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Original Research Article

Evaluation of POSSUM scoring system in patients with perforation peritonitis

Amarnath Kumar[1]*, Shilpi Suman[2], Kundan[1], Pawanjeet Kumar[1]

[1]Department of Surgery, Patna Medical College, Patna, Bihar, India
[2]Department of Preventive and Social Medicine, Nalanda Medical College, Patna, Bihar, India

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***Correspondence:**
Dr. Amarnath Kumar,
E-mail: dr.amarnath.kumar5@gmail.com

ABSTRACT

Background: Continuous audit of clinical practice is an essential part of making improvements in medicine and enhancing patient care. Recently, physiological and operative severity score for the enumeration of mortality and morbidity (POSSUM) scores has been developed, which would help to identify those patients who are at increased risk of developing complications and deaths. This scoring system is based on 12 physiological characteristics of patient and 6 characteristics of the surgery performed.
Methods: This study was done in Department of surgery at Patna medical college, Patna, Bihar, India from April 2014 to October 2015 on 100 patients. Physiological variables were collected prior to induction of anesthesia and operative variable collected during operation chi-square test was used for expected and actual mortality differences.
Results: In present study 100 patients of peritonitis due to different cause of intestinal perforation were studied. Comparison of observed and POSSUM predicted mortality and morbidity rates were done. Observed to expect mortality and morbidity ratio was 1.005 and 1.001 respectively and there was no statistically significant difference between the predicted and observed values.
Conclusions: This study confirms and validates the findings of previous work that POSSUM is an accurate and reliable tool for estimating in-hospital mortality.

Keywords: Peritonitis, Mortality, Intestinal perforation, POSSUM

INTRODUCTION

In modern era, the prediction of complications is an essential part of risk management in surgery, especially in high risk patients of perforation peritonitis. Majority of peritonitis can be attributed to perforation in stomach, duodenum, small intestines, appendix and colon.[1] In these patients, due to delay in operative intervention and co-morbidities, there is significant postoperative mortality and morbidity. POSSUM would help to identify those patients who are at increased risk of developing complications and death.

POSSUM was developed by Copeland et al.[4] This present study was undertaken to assess the validity of POSSUM scoring system in patients with perforation peritonitis in this high risk group.

POSSUM scoring system includes 12 physiological factors and 6 operative factors as shown in Table 1 and Table 2.

METHODS

Hundreds patients scheduled to undergo emergency Laparotomy for perforation peritonitis in Department of General surgery in Patna medical college from April

2014 to November 2015, were selected based on inclusion and exclusion criteria according to POSSUM score.

Inclusion criteria

Age above 12 y. Patients less than 12 y of age are managed by the Department of Paediatric Surgery in our hospital. Patients with established peritonitis following hollow viscus perforation. Patients with intra-peritoneal abscess due to hollow viscus perforation.

Exclusion criteria

1. Age 12 y and below.
2. Patients undergoing emergency explorative laparotomy due to other causes like abdominal trauma.
3. Patients with primary peritonitis due to tuberculosis alcoholic cirrhosis, nephrotic syndrome, cardiac failure or systemic lupus erythematosus

Scores were allotted to the physiological and operative factors in the study and expected mortality and morbidity rate were calculated. Complications were assessed by clinical observation. Routine bacteriological screening and postoperative radiological scanning were not carried out, but confirmatory bacteriological and radiological tests were done when clinical suspicion existed.

POSSUM equation for morbidity

Ln R/1 - R = - 5.91 + (0.16 x physiological score) + (0.19 x operative severity score)

POSSUM equation for mortality

Ln R/1 - R= -7.04+ (0.13 x physiological score) + (0.16 x operative severity score)

Where R = predicted risk.[4]

After calculating R (Risk of mortality) for each patient, all patients were divided in to different risk-bands on the basis that each band receives enough number of patients and deaths for statistical analysis. The Risk bands according to the predicted mortality were:-

0-5% - Risk Band or group

5-15% - Risk Band or group

15-30% - Risk Band or group

30-45% - Risk band or group

45-100% - Risk band or group

Now expected or predicted death in each risk group was calculated as:-

Expected or predicted No. of death in each Risk group = the No. of Pt. in the Range x lowest mortality in each group.

The patients were then followed up for a period of 2 months post operatively and complications were noted upon the criteria as defined by POSSUM scoring system.

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.

Table 1: Physiological severity assessment for the POSSUM.

Score	1	2	4	8
Age (in years)	≤60	61-70	≥71	-
Cardiac signs	Normal	Cardiac drugs or taking steroids	Edema; taking warfarin, Borderline cardiomegaly	JVP raised, Cardiomegaly
Respiratory signs CXR	Normal	Breathlessness on exertion, mild COPD	Breathlessness on walking, moderate COPD	Breathlessness on rest, any other changes in lungs
Systolic (mm Hg)	110-130	131-170, 100-109	≥171, 90-99	≤89
Pulse (beats/min)	50-80	80-100, 40-49	101-120	≥121 ≤39
GCS	15	12-14	9-11	≤8
Urea nitrogen, (mmol/L)	<7.5	7.6-10	10-1-15	≥15-1
Na (meq/L)	>136	131-135	126-130	≤125
K (meq/L)	3.5-5	3.2-3.4; 5.1-5.3	2-9-3.1; 5-4-5-9	≤2.8; ≥6
Hb (g/dI)	13-16	11	10-11-4; 17-1-18	≤9.9; ≥18.1
WBC ($x10^{12}$/L)	4-10	11.0-20.0	≥20-1; ≤3	-
ECG	Normal		AF (60-90)	Any other Change

Table 2: Operative severity assessment for the POSSUM system.

Score	1	2	4	8
Operative Magnitude	Minor	Intermediate	Major	Major+
No. of procedures during operation	1	-	2	>2
Blood loss per operation (in ml)	<100	101-500	501-999	>1000
Peritoneal tam contamination	No	Serous	Local pus	Free Bowel Content, pus or blood
malignancy	No	Primary cancer only	Node metastases	Distant metastases
Timing of operation	Elective	-	Emergency (Resuscitation possible) Operation within 24hrs.	Emergency (immediate), Operation within 2hrs.

RESULTS

The causes of perforation peritonitis in our study are given in (Table 3) and the types of surgeries performed are given in (Table 4). Out of 50 patients studied, death occurred in 9 patients resulting in crude mortality rate of 18%. Of the 41 patients alive, 25 patients had at least one complication, resulting in crude morbidity rate of 61%. The remaining 16 patients showed no evidence of any complication. The complications during the 2 months follow up period were as follows in (Table 5).

Comparison of observed and POSSUM predicted mortality and morbidity rates was done using linear analysis is represented in (Table 7) respectively. Observed to expected mortality and morbidity ratios were 1.005 and 1.001 respectively and there was no statistical significant difference between the predicted and observed values ($\chi 2 = 3.54$, $p = 0.316$) and ($\chi 2 = 2.40$, $p = 0.792$) respectively. Of the POSSUM score factors, 9 factors were found to be statistically significant in predicting mortality.

Table 3: Causes of peritonitis.

Cause	No. of pt.
Duodenal perforation	24
Gastric perforation	1.8
Jejunal perforation	18
Ileal perforation	21
Appendicular perforation	12
Colonic perforation	7

Table 4: Types of surgery.

Type	No. of pt.
Minor	0
Intermediate	0
Major	62
Major plus complex major	38

Table 5: Complications.

Post-operative complications	No. of Pts.
Septicaemia	10%
Deep infections	8%
Wound infections	8%
Chest infections	6%
Multiple infections	30%

Table 6: Observed and expected mortality.

Possum score-range	No. of total patients	No. observed death	No. expected death
18 - 36	31	2	1.6
36 - 54	32	3	3.2
54 - 72	18	5	5.6
72 - 90	13	4	3.8
90 - 108	4	2	2.3
108 - 126	2	2	2.2
126 - 144	0	0	0
Total	100	18	18.7

Using logistic equations, the predicted risk of mortality and morbidity was calculated and compared with the observed mortality and morbidity, shown in (Table 6) respectively. For mortality and morbidity, positive predictive value was 100% and 94%, negative predictive value 78% and 82%, sensitivity 95% and 71%, specificity 100% and 96% respectively.

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. In a developing nation like India, due to poverty and ignorance, the presentation of a particular

illness is delayed leading to an increased number of complications and high death rates. The use of POSSUM scoring system can identify those patients who are at increased risk of death or complications. However, it has to be correlated to the general condition of the local population to be more precise.

Table 7: Observed versus expected deaths in various risk range.

Risk range %	Total no. of patient	No. of death		Observed: Expected Ratio O:E	P - Value
		Observed (O)	Predicted expected (E)		
0 – 5	48	3	5	0.60	0.45
5 -15	12	3	3	1.00	0.67
15-30	11	7	6	1.16	0.37
30-45	17	2	3	0.66	1.00
45-100	12	5	6	0.83	1.01
Total	100	20	23	0.87	0.76

Numerous scoring systems have been developed such as ASA (American Society of Anaesthesiologist) [5] 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 ACPGBI (Association of coloproctology of Great Britain and Ireland).[6-9] 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.[10,11] POSSUM was developed by Copeland et al., from a cohort of 1372 patients mainly for surgical audits. It 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.[4] 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.[11] It has already been used in general, vascular, colorectal, oesophageal and laparoscopic procedures.[12-21] However, the studies mostly have been done in developed countries where patient characteristics, presentation and hospital resources differ from our setup.[22] Hence, there is a need to validate POSSUM in Indian scenario where problems like delayed presentation and limited resources can affect the outcome even with adequate quality care.[23-25]

In this study, the validity of POSSUM scoring system in 50 patients undergoing emergency laparotomy for perforation peritonitis in a single surgical unit was assessed by comparing the observed and expected mortality and morbidity rates. 9 patients died; a crude mortality rate of 18%. The most common cause of mortality was septicaemia. Prytherach DR et al obtained similar results of overall mortality rate of 19.1%. POSSUM predicted mortality rate in our study was 17.9%.[26] On analysis we found no statistical difference between observed and expected mortality rate (χ^2 = 3.54, p = 0.316). An O:E ratio of 1.005 was obtained, similar finding was obtained by Prytherach DR et al (O:E = 0.9), Sagar PM et al (O:E = 0.87) and Parihar V et al, (O:E = 0.97).[17,24,26] Das K et al compared Apache II, p-POSSUM and SAPS II scoring system and found p-POSSUM scoring system reliable for prediction of overall hospital stay.[27] Vishwani A et al studied the efficacy of POSSUM in predicting mortality and morbidity in patients of peritonitis undergoing laparotomy in 89 patients in single surgical unit and found that POSSUM scoring system is reasonably good predictor of mortality (O:E = 0.6) and morbidity (O:E = 0.7) using exponential and linear analysis respectively.[28] Teleanu G et al validated CR-POSSUM in 58 patients and concluded that it has prognostic value for patients with abdominal sepsis in colonic peritonitis.[29] Kumar S compared POSSUM and P-POSSUM in 172 cases studied in single surgical unit over period of two years and found that POSSUM over predicted mortality and morbidity by linear and exponential analysis.[30] Kumar S et al validated POSSUM score in enteric perforation peritonitis and concluded that POSSUM is a good predictor of morbidity (O:E = 0.85) and over predicts mortality (O:E = 0.47).[30]

Out of 41 patients who survived, 25 patients suffered complications and the remaining 16 patients did not show any evidence of complications. An observed to expected ratio (O:E) of 1.001 was obtained and there was no significant difference between the predicted and observed values (χ^2 = 2.40, p = 0.792).

For mortality and morbidity, positive predictive value was 100% and 94%, negative predictive value 78% and 82%, sensitivity 95% and 71%, specificity 100% and 96% respectively.

Factors like ventilation perfusion mismatch, impaired tissue per-fusion and ischemia to vital organs, impaired mental status due to hyponatremia and hypokalaemia, cancer cachexia and prolonged operative time could be attributed to postoperative mortality.

In our study two risk factors were separately validated that affect the mortality significantly in patients with perforation peritonitis; perforation – operation time and presence of co-morbid status. A statistical significance was established with these factors. In our study, complications noted were septicaemia (10%), deep Infections (8%), wound infections (8%), chest infections (6%), and multiple complications (wound dehiscence, deep infection, chest infection, urinary infection, impaired renal function and anastomotic leak) (30%). These complications can be attributed to gross peritoneal contamination, depressed immune function, raised diaphragm, upper abdominal incisions and presence of co-morbidities like asthma, chronic obstructive airway disease, diabetes mellitus, anaemia and hypo-proteinaemia.

CONCLUSION

A small sample size is the limitation of this study. However, findings of our study suggest that POSSUM scoring system can be used as a tool to predict the mortality and morbidity of patients operated for perforation peritonitis. Inclusion of factors like perforation to operation time and co-morbid status can improve the scoring system. Strict vigilance and prompt correction of the validated factors can improve the general condition of the patient and decrease the mortality and morbidity. Studies with larger sample size can further validate this scoring system. In addition, general awareness, early referrals, early diagnosis and timely treatment need to be implemented to reduce the perforation to operation time duration and control the co-morbidities.

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