

Evaluation of Clinical Outcome of Patients Undergoing Emergency Laparotomy with the Help of Portsmouth Predictor Equation for Mortality (P-Possum Score)

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ABSTRACT

Introduction: Emergency laparotomy, though lifesaving, may result in significant morbidity and mortality. In an attempt to clinically evaluate patients undergoing emergency laparotomy and predict their mortality using the worldwide accepted Portsmouth Predictor equation for mortality (P POSSUM), the present study was undertaken in the Surgery department of a tertiary care hospital in eastern India.

Material and methods: This observational cross-sectional study included 60 patients aged between 15 to 75 years, undergoing emergency laparotomy during the specified study period of one and half years.

Results: It was observed that out of 60 patients, 63.3% were male, and mean age was 40.60 (16.67) years. Peptic perforation was the most common indication for laparotomy. Mean P POSSUM predicted mortality risk was 40.617% (Range-0.8 to 99.7). Twenty-four patients died during hospital stay. ROC curve analysis of P POSSUM scores revealed that if a cut off value of P POSSUM score of 42.45% was selected, mortality could be predicted with a sensitivity of 70.80% and a specificity of 83.30%.

Conclusion: Thus, P POSSUM might be a useful tool in predicting risk of short-term mortality following emergency laparotomy.

Keywords: Emergency; Laparotomy; Risk Assessment; Mortality; P-Possum

INTRODUCTION

Acute abdominal conditions requiring urgent surgery need timely treatment and remain important causes of morbidity and mortality in India and many resource-constraint countries where access to surgical care remains poor.^{1,2}

However, crude morbidity and mortality rates are fallacious because of differences in general health of the local population and variable presentation of the patient. Hence it is inadequate to monitor the performance of hospital units, and to assure quality service. An accurate risk stratification tool enables clinical decision making perioperatively and meaningful comparison of outcomes between providers for service evaluation or clinical audit.^{3,4,5} Hence, several scoring systems with adjustable risks and stratified for specific populations have been developed.

Therefore, easy to use, fast accurate risk adjusted scoring and/or prediction system is needed which should be specific to the patient being studied, should incorporate the influence of the indication for surgery and allow for assessment of variable presentations of each patient, to assess the efficiency

of the particular procedure performed. It could also help adapting a new procedure fast comparing the reduction in the observed to expected(O:E) adverse outcome rates predicting the individual prognosis, influencing treatment decisions and helping in rationalizing regimens⁶ Calibrated systems were developed to obtain mortality estimates for various patient groups.^{7,8,9}

The Physiological and Operative Severity Scoring system for the enumeration of Morbidity and mortality (POSSUM) has been proposed as a risk-adjusted scoring system to allow direct comparison between the observed and expected adverse outcome rates^{10,11} It has been called as a surgeon-based scoring system. The Portsmouth POSSUM is a modification of the POSSUM scoring system, with same variables and grading system, but a different equation, providing a better fit to the observed mortality rate, which is objective measure of outcome.^{12,13} It has already found use in general, vascular, colorectal, esophageal and laparoscopic procedures but the studies mostly involved patients in developed countries, where the patient characteristics, presentation and available resources differ from developing countries' health infrastructure.¹⁴⁻²⁴

Factors influencing operative outcome in developing countries are distinct from those affecting clinical and recovery parameters due to variance in physiological, economic and socio-cultural aspects.^{25,26}

Keeping this in mind, Portsmouth-POSSUM (P-POSSUM) includes both physiological and operative finding parameters. It is widely used guide for better utilization of health care resources for postoperative patients.

The POSSUM score describes 18 factors in two component parts; 12 physiological factors (PS) and 6 operative factors

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(OS) from which predicted mortality can be calculated. P-POSSUM, the refinement of the original scoring system, collects the same physiological and operative parameters, a different formula is employed to calculate predicted mortality.¹⁰

In this context the study aimed to assess the validity of POSSUM scoring system in patients undergoing emergency laparotomies in a tertiary level hospital in Kolkata and, to try to analyze the outcome and compare the predictive and observed values.

MATERIAL AND METHODS

It was an institution based, observational study conducted in General Surgery ward (emergency), General Surgery OT, General Surgery outpatient department (OPD) of R G Kar Medical College, Kolkata. Study was done on 60 patients undergoing emergency laparotomy in R G Kar Medical college available in the study area for the period of January 2015 to June 2016.

Sample design

It is a cross-sectional study and 60 consecutive patients undergoing emergency laparotomy were recruited for study using following inclusion and exclusion criteria. Written informed consent was taken from all cases. Approval was taken from institutional ethical committee.

Inclusion criteria

All the patients, except those in exclusion criteria undergoing emergency laparotomy in the study area and gave informed written consent (either by self or proxy medical decision maker) were included in the study.

Exclusion criteria

The following patient will be excluded

- Patient age < 15yrs and >75yrs.
- Patient died before intubation.
- Re-exploration

Study tools

- History,
- Clinical examination,
- Physiological score of the patients at the time of admission,
- Operative score undergoing emergency laparotomy.
- POSSUM Score and P POSSUM Score

Study techniques

The principal investigator collected data by use of questionnaires and direct observation of the laparotomy patient in the pre, peri-operative and postoperative periods. The questionnaires were designed for recruitment of the investigations and follow-up of these patients. The patients were then followed up for a period of 30 days following the surgical procedure and complications if any, were noted depending upon the following criteria as defined for P-POSSUM scoring system.

The equation we used for calculating P-POSSUM score was $\ln(R/1-R) = -7.04 + (0.13 \times \text{physiological score}) + (0.16 \times \text{operative severity score})$; R= predicted mortality rate.

The physiological and operative scores were calculated by noting parameters depicted in table-1 and table-2 respectively.

STATISTICAL ANALYSIS

All the data were entered into MS excel[®] and spreadsheets were used for analysis. Statistical analysis was done using SPSS[®] version 20.0. The expected mortality rate was obtained using linear regression analysis and O: E ratio was calculated. Chi square test was applied to obtain the p value to note any significant difference between the predicted death rate and the actual outcome. Rate of increment in deaths for each risk factor was calculated based on the hypothesis that deaths were linearly related with the score for each of the studied risk factors and Student 't' test was applied to validate this hypothesis.

For all statistical tests of significance, p value less than 0.05 was considered to reject the null hypothesis.

RESULTS

Indication for Midline Laparotomy

In our study most of the patients needed midline laparotomy due to peptic perforation and Carcinoma colon and Sigmoid volvulus was least encountered indication in our study (figure-1).

Distribution according to P-POSSUM predicted mortality and Actual mortality in subjects

In our study P-POSSUM predicted mortality score distribution is shown in figure-2. Mean P POSSUM predicted mortality risk was 40.617% (Range-0.8 to 99.7).

It was observed that if calculated risk by P POSSUM was

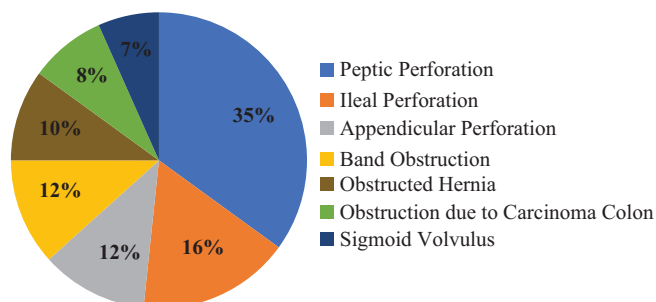


Figure-1: Pie chart showing distribution of patients according to indication of midline laparotomy

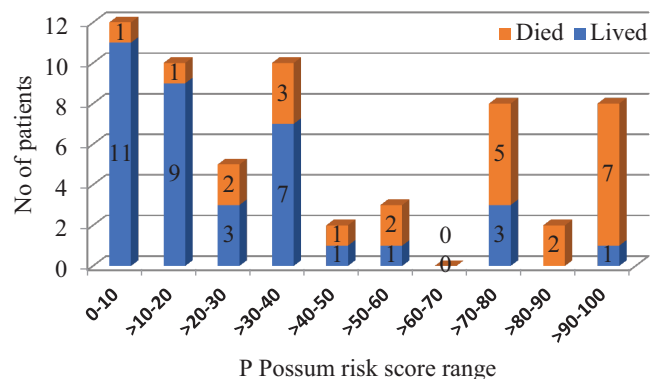


Figure-2: Bar diagram showing P-POSSUM predicted risk score vs Actual mortality in study subjects.

Parameters	1	2	4	8
Age (years)	≤60	61-70	≥71	-
Cardiac Sign	No failure	Diuretic, Digoxin, Antianginal, antihypertensive	Peripheral edema, Warfarin, Mild Cardiomegaly	Raised JVP, Cardiomegaly
Respiratory	No dyspnea	Mild COPD	Moderate COPD	Fibrosis, Consolidation, Dyspnea on rest
Systolic Blood Pressure (mm of Hg)	110-130	100-109 131-170	90-99 ≥171	≤89
Pulse (b.p.m)	50-80	40-49 81-100	101-120	≤39 ≥121
Glasgow Coma Scale	15	12-14	9-11	≤8
Hemoglobin (gm/dl)	13-16	11.5-12.9 16.1-17	10-11.4 17.1-18	≤9.9 ≥18.1
WBC count	4000-10000	3100-3900 10100-20000	≤3000 ≥20100	-
Urea (mmol/L)	≤7.5	7.6-10	10.1-15	≥15.1
Sodium (meq/L)	≥136	131-135	126-130	≤125
Potassium (meq/L)	3.5-5	3.2-3.4 5.1-5.3	2.9-3.1 5.4-5.9	≤2.8 ≥6
ECG	Normal		Atrial Fibrillation	Abnormal rhythm, ST-T and Q wave changes

Table-1: Physiological Score

Parameter	1	2	4	8
Operative severity	minor	moderate	major	Major+
Multiple Procedure	1		2	>2
Total Blood Loss (ml)	<100	101-500	501-999	≥1000
Peritoneal Soiling	none	Minor (serous fluid)	Local pus	Free bowel content
Cancer	None	Primary only	Nodal Metastasis	Distant metastasis
Mode of Surgery	elective		Emergency (>2-24hr)	Emergency (<2 hr)

Table-2: Operative score

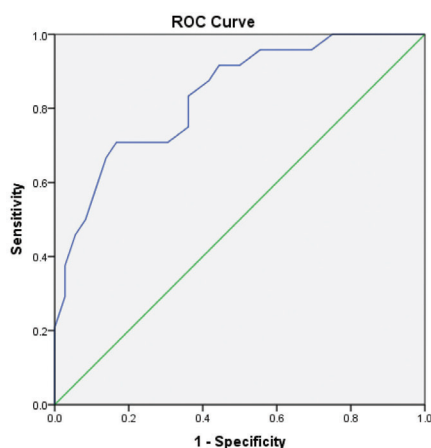


Figure-3: ROC curve analysis of p possum mortality risk score

>42.45%, mortality could be predicted with a sensitivity of 70.80% and a specificity of 83.30%. Thus, it may be used as a cut off for predicting high risk of mortality (figure-3).

In our study we also found that among the parameters encountered in physiological and operative score Cardiac sign (p=0.034), respiratory sign (p=0.025), GCS score (p=0.001), Urea score (p=0.008), Sodium and potassium score (p= 0.037;p=0.028 respectively), ECG score (0.011), Operative severity score (p=0.017), number of procedures

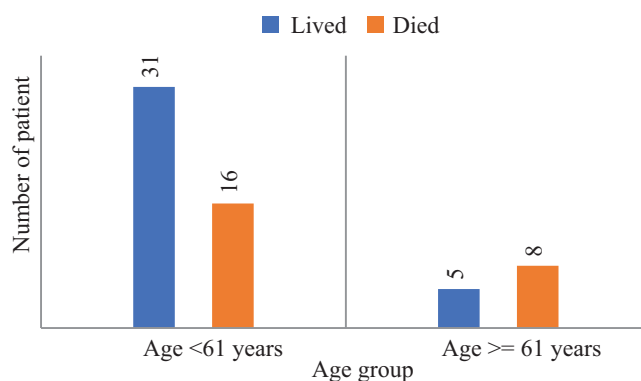


Figure-4: Bar diagram showing comparison of different age group with actual mortality

performed (p=0.007), soiling during procedure (p=0.001) were significantly associated with mortality in the study population (p<0.05 denotes significance).

Comparison of demographic variables in study population

Mean age of our study population was 40.6±16.67 years. 36.7% of our study subject were female and 63.3% were male. The age wise comparison in terms of actual mortality has been depicted in figure-4. Chi-square test shows value of 3.208 and p=0.073. Thus, it was not statistically significant.

DISCUSSION

Previously, for risk stratification, clinical and biochemical assessment and high-risk pathological features were applied to help clinicians distinguishing the group, likely to benefit from treatments available. These systems only described the extent of the spread of lesions, the overall condition e.g. the physiological status and the level of insult imposed from the surgical intervention were neglected. Hence the relationship between objective assessment using the POSSUM score and long-term survival is investigated.

Kitara et al. 2011 showed P-POSSUM was able to accurately predict the adverse outcome following midline emergency laparotomy.²⁷

The average age was 40.6 years in keeping with regional published figures.^{28,29} Mortality rate was 40% comparable poorly to international figures (10-14%).^{30,31} Possible explanation may be difference in standards of post-operative care, selection criteria in various centers and low case volumes locally.

The highest mortality was in older age groups (>60yrs) consistent with international literature and may be associated with undisclosed chronic conditions.

Operative scores in P-POSSUM had a greater impact on the mortality rate than POSSUM operative scores. This could be due to more measured parameters in the P-POSSUM operative score affecting the post-operative period. Thus, the need to optimize the patient physiologically cannot be overemphasized. Linear analysis of the two scores showed an overestimation of mortality rate. Similar studies showed no differences in predicted and observed mortality rates in P-POSSUM while POSSUM overestimated mortality rates in the elderly.³²⁻³⁶ Both scores in this study showed a significant fit with the observed deaths which was similar to other studies for P-POSSUM in contrast to studies on POSSUM which showed a lack of fit. ROC analysis showed both scores had fair discriminatory power that was better than chance which was similar for POSSUM in similar studies. However, studies done on P-POSSUM showed a moderate to good discriminatory power. Finally, P-POSSUM performed better than POSSUM in predicting mortality.

Previous studies concentrating on surgical specialty alone have observed significant variation from the predicted models at particular deciles of risk banding, most notably the lower bands of predicted risk.¹³ Investigators have also explored the performance of these models for a variety of surgical specialties. A systematic review³⁷ reported a mean O:E of 0.9 for PPOSSUM (confidence interval 0.88-0.92) in colorectal cancer. A large multi-center study described mean O:E mortality of 1.0 (CI 0.88-1.13)³⁸. Similar discrepancies have been reported in other surgical specialties^{39,40}. With other scoring systems frequently employed in critical care areas, research describing the appropriateness of POSSUM based models to predict mortality in areas delivering higher dependency care is sparse. Cavaliere and Organ observed mortalities of approximately half that predicted by POSSUM and P-POSSUM scoring.^{34,41} Clarke,

on the other hand, found higher O:E mortality in a small number of patients undergoing emergency laparotomy admitted to a post-anesthesia care unit (PACU)-ward (O:E 0.82), compared to a PACU-HDU-ward pathway or ICU-high dependency unit (HDU)-ward pathway (O:E 0.0; O:E 0.69, respectively).⁴² Level 2 and 3 care is currently not thought appropriate for majority postoperatively, however targeted critical care admission for pre-identified high-risk surgical patients may demonstrate improved outcome⁴³⁻⁴⁵. Demonstration of a comparable or improved patient outcome following level 1 care postoperatively for low-risk individuals have obvious economic implications.

Logistic regression analysis of data from this present study supports this view, suggesting that more selective assessment of patients destined for a level 1 care environment may be possible by placing greater weight on physiological score and urgency rather than nature of operation and by utilizing our proposed scoring system P-POSSUM. Together these findings indicate that further research is required in the area to better quantify the extent to which physiological score and urgency of surgery influence outcome. In addition, further prospective testing needs to be undertaken to assess the effectiveness of any novel scoring system.

CONCLUSION

We studied 60 emergency laparotomy patients, which resulted in 24 deaths (40% mortality rate). On applying P-POSSUM we found the expected number of deaths for our study group was 24 (O: E= 0.63), relationship was statistically significant.

The present study suggests that P-POSSUM is accurate scoring system for predicting postoperative adverse outcome among patients undergoing major surgeries.

Peritoneal perforation and wound infection (17%) are concerns and require better care for prevention following major general surgeries.

All the studied risk factors were found to have a positive rate of increment of deaths with higher scores. Presence of Cardiac sign, respiratory sign, GCS score, Urea score, Sodium and potassium score, ECG score, Operative severity score, number of procedures performed, soiling during procedure were significantly associated with mortality in the study population were found to be significant in our study. Hence adequate and prompt correction of these factors could decrease the mortality rate.

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