

# Accuracy of BOEY Score in Predicting Morbidity and Mortality in Patients of Perforation Peritonitis

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## ABSTRACT

**Background:** Perforation peritonitis is one of the most common gastrointestinal surgical emergencies in India and worldwide. Early prognostic evaluation of patients with peritonitis is desirable to select high-risk patients for intensive management and also to provide a reliable objective classification of severity and operative risk. The Boey score is among the most commonly used scores for risk stratification because of its simplicity and high predictive value for mortality and morbidity in cases of peptic ulcer perforation. **AIM:** To evaluate the accuracy of the Boey scoring system in predicting postoperative morbidity and mortality in patients operated for perforation peritonitis. **Methods:** The study was a hospital-based observational study conducted in the Department of General Surgery, Government Medical College and Rajindra hospital from 2016 to 2019. Postoperative outcomes in terms of recovery and complications were studied. Prediction of morbidity and mortality was made on the basis of the preoperative Boey score. **Results:** The mortality and morbidity rates increased progressively with increasing numbers of the Boey score. **Conclusion:** Boey score is a useful tool for assessing the prognosis of operated cases of perforation peritonitis and helps in the assessment of mortality and morbidity of these patients.

**Keywords:** Boey, Perforation, Peritonitis, Morbidity, Mortality.

## INTRODUCTION

Perforation Peritonitis is defined as inflammation of the peritoneum due to the perforation of a hollow viscus.<sup>[1]</sup> Most commonly perforation occurs in the stomach, duodenum, small intestines, appendix and colon.<sup>[2]</sup> The common causes in India include perforated gastric /duodenal ulcer followed by appendicitis, blunt trauma abdomen, typhoid fever and tuberculosis. Other causes may include diverticulitis, malignancy and instrumentation.<sup>[3-5]</sup> Surgery is the mainstay of treatment in bowel perforation, which provides for conventional laparotomy and endoscopic or laparoscopic procedures.<sup>[6,7]</sup> Early prognostic evaluation and grading of patients with peritonitis are desirable to select high-risk patients for intensive management and also to provide a reliable objective classification of severity and operative risk.<sup>[8]</sup>

Several scoring systems assist in the classification of the patients with peritonitis like Boey score, Peptic ulcer perforation (PULP) score, Acute physiology and chronic health evaluation score (APACHE), Mannheim peritonitis index (MPI) etc. These scoring systems compare postoperative mortality as an outcome parameter and also predict morbidity

among the patients.<sup>[9]</sup> They also serve as prognostic markers and help in evaluating the line of management.<sup>[10]</sup>

The Boey score is the most commonly used because of its simplicity and high predictive value for mortality and morbidity in cases of PPU.<sup>[11,12]</sup> Higher the Boey score, more are the rates of both morbidity and mortality.<sup>[12]</sup> As originally described by John Boey et al, the Boey score included only duodenal perforations.<sup>[13,14]</sup> Our study was designed to highlight the spectrum of Boey score in perforation peritonitis, including gastroduodenal, small intestinal and appendicular perforations.

## MATERIALS AND METHODS

A hospital-based prospective observational study was conducted in the Department of General Surgery, Government Medical College and Rajindra hospital from 2016 to 2019. All patients presenting to surgical emergency diagnosed as a case of perforation peritonitis were taken into study. The patients excluded from the study were patients below 12 years, primary peritonitis, tertiary peritonitis and iatrogenic perforations, Perforations associated with proven malignancy and pregnant patients.

A detailed clinical history regarding the symptoms, co-morbid conditions (cardiorespiratory diseases - hypertension, bronchial asthma, renal disease, hepatic disease, and diabetes mellitus) and past history was taken. After a general examination of the patient, including the assessment of the vitals i.e.,

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pulse, blood pressure, temperature, Glasgow Coma Scale (GCS) and respiratory rate, a detailed per abdomen examination of the patient including tenderness, guarding, rigidity and a palpable mass were checked for. The remaining systemic examination included the respiratory system, cardiovascular system and the central nervous system. Meticulous examination to look for signs of any liver disease was done. All patients underwent appropriate biochemical investigations, radiological investigations such as x-rays of the chest to check for the presence of free air under the diaphragm and erect x-ray of the abdomen along with ultrasonography of abdomen and pelvis to check for free fluid in abdominal cavity and ecg. The preoperative Boey score was calculated and the patients were taken up for laparotomy after aggressive resuscitation. The Boey score is based on the following parameters.<sup>[13,14]</sup>

Parameter	Score
CONCOMITANT MEDICAL ILLNESS (Cardiorespiratory disease, Renal disease, Liver disease, Diabetes mellitus)	1
PREOPERATIVE SHOCK (SYSTOLIC BP <90 mm of Hg)	1
DURATION OF PERFORATION MORE THAN 24 HOURS (DEFINED AS INTERVAL FROM THE ONSET OF SYMPTOMS UNTIL SURGERY)	1
NONE OF THE ABOVE	0

In each and every case of perforation peritonitis during laparotomy appropriate surgical management of perforation (Omental patch repair for gastric/duodenal perforations, primary repair, or ileostomy for ileal holes, appendectomy for appendicular aperture) as per surgeon's choice depending upon the condition of the patient. An intra-abdominal drain was placed and thorough peritoneal lavage was done using normal saline in all cases.

Postoperatively, intravenous antibiotics were given for 3– 5 days. During postoperative period evaluation was done regarding morbidity and mortality. In the case of uneventful recovery, patients were discharged from the hospital when they had a good appetite and were ambulatory. Patients who had complications were managed accordingly. All patients were called for follow up 15 days after surgery and after that as per requirement.

During the postoperative period, an evaluation was done regarding morbidity and mortality. All patients were called for follow up 15 days after surgery and after that as per requirement. In-hospital mortality and morbidity up to 30 days postoperatively were taken as the outcome. Morbidity was assessed in terms of wound infection, wound infection grade (as per CDC criteria - Superficial/Deep/Organ space), wound dehiscence, pneumonia, length of hospital stay, intra-abdominal collection requiring any intervention, need for re-exploration and

postoperative parameters including day of passage of flatus, day of adoption of stools, day of the start of the oral feed.

The data thus collected was transferred to a computer based spreadsheet and analyzed using SPSS statistical software version. The association of various levels of Boey with mortality incidence and morbidity occurrences was tested using Chi-Square Test for trend analysis. Logistic regression analysis and Receiver Operating Characteristics (ROC) curve analysis were used to estimate the predictive ability of Boey's score in assessing the postoperative mortality and morbidity.

## RESULTS

A total of 50 patients who underwent surgery for perforation peritonitis were included in our study. The mean age of patients was 45.62±16.65 years and the maximum number of patients (22 out of 50) were seen in the age group 20- 60 years. 44 (88.0%) out of 50 patients were males and 6 (12.0%) were females. 23 (46%) patients presented to the hospital after 24 hours of the onset of acute abdominal pain and preoperative shock was seen in 17 (34%) patients. The concomitant medical illness was present in 14 (28%) patients. The most common site of perforation seen was an ileal perforation, followed by Gastro duodenal perforations. The appendicular hole was the least common.

The overall postoperative complication rate was 42% (21 Patients). The most common complications were found to be wound infection and wound dehiscence seen in 21 (42%) patients and 11 (22%) patients, respectively. Out of 21 patients who developed wound infection, 5 (23.81%) patients developed a superficial infection while grave and organ space disease was seen in 11 (52.38%) and 5 (23.81%) patients, respectively. Pneumonia was observed in only 2 (4%) patients and both of them were managed conservatively. 1 (2%) patient had a copious collection in spite of intra-abdominal drains and this patient had to be re-explored.

The mean day of passage of flatus and passage of stool was 2.12±0.52 and 3.96±1.35 days, respectively. The mean day of the start of oral feed was 3.74±0.79 days. The patients with the least Boey score passed flatus and stool early and also were started orally soon as compared to patients with a higher Boey score. The relationship of the Boey score with the passage of flatus, stool and start of oral feed was significant (p=0.004, p=0.021 & p=0.001 respectively).

The mean duration of hospital stay in patients was 11.52±6.78. The period of hospital stay increased with an increase in the Boey score and the relation was statistically significant (p=0.009). The mean duration of hospital stay was less in patients with Boey score 3 because 3/5 (60%) patients died in the early postoperative period. 1/2 patients with Boey

score 3 who survived had the most extended duration of hospital stay i.e. 32 days.

The overall postoperative mortality rate was 16% (8 Patients). Out of the 8 patients who died, 6 (75%) died due to septicemia and subsequent multi-organ failure. 1 (12.5%) patient had an acute myocardial infarction and 1 (12.5%) patient succumbed to respiratory complications in the postoperative period.

**Parameters of Boey score and outcome**

In our study, both mortality and morbidity were much higher in patients presenting after 24 hours of the onset of symptoms. The statistical relationship of

duration of perforation with both mortality and morbidity was also significant (p = 0.010 & p=0.002, respectively). In patients with the presence of preoperative shock (SBP < 90 mm of Hg) also showed high mortality and morbidity. The relationship of preoperative trauma (SBP ≥ 90 mm of Hg) with both mortality and morbidity was also statistically significant (p=0.001 & p=0.045, respectively). However, in patients with the presence of concomitant medical illness, the death was low as but morbidity was high as compared to patients with no concurrent medical disease. The relationship of concomitant illness with mortality was insignificant (p=0.211) but significant (p =0.009) with morbidity.

**Table 1: Important Clinical Characteristics**

Characteristics	No. of patients (%age)	Mortality	Morbidity
Presence of preoperative Shock (SBP <90mm of Hg)	17 (34%)	8 (47%)	9 (52.9%)
Duration of perforation ≥ 24 hour	23 (46%)	7(30.4%)	15 (65.2%)
Presence of Concomitant medical illness	14 (28%)	3 (21.4%)	10 (71.4%)

**Table 2: Distribution of Patients According to Type of Perforation**

Type of Perforation	No. of patients (%age)	Mortality	Morbidity
Appendicular perforation	2 (4%)	0	1 (50%)
Gastro duodenal Perforation	21 (42%)	4 (19.0%)	6 (28.5%)
Ileal Perforation	27 (54%)	4 (14.8%)	14 (51.8)
Total	50 (100%)	8 (16%)	21 (42%)

**Table 3: Showing Incidence of Postoperative Complications**

Postoperative Complications	Patients	Percentage	
Wound Infection (n=21)	Superficial	5	23.81%
	Deep	11	52.38%
	Organ Space	5	23.81%
Wound dehiscence	11	22%	
Pneumonia	2	4%	
Need for Re-exploration	1	2%	

**Table 4: Showing Correlation of BOEY Score and Postoperative Parameters**

Boey Score	No. of Patients	Mean day of passage of flatus	Mean day of adoption of stool	Mean day of the start of an oral feed	Mean Hospital Stay (in days)
0	16	1.75±0.45	3.56±1.21	3.31±0.48	7.56±1.36
1	19	2.16±0.37	3.72±1.53	3.67±0.69	13.42±4.83
2	10	2.40±0.52	4.88±0.64	4.50±0.84	13.50±9.73
3	5	2.60±0.55	5.00±1.00	5.00±0.00	13.00±12.04

**Table 5: Showing Distribution of Patients with Morbidity and Mortality According to BOEY Score**

Boey Score	No. of Patients (%age)	Morbidity (%age)	Mortality (%age)
0	16 (32%)	1(6.25%)	0 (0%)
1	19 (38%)	10 (52.63%)	1 (5.26%)
2	10 (20%)	6 (60%)	4 (40%)
3	5 (10%)	4 (80%)	3 (60%)
Total	50 (100%)	21(42%)	8 (16%)

**Type of perforation and outcome**

Mortality was highest in patients with gastroduodenal perforations followed by ileal perforation patients, while no death was seen in patients of appendicular perforation. Morbidity was highest in patients of ileal perforation, followed by appendicular perforation patients and least in patients of gastroduodenal perforation patients. The relationship of type of hole with both mortality and morbidity was statistically insignificant (p= 0.840 & p=0.272 respectively).

**Boey score and outcome**

The mortality rate increased progressively with increasing of Boey score: 0%, 5.26%, 40%, and 60% for 0, 1, 2, and 3 scores, respectively. The morbidity rate also increased progressively with increasing Boey score: 6.25%, 52.63%, 60% and 80% for 0, 1, 2 and 3 scores, respectively. The relationship of Boey score with mortality and morbidity was also statistically significant (p=0.001 & p=0.014) in our study.

**Predictability of Boey score**

The area under the curve (AUC) in ROC curve analysis was 0.881 and 0.776 for mortality and

morbidity, respectively. The sensitivity for mortality and morbidity was 88.1% and 77.6%, respectively. Receiver–operating characteristic (ROC) curve analysis demonstrated the high predictive value of Boey score in predicting postoperative mortality and morbidity in our study.

## DISCUSSION

The mean age of patients of perforation peritonitis in our study was  $45.62 \pm 16.65$  years. The mean age is comparable to earlier studies.<sup>[15,16]</sup> We found male preponderance in all types of perforation peritonitis which is also well depicted in earlier studies.<sup>[13,17-20]</sup> Ileum was the common site of perforation in our study and the same trend has been seen in previous studies.<sup>[21]</sup>

### Parameters of Boey Score and Outcome

In our study, both mortality and morbidity increased significantly with an increase in the duration of symptoms as with an increase in time of the perforation. There is heavy bacterial contamination which worsens the prognosis.<sup>[13,22]</sup> Malik et al,<sup>[23]</sup> in their study termed first 24 hours as the most important factor to determine the outcome in patients of perforation peritonitis. Similar findings have been published by various authors in the past.<sup>[24-26]</sup>

The preoperative shock has been a significant outcome defining factor both in terms of mortality and morbidity in previous studies.<sup>[27-31]</sup> Preoperative shock in patients of perforation peritonitis can be due to various reasons such as hypovolemia due to third space loss, dehydration and as a part of sepsis syndrome. Prolonged preoperative shock may eventually lead to a renal shutdown, thus increasing the mortality in these patients.<sup>[32]</sup> In our study also preoperative trauma was associated with an increase in both mortality and morbidity in patients of perforation peritonitis.

Although mortality and morbidity rates were higher in patients with concomitant medical illness but the relationship of concomitant medical illness was statistically significant only for morbidity in our study. The mortality was higher in patients with concomitant medical illness because of preexisting chronic diseases such as cardiopulmonary disease, chronic kidney disease, liver disease etc which are itself a high-risk factor for mortality in patients undergoing emergency surgery.<sup>[33]</sup> Postoperative complications such as wound infections are also common in patients with a chronic medical illness such as diabetes mellitus because of decreased immunity.<sup>[34]</sup> The significant association of concomitant medical illness with only morbidity in our study is in agreement with previous studies.<sup>[30,35-36]</sup>

### Site of Perforation

The relationship between site of perforation and both mortality and morbidity was statistically

insignificant in our study. The location of hole was neither a predictor of mortality nor morbidity in our study.

### Boey Score and Postoperative Parameters

In our study, we studied 4 postoperative parameters, namely hospital stay, day of passage of flatus and stool and day of the start of the oral feed. The mean duration of hospital stay was  $11.52 \pm 6.78$  days. The minimum hospital stay was 3 days and the maximum stay was 32 days. The duration of hospital stays increased with an increase in the Boey score of the patients. The reason for the increased duration of hospital stay with an increase in the Boey score is that patients with higher Boey score had more incidences of complications. Patients with wound infection and wound dehiscence required daily aseptic dressings along with intravenous antibiotics for a longer duration and some wounds required open wound care or secondary suturing, which increased the hospital stay. Patients with pneumonia also required a longer duration of intravenous antibiotic therapy and occasionally ICU care. The significant increase in morbidity due to increased hospital stay in patients of perforation peritonitis is comparable with previous studies.<sup>[30,32,37]</sup>

The mean day of passage of flatus and stool and the start of oral feed increased with an increase in Boey score. Patients with higher Boey score passed flatus and stool later than patients with lower Boey score because of the fact that patients with higher Boey score had increased duration of paralytic ileus which may be attributed to various factors like intra-abdominal collections, protein imbalance, metabolic disturbances due to severe sepsis and altered physiological status of the patient. So these patients were kept NPO for a longer duration. This has also been well documented in previous studies.<sup>[38,39]</sup>

### Boey Score and Morbidity

The overall postoperative complication rate in previous literature ranges from 17 % to 63% in patients of perforation peritonitis. In our study the overall morbidity rate was 42%. Emergency surgery for perforation peritonitis carries a high risk of wound infection due to contaminated abdominal cavity with a wound infection rate of 15–40%.<sup>[40,12]</sup>

The morbidity rate increased progressively and significantly with increasing Boey score i.e 6.25%, 52.63%, 60% and 80% for 0, 1, 2 and 3 scores, respectively. The association of Boey score with morbidity in our study is similar to the previous study by Agarwal et al,<sup>[30]</sup> (2015) in which the morbidity rates were 13%, 45.7%, 70.7% and 73.7% for 0, 1, 2 and 3 scores respectively with an overall morbidity rate of 43.9%.

### Boey Score and Mortality

In our study, the overall postoperative mortality rate was 16%. The mortality rate increased progressively

and significantly with increasing numbers of Boey score: 0%, 5.26%, 40%, and 60% for 0, 1, 2, and 3 scores, respectively. In the original study by Boey et al,<sup>[13]</sup> (1987) also mortality rate increased progressively with increasing Boey score i.e. 0%, 10%, 45.5% and 100 % for a score of 0,1, 2 and three respectively. In a study by Agarwal et al,<sup>[30]</sup> (2015), the mortality rates increased significantly with an increase in Boey score i.e. 1.9%, 7.1%, 31.7% and 40% for score of 0,1, 2 and 3 respectively with overall mortality rate of 13.9%. Similar results were seen in other studies also.<sup>[12,37,41]</sup> The mortality rate is less in patients with Boey score 3 in our study as compared to original study by Boey et al,<sup>[22]</sup> (1982) because of the fact that medical services have seen advances over time. Ours being a tertiary health care center has specialized and dedicated ICU & ICCU care. Immediate and regular consultations by multispecialty departments and coordination with anesthetic experts lead to better management of these patients.

### ROC curve analysis and AUC

The area under the curve (AUC) in ROC curve analysis in our study was 0.881 and 0.776 for mortality and morbidity, respectively. The area under the curve for mortality and morbidity seen in previous studies were 0.860 and 0.800 by Lohsiriwat et al,<sup>[12]</sup> (2009), 0.793 and 0.753 by Agarwal et al,<sup>[30]</sup> (2015), 0.849 and 0.887 by Gulzar et al,<sup>[37]</sup> (2016) respectively.

The sensitivity of Boey score in predicting mortality and morbidity was 88.1% and 77.6% in our study, respectively. In previous studies the sensitivity of boey score for predicting mortality and morbidity was found to be 79.3% and 75.3% by Agarwal et al,<sup>[30]</sup> (2015), 86% and 80% by Lohsiriwat et al,<sup>[12]</sup> (2009), 84.90% and 88.70% by Gulzar et al,<sup>[37]</sup> (2016) respectively.

### CONCLUSION

Even with advancement in treatment, perforation peritonitis still carries high risk of mortality and morbidity. It is imperative to classify patients of perforation peritonitis according to high risk in patients in order to plan their appropriate and timely management. Age  $\geq 60$  years, duration of perforation  $\geq 24$  hours from onset of symptoms till surgery, preoperative shock (SBP  $< 90$  mm of Hg) were independent risk factors along with Boey score for both mortality and morbidity. Boey score served as a simple, secure, precise and reliable predictor of mortality and as well as morbidity in patients of perforation peritonitis irrespective of the site of perforation. So, Boey scoring system can be considered for risk stratification in patients of perforation peritonitis. However, the only limitation of our study is its small size. Therefore, to prove and authenticate our results, further studies with a larger sample size may be more conclusive.

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