Section: Surgery

Evaluation of POSSUM Score for Outcome Prediction in Patients Undergoing Emergency Laparotomy.

Dheer Singh Rana[1], Abhilash Singh[2], Prakhar Gupta[3], Vikas Singh[4], Gargi Bandyopadhyay[5]

[1]Senior Resident, Department of Surgery, G.T.B. Hospital and U.C.M.S., Delhi, India.
[2]Senior Resident, Department of Surgery, G.T.B. Hospital and U.C.M.S., Delhi, India.
[3]Senior Resident, Department of Surgery, GEM Hospital, Coimbatore, Tamil Nadu, India.
[4]Senior Resident, Department of Urology, S.M.S. Medical College, Jaipur, Rajasthan, India.
[5]Professor, Department of Surgery, Medical College and Hospital, Kolkata, W.B., India.

ABSTRACT

Background: Emergency Laparotomy is one of the most common surgical procedures performed in Surgical Emergencies, which leads to significant mortality and morbidity. The aim of this study was to evaluate the patients undergoing emergency midline laparotomy, utilizing POSSUM scoring system to help to predict morbidity and mortality in patients, and assuring improved management in present setup. **Methods:** Total 104 consecutive patients underwent emergency midline laparotomy over a period of two years were included in this prospective study. Surgical outcome was assessed and compared with POSSUM scoring system. The relevant data was recorded on predesigned proforma and analysed. **Results:** We studied 104 emergency midline laparotomy patients, which resulted in 15 deaths (14.4% Mortality rate). On applying POSSUM, we found that the expected number of deaths for our study group was 24 (O: E= 0.63), relationship was statistically significant. Observed morbidity was 61 (58.65%). On applying POSSUM we found that the expected number of morbidity for our study group was 65 (O: E= 0.93), relationship was statistically significant. **Conclusion:** The present study validates that the POSSUM is an accurate scoring system for predicting postoperative adverse outcome among patients undergoing major general surgeries in present setup.

Keywords: POSSUM scoring, P-POSSUM, Audit, Perforation Peritonitis, Mortality, Morbidity, Emergency Laparotomy.

INTRODUCTION

The basic and ultimate aim of any surgical procedure is to cause reduction in morbidity and mortality rates which must be determined to cause evolution and help in faster adaptation of more effective treatment regimens. Numerous scoring systems have been developed for surgical audit such as POSSUM (Physiological and Operative Severity Scoring system for the enUmeration of Morbidity and mortality) for observed and expected adverse outcome rates of surgical procedures,[1,2] ASA (American Society of Anaesthesiologist) for general risk prediction,[3] APACHE III (Acute Physiology and Chronic Health Evaluation III) for intensive care,[4] Goldman Index for cardiac related complications peri-operatively and ACPGBI (Association of ColoProctology of Great Britain and Ireland).[5-7] It is important to compare the risk-adjusted mortality and morbidity rates instead of crude rates as the outcome is directly related to the risks associated with surgery because of differences in general health of the local population and variable presentation of the patient's condition.[8-11]

The mode and time of presentation is very much variable in Indian Scenario, so it's difficult and unrealistic to directly compare the one patient to with others.

POSSUM scoring system has been found to be valid in accurately predicting the mortality and morbidity rates, although, a bit over prediction in low risk cases.[12] The Portsmouth 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, which is an important and objective measure of outcome.[8,13] Urgent or emergency laparotomy is a common procedure having mortality rate considerably greater than that of elective laparotomy.[14] In Indian scenario where problems like delayed presentation and limited resources can affect the outcome even with adequate quality care, hence, there is a need to validate POSSUM scoring system in our setup.[15-17]

This study was undertaken to assess the validity of POSSUM scoring system in patients undergoing

Name & Address of Corresponding Author
Dr. Abhilash Singh (M.S.),
Senior Resident,
Department of Surgery,
G.T.B. Hospital and U.C.M.S., Delhi, India.
D-333, Second Floor, Anand Vihar,
East Delhi-110092, Delhi, India.

emergency midline laparotomy in our setup, and to analyse the outcome and compare the observed and expected values.

MATERIALS AND METHODS

A teaching hospital based, non-randomised, present prospective study was conducted on 104 consecutive patients undergoing emergency midline laparotomy in General Surgical wards of Medical College, Kolkata, West Bengal, India, and patients were scored according to POSSUM scoring system over a period of two years.

POSSUM Score: Possum score has 12 Physiological variables and 06 Operative severity variables, each divided into 4 grades. [Table1, 2]

Table 1: Physiological Score

Variables	Score					
	S No		1	2	4	8
	1	Age (years)	≤60	61-70	≥71	
	2	Cardiac History/Signs	No Failure	Diuretic, Digoxin Antianginal or Hypertensive therapy	Peripheral edema, Warfarin therapy, Borderline Cardiomegaly	Raised JVP, Cardiomegaly
	3	Respiratory History	No Dyspnoea	Dyspnoea on Exertion	Limiting Dyspnoea	Dyspnoea at Rest(rate>30/min.)
	4	Systolic BP	110-130	100-109 131-170	90-99 ≥171	≤89
	5	Pulse (beats/min.)	50-80	40-49 81-100	101-120	≤39 ≥121
	6	GCS	15	12-14	9-11	≤8
	7	Haemoglobin	13.0-16.0	11.5-12.9 16.1-17.0	10.0-11.4 17.1-18.0	≤9.9 ≥18.1
	8	WBC Count	4000-10000	3100-3999 10100-20000	≤3000 ≥20100	-
	9	Urea (meq/l)	≤7.5	7.6-10.0	10.1-15.0	≥15.1
	10	Sodium (meq/l)	≥136	131-135	126-130	≤125
	11	Potassium (meq/l)	3.5-5.0	3.2-3.4 5.1-5.3	2.9-3.1 5.4-5.9	≤2.8 ≥6.0
	12	ECG	Normal	-	Atrial Fibrillation +HR 60-90	Abnormal rhythm, ≥5 Ectopic/Min. Q-wave, ST-T wave changes

Table 2: Operative Score

Variables	Score					
	S No		1	2	4	8
	1	Operative Severity	Minor	Moderate	Major	Major+
	2	Multiple Procedures	1	-	2	>2
	3	Total Blood Loss (ml)	<100	101-500	501-999	≥1000
	4	Peritoneal Soiling	None	Minor (Serous fluid)	Local Pus	Free Bowel content, Pus, Blood
	5	Presence of Malignancy	None	Primary only	Nodal Metastasis	Distant Metastasis
	6	Mode of Surgery	Elective	-	Emergency (>2-24hr)	Emergency (<2hr)

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.

Inclusion Criteria
Patients undergoing emergency midline laparotomy were included in the study population.

Exclusion Criteria
The following patients were excluded from the study:
a) Patient age <15 yrs and >75 yrs.
b) Patient died before intubation.
c) Re-exploration.
d) Laparotomy other than midline.

Findings of patient's history and detailed clinical examination, physiological score at the time of admission and operative score of the patients undergoing emergency midline laparotomy were recorded after formal ethical consent. The patients

were followed up till the 30th postoperative day, and complications if any, were noted depending upon the criteria as defined in POSSUM scoring system. All relevant data was recorded on predesigned proforma and analyzed properly.

Statistical methods: The expected mortality rate was obtained using linear regression analysis and the O: E ratio (O=Observed, E=Expected) was calculated using the Microsoft excel 2010, SPSS 22 and SPSS 24. 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 t-test was applied to validate this hypothesis.

RESULTS

A total of 104 patients underwent emergency midline laparotomy were taken in the study, out of which, 81 (77.88%) were male, and mean age of the patients was 39.85 years.

Peptic perforation was the most common indication for laparotomy followed by appendicular perforation. [Table 3]

Table 3: Indications for Laparotomy (n=104)

S No	Diagnosis	Frequency	Percentage
1	Peptic Perforation	23	22.1
2	Appendicular Perforation	15	14.4
3	Ileal Perforation	10	09.6
4	Band Obstruction	07	06.7
5	Obstruction, Ca Caecum	04	03.8
6	Sigmoid Volvulus	04	03.8
7	Gall Bladder Perforation	03	02.9
8	Obstructed Incisional Hernia	03	02.9
9	Obstructed Inguinal Hernia	03	02.9
10	Others	32	30.8
	Total	104	100

Total 61 (58.65%) patients developed complications in postoperative period; Chest infection was the most common morbidity in 28 (26.9%) patients. [Table 4]

Table 4: Causes of Morbidity in study Population (n=104)

S No	Morbidity	Incidence	Percentage
1	Chest Infection	28	26.9
2	Wound Infection	17	16.3
3	Urinary Tract Infection	15	14.4
4	Septicaemia	07	06.7
5	Wound Dehiscence	07	06.7
6	Deep Infection	04	03.8
7	Renal Failure	02	01.9
8	Anastomosis Leak	02	01.9
9	Hypotension	01	01.0

Total 15 (14.4%) patients died during follow up period of 30 days, and the MODS (Multi Organ Dysfunction Syndrome) was the most common cause of mortality. [Table 5]

Table 5: Causes of Mortality in study Population (n=104)

S No	Mortality	Incidence	Percentage
1	MODS	10	09.6
2	Respiratory Failure	04	03.8
3	Cardiac Failure	01	01.0
	Total	15	14.4

Operative Variables

This study include the midline emergency laparotomy, so operative severity comes out to be major in all cases, mode of surgery is also emergency (2-24 hrs) in all cases. These two operative variables become constant in this study.

Table 6: Linear analysis of Observed to Expected Morbidity Ratio (n=104)

Predicted Morbidity	No. of Patients	Observed Morbidity	Expected Morbidity	O:E Ratio
<10%	-	-	-	-
10-20%	02	00	00	-
20-30%	04	01	01	01.00
30-40%	11	03	04	00.75
40-50%	15	05	07	00.71
50-60%	12	06	06	01.00
60-70%	15	09	10	00.90
70-80%	12	09	09	01.00
80-90%	19	14	16	00.88
90-100%	14	14	13	01.08
Total	104	61	66	00.93

O:E ratio [Table 6] shows good correlation between observed and expected values at higher predicted values of morbidity. The relationship was found significant (p = 0.011).

Table 7: Linear analysis of Observed to Expected Mortality Ratio

Predicted Mortality	No. of Patients	Observed Mortality	Expected Mortality	O:E Ratio
<10%	30	01	02	00.50
10-20%	30	01	04	00.25
20-30%	15	02	04	00.50
30-40%	11	03	04	00.75
40-50%	09	02	04	00.50
50-60%	03	02	02	01.00
60-70%	03	01	02	00.50
70-80%	01	01	01	01.00
80-90%	02	02	01	01.00
90-100%	-	-	-	-
Total	104	15	24	00.63

O:E ratio shows good correlation between observed and expected values at higher predicted values of mortality. The relationship was found significant (p= 0.000)

DISCUSSION

The importance of surgical audit has been emphasised repeatedly over the past few years, both as a means of assessing the quality of surgical care and as an educational process. In a developing nation

like India, due to poverty and ignorance, the presentation of a particular illness is delayed and variable, leading to an increased number of complications and high death rates.[18] A number of risk-adjusted scoring systems have been developed to suit surgical audit, in case of emergency surgery, the POSSUM system appears to be of value as all the parameters are usually completed.[19]

Hence in our study we assessed the validity of POSSUM score in 104 emergency midline laparotomy patients in Indian scenario. Since this study includes only the emergency cases, we were unable to normalise all the correctable physiological variables prior to surgery. Preoperative diagnosis of malignancy is also not possible or available in all emergency patients. In this study we excluded the extremes of age, patients who died before the intubation and patients who underwent re-exploration.

In this study 61 (58.65%) patients suffered from postoperative complications, chest infections (28 cases, 27%) and wound infection (17 cases, 17%) accounted for the majority of complications. Similar results were obtained by Mohil RS (20% and 35% respectively).[15] Urinary tract infection (15 cases, 15%) was also found, the crude morbidity rate being 58.65%; however on using POSSUM score expected morbidity was 64.19%. On analysis, no statistically significant difference was found between the observed and expected morbidity rates ($x2=24.822$, df=8, p=0.002). An O:E ratio of 0.93 is obtained, Similar findings were observed in Kitara et al. [20] 2011, Chieng et al.[21] 2013, (O:E=0.78) and Sunil Kumar.[22] 2013, (O:E=0.76). Hence POSSUM was able to accurately predict the adverse outcome following midline emergency laparotomy in our study.

On analysing other risk factors we found positive rate of increment in morbidity with all the risk factors studied but it was found to be statistically significant with respect to pulse rate (p=0.021), haemoglobin level (p=0.016), potassium level (p=0.018), peritoneal soiling(p=0.0001). In this study 15 patients died, wherein MODS (10 cases, 9.6%), respiratory failure (4 cases, 3.8%) and cardiac failure (1 case, 1%) accounts for the major causes of mortality. Total crude mortality rate being 14.42%. However on using POSSUM score, expected mortality was 22.84%. On analysis, there was found to be no statistically significant difference between the observed and expected mortality rates ($x2=33.211$, df=8, p=0.0001). An O:E ratio of 0.63 was obtained. Similar findings were obtained by Nicole Organ et al.[23] 2002, Australia (0.561), Cheing et al.[21] 2007, Malaysia (0.603, emergency laparotomy), Mohil et al.[24] 2004, India (0.82). Hence POSSUM was able to accurately predict the adverse outcome following midline emergency laparotomy in our study.

On analysing the risk factors we found that our 4 variable of POSSUM score became constant including GCS, ECG, Operative severity and Mode of surgery. Wound infections could be attributed to the large number of patients who had gross peritoneal contamination resulting from hollow visceral perforation, resulting in local contamination of the incision site. The cause of increased chest infections might be the combined effect of intra-abdominal hypertension and decreased lung compliance due to upper abdominal incisions.

This study therefore helps to identify those variables which require serious attention by the treating surgeon in order to decrease the morbidity as well as mortality in emergency laparotomy patients as well as counsel the patient regarding the probable outcome after surgery.

CONCLUSION

We studied 104 emergency midline laparotomy patients, which resulted in 15 deaths (14.4% mortality rate). On applying POSSUM we found that the expected number of deaths for our study group was 24 (O:E=0.63), relationship was statistically significant. Observed morbidity was 61 (58.65%). On applying POSSUM we found that the expected number of morbidity for our study group was 65 (O:E=0.93), relationship was statistically significant. The present study suggests that POSSUM is an accurate scoring system for predicting postoperative adverse outcome among patients undergoing major general surgeries.

The complications of chest infection (27%) and wound infection (17%) are a concern and require better care for their 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 increased pulse rate, cardiac signs, decrease haemoglobin, increased urea, decreased sodium, altered potassium level, increased blood loss, presence of malignancy were found to be significant in our study. Hence adequate and prompt correction of these factors could decrease the mortality rate.

This study therefore validates POSSUM score as a valid means of assessing adequacy of care provided to the patient. POSSUM score can be used for surgical audit to assess and improve the quality of surgical care which results in better outcome to the patient.

Limitations

As the study was applied only on a small group of patients, so results may not reflect the scenario worldwide, and needs to be evaluated further in a larger group of patients. The POSSUM score does not includes surgeon's skill variability and delay in presentation.

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