

## Original Research Article

# Poosum scoring system for predicting prognosis in patients of perforation peritonitis

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### ABSTRACT

**Background:** Peritonitis due to perforation of gastrointestinal viscous is one of the most common surgical emergency in India. A need for such a scoring system was felt which could better define the prognosis of such patients with respect to mortality and morbidity for better patient management. Emphasizing that Perforation peritonitis is one of the commonest surgical emergencies in lower strata of the population that is encountered in a rural hospital, this study was undertaken to evaluate POSSUM (physiological and operative severity score for the enumeration of mortality and morbidity) in defining the prognosis of patients and to deliver efficient management.

**Methods:** 157 patients of perforation peritonitis who were admitted in Surgery wards over a period of 3 years were studied in this cross-sectional study. POSSUM Score was calculated for each patient by using the POSSUM Calculator. ROC analysis was done to find the cut off point for POSSUM.

**Results:** The cut-off was 35 which gave the Sensitivity and Specificity to be 100% and 72.29% respectively. The mortality rate was 5.7%.

**Conclusions:** This was one of the first studies in a rural setup in India where POSSUM scoring system was specifically applied for patients of Perforation Peritonitis. 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.

**Keywords:** POSSUM score, Perforation peritonitis, ROC curve

### INTRODUCTION

Peritonitis due to perforation of gastro intestinal viscous is the most common surgical emergency in India. Despite advances in surgical techniques, antimicrobial therapy and intensive care support, management of peritonitis continues to be highly demanding, difficult and complex and the spectrum of disease is different from that found in the western world. The systematic approach to quantifying illness in critically ill patients like peritonitis is a recent phenomenon. The development of such

systems has been specifically the need for methods to compare patient populations and severity of illness, objectively predict mortality, morbidity and to evaluate the treatment strategy. 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. In 1981, Knaus and coworkers developed the acute physiology and chronic health evaluation (APACHE) II score and Le Gall et al

developed the Simplified Acute Physiology Score (SAPS).

Elebute and Stoner developed the sepsis severity score (SSS) while Goris et al published the multiple organ failure score (MOF). Wacha and coworkers published the mannheim peritonitis index (MPI). Currently no ideal and generally accepted scoring system exists to determine the prognosis of peritonitis and intra-abdominal sepsis.<sup>1</sup>

POSSUM (physiological and operative severity score for the enumeration of mortality and morbidity) physiological and operative severity score for the enumeration of mortality and morbidity (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.<sup>2</sup> This is done by allocating a score to 12 physiological variables measured on admission and then allocating a second score to the severity of the operative procedure that the patient undergoes. These scores are then inserted into two formulae and risk of both morbidity and mortality can be predicted for the workload of each surgical team. The actual morbidity and mortality rates reported by a surgical team can then be compared by these predictions and individual patients who are either surgical successes or failures can be identified easily for close inspection at audit meetings. Our hospital is located in rural part of central India with a patient base coming from low socioeconomic strata where it was seen that addictions were more common and there was a huge incidence of GI perforation peritonitis, this study was undertaken to evaluate POSSUM as a tool for predicting mortality and morbidity in such patients and to enhance patient care and management.

## METHODS

### Setting

This study was carried out in the Department of Surgery of a tertiary care hospital attached to a rural medical college.

### Study design

This was an observational cross-sectional study.

A total of 157 patients of perforation peritonitis who were admitted in surgery department over a period of three years were included in the study. All the patients who were operated for perforation peritonitis and whose OT records were complete were included in the study. They were interviewed by the principal investigator and information was recorded and documented. After preoperative resuscitation the patient underwent exploratory laparotomy. Appropriate treatment was carried out according to the findings. Postoperatively standard care was given to all the patients. Patients were observed for complications and mortality.

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.<sup>1,2,4,8</sup> The physiological variables are those apparent at the time of surgery and include clinical symptoms and signs, result of simple biochemical and hematological 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.

The operative part of the score includes 6 variables, each divided into 4 grades with an exponentially increasing score.<sup>1,2,4,8</sup>

Once these scores are known, it is possible to estimate the predicted risk for mortality and morbidity using the following equations.

The equation for prediction of mortality is as follows:

$$\ln \frac{R}{1-R} = -7.04 + (0.13 \times \text{PS}) + (0.16 \times \text{OS})$$

The equation for the prediction of morbidity is as follows:

$$\ln \frac{R}{1-R} = -5.91 + (0.16 \times \text{PS}) + (0.19 \times \text{OS})$$

Where PS is the Physiological score and OS is the operative score.

### Statistical analysis

ROC curve was plotted for POSSUM and a cutoff point was found. At this given score the various indices such as true positive, false positive, false negative, true negative were calculated. Using these values the various statistical indices such as Sensitivity, Specificity, Positive predictive value, Negative predictive value, likelihood ratio positive, likelihood ratio negative were calculated.

### Ethics consideration

Prior approval of institutional ethics committee was obtained for the study. Written informed consent was obtained from all patients included in the study.

## RESULTS

The maximum numbers of patients of gastrointestinal perforations were in the age group of 30-49 years (34.4%) followed by patients in the age group of 50-69 years (31.2%) and then followed by patients in the age group of less than 30 years (29.9 %) and only 4.5% of patients were more than 70 years of age. There were 139 males (88.54%) as compared to 18 females (11.46 %).

M:F ratio was 7.7:1. The patient profile of symptoms is enumerated in Table 1.

**Table 1: Symptomatology.\***

Symptom	Percentage
Pain abdomen	100 %
Vomiting	52.2 %
Distension of abdomen	36.3 %
Constipation/loose stools	31.8 %
Fever	26.1 %
Oliguria	13.4 %
Cold extremities	3.8 %

\*Some of the patients had presented with more than one symptom and the above values indicate the percentage of patients having a particular symptom amongst the total number of patients.

**Duration of symptoms**

Out of total 157 patients 53 patients (33.8%) had presented within 24 hours of onset of features of peritonitis and 104 (66.2 %) had presented after 24 hours of onset of peritonitis

**Site of perforation**

The maximum number of patients of perforation peritonitis had gastro duodenal perforation (80.25%) which was followed by small bowel perforations (14.02%). Small bowel perforations included jejunal and ileal perforations. Appendicular perforations constituted 3.82%. Colonic perforations were 1.27%. There was one case of rectal perforation.

**Complications**

Of the 157 patients, 9 (5.7 %) patients died in the post-operative period. Out of the remaining 148 patients who survived 75 patients had no complications and 73 patients had complications. Thus the complication rate in our study was 49.3 %. Among the 73 patients who developed complications 17 (23.29 %) had fever, 14 (19.18%) had wound infection and 14 (19.18%) had wound gaping. 7 patients (9.59%) had respiratory tract infection. 7 patients (9.59%) developed a fecal fistula. Others had urinary tract infection (8.21%) and electrolyte imbalance (2.74%). 2 patients (2.74%) had burst abdomen and 1 patient (1.37 %) had pelvic abscess while 1 patient (1.37%) had subphrenic abscess and 1 patient (1.37%) had hypotension which required ionotropic support for 5 days. 1 patient (1.37%) had respiratory failure for which patient was kept on mechanical ventilatory support and was weaned off the ventilator in 8 days

**Observed mortality rate**

In the present study the numbers of deaths due to perforation peritonitis were 9 and hence the mortality rate was 5.7%.

The risk of mortality by POSSUM was calculated by the following equation:

$$\ln \frac{R}{1-R} = - 7.04 + (0.13 \times PS) + (0.16 \times OS)$$

Where PS is physiologic score and OS is the operative score. Accordingly the patients were grouped in the following categories of risk of mortality.

- 0-4%
- 5-14%
- 15-49%
- >50%

On classifying patients according to risk of mortality , the ratio of Observed : Predicted rate of mortality (O/P ratio) in group having 0-4% risk of mortality was 0 as there were no deaths in this group, similarly in the next group also i.e. 5-14% risk of mortality there were no deaths and the O/P ratio was 0. In the next group of 15-49% risk of mortality the O/P ratio was 0.09 and in the last group i.e. where the risk of death was more than or equal to 50%, there were maximum no. of deaths i.e. 7 and the O/P ratio was 0.4. Hence for the whole study the O/P ratio was 0.2 (Table 2).

**Table 2: O/P ratio of POSSUM.**

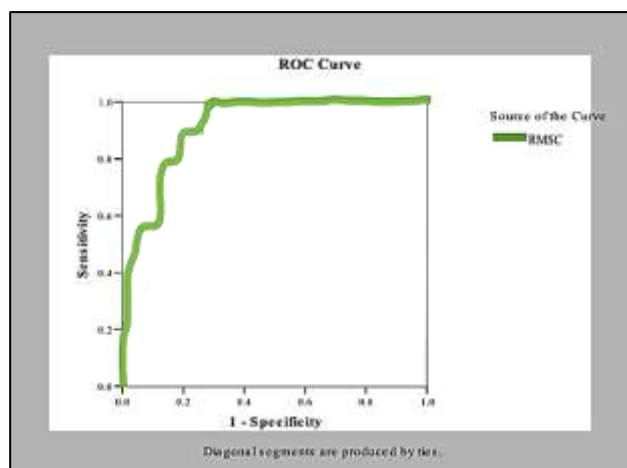
Risk of death (%)	Number of operations	Observed Deaths (o)	Predicted Deaths (p)	O/p ratio
0-4	1	0	0.04	0
5-14	42	0	4.27	0
15-49	77	2	22.38	0.09
≥ 50	27	7	17.68	0.4
<b>Total</b>	<b>157</b>	<b>9</b>	<b>45.37</b>	<b>0.2</b>

**Cut off points for POSSUM**

ROC analysis was done to identify the best cut off POSSUM. Cut off for POSSUM came out to be 35 which gave the sensitivity and specificity for POSSUM to be 100% and 72.29% respectively. From the ROC curve the area under the curve for POSSUM was calculated to be 91.1%. The analysis of POSSUM Scoring system is represented in Table 3.

**Table 3: Analysis of POSSUM scoring system with cut-off of 35 Indices.**

Indices	POSSUM
Sensitivity	100%
Specificity	72.29%
Positive predictive value	0.18
Negative predictive value	1
Positive likelihood ratio	3.57
Negative likelihood ratio	0



**Figure 1: RMSC denotes POSSUM curve.**

This study evaluates the utility of POSSUM as a tool to quantify the severity of peritonitis and predict the morbidity and mortality as currently no ideal and generally accepted scoring system exists to determine the prognosis of peritonitis and intra-abdominal sepsis.

**DISCUSSION**

Males outnumbered females in the present study. Similar pattern of more incidence of perforation peritonitis in males was also seen in various other studies. In the present study the maximum numbers of patients of gastrointestinal perforations were in the age group of 30-49 years (34.4%) followed by patients in the age group of 50-69 years (31.2 %) and then were the patients in the age group of less than 30 years (29.9 %), 4.5% of patients were more than 70 years of age. However maximum number of patients were between 50-69 years of age as shown by Ohmann et al 3 followed by the patients in the age group of 30-49 years in their study.

The comparative account of the clinical profile in our study and that of other studies is depicted in Table 4.

**Table 4: Clinical profile.**

Symptoms	Ghooi and Panjwani <sup>4</sup> N = 280	Desa et al <sup>5</sup> N = 161	Present study N = 157
Pain Abdomen	100%	86.96%	100%
Distension	51.1%	52.79%	36.3%
Constipation/loose stools	50%	30.43%	31.8%
Vomiting	26.8%	53.42%	52.2%
Fever	15.3%	44.10%	26.1%
Retention of urine	-	1.86%	-
Oliguria	-	-	13.4%
Cold extremities	-	-	3.8%

Majority of the patients in our study has presented late i.e. after 24 hours. Similar observations were made by

other authors (Ghooi and Panjwani).<sup>4</sup> The commonest site of perforation in the gastrointestinal tract is gastroduodenal followed by small bowel. Other areas like colon, appendixes are less common sites of perforations. Similar observations have been reported by various authors in the past Jhobta et al, Ramchandra et al.<sup>6,7</sup> Our results on site of perforation go hand in hand with the findings of earlier studies. However, there was an isolated case of rectal perforation in the present study, which was not reported by any other authors. Fever, wound infection and gaping were the commonest complications as observed in the present study (23.29%, 19.18% and 19.18% respectively) followed by faecal fistula and respiratory infections (9.59% each) and others. Budhraj et al, also found wound infection as commonest complication followed by wound gaping and fecal fistula (11.6% each).<sup>8</sup> However none of their patients had fever, urinary tract infection or respiratory tract infections. The overall complication rate in the present series was 48.3% which is in concordance with the rate reported by Edison et al.<sup>9</sup> The rate of complication was less in the studies of other authors like it was 36.8% by Budhraj et al, and 25% by Agrawal et al.<sup>8-10</sup> Of the 157 patients included in the study 9 died, thus giving an overall mortality rate of 5.7%. This is much less than the rate reported by other authors Jhobta et al, Ramchandra et al, Agrawal et al.<sup>6,7,10</sup>

In this study the predicted mortality as given by POSSUM equation was more than the observed mortality (O: P ratio was 0.2). Similar results were also reported by other authors whereas in one of the studies by Hobson SA et al 11 it was observed that mortality was more than the predicted mortality (Table 5).

**Table 5: Observed (O) to predicted (P) mortality ratio by POSSUM.**

Study	O/P ratio
Yii and Ng <sup>12</sup> N = 605	0.58
Prytherch et al <sup>13</sup> N = 10000	0.41
Hobson et al <sup>11</sup> N = 163	1.15
Present study N = 157	0.2

ROC (receiver operating characteristic) curve analysis was done for prediction of morbidity using POSSUM. Area under the curve was 20% and hence was not useful for predicting morbidity. Similar result was observed by Kitara et al 14 in 76 patients who underwent laparotomies. POSSUM failed to predict any of the complications observed. When the ROC curve was plotted, the area under the curve was just 58.8% in their study. When compared statistically it was found that POSSUM evaluates mortality slightly better and it also predicts morbidity, but statistically was found to be inefficient in predicting morbidity. POSSUM scoring system is better since it takes into consideration both physiological and operative parameters. In the present study the cut off score was 35 according to the ROC curve. The sensitivity and specificity of POSSUM were

100% and 72.29% respectively with a high positive likelihood ratio of 3.57.

## CONCLUSION

Our study was a pioneering study in India where POSSUM scoring system has been applied specifically for patients of perforation peritonitis in a rural hospital setup. Till date no other studies have been found in the literature and on the internet data base as far as it could be traced; who have observed the potential of POSSUM score in Indian subcontinent for predicting the outcome in patients of perforation peritonitis. We propose that POSSUM scoring system is better as it predicts morbidity and mortality and takes into consideration both physiological and operative parameters which is not so in most of other scoring systems. Till today POSSUM scoring system is being used to predict outcome of patients in general surgery, gastrointestinal surgery and vascular surgery etc. and has not been applied specifically for patients of perforation peritonitis and hence more studies are needed to substantiate our data. Strict vigilance and prompt correction of the validated factors can improve the general condition of the patient and decrease the mortality and morbidity.

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*Ethical approval: The study was approved by the institutional ethics committee*

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