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Risk Adjusted Analysis of Patients Undergoing Emergency Laparotomy Using Possum and P- Possum Score - A Prospective Study

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Abstract

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 for direct comparison between the observed and expected adverse outcome rates. The Portsmouth POSSUM (P-POSSUM) is a modification of the POSSUM scoring system. There is variation in patient population between different region which can influence the results of various scoring system. The study was done with the aim to assess the validity and overall predictive value of POSSUM scoring system for morbidity and mortality and P-POSSUM scoring system for mortality, and also, to compare the POSSUM and P-POSSUM scoring system for risk adjusted audit in patients undergoing emergency laparotomy at our centre. This study was a prospective observational study conducted on 100 patients undergoing emergency laparotomy. The patients were scored depending on their physiological parameters and the intra operative findings. The POSSUM score for morbidity and mortality and P-POSSUM score for mortality was calculated by online calculator. The main outcome measure was morbidity

and mortality within 30 days of operation. Statistical analysis was done using SPSS version 12.0 and 20.0 (SPSS Inc., Chicago, USA). An observed to expected morbidity ratio (O/E) by POSSUM scoring system of 0.975 was obtained (*P* value 0.0001). An observed to expected mortality ratio (O/E) by POSSUM scoring system of 0.56 was obtained (*P* value 0.0001). An observed to expected mortality ratio (O: E) by P-POSSUM scoring system of 1 was obtained (*P* value 0.0001). The area under Receiver Operating Characteristic (ROC) curve was more for P-POSSUM (0.978) than POSSUM (0.973), this suggests P-POSSUM scoring system was better in predicting the mortality. The present study validates that POSSUM scoring system accurately predicts the morbidity but not mortality and P-POSSUM scoring system is more accurate than POSSUM scoring system in predicting the mortality.

We suggest the use of POSSUM scoring system to predict the morbidity & P-POSSUM scoring system to predict the mortality, in our study population.

Keywords: POSSUM score, P-POSSUM score, Post-operative morbidity, Post-operative mortality.

Introduction

The basic aim of any surgical procedure is to cause reduction in morbidity and mortality rates. Adverse outcome after an operation can be influenced by multiple factors other than the surgical procedure performed. By comparing the influence of these factors on the adverse outcome, we can assess the efficacy of that particular operation and quality of care being provided. There is a need for an accurate risk adjusted scoring system, which should be specific, easy to use, fast and comparable among different patient groups. The Physiological and Operative Severity Scoring System for the enumeration of Morbidity and Mortality (POSSUM), was proposed as a risk adjusted scoring system to allow for direct comparison between the observed and expected adverse outcome rates.[1] It had been called as a surgeon based scoring system. By using physiological variables of the patient and the surgical procedure, POSSUM assesses the outcomes of the surgical interventions, their complications and the ratio between predicted and observed morbidity and mortality in each death risk range of the population.[2]

The Portsmouth POSSUM (P-POSSUM) is a modification of the POSSUM scoring system, incorporating the same variables and grading system, but a different equation, which provides a better fit to the observed mortality rate.[3]

There is variation in patient population between different region which can influence the results of various scoring system.[4] Hence, there was felt a need to test the validity of POSSUM and P-POSSUM scoring system in other population group.[5] Patient undergoing emergency laparotomy have significant morbidity and mortality as compared to other surgeries, especially at our centre.

Therefore, the study was done with the aim to assess the validity and overall predictive value of POSSUM scoring system for morbidity and mortality and P-POSSUM scoring system for mortality, and also, to compare the POSSUM and P-POSSUM scoring system for risk adjusted audit in patients undergoing emergency laparotomy at our centre.

Material and Methods

This study was a prospective observational study conducted at our centre after the approval of the Institutional Ethical committee. The intervention, i.e., emergency laparotomy was not influenced by study protocol and was decided routinely by treating surgeon. All the patients undergoing emergency laparotomy

were considered for inclusion in the study protocol, if the patient age was ≥18 years, all related investigations were done and available, informed written consent was given by the patients and their attendant. Any patient, not satisfying any of these criteria were excluded.

Depending on inclusion criteria, 103 patients were initially selected for the study. The physiologic variables for each patient were recorded and relevant investigations were done and recorded before the emergency laparotomy. The operative variables were recorded immediately after surgery by the operating surgeon. The patients were scored depending on their physiological parameters (Table 1) and the intra operative findings (Table 2).

Minimum physiological score was 12 and maximum was 88. The minimum operative score was 6 and maximum was 48.

Table 1: Physiological scoring

Score	1	2	4	8
Age (years)	<60	61-70	>71	
Cardiac signs, Chest Radiography	No failure	Diuretic, Digoxin, anti-angina or hypertensive therapy	Peripheral edema, warfarin therapy, borderline cardiomegaly	Raised JVP, cardiomegaly
Respiratory history, Chest radiography	No dyspnoea	Dyspnoea on exertion, Mild COAD*	Limiting dyspnoea (on one flight), Moderate COAD*	Dyspnoea at rest (rate>30/min), Fibrosis or consolidation
Blood Pressure (systolic) (mmHg)	110-130	131-170 100-109	>171, 90-99	<89
Pulse Rate (beats/min)	50-80	81-100, 40-49	101-120	>121, <39
Glasgow Coma Scale	15	12-14	9-11	<8
Hemoglobin (g/dl)	13-16	11.5-12.9, 16.1-17.0	10.0-11.4, 17.1-18.0	<9.9, >18.1
White cell count ($x10^9$/lt)	4-10	10.1-20.0, 3.1-4.0	>20.1, <3.0	
Urea (mmol/lt)	<7.5	7.6-10.0	10.1-15.0	>15.1
Sodium (mmol/lt)	>136	131-135	126-130	<125
Potassium (mmol/lt)	3.5-5.0	3.2-3.4, 5.1-5.3	2.9-3.1, 5.4-5.9	<2.8, >6.0

Electrocardiogram	Normal		Atrial fibrillation (rate 60-90)	Any other abnormal rhythm or >5 ectopic/min, Q waves or ST/T wave changes

*COAD: Chronic Obstructive Airway Disease

Table 2: Operative severity scoring

Score	1	2	4	8
Operative severity	Minor	Moderate	Major	Major+
Multiple Procedures	1		2	>2
Total blood loss (ml)	<100	101-500	501-999	>1000
Peritoneal soiling	None	Minor (serous fluid)	Local pus	Free bowel content, pus or blood
Presence of Malignancy	None	Primary only	Nodal metastasis	Distant metastasis
Mode of surgery	Elective		Emergency resuscitation of >2h possible <24h after admission	Emergency (immediate) surgery <2h needed

Final expected morbidity and mortality rate was calculated according to the respective formula.

Predictive scores Equations for calculation For morbidity the POSSUM Formula is: [1]

$Log_e[R/1-R]$ = (0.16 x Physiological score) + (0.19 x Operative severity score) – 5.91 Where R = Risk of mortality.

For mortality the POSSUM Formula is: [1]

$Log_e[R/1-R]$ = (0.13 x Physiological score) + (0.16 x Operative severity score) – 7.04

Where R = Risk of mortality.

For mortality the P-POSSUM Formula is: [3] $Log_e[R/1-R]$ = (0.1692 x Physiological score) + (0.155 x Operative severity score) – 9.065.

Where R = Risks of mortality.

In our study, we had calculated the POSSUM score for morbidity and mortality by submitting values in the POSSUM score form provided at the website

www.mdcalc.com [6] and P-POSSUM score for mortality by submitting values in the P-POSSUM score form provided at the website www.riskprediction.org.uk [7] for calculating these scores.

The main outcome measure was morbidity and mortality within 30 days of operation. The patients were followed up for 30 days and the morbidity and mortality was noted. Three patients were lost to follow up in the 30 days post-operative period and were excluded from the final analysis, leaving 100 patients.

Statistical analysis: The patient's data were collected in a proforma and entered in Microsoft Excel® version 2013. Statistical analysis was done using SPSS version 12.0 and version 20.0 (SPSS Inc., Chicago, USA). Results were expressed in form of observed to expect ratio (O/E) and the area under Receiver Operating Characteristic (ROC) curve. ANOVA (Analysis of Variances) test was applied to find statistical significance of study results. A *P* value < 0.05 was considered as statistically significant.

Observation and Results

This was a prospective observational study done on 100 patients who underwent emergency laparotomy. As the number of patients (n) was 100, therefore n = percentage. The total numbers of male patients were 79 and total numbers of female patients were 21. The Mean (± S.D.) age of study group was 43.09 (± 19.06) years (Range: 18-86 years). The indication of surgery is given in table no. 3:

Table 3: Indication of Surgery

S.N.	Indication	No. of Cases (n = %)
1.	Peptic perforation	38
2.	Trauma	18
3.	Small intestine perforation	17
4.	Intestinal Obstruction	17
5.	Appendicular perforation	4
6.	Malignancy	3
7.	Obstructed hernia	2
8.	Ruptured liver abscess	1
	Total	100

The post-operative complications are summarised in table no.4. The most common complication after surgery was wound infection (56%) followed by respiratory tract infection (49%). Some patients had more than one complication.

Table 4: Complications in study subjects

S.N.	Type	No. of cases
1.	Wound infection	56
2.	Respiratory tract infection	49
3.	Hypotension	27
4.	Septicemia	26
5.	Impaired renal function	23
6.	Respiratory failure	20
7.	Urinary tract infection	10
8.	Deep surgical site infection	8
9.	Anastomotic leak	3
10.	Cardiac failure	3
11.	Deep vein thrombosis	2
12.	Burst abdomen	2

The comparison of predicted morbidity (By POSSUM scoring system) and observed morbidity is given in table no.5

Table 5: Comparison of POSSUM Predicted Morbidity with Observed Morbidity

Predicted Morbidity Rate [Score]	Total Number of patients (n = %)	Mean Predicted Morbidity Rate	Observed No of patients with morbidity (O)	Expected No. of patients with morbidity (E)	Ratio (O/E)
<10	0	0	0	0	0
10 to 20	0	0	0	0	0
20 to 30	1	20.4	0	0	0
30 to 40	2	34.9	0	1	0
40 to 50	2	45.2	0	1	0
50 to 60	4	56.15	0	2	0
60 to 70	18	64.76	11	12	.92
70 to 80	15	75.4	10	11	.91
80 to 90	21	83.70	21	18	1.17
90 to 100	37	95.59	36	35	1.03
Total	100	47.61	78	80	0.975

An observed to expected ratio (O/E) of 0.975 was obtained and it was found statistically significant (*P* value 0.0001) by using ANOVA test.

After the emergency laparotomy, 78 patients remained alive and '30 day mortality' was seen in 22 patients.

The comparison of predicted mortality (By POSSUM scoring system) and observed mortality is given in table no.6

Table 6: Comparison of POSSUM Predicted Mortality with Observed Mortality

Predicted Mortality Rate [Score]	Total Number of patients (n = %)	Mean Predicted Mortality Rate	Observed no. of death (O)	Expected No. of Death (E)	Ratio (O/E)
<10	5	6.96	0	0	0
10 to 20	23	15.83	0	4	0
20 to 30	25	26.27	0	7	0
30 to 40	9	34.02	0	3	0
40 to 50	11	44.75	3	5	0.6
50 to 60	7	55.92	1	4	0.25
60 to 70	7	64.42	6	5	1.2
70 to 80	5	77.62	4	4	1
80 to 90	7	84.1	7	6	1.17

90 to 100	1	91.7	1	1	1
0 to 100	100	50.16	22	39	0.58

An observed to expected ratio (O/E) of 0.56 was obtained and it was statistically significant (*P* value 0.0001) by using ANOVA test.

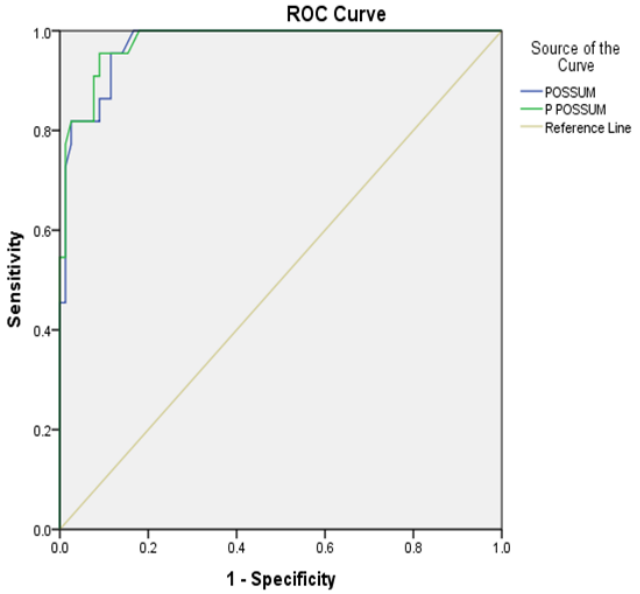
The comparison of predicted mortality (By P-POSSUM scoring system) and observed mortality is given in table no.7

Table 7: Comparison of P-POSSUM Predicted Mortality with Observed Mortality

Predicted Mortality Rate [Score]	Total Number of patients (n = %)	Mean Predicted Mortality Rate	Observed no. of death (O)	Expected No. of Death (E)	Ratio (O/E)
<10	46	5.57	0	3	0
10 to 20	22	14.12	1	3	0.33
20 to 30	8	25.97	3	2	1.5
30 to 40	6	34.1	1	2	0.5
40 to 50	4	43.32	4	2	2.0
50 to 60	2	56.3	1	1	1.0
60 to 70	5	65.86	5	3	1.67
70 to 80	5	75.5	5	4	1.25
80 to 90	2	87.8	2	2	1
90 to 100	0	0	0	0	0
0 to 100	100	40.85	22	22	1

An observed to expected ratio (O: E) of 1 was obtained and it was found statistically significant (*P* value 0.0001) by using ANOVA test.

To compare the POSSUM scoring system and the P-POSSUM scoring system, ROC curve was made. (Figure no.1)



Area Under the Curve

Test Result Variable(s)	Area	P value	95% Confidence Interval	
			Lower Bound	Upper Bound
POSSUM	.973	.000	.946	1.000
P POSSUM	.978	.000	.954	1.000

Figure 1: ROC curve comparing POSSUM and P-POSSUM scoring system.As area under ROC curve is more for P-POSSUM (0.978) than POSSUM (0.973) Score, so P-POSSUM scoring system is better predictor of mortality than POSSUM scoring system.

Discussion

Any scoring system should be correlated to the general condition of the local population for it to be effective.[8, 9]

This is especially true in patients in developing countries like India where the general health of the population is poor, malnutrition is a common problem and presentation frequently delayed. POSSUM and P-POSSUM scoring system can be used for surgical audit to assess and improve the quality of surgical care and can result in better outcome to the patient. In our study, we assessed the validity of POSSUM & P-POSSUM scoring system in 100 patients undergoing emergency laparotomies by comparing the observed morbidity and mortality rate with expected morbidity and mortality rate. The observed and expected morbidity by POSSUM scoring system was 78 & 80, respectively, the (O: E) ratio being 0.975 (*P* value 0.0001). This shows that POSSUM scoring system accurately predict morbidity. The result of our study is similar to other studies, [9, 10, 11] although, one study showed different result, according to which POSSUM does not accurately predict morbidity.[12]

The observed 30-day mortality was 22 and the predicted mortality using POSSUM and P-POSSUM scoring system were 39 and 22 respectively. The observed and expected mortality ratio (O: E) were 0.56 & 1 respectively. This shows that POSSUM scoring system over predict the mortality, which was better predicted by P-POSSUM scoring system. Also the area under ROC curve was more for P-POSSUM (0.978) than POSSUM (0.973), this suggests P-POSSUM scoring system was better in predicting the mortality. The results of this study are consistent with the other published papers in that POSSUM over-predicts the number of deaths[10, 11, 13, 14] and P-POSSUM serves as a better scoring system in predicting death as a whole.[11, 13, 14] Although, one study showed different result, according to which the accuracy of mortality prediction of POSSUM scoring system equalled that of P-POSSUM scoring system.[15]

Conclusion

The present study validates that POSSUM scoring system accurately predicts the morbidity but not mortality. P-POSSUM scoring system is more accurate than POSSUM scoring system in predicting the mortality. Based on our study, we suggest the use of POSSUM scoring system to predict the morbidity & P-POSSUM scoring system to predict the mortality, in our study population.

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