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Original Research Article

Role of acute physiology and chronic health evaluation II scoring system in risk stratification and management of small bowel perforations

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ABSTRACT

Background: Despite the surgical treatment, sophisticated intensive care units, latest generation antibiotics and a better understanding of pathophysiology, the morbidity and mortality rate of perforation peritonitis are still high. Patients are usually managed by subjective decision of surgeon based on which mortality is very high.
Methods: This was a double-blind observational study conducted over a period of 18 months on 50 patients with small bowel perforations. Based on the acute physiology and chronic health evaluation (APACHE) II score at presentation, patients were triaged into 3 groups: group 1 (score ≤10), group 2 (score 11 to 20) and group 3 (score >20). Study population was managed by the subjective decision of the operating surgeon who was blinded off the APACHE II score of patients. Hence removing the possibility of bias and observing a correlation between surgical outcome and APACHE II score of the patient.
Results: Patients with higher APACHE II score (>10) were more likely to undergo exteriorization of bowel. Length of hospital stay was also found to be increased with an increase in score. APACHE II score of 10 was found to predict mortality with significant difference between 2 groups. Below this score the mortality was 0% and above this score the mortality rate rose to 31.25%.
Conclusions: APACHE II can be used as a reliable and uniform scoring system as its assessment at presentation in patients of small bowel perforations provides an insight to their surgical management as well as predicting overall outcome.

Keywords: APACHE II score, Mortality, Small bowel perforations, Surgical outcome

INTRODUCTION

Perforation peritonitis continues to be a challenging experience for a surgeon. Surgeons must continually reassess the standard of treatment and be receptive to new ideas. Despite the surgical treatment, sophisticated intensive care units, latest generation antibiotics and a better understanding of pathophysiology, the mortality rate of perforation peritonitis is still high.[1] One of the reasons for high mortality is that peritonitis due to perforation of gastrointestinal tract causes profound sepsis and affects the general condition leading to systemic inflammatory response which may lead to multiple organ failure.[2] The objective evaluation of severity, therapeutic approach and effectiveness of treatment of acute generalized peritonitis from perforation is hampered by lack of precise classification in this environment.

Till date the focus of decision making in patients of perforation peritonitis has been the clinical assessment of treating surgeon based on which the mortality and

morbidity is very high. There is a lack of uniformity of opinion regarding the optimal surgical treatment to be performed. Currently no ideal and generally accepted scoring system exists to determine the prognosis of peritonitis.[3]

Although various scoring systems had been used to assess the prognosis and outcome of patients of peritonitis, acute physiology and chronic health evaluation (APACHE) II scoring system, a simplified version of APACHE (acute physiology and chronic health evaluation) is a more feasible tool in emergency situations for pre-operative risk stratification and prompt management in an objective manner.

The study highlights the importance of a reliable scoring system not only for predicting the prognosis but also for decision making regarding the optimum surgical procedure for a satisfactory outcome in patients with abdominal sepsis and peritonitis following small bowel perforations.

METHODS

This was a prospective double-blind observational study conducted over a period of 30 months (from October 2017 to March 2020) at Department of General Surgery, Vardhman Mahavir Medical College and Safdarjung Hospital on 50 patients of small bowel perforation peritonitis regardless of causative etiology.

Inclusion criteria

All the patients who presented to surgical emergency wing of Safdarjung Hospital with diagnosis of perforation peritonitis due to small bowel perforation. Both sexes and patients above the age of 12 years were included.

Exclusion criteria

Patients below 12 yeras of age, pregnant women, patients with duodenal perforation and patients who died before resuscitation were excluded.

A written, informed consent was obtained from all patients. Every patient was subjected to detailed clinical evaluation of present illness on the basis of a detailed history including history of co-morbid illness. Relevant investigations for APACHE II scoring were done along with abdominal X-ray and ultrasound. Urinary catheter was inserted to measure urine output and nasogastric tube inserted to decompress the stomach. The parameters of APACHE II were recorded at the time of admission to determine APACHE II score.

The admitted cases were selected on the basis of clinical diagnosis and confirmed by operative diagnosis. Observation and evaluation of cases were done clinically from time of admission to discharge or death.

Based on their APACHE II score patients were triaged into three groups.

- Group 1: score equal to or less than 10
- Group 2: score ranging between 11 and 20
- Group 3: score more than 20

Patients were allocated into 3 groups on the basis of their APACHE II score at presentation to our hospital to facilitate comparison of surgical outcome to the APACHE II score of patients. The study hypothesis states that the patients of small bowel perforation classified preoperatively as described above should be managed in following manner.

Group 1 (APACHE score ≤10)

Patients presenting in a better clinical condition than their counterparts in group 2 and 3 should be managed by emergency laparotomy only. A solitary perforation irrespective of size of perforation, state of bowel, or the extent of peritoneal soiling should be managed by simple closure in 2 layers. In bowel with multiple perforations distributed more than 1 feet (0.3 m) apart, each perforation to be closed in similar manner while in patients with multiple perforations confined to a segment only, resection of affected segment followed by end-to-end double layered anastomosis.

Group 2 (APACHE score 11 to 20)

In all these patients irrespective of size and number of perforations, state of bowel and the extent of peritoneal soiling exteriorization of the bowel was the key element in management. Repair of perforation with proximal ileostomy should be done.

Group 3 (APACHE score >20)

These are gravely ill patients in whom any immediate definitive surgical management could have been fatal. Immediate resuscitative measures in the form of correction of fluid and electrolyte imbalances and other support measures depending upon their clinical picture is necessary. They should be managed by bilateral flank drain placement under local anesthesia along with vigorous resuscitative measures followed by reassessment after 24 hour and 48 hours. If their scoring improved to group 2, they should be managed as such.

Study population was managed by subjective decision of operating surgeon based on general condition of the patient, availability of blood, condition of the bowel, intra-operative condition of the patient as well as the experience of the surgeon, etc. and operating surgeon was blinded of the APACHE II score of the patient. Hence, removing the possibility of bias and making an accurate correlation between surgical outcome and APACHE II score.

Therefore, a comparison was made between surgical management of the patient based on decision of operating surgeon to as hypothesised by APACHE II score the results of which determined the reliability of APACHE II scoring system as a predictor of optimal management of patients with small bowel perforation. Observation and analysis of results was done in relationship to age, sex, surgical procedure, morbidity and mortality.

Descriptive statistical analysis was carried out in our study with Statistical Package of Social Sciences (SPSS) version 19.0. Results on the continuous measurements were presented on mean±SD and results on categorical measurements were presented in numbers and percentage. P value calculated using t test and chi-square test, p value <0.005 was taken as statistically significant.

Ethical approval was obtained from Institute Ethics Committee, Vardhman Mahavir Medical College and Safdarjung Hospital, before initiating this research project.

RESULTS

Table 1 depicted the age distribution of patients. The mean age of the study population was 36.16±16.74 years.

Table 1: Age distribution of patients.

Age (in years)	Frequency	Percentage
<20	8	16.00
21-30	16	31.00
31-40	7	14.00
41-50	8	16.00
51-60	5	10.00
61-70	6	12.00
Total	50	100.00

Table 2 shows gender distribution in the study population. Out of 50 patients, 38 patients were males and the remaining 12 were females i.e., 76% were males and 24% were females.

Table 2: Gender distribution of patients.

Gender	Frequency	Percentage
Female	12	24
Male	38	76
Total	50	100

Figure 1 showed that majority of patients (27, 54%) in the study population were managed by exteriorization of bowel in the form of stoma i.e., jejunostomy (in 2 patients) and ileostomy (in 25 patients). 3 patients (6%) were managed by placement of bilateral flank drain alone. Rest 40% of patients were managed with either primary repair of perforation or resection and anastomosis of perforated bowel i.e., majority (24%) with primary repair of perforation and rest 16% with resection and anastomosis of perforated bowel segment.

Figure 2 showed that the surgical procedures of patients in comparison to their grouping based on their APACHE II score.

All the patients in group 2 were managed by exteriorization of bowel i.e., jejunostomy or ileostomy. Out of 8 patients in group 3, 5 (10%) patients were managed by exteriorization of bowel and rest 3 (6%) patients were managed by placement of bilateral abdominal drain placement under local anaesthesia, alone.

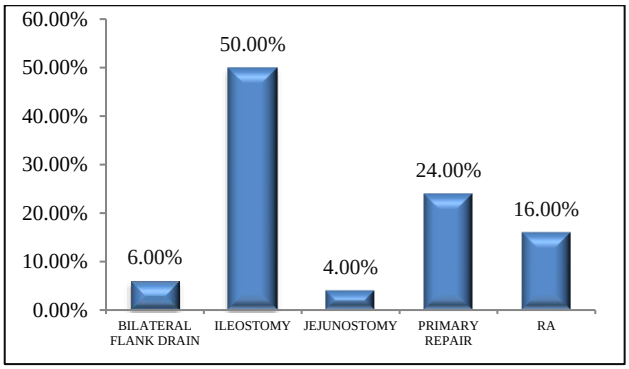

Figure 1: Surgical procedures in study population.

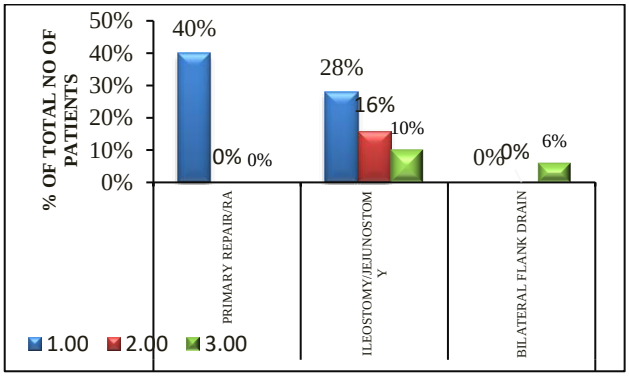

Figure 2: Surgical procedures in the group according to APACHE score.

Table 3: Surgical procedure in comparison to mean length of stay in hospital.

Mean length of stay	Primary repair/ RA	Ileostomy/ Jejunostomy	Bilateral abdominal drain	P value
	13.8	15.39	9.3	<0.001

The patients in group 1 had variable surgical outcome. Out of 34 (68%) patients in group 1, 20 (40%) patients were managed with either primary repair of perforation or resection of perforated bowel segment and anastomosis. 14 (28%) patients were managed with either jejunostomy or ileostomy. None of the patients in group 1 required the placement of bilateral abdominal drain under local anaesthesia instead of operative intervention. Table 3 presented the surgical procedure in comparison to the mean length of stay (LOS) in hospital.

Table 4 represented the rate of anastomotic leak in patients managed with resection and anastomosis of perforated bowel segment.

Table 4: Anastomotic leak rate.

Anastomotic leak	Frequency	Percentage
Present	2	25
Absent	6	75

8 out of the total number of 50 patients were managed with resection and anastomosis of perforated bowel segment. 6 (75%) out of 8 patients had an uneventful post-operative period and were discharged successfully whereas anastomotic leak was observed in 2 (25%) patients who were re-explored and managed with exteriorization of bowel.

Table 5 presented the mortality rate of patients included in this study. As shown in the table, out of 50 patients included in the study 45 patients were discharged whereas 5 deaths were observed i.e., 10% of patients did not survive.

Table 5: Mortality rate of patients.

Outcome	Frequency	Percentage (%)	P value
Died (non - survivor)	5	10	0.004
Discharged (survivor)	45	90	
Total	50	100	

Figure 3 depicts the outcome of patients in relation to their APACHE II score at admission. The mortality rate among patients who had a score of less than 10 was zero. Only 1 death was observed in the group of patients with APACHE II score in the range of 11-20. Mortality rates rose to high levels among patients with a higher APACHE score (>20). 4 deaths were recorded out of 8 patients who had a score >20.

To determine the accuracy of APACHE II score in predicting mortality Receiver Operating Characteristics (ROC) curve was used. The best cut off for APACHE II score to predict mortality was determined from ROC curve. The area under the curve (AUC) was calculated for different cut off points and the cut off at which maximum AUC was obtained was chosen. The cut off came to be 10. At APACHE II score 10 sensitivity and specificity was calculated to be 100% and 75.6% respectively.

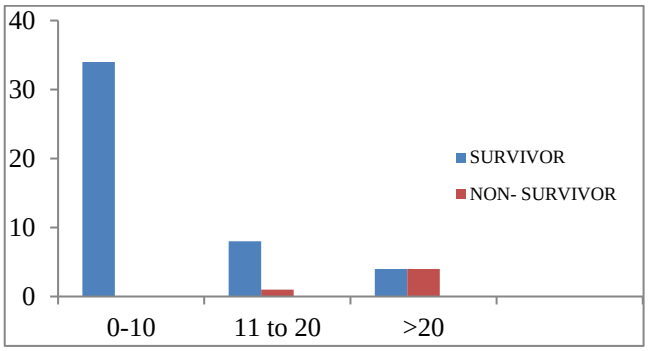

Figure 3: Mortality rate in relation to APACHE score.

DISCUSSION

This was a double-blind observational study to categorize the patients of small bowel perforations as per the APACHE II score and assess its predictive value. The surgeon was blinded by the APACHE II score of each patient calculated at admission. The decision regarding the particular operative procedure done was a subjective decision based on the capability and experience of surgeon, general condition of patient, condition of the bowel, availability of blood, presence of septicaemia, pyaemia, etc. The outcome of the patient was studied as per the APACHE II score and the predictive value of score regarding the outcome was assessed viz. the subjective decision of surgeon. It was assessed whether the outcome was different or similar to as hypothesised in the study. Patients were triaged in group 1 (APACHE II score 0-10), group 2 (APACHE II score 11-20) and group 3 (APACHE II score >20) based on their APACHE II score at admission.

In our study, 50 patients of small bowel perforation peritonitis were included with age ranging from 13 years to 70 years. The mean age of the study population was 36.16 years. The highest number of patients were in the age group of 21-30 years and they constitute 31% of the study population. The median age of study population was 33 years. Male predominance was seen with a male to female ratio of 3.1:1.

When categorized by APACHE II score 34 (68%) patients were in group 1 (APACHE score 0-10), 8 (16%) patients were in group 2 (APACHE score 11-20) and 8 (16%) patients were in group 3 (APACHE score >20).

Primary repair of perforation and/or resection and anastomosis was done in 20 (40%) patients. On correlating their APACHE II score at admission, they were found to have an APACHE II score <10 at the time of admission. Hence, primary repair of perforation or resection and anastomosis of perforated bowel segment was done only in group1 patients which was found to be

statistically significant (p value <0.005). These results were similar to other studies available in the literature, performed on similar lines.[4-6]

In the study, 8 patients out of 20 were managed by resection and anastomosis, 6 of which were discharged satisfactorily while 2 patients developed anastomotic leak post operatively. All the patients in group 1 in our study were discharged satisfactorily i.e. mortality rate was 0%.[4,6,7] Exteriorization of bowel in the form of ileostomy or jejunostomy was performed in 27 (54%) patients out of which 14 (28%) were categorized on the basis of APACHE II score in group 1, 8 (16%) in group 2 and 5 (10%) in group 3.

Mean length of hospital stay was found to be higher (15.39 days) in these patients as compared to mean length of stay in hospital in patients managed with primary repair or resection and anastomosis of bowel (13.8 days). Therefore, it can be inferred that the group 1 patients who underwent exteriorization of bowel could have been well managed with primary repair or resection an anastomosis. Surgeon's decision of exteriorization of bowel increased morbidity in these patients measured in terms of length of stay in hospital, stoma related complications as and the need for a second surgery (surgery for stoma closure).[4,5]

All the patients in group 2 (APACHE II score 11-20) underwent exteriorization of bowel in the form of ileostomy or jejunostomy well correlating with our hypothesis. Hence, indicating that patients with higher APACHE II score are more likely to undergo exteriorization of bowel as compared to those with lower APACHE II score. This is in accordance with the study conducted by Singh et al.[4]

Out of 8 patients with APACHE II score >20, 5 were managed with exteriorization of bowel. Rest of the 3 patients were managed by placement of bilateral abdominal drain alone. These 3 patients expired i.e. placement of drain did not prove to be helpful. They were septicaemic and in dyselectrolemia and could not tolerate well even minimal surgical insult. However, literature is deficient regarding management of patients of perforation peritonitis in this manner.

Overall analysis of data showed that 14 out of 34 i.e., 28% of patients in group 1 underwent exteriorization of bowel contrary to as hypothesised in our study. This decision was based on the surgeon's subjective assessment. These patients had a mean APACHE II score of 7.21 which is higher than the mean APACHE II score of 4.25 of group 1 patients who underwent primary repair of perforation or resection and anastomosis of perforated bowel segment. Similarly, 5 out of 8 i.e., 62% patients in group 3 (APACHE II score ≥20) underwent exteriorization of bowel contrary to the study hypothesis to manage these patients by placement of bilateral abdominal drain placement alone. These patients had a mean APACHE II score of 22.2 which is lower than the mean APACHE II score of 27.3 of group 3 patients who were managed by placement of bilateral abdominal drain. Hence, it can be inferred that patients with an APACHE II score between the range of 7 to 22 can be safely managed by exteriorization of bowel.

In our study APACHE II parameters like temperature, mean arterial pressure, hematocrit and TLC (p value >0.05) did not prove to be of prognostic relevance to surgical outcome. One of the limitations can be the small sample size of the study and a study with large number of patients is required to comment upon their significance. The values of parameters like age, heart rate, repiratory rate, pH, sodium, potassium and creatinine were found to be statistically significant (p value <0.05) and hence of prognostic relevance to the surgical outcome of patients with perforation peritonitis.

Out of the 50 patients in the study population, 45 patients were discharged satisfactorily (survivors) and 5 patients expired (non-survivors). Hence, the overall mortality rate of the study population was 10%. 100% patients in group 1 and 87.5% patients in group 2 were discharged in satisfactory manner. 50% mortality was observed in patients in group 3. Thus, higher APACHE II score was associated with higher mortality. In our study the mean APACHE II score in survivors was 8.38 and mean APACHE II score in non-survivors was 20.6 concluding that mortality is directly linked with higher mean APACHE II score.[3,6,8,9]

To determine the accuracy of APACHE II score in predicting mortality Receiver Operating Characteristics (ROC) curve was used. The best cut off for APACHE II score was calculated to be 10. At APACHE II score 10 sensitivity and specificity was calculated to be 100% and 75.6%. An APACHE score >10 was found to predict mortality with significant difference between 2 groups. Below this score, the mortality rate was 0% and above this score, the mortality rate rose to 31.25%.[10,11]

CONCLUSION

Management of small bowel perforations pose a challenge to general surgeons even in the present world. An objective approach helps establish optimal treatment strategy in patients of small bowel perforations and hence, the best possible treatment along with significant reduction in morbidity and mortality. APACHE II scoring system can be reliably used for preoperative risk stratification and plan management in patients of small bowel perforations.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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