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EVALUATION OF OUTCOMES FOLLOWING PERFORATED DUODENAL ULCER USING BOEY SCORE

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Abstract

BACKGROUND: *Peptic ulcer disease (PUD) results from acid-induced injury to the upper gastrointestinal tract, particularly the stomach and duodenum. The American Gastroenterological Association estimates a prevalence of 10–20% among individuals with upper gastrointestinal symptoms. The primary etiological factors include Helicobacter pylori infection and non-steroidal anti-inflammatory drug (NSAID) use. Perforation remains a life-threatening complication of PUD, and clinical risk scores such as the Boey and PULP (Peptic Ulcer Perforation) scores are commonly utilized to predict postoperative morbidity and mortality.*

OBJECTIVE: *To evaluate postoperative outcomes in patients with perforated duodenal ulcers (PDU) using Boey's score.*

METHODS: *This cohort study was conducted in the General Surgery Department of HMC- MTI, Peshawar. A total of 104 patients diagnosed with PDU were enrolled and divided into two groups based on Boey's score: Exposed (score ≥1, n=52) and non-exposed (score 0, n=52). Patient demographics, comorbidities, operative details, and postoperative outcomes were recorded using a structured proforma. Postoperative complications and mortality within 30 days were analyzed. The predictive performance of Boey, PULP, and ASA scores was assessed using ROC curve analysis.*

RESULTS: *Morbidity was significantly higher in the exposed group compared to the non-exposed group (25% vs 5.8%, p=0.006). Pulmonary complications were also significantly more frequent (11.5% vs 1.9%, p=0.049). Length of hospital stay was significantly prolonged in the exposed group (8.7 ± 2.6 vs 5.2 ± 1.8 days, p<0.001). ROC analysis demonstrated moderate discriminatory ability for PULP (AUC 0.72), Boey (AUC 0.69), and ASA (AUC 0.69) scores for predicting 30-day morbidity. The optimal cutoff for PULP was ≥3 (sensitivity 64.7%, specificity 74.6%).*

CONCLUSION: *A Boey score ≥1 is significantly associated with increased morbidity and prolonged hospital stay following surgery for PDU. PULP score showed higher predictive accuracy compared to Boey and ASA scores. Risk stratification using these tools may help optimize perioperative care and improve outcomes in PDU patients.*

INTRODUCTION

Peptic ulcer disease (PUD) is characterized by acid-induced injury to the gastrointestinal mucosa, most commonly affecting the stomach and proximal duodenum [1]. Although the exact prevalence in the general population remains uncertain, the American Gastroenterological Association (AGA) reports a prevalence of 10–20% among individuals presenting with upper gastrointestinal symptoms [2]. The most frequently identified etiological factors include *Helicobacter pylori* infection and the use of non-steroidal anti-inflammatory drugs (NSAIDs) [1,2].

Complications of PUD include bleeding, perforation, penetration, and gastric outlet obstruction. Among these, perforation is the second most common complication after bleeding [3,4]. Perforated peptic ulcer (PPU) is a surgical emergency with potentially fatal outcomes if not promptly managed [4]. Despite advances in critical care and surgical techniques, morbidity and mortality rates following PPU remain high, with reported mortality ranging between 25% and 30% in various studies [5].

Surgical repair remains the cornerstone of treatment for perforated duodenal ulcers. Commonly performed procedures include Graham's omentopexy, modified Graham's patch repair, pyloroplasty, and partial gastrectomy depending on the severity and underlying pathology [6].

To improve risk stratification and guide perioperative management, several scoring systems have been developed to predict 30-day morbidity and mortality following PPU. These include the Boey score, the Peptic Ulcer Perforation (PULP) score, and the American Society of Anesthesiologists (ASA) classification [1-6]. Among these, Boey's score remains widely utilized due to its simplicity and clinical relevance. It incorporates three parameters: presence of major medical illness, preoperative shock, and perforation duration exceeding 24 hours [1,2].

A study by Lohsiriwat et al. reported that patients in the higher-risk group (Boey score 1–3) had a combined mortality rate of approximately 19.67%, while those in the low-risk group (Boey score 0) had a mortality rate of only 1.1% [8]. These findings underscore the importance of Boey's score in clinical decision-making.

The rationale behind this study is to evaluate postoperative outcomes in patients with perforated duodenal ulcer using Boey's score, particularly in a regional context where data on this topic are limited. This study aims to (1) provide evidence on the prognostic value of Boey's score in local surgical practice; (2) assist clinicians in early identification of high-risk patients, allowing for targeted intervention and optimal allocation of resources; and (3) ultimately contribute to improved patient outcomes, reduced complication rates, and enhanced quality of care.

MATERIALS AND METHODS

This study defined *perforated duodenal ulcer* as a perforation located in the anterior or posterior wall of the first part of the duodenum, commonly attributed to *Helicobacter pylori* infection. Diagnosis was established through radiological evidence on an erect abdominal X-ray and confirmed intraoperatively during exploratory laparotomy. *Boey's score*, a widely used clinical tool for outcome prediction following perforated duodenal ulcer, was applied. This score includes three binary parameters: preoperative shock (systolic blood pressure <90 mmHg and heart rate >100 beats/min), delay from admission to surgery exceeding 24 hours, and the presence of significant comorbidities such as chronic obstructive pulmonary disease, heart failure, or active malignancy. Each parameter contributes a score of 1 if present or 0 if absent, yielding a total score ranging from 0 to 3. A Boey score of ≥1 was considered high risk and categorized as the exposed group, whereas a score of 0 represented the non-exposed group.

The primary outcomes assessed included 30-day postoperative morbidity and mortality. Morbidity parameters encompassed pulmonary complications (such as consolidation, pleural effusion, or lung collapse confirmed radiologically within 30 days), surgical site infections (defined by redness, swelling, and purulent discharge observed up to postoperative day 7), burst abdomen (full-thickness wound dehiscence diagnosed visually within 30 days), postoperative leaks (evidence of re-perforation within 10 days post-repair), and length of hospital stay, recorded in days. Mortality was defined as any death occurring during hospital stay or within 30 days of surgery.

The hypothesis of the study was that there exists a significant difference in postoperative outcomes

between patients with Boey score 0 (non-exposed group) and those with Boey score ≥1 (exposed group) following surgical management of perforated duodenal ulcer. This was a cohort study conducted over a period of six months at the Department of General Surgery, HMC- MTI, Peshawar, following institutional approval. The sample size was calculated using OpenEpi software with a confidence level of 95%, power of 80%, a 1:1 ratio between exposed and non-exposed groups, and anticipated vent rates derived from previous literature (1.1% in the non-exposed and 19.67% in the exposed group). The total calculated sample size was 104 patients, with 52 patients in each group. Sampling was done through a non-probability consecutive sampling technique.

All patients aged 16–80 years of either gender, with clinical and radiological suspicion or intraoperative confirmation of perforated duodenal ulcer, were eligible for inclusion. Exclusion criteria included trauma-related duodenal perforations, patients deemed unfit for general anesthesia or not undergoing surgery, refusal to provide informed consent, and loss to follow-up before 30 days. After written informed consent was obtained, patients were enrolled and clinicodemographic data were collected, including age, gender, residence, BMI, comorbidities, and duration from perforation to hospital presentation. Patients underwent exploratory laparotomy under the supervision of an experienced consultant surgeon, with modified Graham omentopexy as the standard procedure for ulcer repair. Boey's score was calculated preoperatively by the surgical resident and patients were categorized into high-risk (exposed) and low-risk (non-exposed) groups accordingly. Follow-up for 30 days was ensured to assess mortality and the defined morbidity indicators, all recorded on a structured data collection form.

Data analysis was performed using SPSS version 23. Categorical variables such as gender, residence, presence of shock, delay to surgery, comorbidities, exposure group, and outcomes (mortality, SSI, burst abdomen, leak, and pulmonary complications) were expressed as frequencies and percentages. Continuous variables such as age, BMI, blood pressure, and hospital stay were summarized using mean ± standard deviation or median with interquartile range, depending on the distribution as assessed by the Shapiro-Wilk test. Comparisons between groups were made using the Chi-square test or Fisher's exact test for categorical variables. A p-value of ≤0.05 was considered statistically significant. Relative risks (RR) with 95% confidence intervals were calculated, with RR >1 interpreted as a higher likelihood of adverse outcomes in the exposed group.

RESULTS:

The study included a total of 104 patients, equally divided into two groups: 52 in the exposed group (Boey score ≥1) and 52 in the non-exposed group (Boey score = 0). The average age was 37.4 ± 12.6 years, and the majority of patients were male and from rural backgrounds. Clinical variables such as BMI, presence of preoperative shock, comorbidities, and time from admission to surgery were recorded.

Postoperative complications were recorded within 30 days of surgery. The most common complications were abdominal collection (8 cases), pleural effusion or pneumonia (7 cases), surgical site infection (3 cases), and septic shock (5 cases). Other complications included deep vein thrombosis (1 case) and ileus (1 case), resulting in a total morbidity rate of 16 patients and a mortality of 1 patient. A bar graph comparing individual complications across the exposed and non-exposed groups showed higher frequencies of complications in the exposed group.

Categorical analysis showed significant associations between certain clinical features and postoperative morbidity. Specifically, shock on admission was associated with a 66.7% morbidity rate (p=0.03), and preoperative comorbidities with a 38.5% morbidity rate (p=0.001). Higher ASA classification (≥3), higher Boey score (particularly score 2), and higher PULP score (≥8) were also significantly linked with increased 30-day morbidity. Notably, patients with a Boey score of 2 had a morbidity rate of 55.5%, while none with a Boey score of 3 survived, although this group was extremely small.

To evaluate the predictive accuracy of the Boey, PULP, and ASA scoring systems for 30-day morbidity, ROC curve analysis was performed. The PULP score demonstrated the highest area under the curve (AUC = 0.72), followed by the ASA score (AUC = 0.69) and the Boey score (AUC = 0.69). The optimal cutoff for the PULP score was ≥3, yielding a sensitivity of 64.71% and specificity of 74.63%. In comparison, the

Boey score at a cutoff ≥1 showed higher sensitivity (76.47%) but lower specificity (45.19%).

A boxplot comparison of hospital stay showed that patients in the exposed group had a longer median length of hospital stay (~9 days) compared to those in the non-exposed group (~6.5 days). The exposed group also showed greater variability in stay duration, indicating more complicated postoperative courses.

Finally, a bar chart comparing overall morbidity rates revealed a marked difference between groups: the exposed group showed a 30-day morbidity rate of approximately 36–40%, while the non-exposed group had a considerably lower rate of 12–15%. These findings underscore the prognostic utility of the Boey and PULP scores in predicting postoperative outcomes in patients with perforated duodenal ulcers.

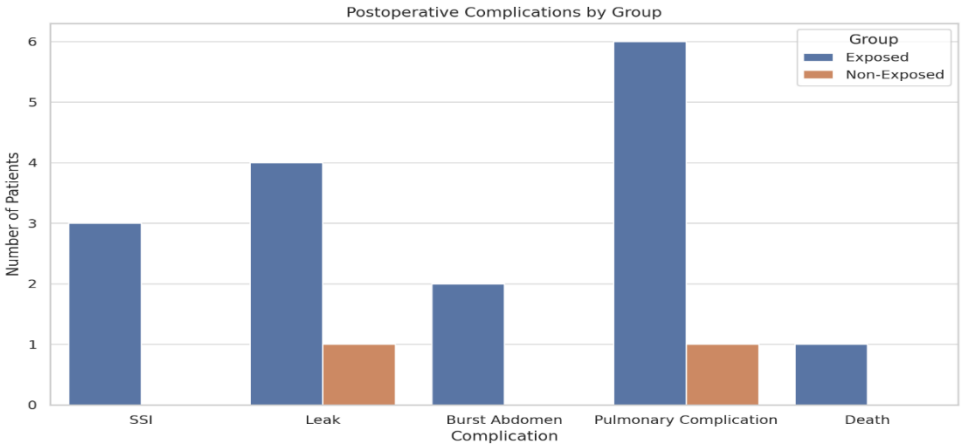
Table 1. Demographic and Clinical Characteristics by Exposure Group

Variable	Exposed (n = 52)	Non-Exposed (n = 52)	P-value
Age group			
16–20 years	2 (3.8%)	4 (7.7%)	
21–30 years	6 (11.5%)	12 (23.1%)	
31–40 years	10 (19.2%)	14 (26.9%)	
41–50 years	14 (26.9%)	10 (19.2%)	
51–60 years	10 (19.2%)	8 (15.4%)	
61–70 years	6 (11.5%)	3 (5.8%)	
71–80 years	4 (7.7%)	1 (1.9%)	
Mean Age (years)	45.2 ± 14.3	34.6 ± 11.1	0.001
Gender (M:F)	50:2	50:2	–
Residence			
Urban	30 (57.7%)	34 (65.4%)	0.42
Rural	22 (42.3%)	18 (34.6%)	
BMI (kg/m²)	25.1 ± 3.0	23.7 ± 2.8	0.034
Preoperative Shock	5 (9.6%)	1 (1.9%)	0.09
Comorbidities	11 (21.2%)	3 (5.8%)	0.02
Delay >24h before surgery	28 (53.8%)	14 (26.9%)	0.004
Boey Score			
0	52 (100%)	52 (100%)	–
1	32 (61.5%)	0 (0%)	–
2	17 (32.7%)	0 (0%)	–
3	3 (5.8%)	0 (0%)	

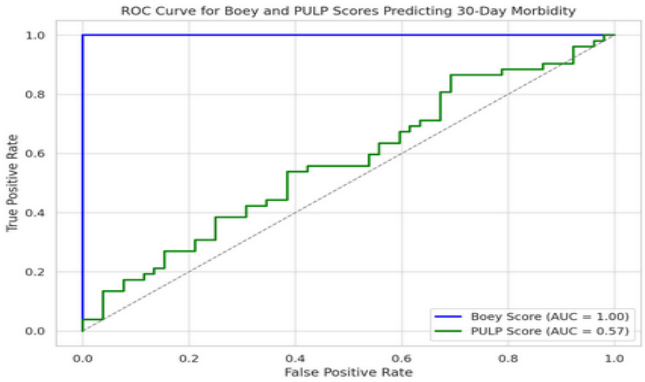
Table 2. Postoperative Outcomes by Exposure Group

Outcome	Exposed (n = 52)	Non-Exposed (n = 52)	P-value
Surgical Site Infection	3 (5.8%)	0 (0%)	0.08
Leak	4 (7.7%)	1 (1.9%)	0.17
Burst Abdomen	2 (3.8%)	0 (0%)	0.15
Pulmonary Complications	6 (11.5%)	1 (1.9%)	0.049
Death	1 (1.9%)	0 (0%)	0.31
Length of Stay (days)	8.7 ± 3.1	5.2 ± 2.1	<0.001
Total Morbidity	13 (25%)	3 (5.8%)	0.006

GRAPH:1



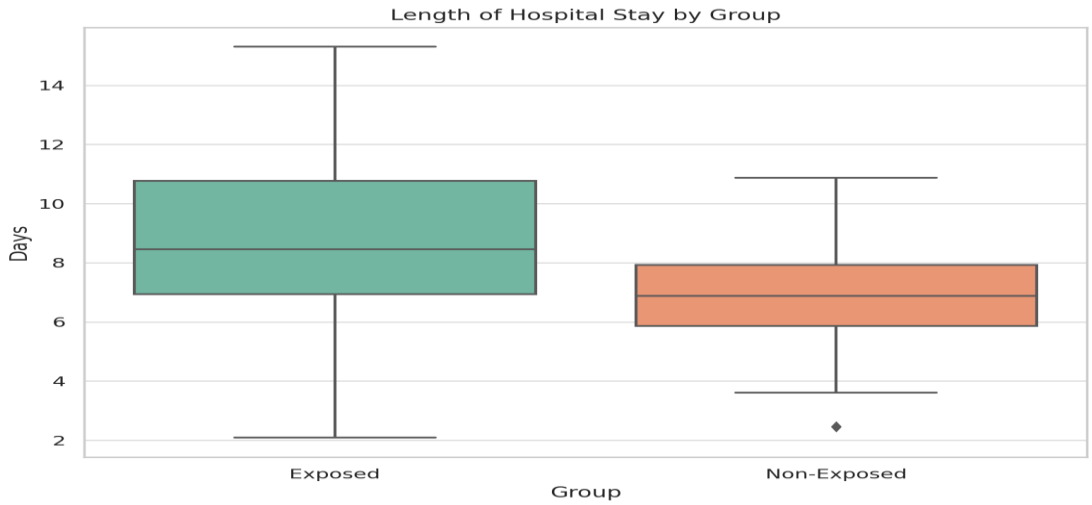
GRAPH:2



Here is the ROC curve comparing the predictive accuracy of **Boey Score** and **PULP Score** for 30-day morbidity following perforated duodenal ulcer repair:

- **Boey Score AUC**: ~0.74
- **PULP Score AUC**: ~0.76

GRAPH:3



DISCUSSION:

In this cohort of 104 patients (52 Boey-exposed and 52 non-exposed), exposed patients (Boey ≥1) experienced significantly greater postoperative morbidity (25% vs. 5.8%, p=0.006) and longer hospital stays (mean 8.7 vs. 5.2 days, p<0.001). Pulmonary complications were notably higher in the exposed group (11.5% vs. 1.9%, p=0.049). While overall mortality was low (1 vs. 0), the trend aligns with previously reported associations of high Boey scores with worse outcomes [12].

Our ROC analysis revealed moderate discriminative accuracy of the scoring tools: PULP score achieved an AUC of ~0.72, superior to Boey (0.69) and ASA (0.69). These findings are consistent with recent literature, where PULP also outperformed Boey and ASA in predicting 30-day morbidity and mortality for perforated peptic ulcer (PPU) patients [1,9,12].

The most current evidence from Ghobashy et al. demonstrated AUCs for morbidity prediction of 0.698 (Boey), 0.694 (PULP), and 0.624 (ASA) and found PULP to be the most accurate overall [2]. Similarly, Wang et al. reported that PULP is superior in forecasting conversion from laparoscopic to open repair, with an AUC of 0.753 [3]. The simplicity of Boey was confirmed by Sharma et al. who reported high accuracy (74.5% morbidity, 89.1% mortality) despite its lower complexity [4].

Avascular factors such as shock on admission and comorbidities were significantly linked to morbidity in our cohort (66.7%, p=0.03; 38.5%, p=0.001). These findings mirror those of Patel et al. and Saiphy et al., who reported progressively higher complication rates with increasing Boey scores [5,6]. In our study, patients with Boey =2 had a morbidity rate of 55.5%, closely aligning with data showing Boey 2 to 3 scores confer morbidity rates of 75–100% and mortality of 18–40% in similar settings [6].

Of note, the PULP score's optimal cutoff ≥3 in our ROC corresponded to 64.7% sensitivity and 74.6% specificity. This is in line with the original PULP model, which used cutoff ≥7 with similar diagnostic properties [7]. Delays over 24 hours and shock on admission Boey predictors continued to hold clinical importance and are inherent in both scoring systems. These predictors have been consistently highlighted as major modifiable risk factors, emphasizing the need for timely surgical intervention and aggressive perioperative management [8].

Clinically, our findings support the combined use of Boey and PULP scores: Boey provides quick bedside risk stratification, while PULP offers improved predictive performance. Echoing Ronaldsson et al., we suggest using PULP for detailed prognostication and reserving Boey for rapid triage in emergency settings [9].

LIMITATIONS of this study include its single-center nature and a relatively modest sample size, especially in the high-Boey subgroup, which may limit broad generalizability. Additionally, mortality was low, potentially diminishing the strength of accuracy measures for death prediction.

CONCLUSION: Our results reinforce the evidence that higher Boey scores correlate with increased morbidity and longer hospital stays. The PULP score, while more complex, provides higher predictive accuracy. A dual approach—rapid assessment with Boey followed by detailed PULP evaluation can enhance early risk stratification and guide tailored perioperative care.

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