Original Research Article

Predicting Morbidity and Mortality using POSSUM Scoring in Patients Undergoing Emergency Laparotomy –An Observational Study

Ashish Singh[1], Rishi Jindal[2*], Abhinav Jauhari[3], Jagadamba Sharan[4]

[1]Post Graduate, Department of General Surgery, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India

[2]Associate Professor, Department of Surgery, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India

[3]Assistant Professor, Department of Surgery, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India

[4]Professor, Department of General Surgery, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India

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Abstract

Background: Emergency laparotomy is a lifesaving procedure with a significant risk of mortality and morbidity. Scoring system should be easy to calculate, reliable and applicable to all people undergoing emergency surgery. An accurate prediction of outcome could then be made, allowing the surgical team to present a more informed choice to the patient on treatment options and their likely outcome. This study was conducted to assess the validity of POSSUM scoring in predicting mortality and morbidity in patients undergoing emergency laparotomy. **Objective:** To evaluate the effectiveness of POSSUM scoring for prediction of mortality and morbidity after emergency laparotomy. **Material and methods:** The present study was conducted in the Department of General Surgery, Rohilkhand Medical College and Hospital, Bareilly. This was an observational study comprising of 74 patients of 18-65 years of age undergoing emergency laparotomy. Parameters for calculating POSSUM score were retrieved and O:E ratio for Mortality and Morbidity calculated using linear and exponential analysis. **Results:** The observed and expected morbidity was 37.8% and 39.2% respectively with observed by expected morbidity ratio (O:E) of 0.97. The observed and expected mortality was 14.9% and 47.3% respectively with observed by expected mortality ratio (O:E) of 0.31.**Conclusion:** POSSUM scoring system has an undeniable advantage in the set up for better patient counselling, improving the surgical outcomes in emergency setting and for better management of limited resources and manpower.

Keywords: Emergency laparotomy, POSSUM score, Morbidity, Mortality.

Introduction

An emergency laparotomy is a lifesaving procedure, undertaken mostly in acute cases, without much preparation of the patient [1]. Internationally reported mortality rates following emergency laparotomy range from 13% to 18% at 30 days [2]. Mortality in age > 65 years of patients was found to be between 22% and 44% and morbidity of 50% by Rix et al. in 2007 [3].Ideally, surgeons need a scoring system which is reliable, easy to calculate and applicable to all people presenting for emergency surgery [3]. Such scoring system provide an objective assessment of morbidity and mortality before undertaking surgical management based on clinical and laboratory measures [4]. Commonly used scoring systems such as Acute Physiology and Chronic Health Evaluation (APACHE II), Simplified Acute Physiology Score (SAPS II), Mortality Probability Model II (MPM II) were developed to help in this process and for facilitation of audit and performance analysis [5].Crude morbidity and mortality rates are faulty because of the differences in the general health condition of the local population and patient's variable presentation. Hence it is inadequate to monitor the performance of hospital units, and to assure quality service. A tool with accurate risk stratification enables clinical decision making perioperatively and meaningful comparison of the results between clinical audit or the providers for helping in service evaluation. Hence, several scoring systems with adjustable risks and stratified for specific populations have been developed [6].One such score is the Physiological and Operative Severity Scoring System for the Enumeration of Morbidity and Mortality (POSSUM) which has been proposed as a risk-adjusted scoring system that allows direct comparison of observed and expected adverse outcomes given by Copeland et al. in 1993 [7]. It has been called as a scoring system which is surgeon based [8]. Factors affecting operative outcome in underdeveloped countries differ from the factors affecting clinical outcome and recovery parameters because of variances in physiological factors, socio-cultural and economic factors [9]. In order to account for this, POSSUM integrates both physiological parameters and operative parameters. It is a commonly used guide for optimal health-care resource use for postoperative patients and perioperative care. The scoring system is made up of 18 components divided into two parts: 12 physiological factors (PS) and 6 operative parameters (OS) used to determine projected mortality and morbidity. P-POSSUM, an improved version of the original scoring system, obtains the same physiological and operating data as the original scoring system [10]. The expected values of both morbidity and mortality obtained by the system are compared with those observed in the sample. Based on these values, the system is useful in several ways [11].

*Correspondence
Dr. Rishi Jindal
Associate Professor, Department of General Surgery, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India
E-mail: rishimanisha@gmail.com

POSSUM provides the operating surgeon with the observed to expected morbidity ratio (O/E ratio) in the series of patients. Keeping an assumption that POSSUM prediction can be used as a reference, an observed morbidity far above expected (O/E > 1) may lead to some opportunities for improvement in future [8].

Materials and method

The present study is observational study was carried out from 01st November 2019 to 31st October 2020 in the department of General surgery at Rohilkhand Medical college and Hospital, Bareilly, Uttar Pradesh, India. All patients 18-65 years of age, who underwent emergency laparotomy were included in the study after taking written and informed consent.

Sample size

A total of 74 patients were included in the study. All elective cases and patients undergoing emergency laparoscopic procedures were not included in the study.

Method

After admission of the patients in the hospital a detailed history was taken and signs and symptoms were recorded. Routine blood investigations such as complete blood counts (CBC) including total leucocyte counts (TLC) and differential leucocyte counts (DLC), blood sugar levels (RBS), renal function tests (blood urea and serum creatinine), serum electrolytes (sodium, potassium and calcium) were done. Electrocardiogram (E.C.G) and chest X-Ray (PA view) were taken to rule out any underlying cardiac complications or respiratory problem. Radiological examination were conducted in all patients to detect any evidence of pneumo-peritoneum. After optimising the patient, data was collected via a prepared proforma for carrying out the study of all cases selected for emergency laparotomy in the stipulated time period. POSSUM score of one (1), two (2), four (4) or eight (8) was given according to the values of each parameters of possum scoring chart and possum score was evaluated for each patient. All the patients had their physiological scores recorded during admission (Table 1). Operative severity scores were calculated based on the intra-operative findings (Table 2). Cases which were excluded were those who were not meeting the standards of inclusion criteria or whose follow up period criteria was not met.

The various parameters for POSSUM scoring are

Table 1: Possum [Physiological score]

POSSUM Score	1	2	4	8
Age (Years)	<30	30-40	>40	
Cardiac signs	No failure	Diuretic, digoxin, Antianginal or hypertensive therapy	Peripheral edema; warfarin therapy; borderline cardiomegaly	Raised jugular venous pressure Cardiomegaly
Respiratory history Chest radiograph	No dyspnea	Dyspnea on exertion Mild COAD	Limiting dyspnea Moderate COAD	Dyspnea at rest (rate >30/min) Fibrosis
Systolic BP (mmhg)	110-130	131-170 or 100-109	>171 or 90-99	<90
Heart rate (beats/min)	50-80	81-100 or 40-49	101-120	>121 or <40
GCS	Fifteen (15)	12-14	Nine to eleven(9-11)	<8
Hemoglobin (g/dl)	13-16	11.5-12.9 or 16.1-17.0	10.0-11.0 or 17.1-18.0	<9.9 or >18.1
WBC ($x10^9$/ 1)	4-10	10.1-20.0 or 3.1-4.0	>20.1 or <3.0	>15.1
Urea (mmol/l)	<7.5	7.6 – 10.0	10.1 – 15.0	>15.1
Sodium (mmol/l)	>136	131 – 135	126-130	<125
Potassium (mmol/l)	3.5 – 5.0	3.2-3.4 or 5.1-5.3	2.9-3.1 or 5.4-5.9	<2.8 or 6.0
ECG	Normal		Atrial fibrillation (rate 60-90/min)	Any abnormal rhythm, >5 ectopics /min, Q waves, ST/ T wave changes

Table 2: Possum [Operative Severity Score]

POSSUM Score	1	2	4	8
Severity score	Minor	Moderate	Major	Major +
Multiple procedures	1	-	2	>2
Blood loss (ml)	<100	101 -500	501-999	>999
Contamination	None	Minor (serous fluid)	Local pus	Free bowel content, pus or blood
Evidence of malignancy	None	Only primary	Nodal metastasis	Distant metastasis
Method of surgery	Elective	-	Urgent	Emergency (immediate<2h)

Predicted Morbidity was determined using the following equation

Log [R/1–R] = –5.91+ (0.16×Physiological score) + (0.19 × Operative severity score), where R represents the predicted morbidity risk.

Predicted Mortality was determined using the following equation

Log [L/1 –L] = −7.04 + (0.13* Physiological score) + (0.16 Operative severity score) where, the expected mortality risk is denoted by the letter L. After discharge, the patient was followed up for a period of 30 days, and pre and post-operative calculation of mortality and morbidity rate were done

Statistical Analysis

The results were presented in percentages, frequencies and mean ± standard deviation (SD). The expected frequencies were calculated and the binary logistic regression analysis was carried out. Data analysis were done on SPSS 23.0 version (Chicago, Inc., USA).

Ethics

Data were collected after taking clearance from the Institutional ethical committee.

Results

More than one third of patients were <30 years of age (39.2%) followed by >40 (36.5%) and 30-40 (24.3%) years. Majority of the patients selected were males (74.3%). Raised JVP was the commonest cardiac history/sign (27%) followed by diuretic, digoxin, antianginal or hypertensive therapy (24.3%) and peripheral edema and warfarin therapy (6.8%). Borderline cardiomegaly and cardiomegaly were among 40.5% and 12.2% patients respectively. Dyspnoea on exertion was found among 18.9% patients and dyspnoea at rest was in 17.6% patients. SBP (Systolic blood pressure) 110-130 mmHG was observed among over half of the patients (54.1%) followed by 131-170/100-109 mmHG in (20.3%), ≤89 mmHG in (13.5%) and 90-99/>171 mmHG in (12.2%).Pulse rate 60-80 beat/min was observed among over 1/3rd of the patients (48.6%) followed by 81-100 &>120 beat/min (17.6%) and 101-120 beat/min (16.2%). GCS 15 was observed among over 1/3rd of the patients (54.1%) followed by <9 (25.7%), 12-14 (12.2%) and 9-11 (8.1%). Urea level <7.5 was observed in over 1/3rd of the patients of patients (45.9%) followed by >15 (35.1%), 7.6-10 (13.5%) and 10.1-15 (5.4%). Na^+ level >136 was observed among over 1/3rd of the patients (44.6%) followed by <126 (24.3%), 131-135 (18.9%) and 126-130 (12.2%). Potassium [K^+] level >3.5-5.0 was observed among over 1/3rd of the patients (44.6%) followed by <2.9/>5.9 (32.4%), 2.9-3.1/5.4-5.9 (13.5%) and 3.2-

3.4/5.1-5.3 (9.5%). Hemoglobin [Hb] level 13-16 gm/dl was observed among over 1/3rd of the patients (37.8%) followed by 11.5-12.9/16.1-17 gm/dl (29.7%), <10.0/18.0 gm/dl (21.6%) and 10.0-11.4/17.1-18.0 gm/dl (10.8%).TLC level 4-10 L/cumm was observed over 1/3rd of the patients (63.5%) followed by 10.1-20.0/3.1-3.9 L/cumm (20.3%) and >20.1/<3 L/cumm (16.2%). Abnormal rhythm, ≥5 Ectopic/Min. Q-wave, ST-T wave changes on ECG was among 36.5% patients and Atrial Fibrillation +HR 60-90 was in 29.7% patients.Major+ operative severity was among over 1/2 of the patients (63.5%) followed by major (35.1%) and minor (1.4%). Operative procedure (>2) was among over 1/2 of the patients (64.9%) followed by 2 (24.3%) and 1 (10.8%). Blood loss >1Litre was among over 1/2 of the patients (51.4%) followed by 501-999 (43.2%) and 100-500 (5.4%). Peritoneal soiling by free Bowel content, pus and by blood was among over 1/2 of the patients (56.8%) followed by localized collection of pus (37.8%) and minor collection by serous fluid in (5.4%). Emergency (Immediate surgery) mode of surgery was among majority of patients (90.5%).

Table 3: Observed morbidity and mortality based distribution

Observed morbidity and mortality	No. (n=74)	%
Morbidity	28	37.8
Mortality	11	14.9

From Table 3, morbidity and mortality was observed among 37.8% and 14.9% patients respectively

Table 4: Multiple Logistic regression analysis of Observed to Expected Morbidity Ratio

Predicted Morbidity	No. of patients		Observed (O) morbidity		Expected (E) morbidity		O:E ratio
	No.	%	No.	%	No.	%	
<30%	13	17.6	4	30.8	0	0.0	-
30-40%	32	43.2	10	31.2	0	0.0	-
41-50%	25	33.8	11	44.0	25	100.0	0.44
>50%	4	5.4	3	75.0	4	100.0	0.75
Total	74	100.0	28	37.8	29	39.2	0.97

From Table 4 and Figure 1, Predicted morbidity was 30-40% among 43.2% patients and 41-50% was among 33.8% patients. Hence, observed and expected morbidity rate was 37.8% and 39.2% with observed to expected morbidity ratio (O:E) of 0.97 respectively. The morbidity rate observed was 75% among whom predicted morbidity rate was >50%.

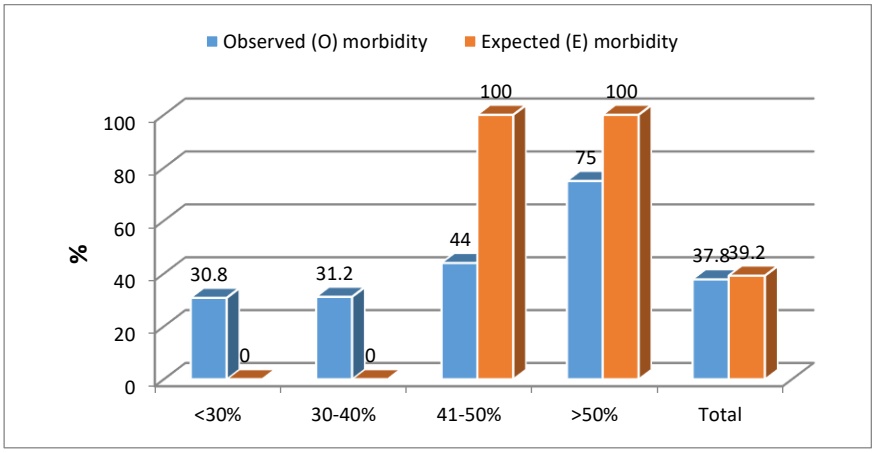

Fig. 1: Multiple Logistic regression analysis of Observed to Expected Morbidity Ratio

Table-5: Multiple Logistic regression analysis of Observed to Expected mortality Ratio

Predicted Mortality	No. of patients		Observed (O) mortality		Expected (E) mortality		O:E ratio
	No.	%	No.	%	No.	%	
<15%	39	52.7	5	12.8	0	0.0	-
15-20%	35	47.3	6	17.1	35	100.0	0.17
Total	74	100.0	11	14.9	35	47.3	0.31

From Table 5 and Figure 2, Mortality rate predicted was <15% among 52.7% patients and was 15-20% among 47.3% patients. Thus, observed and expected mortality rate was 14.9% and 47.3% respectively with observed to expected mortality ratio (O:E) of 0.31. The mortality rate observed was 17.1% among whom predicted mortality rate was 15-20%.

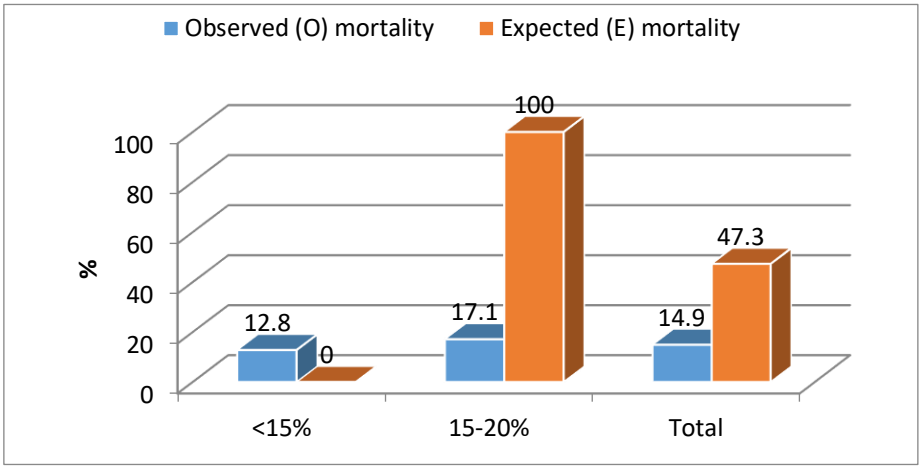

Fig. 2: Multiple Logistic regression analysis of Observed to Expected mortality Ratio

Discussion

In this study, more than 1/3rd of patients were <30 years of age (39.2%) followed by >40 (36.5%) and 30-40 (24.3%) years. Srinath et al. studied that, out of 72 patients, 50 (69.4%) were male and 22 (38.6%) were females. 63 (87.5%) patients were below the age of 60 years and 9 (17.5%) were between 61-70 years [12].This study evaluated that raised JVP was the commonest cardiac history/sign (27%) followed by diuretic, digoxin, anti-anginal or hypertensive therapy (24.3%), peripheral edema and Warfarin therapy (6.8%). Eugene et al**.** found that use of diuretic, digoxin, anti-hypertensive therapy was found in 21% patients [13]. SBP (systolic blood pressure) of 110-130 mmHG was observed among (54.1%) patients followed by 131-170/100-109 mmHG in (20.3%), ≤89 mmHG (13.5%) and 90-99/ >171 mmHG in (12.2%). This study observed that pulse rate 60-80 beat/min was observed among more than 1/3rd of patients (48.6%) followed by 81-100 & >120 beat/min (17.6%) and 101-120 beat/min in (16.2%). GCS 15 was observed among more than half of patients (54.1%) followed by <9 (25.7%), 12-14 (12.2%) and 9-11 (8.1%) in the current study. Urea level <7.5 was observed among more than one third of patients (45.9%) followed by >15 (35.1%), 7.6-10 (13.5%) and 10.1-15 (5.4%) in this study. Sodium [Na^+] level >136 was observed among more than one third of patients (44.6%) followed by <126 (24.3%),131-135 (18.9%) and 126-130 (12.2%). This current study showed that potassium [K^+] level >3.5-5.0 was observed among more than 1/3rd of patients (44.6%) followed by <2.9/>5.9 (32.4%), 2.9-3.1/5.4-5.9 (13.5%) and 3.2-3.4/5.1-5.3 (9.5%). In this study, haemoglobin [Hb] level 13-16 mg/dl was observed among more than 1/3rd of patients (37.8%) followed by 11.5-12.9/16.1-17 mg/dl (29.7%), <10.0/18.0 mg/dl (21.6%) and 10.0-11.4/17.1-18.0 mg/dl (10.8%). This study found that TLC level 4-10 was observed among more than half of patients (63.5%) followed by 10.1-20.0/3.1-3.9 (20.3%) and >20.1/<3 (16.2%). Abnormal rhythm, ≥5 ectopic/min, Q-wave, ST-T wave changes on ECG was among 36.5% patients and atrial fibrillation +HR 60-90 was in 29.7% patients. Blood loss >1 litre were among about half patients (51.4%) followed by 501-999 (43.2%) and 100-500 (5.4%) in this study. Study by Eugene et al**.** reported that intra-operative blood loss was 101-500 ml among 45% patients [13]. Peritoneal soiling by bowel content, pus or blood was found in more than half of patients (56.8%) followed by localised collection of pus (37.8%) and by minor (serous fluid) (5.4%). Emergency (immediate surgery) mode of surgery was among majority of patients (90.5%) in this study. Gonzalez et al. reported that in 616 (85.5%) patients, surgery was elective and 105(14.5%) patients underwent emergency general surgery [14].Ngulube et al. compared observed and expected POSSUM morbidity rates and found an (O: E) ratio of 0.88, with no significant difference. The area under the curve (AUC) for POSSUM morbidity score was 0.775 (p <0.0001) [15] According to Dhanraj et al**.** when the predicted and observed morbidity were compared, the prediction using the POSSUM score and the observed morbidity were found to be similar. An emergency laparotomy is a lifesaving procedure, undertaken mostly in acute cases [16]. In an ideal world, surgeons would have a reliable, easy-to-calculate scoring system to use on everyone who comes in for emergency surgery. The surgical team would therefore be able to make a more accurate forecast of outcome, allowing the patient to make a better informed decision about the risks and outcomes of the proposed treatment. One of the limitations in this study was small sample size and short duration of study period. The studies with larger sample size and long duration of study period are supposed to have robust findings.

Conclusion

This study establishes the POSSUM score as a reliable tool for evaluating the care provided to patients during the peri-operative period. It is a commonly used guide for optimal health-care resource use for postoperative patients and perioperative care. The POSSUM score can also be used in a surgical audit for evaluation and improving the surgical care quality, resulting in a better patient outcome. Unfortunately, there are very few studies in the past that have revisited old scoring systems or attempted to compare systems to assess which is best.

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