

Original Research Article

Study of POSSUM Score for Risk Assessment in Patients of Perforation Peritonitis at a Tertiary Care teaching hospital**Sunil Gurjar¹, Suraj Jain², Abhishek Kansal³, Advait Prakash^{4*}**¹Senior Resident, Department of General Surgery, Sri Aurobindo Medical College & Post graduate Institute, Indore, India²Associate Professor, Department of General Surgery Government Medical college, Khandwa, M.P., India³Professor, Department of General Surgery, Sri Aurobindo Medical College & Post graduate Institute, Indore, India⁴Associate Professor, Department of General Surgery, Sri Aurobindo Medical College & Post graduate Institute, Indore, India

Received: 09-02-2021 / Revised: 23-03-2021 / Accepted: 02-05-2021

Abstract

Background: Perforation peritonitis carries considerable morbidity and mortality with the unpredictable postoperative period. Continuous audit of clinical practice is an essential part of making improvements in enhancing patient care. This warrants a scoring system that predicts the post-operative outcome. POSSUM (Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity) helps in predicting the post-operative morbidity and mortality in these patients. This study was done in our centre to evaluate the POSSUM score in our set of patients. **Material and methods:** This prospective observational study was performed in patients of perforation peritonitis admitted under the Department of General Surgery, Sri Aurobindo Medical College And Post Graduate Institute Indore (M.P.) from June 2018 to January 2020. A total of 92 patients were recruited. Data was collected from patients by their clinical history, examination, with appropriate investigations. Data were analysed using appropriate statistical tests. **Results:** Most common site of perforation was gastro-duodenal followed by ileal perforation. The most common surgical procedure performed was modified Graham's patch repair. Most common complication was wound infection followed by wound dehiscence and anastomotic leak. Patients who had complications had higher mean POSSUM morbidity score. It was also observed that POSSUM mortality score was significantly higher in subjects who died. **Conclusion:** POSSUM scoring system is a good indicator of postoperative outcome in patients with perforation peritonitis and was applicable in our setup. It is useful in identifying high risk patients and give preferential care to them for better outcome

Keywords: POSSUM, scoring system

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Introduction

Perforation of gastro- intestinal viscous causing peritonitis is the most common surgical emergency in India requiring exploratory laparotomy. Exploratory laparotomy performed in emergency setting has higher mortality rate than elective laparotomy. Despite advances in surgical techniques, antimicrobial therapy and intensive care support, management of peritonitis continues to be highly demanding, difficult and complex.[1] Outcome of all surgical procedures depends on various factors such as surgeon's expertise, patients present illness, type of surgical interventions and associated co-morbid conditions. In surgical practice, where major invasive procedures are being performed, audits are mandatory for improving the standard of care and are indicators for allotting resources. [2] Scoring systems have been developed in response to an increasing emphasis on the evaluation and monitoring of health services. These systems enable comparative audit and evaluative research of intensive care. In the past two decades several scoring systems have been developed viz acute physiology and chronic health evaluation (APACHE), Simplified Acute Physiology Score (SAPS), sepsis severity score (SSS), multiple organ failure score

(MOF) and Mannheim Peritonitis Index (MPI). Currently no ideal and generally accepted scoring system exists to determine the prognosis of peritonitis and intra-abdominal sepsis[1]. POSSUM (physiological and operative severity score for the enumeration of mortality and morbidity) was developed by Copeland et al. [3] POSSUM has been proposed as a method for standardizing patient data so that direct comparisons of patient outcomes can be made in spite of differing patterns of referral and population. [4] POSSUM would help to identify those patients who are at increased risk of developing complications and death. [2] This study was undertaken to evaluate POSSUM as a tool for predicting mortality and morbidity in perforation peritonitis patients of our region with an aim to enhance patient care and management.

Material and Methods

This prospective observational study was performed in patients of perforation peritonitis in the Department of General Surgery, Sri Aurobindo Medical College And Post Graduate Institute Indore (M.P.) from June 2018 to January 2020. A total of 92 patients were recruited according to the under mentioned criteria

Inclusion criteria: Patients of more than 18 years of age who were willing to participate and undergone laparotomy for perforation peritonitis.

Exclusion criteria:

1. Patients age <18 years.
2. Patients with significant immunosuppression (DM, steroid use, post transplant (renal), retro virus positive).

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3. Patients with primary peritonitis due to tuberculosis alcoholic cirrhosis, nephrotic syndrome, cardiac failure or systemic lupus erythematosus(SLE)

Data was collected for all the recruited patients and their demographic profile, detailed history and examination were recorded in predesigned proforma. Investigations for POSSUM scoring like haemoglobin, WBC count, blood urea, serum electrolytes, arterial blood gases, chest X-ray and ECG were done at admission. Other relevant haematological and radiological investigations were also performed for confirmation of diagnosis. After preoperative resuscitation the patient underwent exploratory laparotomy. Appropriate treatment was carried out according to the intra-operative findings. Postoperatively standard care was given to all the patients. Patients were observed for complications and mortality

POSSUM SCORE

In 1991 G P Copeland et al devised a Physiological and Operative Severity Score for the enumeration of Mortality & Morbidity (POSSUM).[3] This scoring system produced assessment for morbidity & mortality rates which did not significantly differ from observed rates. The POSSUM system is a two part scoring system that includes a physiological assessment and measure of operative severity. The physiological part of the score includes 12 variables, each divided into 4 grades with an exponentially increasing score.1,2,4,8 The physiological variables are those apparent at the time of surgery and include clinical symptoms and signs, result of simple biochemical and haematological investigations and ECG changes. If particular variable is not available then a score of 1 is given. The minimum score is 12 and a maximum score of 88 is possible.[Table 1a]The operative part of the score includes 6 variables, each divided into 4 grades with an exponentially increasing score.1,2,4,8 .[Table 1b]

Table 1a:Physiological Severity Assessment

Score	1	2	4	8
Age years	60	61-70	71-80	>80
Cardiac signs	Normal	Cardiac drugs or steroids	Oedema; on warfarin	JVP
CXR	Normal	-	Borderline cardiomegaly	Cardiomegaly
Respiratory signs	Normal	SOB exertion	SOB stairs	SOB rest
CXR	Normal	Mild COAD	Mod COAD	Any other change
Systolic BP, mm Hg	110-130	131-170 109-100	> 171 99-90	< 90
Pulse beats / min	50-80	81-100 40-49	101-120	> 121 <40
Coma score	15	14-12	11-09	<9
Urea mmol/L	< 7.5	7.6-10	10.1-15	>15
Na mEq/L	> 136	135-131	130-126	<125
K mEq/L	3.5-5	3.4-3.2 5.1-5.3	3.1-2.9 5.4-5.9	< 2.9 >5.9
Hb. gm/Dl	16-13	12.9-11.5 16.1-17	11.4-10 17.1-18	<10 >18
WBC x 1012/L	4-10	10.1-20 3.1-3.9	20.1-30 3	>30
ECG	Normal	Occasional premature beat	AF (60-90)	Any other change

Table 1b:Operative Severity assessment

Score	1	2	4	8
Magnitude of surgery	Minor	Moderate	Major	Major+
Multiple Procedures	1	-	2	>2
Total Blood Loss	<100	100-500	501-999	>1000
Peritoneal Soiling	None	Minor (Serous only)	Local Pus	Free Bowel content, Pus/Blood
Malignancy Present	None	Primary only	Nodal Metastasis	Distant Metastasis
Mode of Surgery	Elective	-	Emergency(<2 Hours)	Emergency(>2 Hours)

Methods of calculating POSSUM predicted morbidity or mortality

After knowing the scores it is possible to estimate the predicted risk for mortality and morbidity. This score is then inserted into following formulae and risk of both mortality and morbidity can be predicted.

(i) POSSUM equation for morbidity:

$\text{Log}_n R/(1-R) = -5.91 + (0.16 \times \text{physiological score}) + (.19 \times \text{operative severity score})$

(ii) POSSUM equation for mortality:

$\text{Log}_n R/(1-R) = -7.04 + (.13 \times \text{physiological score}) + (.16 \times \text{operative severity score})$

Where R = predicted risk

The outcome of operative procedures was measured as the patient having complications, no complication or death. All Complications were recorded according to guidelines provided by POSSUM Scoring system. [3] Both surgical and systemic complications were recorded. Surgical complications included haemorrhage, wound infection, deep space infection, wound dehiscence, deep venous thrombosis and anastomotic leak. The systemic complications included chest infection, septicaemia, pyrexia of unknown origin pulmonary embolism, cardiac failure, impaired renal function, hypotension and respiratory failure.

Statistical analysis

Using outcome (dead/alive or complicated/uncomplicated) as a dichotomous dependent variables, comparison between predicted and observed rates of morbidity and mortality was assessed using chi-square (χ^2) test and statistical significance was determined. The differences in quantitative variables between groups were assessed by means of the

unpaired t test. A p-value of < 0.05 using a two-tailed test was taken for its significance in all statistical tests. Logistic Regression analysis was used to assess the mortality and morbidity variables.

Statistical methods:Expected mortality rate was obtained using regression analysis and the O: E ratio was calculated. Chi square test was applied to obtain the p-value to note any difference between expected and observed outcome.

Results

This study comprised of 92 patients in the age range of 17 to 80 years with a mean of 37.59 years (SD 16.59).These patients were divided into six categories out of which majority i.e. 44 patients (47.8%) were less than 30 years in age followed by 17 patients (18.5 %) and 14 patients (15.2%) in 51-60 and 31-40 year age groups respectively. There was a male preponderance with 63 males (68.5%) and 29 females(31.5%) out of 92 patients .

Perforation site

According to the site of perforation maximum patients were suffering from pre-pyloric perforation while 19 patients had single ileal perforation and 6 patients had multiple ileal perforations. The distribution of site of perforation is shown in figure 1a.

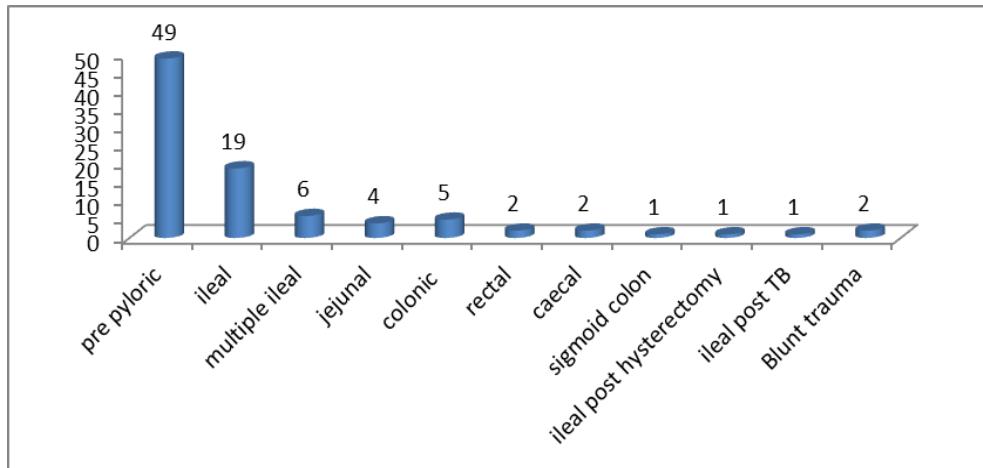


Fig 1a: Site of perforation

Surgical procedures

Modified Graham’s patch was the most commonly performed surgery. Various surgical procedures which were performed according to the site and condition of the patient and bowel which are depicted in Figure 1b. After these procedures 76 patients (82.6%),

out of the total 92 patients, survived and were discharged while 16 patients (17.4%) expired.

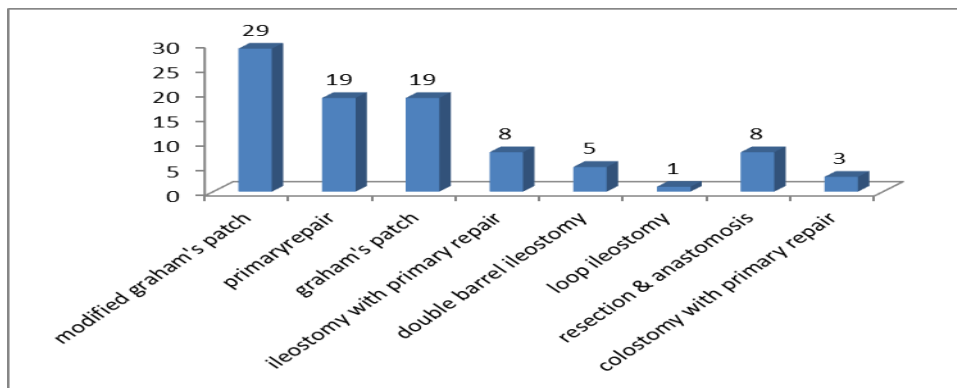


Fig 1b: Various surgical procedures performed

Hospital stay

The hospital stay ranged from 4 days to 56 days with a mean of 18.28 days. The distribution of hospital stay for various patients has been shown in figure 1c.

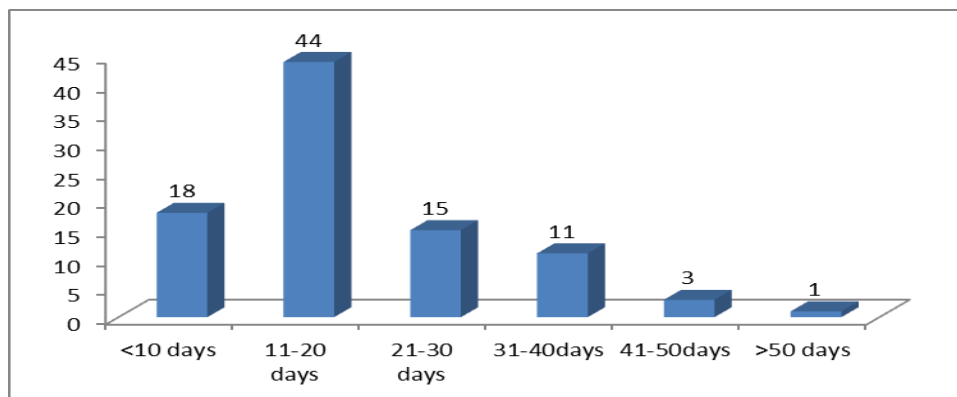


Fig 1 c : hospital stay in days

Complications

The complications related to surgery are described in figure 2a. The most common complication was wound infection 41(44.6%) followed by wound dehiscence and burst abdomen in 7 patients each (7.6%). Various other systemic complications that were observed are shown in figure 2b

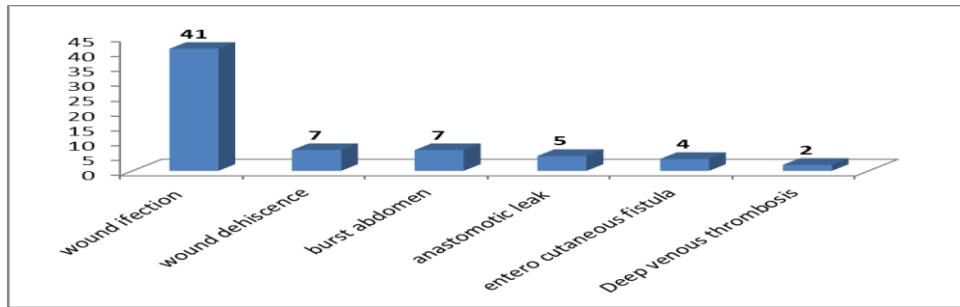


Fig 2a: Complications related to surgery

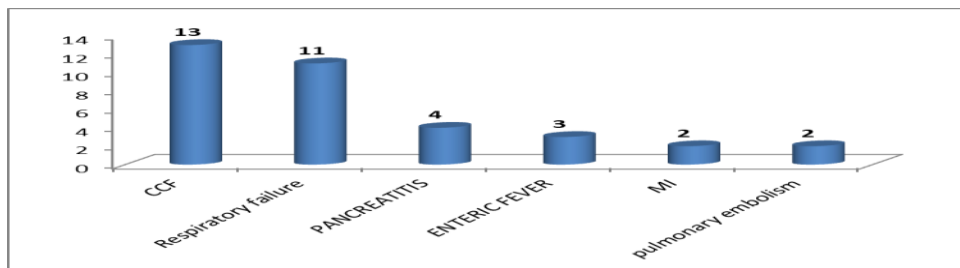


Fig 2b: Other systemic complications

Peritoneal fluid evaluation

The evaluation of peritoneal fluid for Adenosine Deaminase was performed and the findings are depicted in Fig 3a.

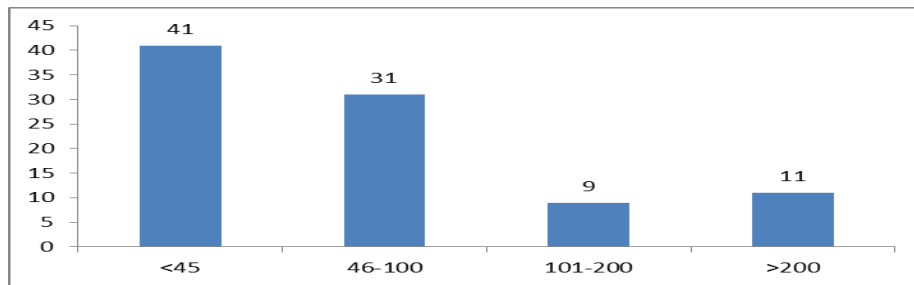


Fig 3a : Peritoneal ADA levels

Blood product transfusion

Out of 92 patients, 62 patients (67.4%) had PT value < 20 while in 30 patients (32.6%) PT value >20 was recorded. 36 patients (39.1%) required transfusion of blood or blood components

Histo-pathological evaluation

The majority of patients had pre pyloric perforations secondary to NSAID induced or H.pylori gastritis. This was followed by ileal perforations secondary to typhoid infection and tuberculosis. The perforations at various sites as shown in figure 3b

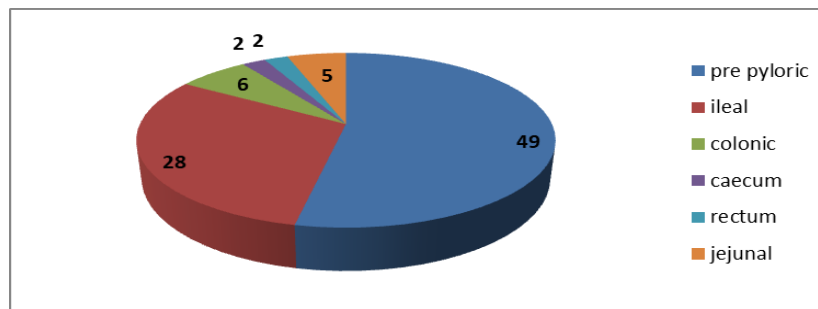


Fig 3b: Histopathology of perforation site

The data obtained on contrasting POSSUM morbidity and mortality score of the study group is tabulated in table 2 and the respective histograms are shown in figure 4 (a and b).

Table 2: POSSUM Morbidity and Mortality Score

	N	Minimum	Maximum	Mean	Std. Deviation
POSSUM Morbidity	92	45	100	89.60	11.396
POSSUM Mortality	92	9	98	53.91	26.247

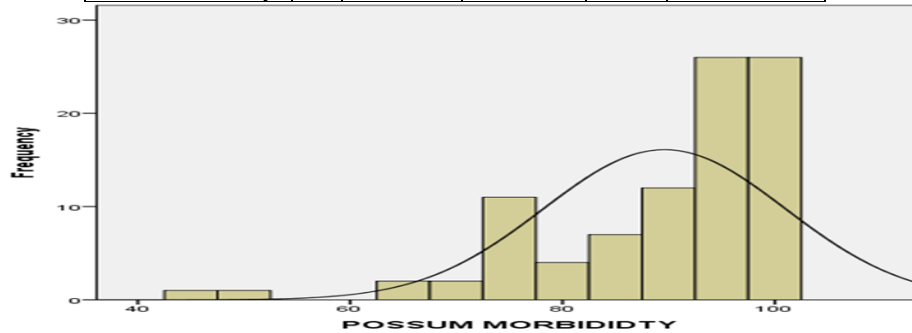


Fig 4(a): Histogram Showing POSSUM Morbidity Score

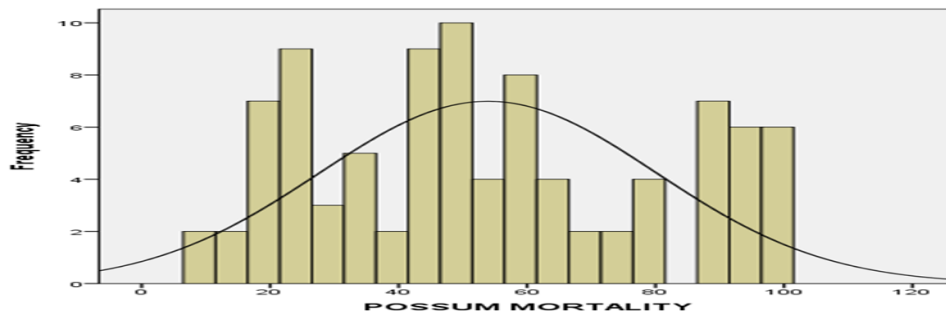


Fig 4(b): Histogram Showing POSSUM Mortality Score.

On comparison of mean POSSUM morbidity score between patients with or without complications it was observed on t-test analysis that patients who had complications had a significantly higher mean

POSSUM morbidity score as compared to the patients who had no complications. The overall complication rate is shown in Table 3a

Table 3a: Comparison of mean POSSUM morbidity score according to overall complications

	OverallComplications	N	Mean	Std. Deviation	p-value
POSSUM Morbidity	Y	62	91.69	11.791	0.010*
	N	30	85.27	9.288	

Various surgical and systemic complications observed during the study were also analysed individually. On evaluating the patients for each specific complication it was observed that a significantly higher POSSUM morbidity score was observed for patients developing respiratory failure, hypotension and CCF. Higher value of mean POSSUM score was also observed in patients with burst abdomen, fecal fistula, secondary repair, re-do laparotomy, anastomotic leak and pyrexia of unknown origin but the values were not statistically significant. [table 3b]

Table 3b: Specific Complication Wise Possum Morbidity Score

Complications	N	Mean POSSUM Score	Std. Deviation	p-value	
Burst Abdomen	Y	7	95.5	3.3	0.150
	N	85	89.11	11.6	
Fecal Fistula	Y	4	92.75	2.06	0.574
	N	88	89.45	11.62	
Secondary Repair	Y	1	93.00		0.766
	N	91	89.56	11.453	
Redo Laparotomy	Y	1	93.00		0.766
	N	91	89.56	11.453	
Wound Infection	Y	41	88.34	13.215	0.346
	N	51	90.61	9.712	
Wound Dehiscence	Y	7	95.86	2.968	0.131
	N	85	89.08	11.685	
Anastomotic leak	Y	5	93.40	2.302	0.446
	N	87	89.38	11.674	
Respiratory Failure	Y	25	96.20	6.640	<0.001

	N	67	87.13	11.847	
Hypotension	Y	29	94.86	8.643	0.002
	N	63	87.17	11.745	
CCF	Y	13	99.69	1.109	<0.001
	N	79	87.94	11.469	
PUO	Y	2	95.00	7.071	0.501
	N	90	89.48	11.470	

On further contrasting patients who survived against those who succumbed t-test analysis suggests that POSSUM mortality score was significantly higher in subjects who died as compared to subjects who survived(p-value was <0.001). [table 4]

Table 4: Comparison Of Possum Mortality Score With Survival

	Outcome	N	Mean	Std. Deviation	P-Value
POSSUM Mortality	Live	76	45.93	20.864	<0.001
	Dead	16	91.81	12.172	

Hence respiratory failure, hypotension, congestive cardiac failure, morbidity with complications and mortality values had significantly higher POSSUM score. On the other hand in patients with complications like wound dehiscence, burst abdomen, faecal fistula, anastomotic leak, PUO and Re-do laparotomy even though the POSSUM score was higher but it was not statistically significant.

Discussion

The importance of surgical audit has increased over the past years both, as a means of assessing the quality of surgical care and as an educational process. In this era, the use of crude mortality rate can be misleading. A risk adjusted POSSUM was proposed to overcome these shortcomings. [5] In a developing nation like India, due to poor socio-economic status and ignorance, the presentation of a particular illness is delayed leading to high morbidity and mortality rates. The use of POSSUM scoring system can identify those patients who are at increased risk of death or complications. However, it needs correlation with the general condition of the local population to be more precise. [5] Numerous scoring systems have been developed such as ASA (American Society of Anaesthesiologist) for general risk prediction, APACHE III (Acute Physiology and Chronic Health Evaluation III) for intensive care, Goldman Index for cardiac related complications peri-operatively and ACPGIBI (Association of ColoProctology of Great Britain and Ireland). [6-10] These scoring

systems have provided an objective assessment of patients' health and therefore a meaningful comparison can be made. For general surgical procedures, POSSUM and its subsequent modifications incorporate physiological, operative and pathological information and provide a comparison of outcomes between surgeons, units and healthcare systems. [11,12] POSSUM is a scoring system based on 12 preoperative physiological factors and six operative factors. Each factor is scored with 4 graded score values; the sum of individual scores was used to predict 30 days' postoperative morbidity and mortality after deriving equations from logistic regression analysis. [3] The P-POSSUM is a modification of POSSUM, which incorporates the same variables and grading system, but uses a different equation, which provides a better fit to the observed mortality rate [12]. However, the studies mostly have been done in developed countries where patient characteristics, presentation and hospital resources differ from our setup. [13] Hence, there is a need to evaluate POSSUM in Indian scenario where problems like delayed presentation and limited resources can affect the outcome even with adequate quality care. [14,15] In this study, we evaluated the POSSUM scoring system in 92 patients undergoing emergency laparotomy for perforation peritonitis was assessed by comparing the observed and expected mortality and morbidity rates. The contrast of our study with various other similar studies are shown in table 5

Table 5: Comparison of relevant studies from india Surgical complications

Character	Present study	Murugappan et al [16]	Batra et al[1]	Akbar et al [17]	Manikanta et al [18]	Chatterjee et al[2]
Commonest age group	<30 yrs	30-50	30-49 yrs	30-50 yrs	30-50yrs	
Male patients	68.5%	88.5%	77%	88%		-
Site of perforation	Prepyloric (53%)	Prepyloric (58%)	-	ileal	Gastroduodenal (66%)	gastroduodenal
Most common procedure performed	Modified graham's patch(31.5%)	Primary closure (66%)			Primary closure(65%)	Modified graham's patch
Commonest Complication	Wound infection	Wound infection	fever	Wound infection	Wound infection	septicemia
Hospital stay	11-20 days	7 days			13.5 days	
mortality	17.4%				5.7%	18%

Contrast of surgical complications is mentioned in table 5. With regard to surgical technique maximum complications were observed with resection anastomosis which is highest and minimum complications were recorded with primary closure. In Sunil Kumar et al study surgical site infection (SSI) was the commonest complication occurring in 60.8% patients[19]. The SSI rate observed by us was slightly higher than most other studies. [14,20,21]

Systemic complications

In our study 2 patients(2.2%) has myocardial infarction, 2 patients(2.2%) has deep vein thrombosis/ pulmonary embolism, 4 patients(4.3%) has pancreatitis with amylase and lipase value raised,

11(11.9%) patients has respiratory failure, 3 patients(3.3%) has WIDAL serology positive and 13(14.1) patients developed CCF. Murugappan et al found 17 patients out of 97(17.5%) were WIDAL serology positive.[16] Gopal tak et al observed that the complications in 21 patients who died in their study were infection, fistula and pneumonia, respiratory failure leading to multiple organ dysfunction syndromes (MODS), septicemia and shock. They also noticed that the complications in remaining 49 patients who survived were wound infection in 13 patients, respiratory failure in 10 patients, hypotension and septicemia in 9 patients each,

pneumonia in 5 patients, wound dehiscence, deep vein thrombosis (DVT) and pyrexia of unknown origin (PUO) in 1 patient each.[22]

Morbidity and mortality

In our study 76 out of 92 patients survived and discharged while 16 patients expired (17.4%) during total hospital stay. The standard deviation of morbidity and mortality observed in present study is 11.4 and 26.25 respectively. The t-test analysis here also revealed that patients with respiratory failure, hypotension and CCF complications had significantly greater POSSUM morbidity score as compared to patients who didn't had that. The p-value was <0.05. Chatterjee et al showed similar findings like respiratory failure, hypotension, multiple procedures etc.[2] In another study by S. Geethapriya et al there was no significant difference between the observed and predicted values for morbidity($X^2 = 45.00$, 24 df, $p = .006$), for POSSUM mortality($X^2 = 34.840$, 20 df, $p = .021$). [23] Sunil Kumar et al observed that POSSUM under predicted morbidity in EP patients especially in the low risk band. Overall O: E ratio was 1.27 and the difference between observed and predicted morbidity was not statistically significant.[19] It was also observed in our study that POSSUM mortality score was significantly higher in subjects who died as compared to subjects who survived. The p-value was <0.05. S. Geethapriya et al discovered that in emergency surgery sum of observed mortality and morbidity was 6(12 %) & 22(44%) while predicted mortality and morbidity by POSSUM was 9(18%) & 28.17(56.34%). [23] Sunil Kumar et al showed that POSSUM tended to over predict mortality. Overall O: E ratio was 0.47. The difference between observed and expected mortality was statistically significant ($p = 0.0162$).[19]

Conclusion

Perforation peritonitis was most commonly observed in young to middle aged males. Most common site of perforation is gastro-duodenal followed by ileal perforation. The commonest cause of perforation was NSAIDS induced and H.Pylori infection related gastro-duodenal ulcers followed by enteric fever and tuberculosis leading to ileal perforation. Common surgical procedure performed was MGP and GP followed by primary repair. POSSUM score was statistically significant for complications like CCF, hypotension, respiratory failure and also for mortality in our patients. An increasing POSSUM score was associated with higher morbidity and mortality, hence it was concluded that POSSUM is an effective scoring system for predicting outcome in patients of perforation peritonitis.

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Conflict of Interest: Nil

Source of support: Nil