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Original Research Article

The utility of the Boey scoring system in predicting postoperative morbidity and mortality in patients with perforative peritonitis

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ABSTRACT

Background: Perforated peptic ulcer remains a common surgical emergency despite advances in medical therapy. The Boey score-based on duration of perforation >24 hours, preoperative shock, and significant comorbidity-has been proposed as a simple prognostic tool for postoperative outcomes.
Methods: In this prospective observational cohort study conducted over 18 months at a tertiary rural hospital, 46 consecutive patients with confirmed perforated peptic ulcer underwent urgent open repair with primary closure and pedicled omentoplasty. Boey scores (0-3) were calculated at admission, and patients were classified as low risk (0-1) or high risk (2-3). Demographic, clinical, radiographic, operative and postoperative data were recorded. Associations between Boey score components and mortality were analyzed using chi-square/Fisher's exact tests and multivariate logistic regression. Diagnostic performance was assessed by ROC analysis, sensitivity, specificity, predictive values, and Likelihood ratios (LR).
Results: Forty-six patients (mean age 52.07±15.97 years; 73.9% male) were studied; overall mortality was 13.0% (6/46). Comorbidities were present in 14 (30.4%). Boey scores: 0 (n=13, 28.3%), 1 (n=19, 41.3%), 2 (n=11, 23.9%), 3 (n=3, 6.5%); high scores (2-3) comprised 14 (30.4%). Mortality increased with Boey score (score 2: 27.3%; score 3: 66.7%). Preoperative shock was significantly associated with death (p=0.009); delayed presentation (>24 h) was more frequent among deaths but not significant (p=0.198). Boey score and age were independent predictors; AUC for Boey=0.792 (p=0.022).
Conclusions: The Boey score is a practical and moderately accurate predictor of postoperative mortality in perforated peptic ulcer patients; preoperative shock is the strongest individual predictor, and delayed presentation and comorbidity further increased risk.

Keywords: Boey scoring system, Peptic ulcer perforation, Perforation peritonitis, Predictive scoring system, Risk stratification

INTRODUCTION

Peptic ulcer perforation has been one of the common causes of acute abdomen presenting in an emergency setting. Even after the widespread use of anti-ulcer therapy and Helicobacter eradication, perforated peptic ulcer remains the most common indication for emergency surgery. And even though perforated duodenal ulcers result in 6% operative mortality, surgeons still prefer immediate definitive surgery as the first line of management.[1]

Duodenal ulcers have been found to be the principal cause of peptic ulcer perforations amounting to 79% and are seen not only in acute ulcers due to the use of non-steroidal anti-inflammatory drugs (NSAIDs) but also in chronic ulcers refractory to treatment or in patients with poor compliance to medications.[2,3] *Helicobacter pylori* and NSAID intake are two independent risk factors associated with perforated duodenal ulcers and the absence of duodenitis in NSAID users as compared with those with *H. pylori* infection suggests a separate pathogenesis.[4]

Perforated peptic ulcer disease has historically been managed through both operative and non-operative strategies. Nevertheless, surgical intervention remains the standard of care in most clinical settings, owing to its effectiveness in controlling sepsis, repairing the perforation, and reducing mortality risk.

Boey et.al. identified three individual clinical factors which can help in risk stratification.[1] We prospectively analyzed the usefulness of Boey scoring system in predicting post-operative mortality in perforated peptic ulcer patients in a tertiary hospital in rural India. This straightforward scoring system can assist in categorizing risks, forecasting potential post-operative complications and challenging recovery phases, as well as managing the expectations of family members.

This study objectives were to evaluate the utility of the Boey scoring system in predicting postoperative outcomes among patients with peptic ulcer perforation presenting with acute abdomen. Specifically, the study assessed the prognostic significance of the individual components of the Boey score, including duration of perforation, preoperative shock, and associated comorbid conditions, and correlated the calculated score with postoperative morbidity and mortality.

METHODS

Study design and ethical approval

This was a prospective observational cohort study conducted over 18 months at Bharati Vidyapeeth Deemed to be University Medical College and Hospital Sangli, a tertiary care hospital. The study was initiated after obtaining approval from the institutional ethics committee.

Patient selection

All patients presenting with acute abdominal pain were evaluated. Those with confirmed peptic ulcer perforation were included, while other causes of acute abdomen were excluded. A purposive sampling technique was applied.

Clinical evaluation

Upon admission, a thorough clinical history was obtained, emphasizing the duration of symptoms. A complete general and systemic examination was performed, with relevant findings documented. Blood pressure was measured in the supine position using a mercury sphygmomanometer.

All patients underwent both chest and upright abdominal radiographs to detect pneumoperitoneum. In the absence of computed tomography, diagnosis was based on plain radiographs. Patients with confirmed perforation peritonitis were promptly scheduled for urgent surgery.

The Boey score was calculated for each patient based on three risk factors: Duration of perforation (>24 hours), preoperative shock (systolic BP<90 mmHg) and presence of major comorbid illness

Each factor was assigned a score of 1, yielding a total score ranging from 0-3. Patients were categorized as low risk (0-1) or high risk (2-3).

Surgical procedure and postoperative care

All patients underwent open repair with primary closure and pedicled omentoplasty, accompanied by copious peritoneal lavage. Peritoneal fluid was submitted for culture and sensitivity testing, and antibiotics were administered according to culture results. Patients were followed postoperatively until discharge, and all complications were recorded.

Statistical analysis

Data were analyzed to determine: Age-and sex-wise distribution of patients and their relationship with postoperative outcomes. Association of Boey scores and its individual components with postoperative morbidity and mortality using the Chi-square test. Strongest predictors of postoperative outcomes using multivariate analysis. Diagnostic accuracy of the Boey score by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), false-positive rate, and false-negative rate. A receiver operating characteristic (ROC) curve was generated to determine the optimal cutoff value of the Boey score for mortality prediction.

RESULTS

The total number of patients in this study was 46. The mean age of the study subjects was 52.07 and SD±15.967. Their age ranged from 16 years to 80 years as the oldest. Out of 46, there were 12 (26.09%) females, and the males were 34 (73.91%). There was male predominance in this study in patients presenting with perforated peptic ulcer. Out of 46 patients 6 (13.04%) patients died postoperatively and 40 (86.96%) recovered completely.

Table 1: Age and gender wise distribution of patients.

Age group (in years)	Gender		Total
	Female	Male	
16-35	1	6	7
	14.29%	85.71%	100.00%
36-60	4	19	23
	17.39%	82.61%	100.00%
61-80	7	9	16
	43.75%	56.25%	100.00%
Total	12	34	46
	26.09%	73.91%	100.00%

The number of patients having hypertension was 5 (10.87%) while those having diabetes mellitus were 4 (8.69%). Chronic obstructive pulmonary disease (COPD) had 2 (4.35%) patients while dilated cardiomyopathy, cerebrovascular accidents, steroid dependency and liver cirrhosis had 1 (2.17 %) patient each. There was one patient having both diabetes mellitus and hypertension (2.17%).

Thirteen patients (28.26%) had a Boey score of 0, 19 (41.30%) had a score of 1, 11 (23.91%) had a score of 2, and 3 (6.52%) had a score of 3; overall, patients with lower Boey scores (0-1) predominated compared with those with higher scores (2-3).

Gender distribution by score was as follows: for score 0 (n=13), there were 3 females (23.08%) and 10 males (76.92%); for score 1 (n=19), 3 females (15.79%) and 16 males (84.21%); for score 2 (n=11), 5 females (45.45%) and 6 males (54.55%); and for score 3 (n=3), 1 female (33.33%) and 2 males (66.67%). There was no association between gender and score after applying Fischer's exact test with the values (x^2=3.328, df=3, p=0.361).

There was a total of 13 patients with Boey score of 0 from which 12 (92.31%) survived and 1 (7.69%) died. The Boey score of 1 had 19 patients, of which all 19 (100%) patients survived. The Boey score of 2 had 11 patients out of which 8 (72.73%) survived and 3 (27.27%) died. There were similarly 3 patients with Boey score of 3 of which only 1 (33.33%) survived and other 2 (66.67%) died.

Of the forty patients who survived, five (twelve-point five percent) presented with preoperative shock and the remaining thirty-five (eighty-seven-point five percent) were normotensive; among the six patients who died, two (thirty-three-point three percent) were normotensive and four (sixty-six-point seven percent) had preoperative shock, indicating that postoperative mortality was more common in patients who presented with preoperative shock. The values were obtained after applying Fischer's exact test (x^2=9.727, df=1, p=0.009). Thus, pre-operative shock has a significant association with post-operative outcomes.

Of the 40 survivors, 20 (50.00%) presented within 24 hours of symptom onset and 20 (50.00%) presented after 24 hours; among the six patients who died, one (16.67%) presented within 24 hours and five (83.33%) presented after 24 hours, suggesting higher mortality for perforated peptic ulcer patients who present more than 24 hours after perforation.

However, the observed difference was not statistically significant as per Fischer's exact test (x^2=2.33, df=1, p=0.198)

Table 2 shows the association between co-morbidities and post-operative outcomes. The patients who survived were 40 out of which 29 (72.50%) patients had no co-morbidities while the remaining 11 (27.50%) patients had co-morbidities.

While out of the 6 patient who died 3 (50.00%) patients had no co-morbidities and the other 3 (50.00%) patients had co-morbidities, namely diabetes mellitus, liver cirrhosis and cerebrovascular accidents individually. The values were obtained after applying Fischer's exact test (x^2=1.248, df=1, p=0.350) not statistically significant.

Binary logistic regression analysis was done to identify strong predictors of post-operative outcomes by using the backward Wald method. It shows that Boey score was strong predictor of outcome followed by age.

Table 2: Association between co-morbidities and post-operative outcome.

Post-operative outcome	Co-morbidities		Total	Significance
	No	Yes		
Alive	29	11	40	x^2=1.248 df=1 p=0.350
	72.50%	27.50%	100.00%	
Death	3	3	6	
	50.00%	50.00%	100.00%	
Total	32	14	46	
	69.57%	30.43%	100.00%	

Table 3: Binary logistic regression analysis for identifying strong predictors for post-operative outcome.

Factors	B	S.E.	Wald	Df	Sig.	Exp (B)	95% C.I. for EXP (B)	
							Lower	Upper
Age (in years)	0.048	0.038	1.614	1	0.204	1.049	0.974	1.13
Boey score	1.454	0.639	5.179	1	0.023	4.28	1.224	14.974
Constant	-6.781	2.675	6.427	1	0.011	0.001		

Table 4: Predictive accuracy of Boey score.

Boey score	Post-operative outcome		Total
	Death	Alive	
High score (2+3)	5	9	14
Low score (0+1)	1	31	32
Total	6	40	46

Table 5: Validity measures of Boey score.

Measures	Calculated value (%)
Sensitivity	83.33
Specificity	77.50
Predictive value of a positive test	35.71
Predictive value of a negative test	96.88
Percentage of false-negative	16.67
Percentage of false-positive	22.50

Sensitivity

Boey score can predict the post-operative outcome correctly for 83.33% of cases (True-positive).

Specificity

Boey score has the ability to identify survival correctly in 77.50% of cases (True-negative).

Predictive value of a positive test

Predictive accuracy of Boey score for positive test is 35.71%.

Predictive value of a negative test

Predictive accuracy of Boey score for negative test is 96.88%.

Percentage of false-negative

The percentage of patients predicted by Boey score to survive but died was 16.67%.

Percentage of false-positive

The percentage of patients predicted by Boey score to die but survived was 22.50%.

Table 6: LR.

LR	Values
LR positive	3.70
LR negative	0.215

Table 6 shows the LRs. The LR positive for Boey score is 3.70 and the LR negative is 0.215. LR positive of 3.70 suggests that death is approximately 4 times more likely to occur in patients with high Boey score. LR of 0.215 indicates a moderate decrease in mortality with the lower Boey score.

Table 7: Test values for ROC curve.

Area	Std. error	Asymptotic sig.	Asymptotic 95% confidence interval	
			Lower bound	Upper bound
0.792	0.125	0.022	0.547	1.000

Table 7 shows the ROC curve. This curve can be considered a 'good' curve. Area under the ROC curve is the measure of accuracy. The area under curve (AUC) for Boey score is 0.792 and can be considered as having a fair accuracy for predicting post-operative mortality. Since p=0.022, Boey score is useful in predicting post-operative mortality.

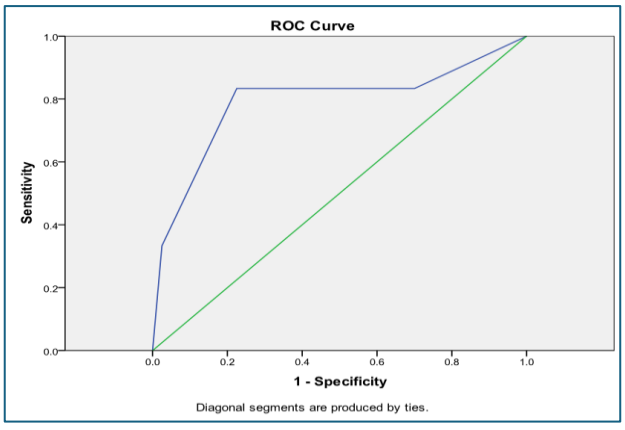

Figure 1: ROC curve.

Table 8: Cut-off values from ROC curve.

Positive if greater than or equal To	Sensitivity	1-Specificity
-1	1	1
0.5	0.833	0.7
1.5	0.833	0.225
2.5	0.333	0.025
4	0	0

Table 8 helps us to decide the cut-off value from the ROC curve. Thus, the Boey score of 1.5 can predict post-operative mortality of 83.3% accurately. And the false-positive is 22.5%.

DISCUSSION

If a patient with perforated peptic ulcer does not receive any treatment, there are very high chances of morbidity and mortality. Such a patient presenting with perforated peptic ulcer should be posted for emergency exploration unless the patient is not fit for surgery. Emergency laparotomy followed by primary closure of perforation and omentoplasty along with proper peritoneal lavage is preferably done. The two types of omentoplasties are Graham's patch and the Cellan-Jones technique. The Grahams patch being the free omental graft while Cellan-Jones involves the use of a pedicled omental graft. The use of pedicled omental graft is advisable as it remains viable for a longer duration. The role of definitive surgeries has been debated in the management of perforated peptic ulcers and remains ill-defined. Definitive procedures like highly selective vagotomy have been done in few centers when patients present early and have no co-morbid factors. However, definitive surgeries like Bilroth I/II, vagotomy adds to morbidity and mortality in patients presenting late and having co-morbid factors by increasing the duration of surgery. Thornby however, advised performing omental patch closure with parietal cell vagotomy claiming that the patients undergoing this procedure had a recurrence rate of 5% compared to 58% seen in patients operated with simple closure.[5]

There are many scoring systems in place to predict mortality in patients with perforated peptic ulcer such as the Boey score, the Mannheim Peritonitis Index score, the American Society of Anesthesiologists score and more. One of the most common questions faced by a surgeon posed by the relatives of the patient is what the chances of patients' survival are. Boey score, which consists of duration of perforation, pre-operative shock and any associated co-morbid illness, has been found as a simple and easily reproducible predictive model in predicting post-operative outcome.

There were a total of 9 (19.57%) patients having pre-operative shock from which 4 (66.67%) did not survive. Also, there is significant association between pre-operative shock and mortality after applying Fischer's exact test. Thus, there is statistical significance of association for pre-operative shock as a risk factor for predicting mortality. Chalya and et al documented mortality of 22.2% in patients having pre-operative shock.[6]

Also, out of the 6 patients who did not survive 5 (83.33%) patients presented beyond 24 hours. Thus, it can be inferred that duration of symptoms is an independent risk factor for predicting mortality. Ugochukwu and et al in their study found that patients presenting beyond 24 hours had about 27.4% mortality.[7] Thus, there is significant association between perforation-operation interval and outcome. However, because our center being a tertiary care unit, most of the patients are referred from peripheral hospitals. These patients might have been resuscitated by intravenous fluids, Ryles tube, antibiotics, etc. which may influence the outcome of mortality and hence could be a limiting factor in outcome.

There was a total of 16 (34.78%) patients in our study having co-morbid illnesses. From the 6 deaths documented in our study, 3 (50%) patients had co-morbid illness. Unver and et al. found that 92.9 % of patients in the mortality group had co-morbid illness.[8] Chalya et al had a mortality of 66.7% in patients having co-morbid illness.[6] Thus, it can be surmised that co-morbid illness is a predictor for mortality.

This study was conducted in a rural medical college hospital. The total number of patients included in this study was 46. The number of male patients was 34 (73.91%) and those of females was 12 (26.09%). Thus, there was significant male preponderance in this study. Their age ranged from 16 to 80 years of age. The mean age of the study subjects was 52 and standard deviation (SD) of ±15.967. Lohsiriwat and et al. had a study group with mean age of 52 years (range: 15-88 years), and 78% were male which is comparable to our study.[9] Unver et al in their study group had 73.2% male patients and 26.8% female patients.[8] Tas et al had a study group which included 87.2% male patients and 12.8% female patients. The mean of their study group was 51.7 with standard deviation (SD) of ±20 (15-88).[10] Even, Lee et al observed that the mean±SD age for the patients in the study group was 51.5±18.3 years (range, 14-92 years), with male predominance.[2] These findings are similar to the findings of our study. Out of the 46 patients in the study group, 6 (13.04%) patients did not survive. Tas et al observed a mortality of 18.2%.[10] Gona et al in their study observed a mortality of 19.3%.[11] Lohsiriwat et al observed a mortality rate of 9%.[9]

The mortality associated with Boey score 2 was 27.27% and Boey score 3 had about 66.67% mortality. The mortality associated with the 30.43% of patients having Boey score >2 was 83.33%. Soreide et al observed in their study that out of the 33% of patients having Boey score >2 had 64 % of death which is comparable to our study.[12] There is a significant risk association between high Boey score and mortality. A binary logistic regression analysis by backward Wald method showed that Boey score followed by age were strong predictors for post-operative outcome.

Area under the ROC curve is the measure of accuracy. The AUC for Boey score is 0.792 and can be considered as having a fair accuracy for predicting post-operative mortality. Since p=0.022, Boey score is useful in

predicting post-operative mortality. Nichakankitti and et al. in their research results had the AUC for Boey to be 0.728 inferring that Boey score made moderately accurate predictions for morbidity and mortality in cases of perforated peptic ulcers.[13] Buck et al in their research found that Boey score had the AUC 0.69.[14] Similarly, Anbalakan and et al found that AUC for Boey score was 0.72 similar to other studies.[15] Also, a cut-off value of 1.5 will predict 83.3% cases accurately.

The LR has been a very useful and most widely applied measure of diagnostic accuracy. It summarizes the information about the diagnostic test by combining the values of sensitivity and specificity. It thereby indicated how much a positive or negative test result changed the likelihood that a patient would have had the disease. The LR is one of the most clinically useful measures.[16] For this study, the LR positive for Boey score is 3.70 and the LR negative is 0.215. LR positive of 3.70 suggests that death is approximately 4 times more likely to occur in patients with high Boey score. LR negative is 0.215 which is closer to zero. This value of 0.215 indicates a moderate decrease in mortality with lower Boey score.

The present study was conducted at a single tertiary care center with a relatively small sample size, which may limit the generalizability of the findings. The use of a purposive sampling technique may have introduced selection bias. In addition, the duration of perforation was determined primarily from patient history, making it susceptible to recall bias and possible inaccuracies. These limitations may be overcome by conducting multicenter studies with larger sample sizes to improve the generalizability and statistical validity of the findings.

CONCLUSION

The Boey score serves as a valuable prognostic tool for predicting postoperative morbidity and mortality in patients with perforated peptic ulcer disease. Among its components, preoperative shock demonstrates strong predictive value for adverse postoperative outcomes, whereas the perforation-to-operation interval (duration of symptoms) functions as a moderate predictor. The presence of comorbid illnesses further enhances the predictive accuracy of the score. Beyond risk assessment, the Boey score facilitates effective prognostication, enabling clinicians to communicate anticipated outcomes to patients' relatives at the time of admission. Moreover, it provides standardized framework for risk stratification, allowing meaningful comparison of outcomes across different treatment modalities and surgical approaches. The patients with high Boey scores also translate to close monitoring, aggressive resuscitative and supportive treatment and longer hospital stays.

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REFERENCES

1. Boey J, Choi SKY, Poon A, Algaratnam TT. Risk stratification in perforated duodenal ulcers. Ann Surg. 1987;205(1):22-6.
2. Lee FYJ, Leung KL, Lai BSP, Ng SSM, Dexter S, Lau WY. Predicting mortality and morbidity of patients operated on for perforated peptic ulcers. Arch Surg. 2001;136(1):90-3.
3. Svanes C, Salvesen H, Stangeland I, Svanes K, Soreide O. Perforated peptic ulcer over 56 years, time trends in patients and disease characteristics. Gut. 1993;34(12):1666-71.
4. Taha AS, Dahill S, Nakshabendi I, Lee FD, Sturrock RD, Rusell RI. Duodenal histology, ulceration, and Helicobacter pylori in the presence or absence of non-steroidal anti-inflammatory drugs. Gut. 1993;34(9):1162-6.
5. Jordan PH, Thornby J. Perforated Pyloroduodenal Ulcers Long-Term Results with Omental Patch Closure and Parietal Cell Vagotomy. Ann Surg. 1995;221(5):479-88.
6. Chalya PL, Mabula JB, Koy M, Mehembe MD, Jaka HM, Kabangila R, et al. Clinical profile and outcome of surgical treatment of perforated peptic ulcers in northwestern tanzania: a tertiary hospital experience. World J Emergency Surg. 2011;6:31.
7. Ugochukwu AI, Amu OC, Nzegwu MA, Dilibe UC. Acute perforated peptic ulcer: on clinical experience in an urban tertiary hospital in south east nigeria. Int J Surg. 2013;11(3):223-7.
8. Unver M, Fırat O, Unalp OV, Uguz A, Gumus T, Sezer TO, et al. Prognostic factors in peptic ulcer perforations: a retrospective 14-year study. Int. Surg. 2015;100:942-8.
9. Lohsiriwat V, Prapasrivorakul S, Lohsiriwat D. Perforated peptic ulcer: clinical presentation, surgical outcomes, and the accuracy of the boey scoring system in predicting postoperative morbidity and mortality. World J Surg. 2009;33(1):80-5.
10. Tas I, Ulger BV, Onder A, Kapan M, Bozdag Z. Risk factors influencing morbidity and mortality in perforated peptic ulcer disease. Ulusal Cer Derg. 2015;31:20-5.
11. Gona SK, Alassan MK, Marcellin KG, Henriette KY, Adama C, Toussaint A, et al. Postoperative morbidity and mortality of perforated peptic ulcer: retrospective cohort study of risk factors among black africans in côte d'ivoire. Gastroenterol Res Pract. 2016;2016.
12. Soreide K, Thorsen K, Soreide JA. Predicting outcomes in patients with perforated gastroduodenal ulcers: artificial neural network modelling indicates a highly complex disease. Eur J Trauma Emerg Surg. 2015;41:91-8.
13. Nichakankitti N, Athigakunagorn J. The accuracy of prognostic scoring systems for post-operative morbidity and mortality in patients with perforated peptic ulcer. Int Surg J. 2016;3(1):286-90.

14. Buck DL, Vester-Andersen M, Moller MH. Accuracy of clinical prediction rules in peptic ulcer perforation: an observational study. Scand J Gastroenterol. 2012;47(1):28-35.
15. Anbalakan K, Chua D, Pandya GJ, Shelat VG. Five year experience in management of perforated peptic ulcer and validation of common mortality risk prediction models- are existing models sufficient? A retrospective cohort study. Int J Surg. 2015;14:38-44.
16. Sedighi I. Interpretation of diagnostic tests: likelihood ratio vs. Predictive value. Iran J Pediatr. 2013;23(6):717.

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