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Scoring system in predicting perforated duodenal ulcer morbidity in a tertiary level hospital of eastern Nepal: A retrospective study

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ABSTRACT

Introduction: Perforated peptic ulcer (PPU) disease is a common indication of emergency surgery, accounting for 2–10% of all peptic ulcer cases. The American Society of Anaesthesiologists (ASA), Boey, and the peptic ulcer perforation (PULP) score are the most regularly utilised scoring systems to risk stratify patients who are likely to develop complications and to focus resources on high-risk patients.

Objective: To assess the accuracy of PULP score, Boey, and ASA in predicting 30-day perforated peptic ulcer morbidity.

Methodology: A retrospective cross-sectional study was done in a tertiary care hospital in Nepal with review of two-year (2018 April 14 to 2020 May 12) data of all (census) perforated duodenal ulcer (PDU) patients (74 cases). Data were collected after taking ethical clearance, which included demographic, clinical history, laboratory investigation, operative finding, and post-operative morbidity and mortality. For inferential statistics, Chi-square, and Independent t-test were applied to find significant association between various cut off values and numerical values of score and other selected variable. A receiver operating characteristic (ROC) curve analysis was used to determine the scale's predictive accuracy for each outcome.

Result: Male predominance (5.7:1) was present (Mean age 46.49 years). Post PDU repair morbidity and mortality were 37.83% and 4.05% respectively. Higher ASA (>3), Boey (>1), PULP (>6), raised creatinine level, and preoperative comorbidity (n = 15) were significantly associated with morbidity. Boey displayed largest (84%) area under the curve (AUC) in predicting morbidity.

Conclusion: Boey and PULP score can be utilised as precise predictor of morbidity.

Keywords: American society of anaesthesiologist; Boey; peptic ulcer perforation score; perforated duodenal ulcer; risk score.

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INTRODUCTION

Perforated peptic ulcer (PPU) is a surgical emergency, representing 2–10% of all peptic ulcer cases.[1] With current peptic ulcer therapy, incidence of PPU has decreased over the last two decades, but mortality is relatively high, despite advancement in surgical technique and perioperative care.[2] Omental patch repair is both easy and successful method for managing duodenal ulcer (DU) perforation in emergency.[3] However, roughly 10% of people die from ulcer perforation treated with simple closure and/or additional techniques. Old age, comorbidity, and preoperative hypotension influence the mortality. Several scoring methods have been proposed for predicting 30-day morbidity and

mortality in patients with PPU in order to risk stratify patients in terms of developing complications. The American Society of Anaesthesiologists (ASA),[4] Boey,[5] and the peptic ulcer perforation (PULP) scores[4] are the most regularly utilised scoring systems. Each one has 3–11 demographic, clinical, and biochemical variables. In order to appropriately risk stratify patients, clinical scoring systems require high diagnostic accuracy.[6] Few studies have evaluated accuracy indices of PULP with Boey and ASA in predicting 30-day morbidity after PPU repair. We wish to assess the accuracy of PULP score, Boey, and ASA in predicting 30-day PPU morbidity and to measure the post perforated duodenal ulcer (PDU) repair 30-day morbidities in Nepali context.

METHODOLOGY

This was a retrospective cross-sectional study conducted in the Department of Surgery of a tertiary level hospital in eastern Nepal, at the B. P. Koirala Institute of Health Sciences (BPKIHS), Dharan, Sunsari, Nepal. Ethical clearance was obtained from Institutional Ethical Review Board of BPKIHS before starting the study (Reference number: IRC/2095/020). All patients (census) presented to emergency department from 2018 April 14 to 2020 May 12 with perforated duodenal ulcer managed surgically under department of general surgery were included. The inclusion criteria were all patients with perforated duodenal ulcer managed surgically. The exclusion criteria were perforated other organs e.g., gastric, intestinal perforation, and incomplete data available in medical record section. Demographic profile of the patients, clinical history, laboratory examinations, operative finding were noted from medical record database. All case were operated by consultant surgeon on emergency basis after adequate resuscitation (semi emergency). The predicted scoring systems, the PULP score, Boey score, and ASA score were calculated. The PULP score, ASA score, and Boey score are defined as "Shock on admission":[7] PULP it was blood pressure <100 mm Hg and heart rate >100 beats/ min; Boey, it was only blood pressure <100 mm Hg. "Perforation" >24 h:[7] PULP, it was time interval from perforation (onset of symptoms) until admission to hospital. Boey, it was the time interval from perforation until surgery. Perforated peptic ulcer:[7] both perforated gastric and perforated duodenal ulcers. Perforated duodenal ulcer:[7] only perforated duodenal ulcers. The morbidity in the form of pleural effusion/pneumonia, abdominal collection, paralytic ileus, intractable vomiting, fever, deep vein thrombosis, enterocutaneous fistula within 30 days of the perforated duodenal ulcer who underwent the surgical procedure were determined. With 95% confidence level, 80% power, and 10.5% morbidity detected by PULP score at admission,[7] using one proportion sample size formula the sample size become, $n= Z^2pq / d^2$ where Z = 1.96 at 95% confidence interval; p = 10.5%; q = 89.5%. Taking d = 20% of 10.5 = 2.1. Putting the values in equation, n = (1.96 x 1.96 x 0.105 x 0.895) / (0.021 x 0.021) = 3610.14/9.261= 389. But according to medical record, it was found that only 70 cases had been admitted in two years prior to data collection. Now using finite population sample size calculation formula, n = Calculated sample size /1+ Calculated sample size/Estimated population:

n= 389/1+389/70 = 389/6.55= 59.3. So, the study included all cases of past two years which were 74 cases using Purposive sampling technique.

The proforma was filled up according to medical record of the patient. Data were entered in Microsoft excel 2010 and converted it into IBM SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, N.Y., USA) for statistical analysis. Descriptive statistics were calculated as percentage, mean, median, standard deviation (SD), Interquartile range, and also graphical and tabular presentation. For inferential statistics, Chi-square and Independent t-test were applied to find significant association between various cut off values and numerical values of PULP Score, Boey score, ASA score and other selected variables. A receiver operating characteristic (ROC) curve analysis was used to determine the scale's predictive accuracy for each outcome. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated by Med Calc Software.

RESULT

Among 74 patients included in this study, 63 (85.1%) were males and 11 (14.6%) were females with the mean age of 46.49±20.35 (minimum=15; maximum=83) years. All the patients presented to the emergency department with features of peritonitis and had obliterated liver dullness on clinical examination with pneumoperitoneum in their erect chest x-rays (Table 1). Of these 29 (39.2%) patients were admitted to Emergency within 24 hours (hrs) of onset of symptoms while the rest 45 (60.8%) presented later than 24 hrs. Nine (12.2%) of these patients were in septic shock at the time of admission.

All the patients underwent exploratory laparotomy after adequate resuscitation of which 74 (100%) patients had perforation in the first part of duodenum. Modified Grahm's Omental patch was placed in 68 (91.9%) patients and Omental patch repair with feeding jejunostomy

was done in six (8.1%). Feeding jejunostomies were performed in delayed presentation after three days, severe septic shock on presentation, comorbidity, oedematous bowel intraoperative with anticipated delayed recovery. The mean duration of the surgery was 118.17 ± 40.02 (minimum = 55; maximum = 300) minutes. The length of stay was 8.53 ± 7.15 (minimum = three; maximum = 47) days.

On evaluating these patients according to the various scoring systems, 42 (56.8%) patients had PULP score between 0-6 while 32 (43.2%) patients scored between 7-18. According to Boey's scoring system eight (10.8%), 43 (58.1%), 19 (25.7%), and four (5.4%) of the patients were marked with 0, 1, 2, and 3 points respectively, while eight (10.8%), 21 (28.4%), 21 (28.4%), and 26 (35.1%) were given 1, 2, 3, and 4 points respectively on ASA scoring system (Table 2).

Following surgery, 28 (37.8%) patients developed 30-day morbidity commonest being pleural effusion/pneumonia in 16 (21.6%) patients, fever in 14 (18.9%) patients, paralytic ileus in 13 (17.5%), and wound dehiscence in nine (12.1%) patients (Table 3). Other complications were intra-abdominal collection, intractable vomiting, septic shock and enterocutaneous fistula. One patient had wound dehiscence following which Bogota bag application was done, thereafter enterocutaneous fistula developed from distal ileum, later managed with repair of enterocutaneous fistula after three months. Two (7.14%) patients underwent re-laparotomy within 30 days due to duodenal ulcer repair leak which was picked up timely and managed doing re-laparotomy. Those patients underwent Omental patch repair + retrograde duodenostomy and feeding jejunostomy. Three (4%) patients had mortality following complications within 30-day post-operative period.

In this study, morbidity was significantly associated with raised creatinine (p-value 0.004), Boey's score (p-value 0.001), ASA score (p-value 0.001), and PULP score (p-value 0.001). Similarly, morbidity was significantly associated with preoperative comorbidity (p-value 0.04) but not significant with perforation on admission >24 hrs and shock on admission (Tables 3, 4).

Boey score had highest area under the curve (AUC) of 0.82 with cut off value >1 with sensitivity 71.43%, specificity 93.5%, PPV 86.96%, and NPV 84.31%. The PULP score had AUC of 0.75 with cut off values >6 with sensitivity 75%, specificity 76.1%, PPV 65.63%, and NPV 83.33%. The ASA score had AUC of 0.765 with cut off value >3 with sensitivity 71.43%, specificity 93.5%, PPV 86.96%, and NPV 84.31% (Tables 5 and 6, Figure 1).

Table 1: Distribution of characteristics of patients

Characteristics	Frequency (Percent)
Sex	
Male	63 (85.1)
Female	11 (14.9)
Risk Factors	
Peptic ulcer diseases	9 (12.2)
Non-steroidal anti-inflammatory drugs (NSAIDs)	2 (2.7)
Alcohol	24 (32.4)
Active smoker	26 (35.1)
Comorbidities	
Gastrointestinal malignancy	2 (2.7)
Cardiovascular disease	5 (6.8)
Pulmonary disease	5 (6.8)
Renal disease	7 (9.5)
Liver disease	1 (1.4)
Endocrine disease	2 (2.7)
Generalised pain abdomen	74 (80)
Duration of history	
≤24 hrs	29 (39.2)
>24 hrs	45 (60.8)
Shock at admission	
Yes	9 (12.2)
No	65 (87.8)
Obliterated liver dullness	74 (100)
Pneumoperitoneum in chest x-ray	74 (100)
Operation	
Modified Grahm's omental patch repair	68 (91.9)
Modified Grahm's omental patch repair + Feeding jejunostomy	5 (6.8)
Omentopexy + Excision + Biopsy	1 (1.4)
Site of perforation	
First part of duodenum	72 (97.3)
Prepyloric	1 (1.4)
Antrum of stomach	1 (1.4)
Content	
Clear bilious	47 (63.5)
Purulent	26 (35.2)
Faecal	1 (1.4)

Table 2: PULP, Boey, and ASA scores

Characteristics	Frequency (Percent)
PULP score	
0-6	42 (56.8)
7-18	32 (43.2)
ASA score	
1	6 (8.1)
2	21 (28.4)
3	21 (28.4)
4	26 (35.1)
Boey score	
0	8 (10.8)
1	43 (58.1)
2	19 (25.7)
3	4 (5.4)

Table 3: Post-operative complication following repair of perforated duodenal ulcer

The 30-day morbidities	Frequency (Percent)
Pleural effusion/Pneumonia	16 (57.4)
Wound dehiscence	9 (32.1)
Enterocutaneous fistula	1 (3.6)
Abdominal collection	3 (10.7)
Paralytic Ileus	13 (46.4)
Acute kidney injury	5 (17.8)
Fever	14 (50)
Intractable vomiting	6 (21.4)
Re-laparotomy	2 (7.1)
Septic shock	3 (10.7)
Total Morbidity	28
Mortality	3

Table 4: Characteristics of perforated duodenal ulcer patients by 30-day morbidity

	The 30-day morbidity	n	Mean ± SD	p-value
Gender (Male:Female)		5.7:1		
Age	No	46	44.28 ± 19.144	0.23
	Yes	28	50.11 ± 22.08	
Haemoglobin	No	46	12.21 ± 2.48	0.66
	Yes	28	12.47 ± 2.45	
White blood cell	No	46	15625.22 ± 30492.51	0.49
	Yes	28	11657.14 ± 4969.49	
Creatinine	No	45	0.91 ± 0.38	0.004†
	Yes	27	1.36 ± 0.89	
Boey's score	No	46	0.91 ± 0.55	0.001*
	Yes	28	1.82 ± 0.61	
ASA score	No	46	2.35 ± 0.76	0.001*
	Yes	28	3.82 ± 0.47	
PULP score	No	46	4.07 ± 1.74	0.001*
	Yes	28	6.32 ± 2.01	

p-value <0.05 significant *= Independent t test, †= Mann-Whitney U test

Table 5: Characteristics of perforated duodenal ulcer patients by 30-day morbidity (categorical variables)

Variables	N	30-day morbidity		p-value
		Yes, n (%)	No, n (%)	
Perforation on admission >24 hrs	45	27 (60)	18 (40)	0.63
Shock on admission	9	5 (55.6)	4 (44.4)	0.242
Preoperative comorbidity	15	9 (60)	6 (40)	0.04‡
Boey score				
0	8	-	8 (100)	0.00‡
1	43	8 (18.6)	35 (81.4)	
2	19	17 (89.5)	2 (10.5)	
3	4	3 (75)	1 (24)	

ASA score				
1	6	-	6 (100)	0.001‡
2	21	1 (4.8)	20 (95.2)	
3	21	3 (14.3)	18 (85.7)	
4	26	24 (92.3)	2 (92.3)	
PULP score				
0-6	42	7 (16.7)	35 (83.3)	0.001‡
7-18	32	21 (65.6)	11 (34.4)	

p-value <0.05 significant ‡= Chi-square test

Table 6: The 30-day morbidity optimal cut off and accuracy indices of three scoring system

Variable	AUC	p-value	Cut off	Sensitivity	Specificity	PPV	NPV	Accuracy
Boey	0.825	0.001	>1	71.43%	93.5%	86.96%	84.31%	85.14%
ASA	0.765	0.001	>3	96.43%	56.5%	57.45%	96.3%	71.62%
PULP	0.755	0.001	>6	75%	76.1%	65.63%	83.33%	75.6%

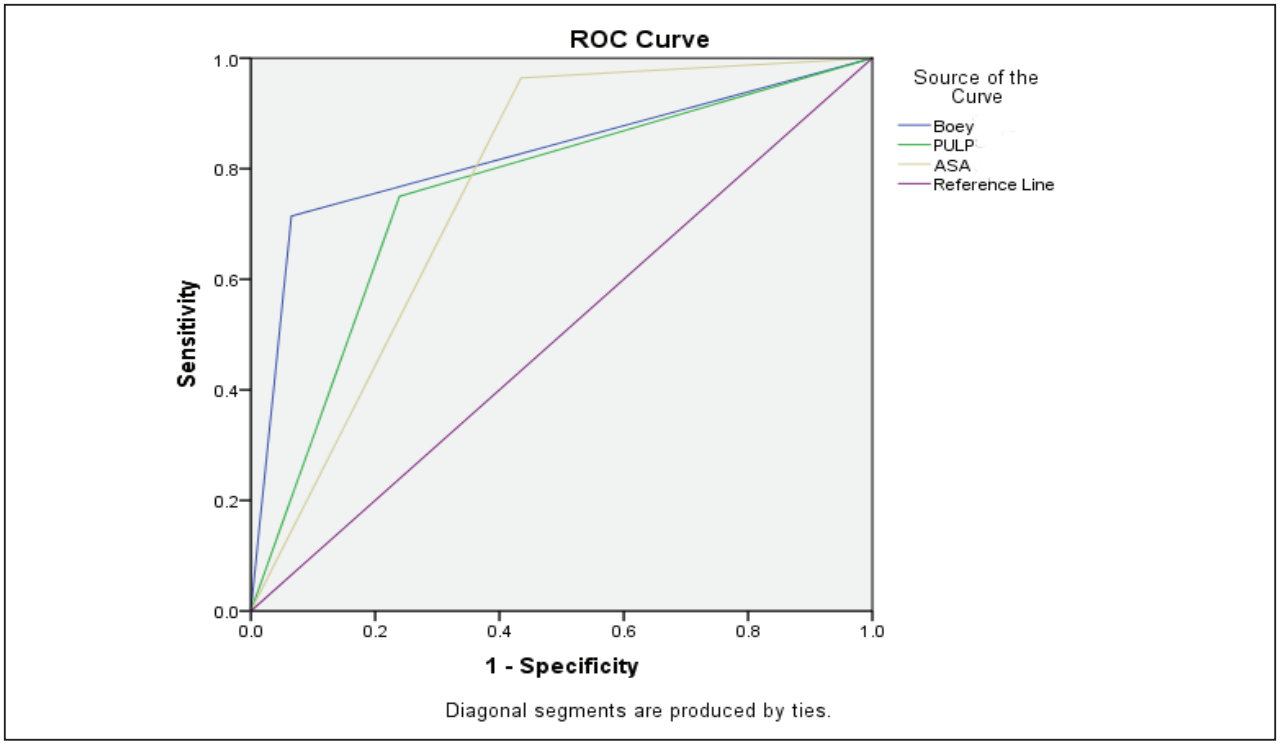

Figure 1: Receiver operating characteristic curve

DISCUSSION

Different scoring systems were developed for risk prediction and adjustment of morbidity from perforated duodenal ulcer. However, these scoring systems are not routinely used in perforated duodenal ulcer patient in everyday clinical practice. Identification of patient with a high risk of adverse outcomes following surgery is important for clinical decision-making which can assist in risk stratification and triage e.g., timing and extent of pre-operative respiratory and circulatory stabilisation, post-operative admission to a high dependency unit (HDU), the level and extent of monitoring, and inclusion in specific perioperative care protocols.

Any scoring system with the ability to predict the mortality and morbidity of any patient with a relatively high sensitivity and specificity is a boon for any clinician and the patient as well. This helps us to predict, prepare

and manage the unforeseen complications early and accurately. With the same aim, this study was started to compare the various scoring system (PULP, Boey's, and ASA) for their sensitivity and specificity in predicting 30-day morbidity in PDU patients.

The morbidity rates, mortality rates, and the efficacy of Boey's score, PULP score and ASA score in predicting the morbidity can be clearly compared (Table 6). The morbidity in current study was 37.83% which was higher than other study (10.5-32.2%).[7-12]

In Saafan et al. study,[7] old age, ASA >3, Boey >1, PULP >8 score, Shock on admission, preoperative comorbidities, and conversely low haemoglobin and albumin were all positively significant associated with high post DU 30-day morbidity. Similarly in current study, ASA >3, Boey >1, PULP >6, preoperative comorbidity and raised creatinine were significantly associated with post DU morbidity. This may be due to the fact that the patients usually come from rural areas where patients do not have easy access to proper healthcare facilities as problems like hypertension, diabetes and respiratory problems are undermanaged or ignored. This data lets us know that this being a tertiary centre has better resuscitation and post-operative management abilities.

In a study done by Sah et al.[3] it was found that the probability of predicting morbidity by Boey's score was 42%, 53%, 100%, and 100% in scores of 0, 1, 2, and 3. The morbidity rates for 0, 1, 2, and 3 Boey scores were 11%, 47%, 75% and 77% respectively in Lohsiriwat et al. study.[1] It was similar to this study.

In study done by Saafan et al.[7] it was found that the probability of predicting morbidity by ASA score were 4.3%, 7%, 20.5%, and 33.3% in scores of 1, 2, 3, and 4 respectively. In contrary to that study, current study had 92.3% had morbidity in ASA 4 as well as no morbidity in ASA 1.

The probability of predicting morbidity by PULP scores 0-7 and 8-18 were 8.57 % and 36.6% respectively by Saafan et al.[7] In contrast, this study had 16.7% and 65.6% in PULP 0-6 and 7-18 respectively.

Pneumonia/pleural effusion was the most common morbidity in this study which was comparable to Lohsiriwat et al. study and Unver et al. study.[1,12] Other causes of morbidity were wound infection, paralytic ileus and abdominal collection which was similar in other study.[1,8,9,12] Pneumonia and pleural effusion can be explained by emergency upper abdominal surgery causing significant pulmonary infection as well as abdominal collection in most cases can lead to pleural effusion. Since duodenal perforation surgery was contaminated surgery, it causes wound infection and wound dehiscence.

Sah et al.[3] concluded that AUC of Boey scoring was 0.78 for morbidity which strongly correlated with the values of this study that was 0.845.Other various studies done by Lohsiriwat et al.[1] and Makela et al.[13] have concluded that the morbidity prediction capability of Boey's score was very good. The AUC of PULP and ASA for morbidity were 0.72 and 0.69 respectively in Saafan et al. study which was comparable to this study[7].

In this study, patients with comorbidities like hypertension, diabetes and respiratory diseases had more chances of developing morbidity which correlated with a study done by Kim et al.[14] The patients with comorbidity had problems in intraoperative and immediate post-operative management which leads to increased morbidity.

This study also showed that the elevated creatinine level had correlations with increased morbidity in patients with PDU which was not mentions in any of the articles and studies reviewed.

The overall mortality in this study was 4.05%. Comparing this number to other studies done by Buck et al.,[15] Thorsen et al.,[16] is significantly low. This may attribute to small sample size compared to the high-volume centres where other studies were conducted.

Boey et al.[8] in his study stated that patients presenting in shock and patients presenting after 24 hrs of onset of symptoms had elevated risk of mortality and morbidity but in this study, this was statistically not significant. In a multivariate study done by Kim et al.[14] showed that preoperative shock was an independent prognostic factor for post-operative morbidity while long-standing perforation was not a significant prognostic factor. In another study conducted by Unver et al.,[12] the authors showed that older age, presence of comorbidities and use of alcohol and tobacco had statistically significant impact on risk of morbidity while this study included that age and use of alcohol and tobacco was statistically not significant for the same.

While comparing the scoring systems, the authors observed that both PULP and Boey's scores had statistically significant ability to predict 30-day morbidity.

CONCLUSION

The current study simultaneously examines Boey, ASA, and PULP scores for PDU only, and assesses the association of PULP with post PDU repair 30-day morbidity. Higher PULP and Boey were all significantly associated with post PDU repair 30-day morbidity. Boey and PULP score can be utilised as precise predictor of morbidity. It is recommended that the Boey and PULP score can be used to predict morbidity which can help in patient counselling.

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