Validation of boey's score in predicting morbidity and mortality in patients operated on for perforated peptic ulcer: A comparison between district and central hospitals

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Abstract

Introduction: This study aims to evaluate the accuracy and the reliability of Boey's score in predicting post-operative complications and mortality rates in patients with perforated peptic ulcers treated at district- and central-level hospitals.

Patients and Methods: The retrospective case series study was conducted at two hospitals: Le Van Thinh Hospital, a district-level facility, and Cho Ray Hospital, a central-level institution. Data were collected from 114 patients at Le Van Thinh Hospital between January 2020 and December 2023, and from 255 patients at Cho Ray Hospital between January 2021 and December 2022. The study included patients diagnosed with Perforated Peptic Ulcer (PPU) who underwent surgical intervention, and met the study criteria. With the data collected, we then determined Boey's score value and variables independent of the complication and mortality ratio. A ROC curve was used, to evaluate the predictive capability of Boey's score.

Results: Le Van Thinh Hospital: The complication and mortality rates were 15.8% and 5.3%, respectively. Both rates exhibited an increase with higher Boey scores: complication rates were 2.3%, 33.3%, 88.9%, and 100% ($p<0.001$) for Boey scores of 0, 1, 2, and 3, respectively, while mortality rates were 0%, 0%, 33.3%, and 100% ($p<0.001$). The (Area Under Curve) AUC for predicting complications was 0.918, and for mortality, it was 0.986. Cho Ray Hospital: The complication and mortality rates were considerably higher at 54.1% and 25.5%, respectively. The complication rates increased progressively with higher Boey scores: 12.5%, 26.7%, 75%, and 98.2% ($p<0.001$), while the corresponding mortality rates were 0%, 2.4%, 31.9%, and 70.2% ($p<0.001$). The AUC for predicting complication was 0.862, and for mortality, it was 0.878.

Conclusions: Boey's score serves as an accurate predictor of both mortality and complication rates in patients undergoing surgical intervention for PPUs.

Keywords: Perforated peptic ulcer, Boey score, Mortality rate, Complication rate, Surgical outcomes, Prognosis, Area Under the Curve (AUC)

Introduction

Peptic ulcer disease (PUD) affects over four million people worldwide annually[1]. One of its most severe complications is perforation, which leads to high complication and mortality rates. Common risk factors include Helicobacter pylori infection, excessive use of nonsteroidal anti-inflammatory drugs (NSAIDs), age over 60, stress, and smoking[2]. Among these, *H. pylori* infection and NSAID use are the two most significant factors [3].

Despite advancements in acid-suppressive therapy and *H. pylori* eradication, the incidence of peptic ulcer perforation remains high. Studies report a perforation rate of 2-14% among PUD patients, with a mortality rate ranging from 1.3% to 20% [4]. Early identification of high-risk patients is essential to optimizing treatment strategies and reducing mortality rates.

Various scoring systems, such as ASA, Mannheim, APACHE II, SAPS II, POSSUM, MPM II, PULP, and Hacettepe, have been developed to predict outcomes in PPU patients. However, Boey's score is the simplest, and specifically designed for prognostic assessment in PPU cases. It incorporates three easily assessable clinical parameters: Preoperative shock, severe concurrent medical illness and duration of symptoms exceeding 24 hours prior to surgery. Numerous studies have demonstrated that the Boey score is effective in predicting mortality and complications associated with this condition[5-9]. The Boey score was the first score directly aimed at mortality prediction for PPUs. The original work by Boey et al. stated that delay of surgery after onset of symptoms for more than 48 hours, shock upon admission and a high degree of comorbidity, were associated with a 100% mortality when all factors where present. Eventually, the delay of surgery was adjusted to 24 hours, and the scoring system was validated in a cohort from Hong Kong.

At Cho Ray Hospital, a central hospital, patients are transferred from various provinces and cities. The majority of patients are admitted more than 24 hours after symptom onset, resulting in more severe conditions at the time of hospitalization. In contrast, Lê Văn Thịnh Hospital, a district-level facility, admits patients earlier after symptom onset. Both hospitals have conducted studies evaluating the effectiveness of the Boey score in predicting mortality and postoperative complications in patients with PPUs[10]. Therefore, we aim to compare patient characteristics and assess the predictive accuracy of the Boey score for this condition in both hospitals.

Patients and methods

Both studies are retrospective descriptive analyses comparing patients with PPUs who underwent surgical treatment at surgery at a district hospital (Le Van Thinh Hospital) and a central hospital (Cho Ray Hospital). The district hospital primarily admits patients from surrounding areas, whereas the central hospital serves a large number of patients from all provinces and cities in southern Vietnam. Patients were admitted with varying clinical conditions, and the Boey score was used to predict disease severity.

Patients included in the study were diagnosed with peritonitis due to gastric or duodenal perforation and underwent surgical treatment during the study period. Only those who consented to surgery and had a postoperative confirmation of peritonitis secondary to gastric or duodenal perforation were included. Patients diagnosed with PPUs who refused surgery or were transferred to another hospital, as well as cases with incomplete medical records, missing data, or inadequate imaging, were excluded from the study.

The study at Le Van Thinh Hospital was conducted from January 2020 to December 2023, with 114 eligible cases recorded, while at Cho Ray Hospital, the study took place from January

2021 to December 2022, documenting 255 cases. Both studies evaluated the effectiveness of the Boey score in predicting mortality and complications in patients undergoing surgery for PPU disease.

Additionally, both studies collected patient characteristics, including age, sex, time from symptom onset to surgery, preoperative shock due to severe comorbidities, and imaging findings on computed tomography scans. Surgical methods and approaches, such as laparoscopic versus open surgery and simple perforation closure versus gastrectomy, were also recorded. Other variables included perforation size, hospital length of stay, and postoperative complications such as surgical site infection, pneumonia, septic shock, residual abscess formation, anastomotic leakage, abdominal wall dehiscence, reoperation, and their association with mortality and morbidity prediction in this condition were enrolled.

Data were collected using Excel software and analyzed using SPSS 20.0. Comparative methods were employed, with a significance threshold set at $p < 0.05$.

Results

From January 2020 to December 2023 at Le Van Thinh Hospital, 114 patients met the inclusion criteria (87 males, 27 females), aged 14–77 years (median: 51). Pain lasting more than 24 hours was reported in 17.5%, 11.4% had severe comorbidities, and 7.9% experienced preoperative shock. All underwent abdominal CT scans, which revealed free intra-abdominal air in every case; 52.6% had gastric or duodenal perforations.

At Cho Ray Hospital, from January 2021 to December 2022, 255 patients met the study criteria—nearly 2.5 times more than the 114 cases seen over four years at Le Van Thinh Hospital. Of these, 202 were males and 53 females, aged 16–81 (median: 61). Prolonged pain lasting more than 24 hours was seen in 76.9%, 48.9% had severe comorbidities, and 30.6% experienced preoperative shock. Abdominal CT scans were performed in 98% of cases (Table 1).

Table 1. Patient demographics

	Le Van Thinh Hospital (n=114)	Cho Ray Hospital (n=255)
Median Age	51 years	61 years
Male (%)	76.3%	79.2%
Pain duration > 24 hours	17.5%	76.9%
Severe Comorbidities	11.4%	48.9%
Preoperative Shock	7.9%	30.6%
Abdominal CT-Scan	100%	98%
Gastric/Duodenal perforation	60 (52.6%)	147 (57.8%)
Free intraperitoneal air	54 (47.4%)	103 (40.2%)

At Le Van Thinh Hospital, 93% of patients had laparoscopic perforation closure and 7% underwent open surgery. This included 4 primary open surgeries, 4 laparoscopic conversions, and 2 immediate open gastrectomies. The average perforation size was 0.87 ± 0.66 cm, median hospital stay was 8 days, mortality rate was 5.3%, and complications occurred in 15.8% - mainly pneumonia (14%) and septic shock (8.8%). Residual abscesses, leaks, and reoperations were rare.

At Cho Ray Hospital, 73% underwent open surgery, with a 97.2% closure rate. The mean perforation size was 1.18 ± 0.93 cm, median hospital stay was 7 days, mortality rate was 25.5%, and complications occurred in 54.1% - mostly pneumonia (39.6%), followed by abscesses (5.1%), leaks (3.1%), and reoperations (1.6%) (Table 2).

Table 2. Surgical Outcomes and Complication/Mortality Rates

Variable	Le Van Thinh Hospital (n=114)	Cho Ray Hospital (n=255)
Laparoscopic Surgery (%)	93%	27%
Open Surgery (%)	7%	73%
Perforation closure	112 (98.2%)	248 (97.2%)
Gastrectomy	2 (1.8%)	7 (2.8%)
Perforation Size (cm)	0.87 ± 0.66	1.18 ± 0.93
Mortality Rate (%)	5.3%	25.5%
Complication Rate (%)	15.8%	54.1%
Pneumonia	24%	39,6%
Septic shock	8,8%	31,4%
Surgical site infection	7,2%	29,8%
Persistent abscess	2,6%	5,1%
Anastomotic leakage	2,6%	3,1%
Abdominal dehiscence	0%	0,4%
Reoperation	2,6%	1,6%

At Le Van Thinh Hospital, all six deaths occurred in patients with a Boey score ≥2. Among 18 patients with complications, 11 also had a score ≥2. No deaths and only a 2.3% complication rate occurred in those with a score of 0. For scores of 1, the mortality rate was 0% and complication rate was 33.3%. At scores of 2 and 3, mortality increased to 33.3% and 100%, with complication rates of 88.9% and 100%, respectively - showing a strong relationship between higher Boey scores and worse outcomes.

A similar pattern was observed at Cho Ray Hospital. The average Boey score was significantly higher in deceased patients (2.6 ± 0.6) than in survivors (1.2 ± 0.9), and in patients with complications (2.2 ± 0.8) versus those without (0.9 ± 0.7), with both differences reaching statistical significance p<0.001.

Table 3. The sensitivity (SS), specificity (SP), positive predictive value (PPV), negative predictive value (NPV), accuracy (Acc), and AUC value of the Boey score.

	Cut Off Boey ≥ 2	SS	SP	PPV	NPV	Acc	AUC Value
Le Van Thinh hospital	Mortality	100	94,4	50	100	94,7	0,986
	Complication	61,1	98,9	91,6	93,1	92,9	0,918
Cho Ray hospital	Mortality	96,9	65,3	48,8	98,4	73,3	0,878
	Complication	79,7	83,8	85,3	77,8	81,6	0,862

At Le Van Thinh Hospital, the Boey score showed an AUC of 0.986 for mortality and 0.918 for complications (both p<0.001). At Cho Ray Hospital, the AUCs were 0.878 for mortality (p=0.022) and 0.862 for complications (p=0.023).

Discussion

Gender

In both studies, the hospitalized patients had a mean age of over 50 years. Patients aged ≥60 years accounted for 47.4% (54 cases) at Le Van Thinh Hospital and 54.5% (139 cases) at Cho Ray Hospital. The male-to-female ratio at Le Van Thinh Hospital was 3.2:1, which closely approximates the ratio reported at Cho Ray Hospital (3.8:1). These findings are consistent with other studies reporting a higher prevalence of PPU in males, likely due to risk factors such as smoking and NSAID [4].

Ages

In both studies, factors such as age ≥60 years, perforation size >1 cm, preoperative shock, severe comorbidities, pain duration >24 hours prior to surgery, open surgery, and conversion from laparoscopic to open surgery were associated with increased mortality and complication rates. These findings are consistent with previous research showing that delaying in surgery and severe comorbidities are key predictors of poor outcomes [8]. CT-scans served as a crucial and routine imaging modality in the diagnosis of this condition, as it has

been shown to have a diagnostic accuracy of up to 98% in detecting perforation [4].

Time to intervention

Patients admitted to Le Van Thinh Hospital primarily had Boey scores of 0 or 1, as the prevalence of severe comorbidities, preoperative shock, and a perforation-to-surgery time of more than 24 hours was low, accounting for 89.5% (102 cases). In contrast, at Cho Ray Hospital, the proportion of patients with Boey scores of 0 or 1 was 49.4%, while 50.6% had a Boey score ≥2. This discrepancy can be attributed to Cho Ray Hospital's status as a central hospital, receiving patients from various provinces and cities, often with prolonged preoperative pain (>24 hours) and a higher incidence of preoperative shock due to severe infections, sepsis, and comorbidities. Consequently, Cho Ray Hospital exhibited significantly higher mortality and complication rates than Le Van Thinh Hospital, with 65 deaths (25.5%) compared to 6 (5.3%) and 138 complications (54.1%) compared to 18 (15.8%).

Effectiveness of Boey scores in predicting mortality and morbidity

The trend of increasing mortality and complication rates with higher Boey scores observed in our study is supported by multiple prior studies. According to Sah (2019), Boey scores are a reliable predictor of mortality and morbidity in PPU patients, with an area under the curve (AUC) for mortality prediction reaching 0.802 and for morbidity prediction at 0.778 [9]. Similarly, Lohsiriwat et al. demonstrated that the mortality rate increased progressively with higher Boey scores: 1%, 8%, 33%, and 38% for scores of 0, 1, 2, and 3, respectively [8]. The morbidity rates followed a similar trend: 11%, 47%, 75%, and 77% ($p < 0.001$). These findings further validate our study's results, reinforcing the predictive power of the Boey score in determining PPU prognosis.

At Le Van Thinh Hospital, mortality rates among patients with Boey scores of 0, 1, 2, and 3 were 0%, 0%, 33.3%, and 100%, respectively ($p < 0.001$), while complication rates were 2.3%, 33.3%, 88.9%, and 100%, respectively ($p < 0.001$). At Cho Ray Hospital, mortality rates corresponding to Boey scores of 0, 1, 2, and 3 were 0%, 2.4%, 31.9%, and 70.2% ($p < 0.001$), while complication rates were 12.5%, 26.7%, 75%, and 98.2% ($p < 0.001$). Among the complications, pneumonia, septic shock, and surgical site infections were the most common. This trend is attributed to the infectious nature of PPU disease, as well as the contribution of nosocomial infections, particularly in patients requiring prolonged mechanical ventilation. These findings are consistent with prior studies reporting pneumonia as the most frequent complication, followed by wound infections and intra-abdominal collections [8].

Recent literature also underscores that prompt surgical intervention is key in improving outcomes. A systematic review by Chung & Shelat (2017) emphasized that early diagnosis, resuscitation, and urgent surgery remain the cornerstone of PPU management [4]. Additionally, surgical techniques play a role in outcomes. While laparoscopic surgery is increasingly favored for its reduced morbidity, open surgery remains necessary for critically ill patients with Boey scores ≥2 [4]. Our study found that Le Van Thinh Hospital had a higher proportion of laparoscopic cases (93%), whereas Cho Ray Hospital predominantly performed open surgeries (73%). The correlation between surgical approach and outcomes has been observed in other studies, where laparoscopic repair has been associated with lower postoperative morbidity rates, although conversion to open surgery may be required in more severe cases [8].

Our findings indicate that higher Boey scores correlate with increased mortality and complication rates. The AUC values of the Boey score in the study conducted at Le Van Thinh Hospital for predicting mortality and complications were 0.986 and 0.918, respectively. At Cho Ray Hospital, the corresponding AUC values were 0.878 and 0.862. Both studies demonstrated that the Boey score is a highly effective tool for predicting mortality and complications in PPU disease. This is in line with prior research indicating that the Boey

score outperforms other predictive models due to simplicity and effectiveness, though some studies suggest the PULP score may offer slightly better predictive capability in certain settings [9].

Conclusion

The Boey score is a simple and easily applicable clinical tool that accurately predicts postoperative mortality and complication rates. Notably, it can be assessed at the bedside without the need for laboratory or imaging tests, enabling rapid risk stratification in patients with PPU disease. A limitation of the Boey score is its exclusion of patient age, which prevents differentiation of prognoses across age groups. However, in the context of a developing healthcare system with limited human and material resources, particularly at lower-tier healthcare facilities, the Boey score serves as a valuable tool for identifying high-risk patients in settings with constrained medical infrastructure. This facilitates informed prognostic counseling for patients, as well as optimized perioperative planning—especially regarding intensive resuscitation—to improve outcomes in this life-threatening condition.

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