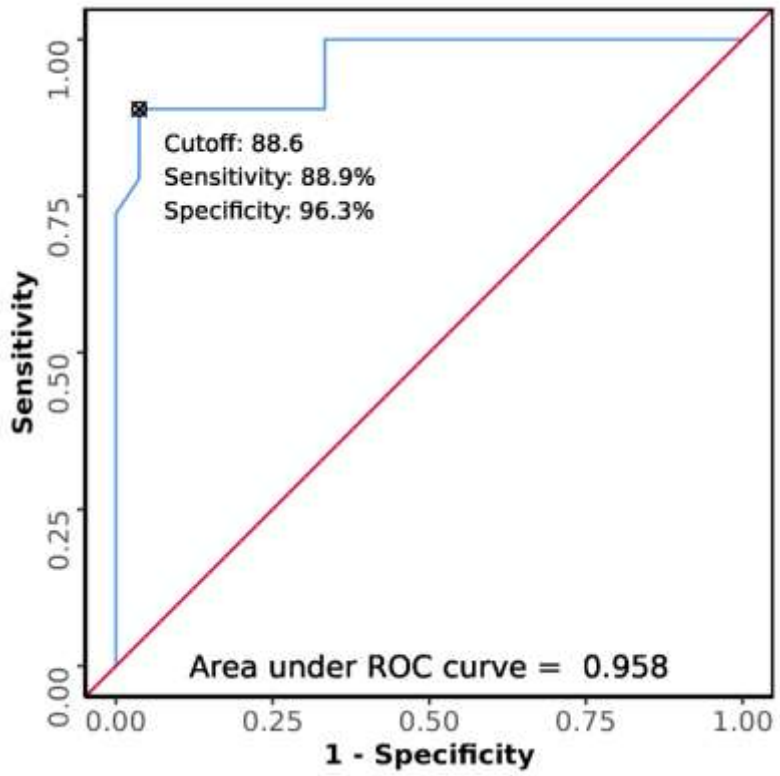



| Parameter | Value (95% CI) |
|---|---|
| Cut-off (p value) | ≥ 87.5 (<0.001) |
| AUROC | 0.945 (0.886 - 1) |
| Sensitivity | 83.3% (59-96) |
| Specificity | 92.6% (76-99) |
| Positive Predictive Value | 88.2% (64-99) |
| Negative Predictive Value | 89.3% (72-98) |
| Diagnostic Accuracy | 88.9% (76-96) |
| Positive Likelihood Ratio | 11.25 (2.92-43.37) |
| Negative Likelihood Ratio | 0.18 (0.06-0.51) |
| Diagnostic Odds Ratio | 62.5 (9.35-417.98) |

At a cut-off of POSSUM morbidity risk (%) ≥87.5, it predicts major complications, with a sensitivity of 83%, and a specificity of 93%.

AUROC for P POSSUM morbidity risk (%) predicting major complications was 0.958 (95% CI: 0.903 - 1), thus demonstrating excellent diagnostic performance. It was statistically significant (p = <0.001). [Table 7].

**Table 7:** ROC Curve Analysis Showing Diagnostic Performance of P POSSUM Morbidity (%) in Predicting Major Complication (n = 45).




| Parameter | Value (95% CI) |
|---|---|
| Cut-off (p value) | ≥ 88.6 (<0.001) |
| AUROC | 0.958 (0.903 - 1) |
| Sensitivity | 88.9% (65-99) |
| Specificity | 96.3% (81-100) |
| Positive Predictive Value | 94.1% (71-100) |
| Negative Predictive Value | 92.9% (76-99) |
| Diagnostic Accuracy | 93.3% (82-99) |
| Positive Likelihood Ratio | 24 (3.48-165.39) |
| Negative Likelihood Ratio | 0.12 (0.03-0.43) |
| Diagnostic Odds Ratio | 208 (17.42-2483.6) |

At a cut-off of P POSSUM morbidity risk (%) ≥88.6, it predicts major complications, with a sensitivity of 89%, and a specificity of 96%.

There was a significant difference between the 5 groups in terms of POSSUM Morbidity (%) ($\chi2$ = 35.539, p = <0.001), with the median POSSUM Morbidity (%) being highest in the ClaveinDindo Grade: 5 group. [Table 8].

**Table 8:** Comparison of the 5 Subgroups of the Variable ClaveinDindo Grade in Terms of POSSUM Morbidity (%) (n = 45).

| POSSUM Morbidity | ClaveinDindo Grade | | | | | Kruskal Wallis Test | |
|---|---|---|---|---|---|---|---|
| (%) | 1 | 2 | 3 | 4 | 5 | $\chi2$ | p value |
| Mean (SD) | 26.21 (14.82) | 74.42 (18.51) | 86.10 (7.70) | 92.05 (0.78) | 96.04 (3.43) | | |
| Median (IQR) | 19.25 (15.12-31.4) | 82.8 (66-86.9) | 87.2 (79.8-91.08) | 92.05 (91.78-92.32) | 96.8 (95.17-98.23) | 35.539 | <0.001 |
| Range | 12.7 - 57.2 | 34.3 - 91.5 | 74.8 - 97.5 | 91.5 - 92.6 | 88.6 - 99.5 | | |

There was a significant difference between the 5 groups in terms of P POSSUM Morbidity (%) ($\chi2$ = 36.602, p = <0.001), with the median P POSSUM Morbidity (%) being highest in the ClaveinDindo Grade: 5 group. [Table 9].

**Table 9:** Comparison of the 5 Subgroups of the Variable ClaveinDindo Grade in Terms of P POSSUM Morbidity (%) (n = 45).

| P POSSUM | ClaveinDindo Grade | | | | | Kruskal Wallis Test | |
|---|---|---|---|---|---|---|---|
| Morbidity (%) | 1 | 2 | 3 | 4 | 5 | $\chi 2$ | p value |
| Mean (SD) | 24.56 (11.36) | 76.90 (16.80) | 87.31 (8.05) | 96.15 (0.35) | 96.42 (3.03) | | |
| Median (IQR) | 22.8 (17.27-28.5) | 82.8 (77.6-86.35) | 89.2 (80-93.75) | 96.15 (96.03-96.28) | 96.9 (94.42-99.08) | 36.602 | <0.001 |
| Range | 12.7 - 57.2 | 34.3 - 91.5 | 74.8 - 96.5 | 95.9 - 96.4 | 91.5 - 99.7 | | |

## Discussion

This study comprised of patients who presented to surgery casualty prepared for emergency gastrointestinal surgery. Physiological component of the POSSUM score was calculated pre-operatively. The patients were operated and intra op findings were noted and the operative component of the POSSUM score was calculated. The physiological and operative scores were compiled and POSSUM and P-POSSUM scores were calculated which predicted morbidity and mortality of the patient. Patients were observed for a period of 30 days post-op to look for grade of morbidity which was defined by Clavein-dindo grade of morbidity.

Mean age of the patients participating in the study was 37.8 years with the range being 18 years-72 years.62.2% of the patients were of the age group of 18-40 years with 95% confidence interval being 46.5%-75.8%.28.9% patients were of 41-60 years while 8.9% of them were of >60 years of age. Yelamanchi et al., 2020 conducted a similar study which had similar age distribution with a mean age of 37.1 years.[11]

Out of 45 patients included in the study 8 had mortality. Mortality rate being 17.8%. Age group 18-40 had 7% mortality,40-60 age group had 30% mortality,>60 age group had 50% mortality, p value being 0.027 which was significant. So, with advancing age mortality rate increased which could be due to increase in co-morbidities with advancing age. Study conducted by Simpson k et al.,2020 in elderly patients undergoing emergencies laparotomies had similar 30 day mortality rate of 16.3%.[12]

Mean Physiologic score of the patients participating in the study was 24.00, median was 23 and the range was between 13-49. The data was positively skewed. Mean physiologic score of patients who had mortality was 34.75 and the range being 23-49, while the mean physiologic score of patients who did not have mortality was 21.68 and the range was 13-34, p value<0.001 which suggests significant difference between two groups in terms of physiologic score. Physiologic score was also a good predictor of major complications post operatively. ROC curve analysis showed a cut off value of 26 in prediction of major complications with a sensitivity of 83.3% and specificity of 88.9%.ROC curve analysis for diagnostic performance of physiologic score in predicting mortality showed a cut off value of 28 with a sensitivity of 87.5% and specificity of 75.7%,thus demonstrating excellent diagnostic performance.(p value<0.001).Ngulube A et al[13]., in 2019 conducted a similar study in which physiologic score correlated significantly with patient morbidity(p=0.002) and mortality(p<0.00001).It supported the observation from other papers that physiological score can be used in isolation for risk stratification of patients pre-operatively.[14,15]

Mean Operative score of the patients participating in the study was 17.42, median was 20 and the range was between 10-27. The data was normally distributed. Mean operative score of patients who had mortality was 21.38 and the range being 13-27, while the mean operative score of patients who did not have mortality was 16.57 and the range was 10-26, p value 0.006 which suggests significant difference between two groups in terms of operative score. Mean operative score calculated by González-Martínez S et al.,2016 was 8, and physiological score was 16.[16] Study by Shekhar et al.,2023found mean physiological score of 24.57 and mean operative time of 19.01 which was similar with our study.[4] Operative score was also a good predictor of major complications post operatively. ROC curve analysis showed a cut off value of 19 in prediction of major complications with a sensitivity of 88.9% and specificity of 55.6%, demonstrating good diagnostic performance. ROC curve analysis for diagnostic performance of operative score in predicting mortality showed a cut off value of 21 with a sensitivity of 50% and specificity of 94.6%, thus demonstrating good diagnostic performance. (p value 0.006). In study by Ngulube A et al[13]operative score correlated significantly with patient morbidity(p=0.007) and mortality(p<0.0036). It supported the observation from other papers that operative score can be used in isolation for risk stratification of patients pre-operatively.[12,15]

28% patients of the age group of 18-40 years had major complications,46% patients of age group of 40-60 years had major complications and of age of >60 years 100% patients had major complications, p-value 0.020 which suggested significant difference between various groups in terms of distribution of age group.

Peritoneal contamination was another determining factor in development of major complications in patients. Among the patients who had major complications in post operative period 44.4% had bowel content contaminating the peritoneal cavity,38.9% had generalized purulent fluid while only 16.7% had no peritoneal contamination.

Mean physiologic score in patients who had major complications was 31.33, range being 21-49 while in those who did not have any major complications was 19.11, range being 13-28. There was a significant difference between the 2 groups in terms of physiologic score p-value <0.001.

Mean operative score in patients who had major complications was 20.67, range being 13-27 while in those who did not have any major complications was 15.26, range being 10-20. There was a significant difference between the 2 groups in terms of operative score p-value <0.001.

Mean POSSUM morbidity score in patients who had major complications was 91.76%, median was 93.7% range being from 77.7-99.5%, while among the patients who did not have any major complications mean POSSUM morbidity score was 49.9%, median was 52%, range being from 12.7-91.5%. There was a significant difference between the two groups in terms of POSSUM morbidity (%), p value <0.001.

Mean P-POSSUM morbidity score in patients who had major complications was 93.06%, median was 94.65% range being from 76.9-99.7%, while among the patients who did not have any major complications mean POSSUM morbidity score was 50.05%, median was 34.3%, range being from 12.7-91.5%. There was a significant difference between the two groups in terms of POSSUM morbidity (%), p value <0.001.

The area under the ROC curve for POSSUM morbidity (%)was 0.945 (95% CI:0.886-1), demonstrating excellent diagnostic performance. It was statistically significant (p <0.001). Cut off value of POSSUM morbidity score was >=87.5%with a sensitivity of 83% and a specificity of 93%. Positive predictive value was 88.2% and relative risk for having major complications when POSSUM morbidity score was >=87.5% was 6.34.

The area under the ROC curve for P-POSSUM morbidity (%) for prediction of major complication was 0.958 (95% CI:0.903-1), which demonstrated excellent diagnostic performance. It was statistically significant (p <0.001). Cut off value of P-POSSUM morbidity score for prediction of major complications was >=88.6%with a sensitivity of 88.9% and a specificity of 96.3%. Positive predictive value was 94.1% and relative risk for having major complications when POSSUM morbidity score was >=88.6% was 9.06.

The area under the ROC curve for POSSUM mortality was 0.961 (95% CI:0.906-1), demonstrating excellent diagnostic performance. It was statistically significant (p <0.001). Cut off value of POSSUM morbidity score was >=56.7%with a sensitivity of 87.5% and a specificity of 94.6%. Positive predictive value was 77.8% and relative risk when POSSUM mortality score was >=56.7% was 13.88. Chatterjee AS et al.[17] in 2015 conducted a study in which POSSUM score was as a predicting tool in patients of perforation peritonitis. POSSUM had a positive predictive value of 100% for mortality which was much better than observed in this study and 94% for morbidity which was also higher than observed in this study. Area under ROC curve for POSSUM predicting mortality and morbidity was 0.943 and 0.93 respectively which was less accurate compared to this study.The area under the ROC curve was 0.818 and 0.836 for mortality prediction by POSSUM and P-POSSUM, respectively, thus showing the accuracy to be higher (Shekar et al.)[4]

The area under the ROC curve for P-POSSUM mortality was 0.944 (95% CI:0.879-1), demonstrating excellent diagnostic performance. It was statistically significant (p <0.001). Cut off value of P-POSSUM morbidity score for prediction of patient mortality was >=22.7%with a sensitivity of 100% and a specificity of 81.1%.Positive predictive value was 53.3% and negative predictive value was 100% and relative risk of patient mortality when P-POSSUM mortality score was >=22.7% was 17.23.In a study conducted by Nag DS et al.,[5]comparing APACHE-II and P-POSSUM scores in predicting mortality in patients undergoing emergency laparotomy, cut off value of p-POSSUM to predict mortality was 63 which was higher than what was observed in this study and the area under the ROC was 0.989 which suggested excellent diagnostic performance which

was similar to this study.In the study conducted by Ngulube A et al.,[13] AUROC for P-POSSUM predicting mortality was 0.814 which was much less compared to this study and it showed a poor diagnostic performance in their study.

### *LIMITATIONS OF THE STUDY:*

1. Small sample size.

2. Single centered study.

3. Patientin our study were of low economic status and thus different strata could not be validated.

## Conclusion

We find that the POSSUM and P-POSSUM scores can be used to predict morbidity and mortality in patients undergoing emergency gastrointestinal procedures with high sensitivity and specificity. In our study, POSSUM score was shown to be the better parameter for predicting mortality, but P-POSSUM was found to be the better parameter for predicting serious complications, but the difference was not statistically significant.

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