IJSCIA

International Journal of Scientific Advances
ISSN: 2708-7972
Volume: 5 | Issue: 6 | Nov – Dec 2024 Available Online: www.ijscia.com
DOI: 10.51542/ijscia.v5i6.103

A Comparison of The Validity of POMPP, Boey, And PULP Scores as Predictors of Mortality in Patients with Perforated Peptic Ulcers at Prof Dr. I G.N.G. Ngoerah Hospital Denpasar

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ABSTRACT

Background: Peptic ulcer is a focal defect in the gastric and/or duodenal mucosa that extends to the submucosa or deeper. Every year peptic ulcer disease affects 4 million people worldwide, 10-20 percent of patients with peptic ulcers develop complications and 2%-14% of them have perforation. Many scoring systems have been reported to predict outcomes in patients with peptic ulcer perforation. The accuracy of each scoring system gives different results in each study. ***Objective:*** This study is to determine the most accurate scoring system (POMPP, Boey, and PULP) in predicting the mortality of perforated ulcer patients at Prof. Dr. I.G.N.G. Ngoerah Hospital, Denpasar. ***Methods:*** The research design was a retrospective diagnostic study. This study involved 40 peptic ulcer patients who performed surgery, divided into 2 groups: died (n16) and survived (n=26). POMPP, Boey, and PULP were scored and then subjected to descriptive analysis, an accuracy test with two-by-two cross-tabulation, and a validity comparison test by assessing the ROC curve. ***Results:*** The scoring values of POMPP, Boey, and PULP are consecutive; sensitivity; 68.7%, 75%, and 63.5%, specificity; 95.8%, 83.3%, and 95.8%, positive predictive value; 91.6%, 83.3%, and 90.9%, negative predictive value; 82.1%, 83.3%, and 79.3, accuracy; 85%, 80%, and 82.5%. The POMPP score had a higher relative risk (RR) value (5.6) compared to Boey (4.8) and PULP (4.6). ***Conclusion:*** In predicting the mortality of perforated peptic ulcer patients who were operated on, it was found that the Boey score had a higher sensitivity than the POMPP and PULP scores, but the accuracy of the POMPP score and the RR value of the POMPP score were higher than the Boey and PULP scores.

Keywords: perforated peptic ulcer; scoring system; POMPP; Boey; PULP; mortality.

INTRODUCTION

A peptic ulcer is a focal defect in the gastric and/or duodenal mucosa that extends to the submucosa or deeper. Every year peptic ulcer disease affects 4 million people worldwide (Di Saverio et al, 2014). Peptic ulcers can develop complications, such as bleeding, perforation, and obstruction. Perforation is the second most common complication after bleeding (Thorsen et al, 2013). Ten to twenty percent of patients with peptic ulcers experience complications and 2%-14% of them perforate (Søreide et al., 2015).

Many scoring systems have been reported to predict outcomes in patients with peptic ulcer perforation. Currently, the ASA (American Society of Anesthesiologists), APACHE II (Acute Physiology and Chronic Health Evaluation II), PULP (Peptic Ulcer Perforation), and Boey scores are the most commonly used prognostic scoring systems in patients with peptic ulcer perforation. (Thorsen K et al, 2013; Soreide JA et al., 2014). The PULP score is a relatively new score for clinically predicting the prognosis of perforated peptic ulcers (Møller MH, et al, 2011). The accuracy of each scoring system gives different results in each study. A study conducted by Møller MH, et al, (2011), showed the accuracy of the PULP score of 0.83, Boey Score of 0.70, and ASA score of 0.78 in predicting mortality and in cases of peptic ulcer perforation.

In 2015, a newer scoring system was proposed, POMPP (Practical scoring system of mortality in patients with perforated peptic ulcer), which is said to be simpler, uses more objective data, and provides faster analytical capabilities in predicting outcomes of perforated peptic ulcer patients.

This scoring system uses the variables of Albumin, BUN, and age as predictors of peptic ulcer perforation patient outcomes (Menekse et al., 2015a).

Each scoring system has advantages and disadvantages, Boey as one of the first developed scoring systems has advantages in terms of ease and practicality but in some studies, the accuracy obtained is not as good as PULP, and ASA. PULP tends to have advantages where the average accuracy obtained is better than other scoring systems but this system is not practical because many factors must be assessed. ASA scoring is a scoring system that is not specific to peptic ulcer perforation cases and its scoring variables tend to be subjective. The recently developed POMPP scoring system has advantages in terms of practicality, the components assessed are more objective and, in some studies, a good accuracy rate was obtained (Dn and Pk, 2018; K. R. et al., 2021; Sudha DhiyaneshR et al., 2017).

METHODS

In a retrospective design diagnostic test study, data was taken from the patient's medical record. The population of this study was all patients with a diagnosis of peptic ulcer perforation and surgery who were treated at Prof. Dr. I G.N.G Ngoerah Denpasar Hospital in the period January 2020 - December 2022. The minimum sample size is close to the number of affordable populations in the 3-year time period, so the entire affordable population is selected as a sample or total sampling is carried out by meeting the inclusion criteria, involving 40 surgically treated peptic ulcer patients, divided into two groups: death (n=16) and survived (n=24).

The inclusion criteria in this study are 1) Peptic ulcer perforation and surgery treated at Prof. Dr. I.G.N.G Ngoerah Denpasar Hospital from January 2020 - December 2022. 2) Complete medical record. The exclusion criteria in this study are 1) Perforated peptic ulcer patients with tumor or malignancy. 2) Patient with perforated peptic ulcer due to trauma. 3) Incomplete medical record. Data analysis was performed using SPSS for Windows version 26.0 software. The statistical analysis descriptive analysis, accuracy test, and validity comparison test.

RESULTS

Description of the Research Subjects

This study involved 40 research subjects, who were peptic ulcer patients who underwent surgery at Prof. Dr. I.G.N.G. Ngoerah Hospital. Respondent characteristics were described based on age, gender, albumin levels, creatinine levels, ASA scores, and comorbid diseases. The data are presented in Table 1.

TABLE 1: Characteristics of Research Subjects.

Characteristics	Peptic Ulcer Perforation	
	Mortality (n=16)	Survived (n=24)
Age (mean±SD)	68,8±14,5	68,66±10,97
Gender (n, %)		
Male	14 (35%)	20 (50%)
Female	2 (5%)	4 (10%)
BUN (mean±SD)	62,4±38	39±24,7
Blood albumin (mean±SD)	2,7±0,40	3,06±0,59
Creatinine (mean±SD)	3,8±3,36	2,4±1,49
ASA score (mean±SD)	3,18±0,45	3,12±0,33
Preoperative shock (n, %)		
Yes	8 (20%)	5 (12,5%)
No	8 (20%)	19 (47,5%)
Steroid use (n, %)		
Yes	3 (7,5%)	3 (7,5%)
No	13 (32,5%)	21 (52,5%)
Symptom onset (n, %)		
Yes (>24 hours)	8 (20%)	10 (25%)
No (< 24 hours)	8 (20%)	14 (35%)
Comorbid diseases (n, %)		
Yes	12 (30%)	10 (25%)
No	4 (10%)	14 (35%)

Results of ROC Curve Analysis of POMPP, Boey, and PULP scoring systems in predicting mortality of Perforated Peptic Ulcer patients

To determine the ability of the POMPP score, Boey score, and PULP to predict mortality of perforated peptic ulcer patients using the ROC (Receiver Operating Characteristic) curve.

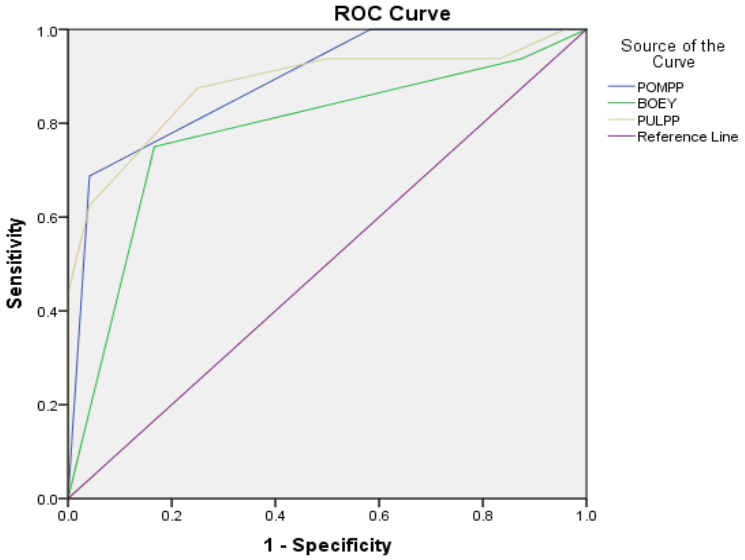

FIGURE 1: ROC curves of POMPP, Boey, and PULP scores.

ROC curve assessment based on the area under the ROC curve is said to be satisfactory when ≥ 70%.

TABLE 2: AUC values of POMPP score, Boey score, and PULP score.

Score	AUC value	CI 95%	p-*value*
POMPP	88,8	0,78-0,99	0,000
Boey	78,1	0,62-0,94	0,003
PULP	88	0,75-1,00	0,000

Figure 1 and Table 2 show the ROC curve of the POMPP score with an AUC value of 88.8% (p=0.000 <0.05). This means that if the POMPP score is used to diagnose the occurrence of mortality of perforated peptic ulcer patients in 40 respondents, the correct conclusion is obtained in 36 patients. Clinically, the AUC value of the POMPP score is satisfactory because it is greater than the minimum AUC value expected by the researcher which is 70%.

The Boey score ROC curve with an AUC value of 78.1% (p=0.003 <0.05). This means that if the Boey score is used to diagnose the occurrence of mortality of perforated peptic ulcer patients in 40 respondents, the correct conclusion is obtained in 31 patients. Clinically, the AUC value of the Boey score is quite satisfactory because it is greater than the minimum AUC value expected by the researcher which is 70%.

The ROC curve of the PULP score with an AUC value of 88% (p=0.000 <0.05). This means that if the PULP score is used to diagnose the occurrence of mortality of perforated peptic ulcer patients in 40 respondents, the correct conclusion is obtained in 35 patients. Clinically, the AUC value of the PULP score is satisfactory because it is greater than the minimum AUC value expected by the researcher which is 70%.

Furthermore, the cut-off point value is determined based on the coordinates of the curve table, obtained POMPP score with a cut-off of 1.5 Boey score with a cut-off of 1.5, and PULP score with a cut-off of 8.5.

Results Analysis of sensitivity, specificity, positive predictive value, negative predictive value of POMPP, Boey, and PULP scoring in predicting mortality of Perforated Peptic Ulcer patients

TABLE 3: Comparison of sensitivity (Sen), specificity (Spe), positive predictive value (PPV), negative predictive value (NPV), accuracy (Ac) of POMPP, Boey, and PULP Scores.

Variables	Peptic Ulcer Perforation		Sen	Spe	PPV	NPV	Ac
	Mortality	Survived					
POMPP score							
≥ *cut-off* (1,5)	11	1	68,7	95,8	91,6	82,1	85
< *cut-off* (1,5)	5	23					
Boey score							
≥ *cut-off* (1,5)	12	4	75	83,3	75	83,3	80
< *cut-off* (1,5)	4	20					
PULP score							
≥ *cut-off* (8,5)	10	1	62,5	95,8	90,9	79,3	82,5
< *cut-off* (8,5)	6	23					

Table 3 shows that the POMPP score ≥ 1.5 with a mortality of 11 perforated peptic ulcer patients and only 1 surviving perforated peptic ulcer patient while the POMPP score < 1.5 obtained a mortality of 5 perforated peptic ulcer patients and 23 living perforated peptic ulcer patients. The results of the sensitivity test based on the 2x2 table obtained a sensitivity of 68.7%, a specificity of 95.8%, a positive predictive value of 91.6%, a negative predictive value of 82.1%, and an accuracy of 85%.

Boey score ≥ 1.5 with a mortality of perforated peptic ulcer patients as many as 12 people and perforated peptic ulcer patients who lived only 4 people while Boey score < 1.5 obtained mortality of perforated peptic ulcer patients only 4 people and perforated peptic ulcer patients who survived as many as 20 people. The sensitivity test results based on the 2x2 table obtained 75%, specificity 83.3%, positive presumptive value 75%, negative presumptive value 83.3%, and accuracy of 80%.

PULP score ≥ 8.5 with mortality of perforated peptic ulcer patients as many as 10 people and perforated peptic ulcer patients who live only 1 person while PULP score < 8.5 obtained mortality of perforated peptic ulcer patients as many as 6 people and perforated peptic ulcer patients who survived only 23 people. The sensitivity test results based on the 2x2 table obtained 62.5%, specificity of 95.8%, positive predictive value of 90.9%, negative predictive value of 79.3%, and accuracy of 82.5%.

Comparison of POMPP, Boey, and PULP scoring in predicting mortality of Perforated Peptic Ulcer patients

TABLE 4: Comparison of POMPP, Boey, and PULP scores.

Variables	Peptic Ulcer Perforation		RR	CI95%	p
	Mortality	Survived			
POMPP score					
≥ *cut-off* (1,5)	11 (27,5%)	1 (2,5%)	5,6	2,27-11,58	0,000
< *cut-off* (1,5)	5 (12,5%)	23 (57,5%)			
Boey score					
≥ *cut-off* (1,5)	12 (30%)	4 (10%)	4,8	1,76-11,50	0,000
< *cut-off* (1,5)	4 (10%)	20 (50%)			
PULP score					
≥ *cut-off* (8,5)	10 (25%)	1 (2,5%)	4,6	2,10-9,17	0,000
< *cut-off* (8,5)	6 (15%)	23 (57,5%)			

Table 4 shows that the POMPP score ≥ cut-off (1.5) was found to be 27.5% higher in mortality in perforated peptic ulcer patients compared to the POMPP score < 1.5 (12.5%). The RR value was 5.6 (p=0.000 <0.05, CI 95%: 2.27-11.58). RR value > 1 indicates that POMPP score ≥ cut-off (1.5) increases the risk of mortality of perforated peptic ulcer patients. Boey score ≥ cut-off (1.5) was found to be 30% higher mortality than Boey score < 1.5 (10%). The RR value of the Boey score was found to be 4.8 (p=0.000 <0.05, CI 95%: 1.76-11.50). RR value > 1 indicates that Boey score ≥ cut-off (1.5) increases the risk of mortality of perforated peptic ulcer patients. PULP score ≥ cut-off (8.5) was found to be 25% higher mortality than PULP score < 8.5 (15%). The RR value was 4.6 (p=0.000 <0.05, CI 95%: 2.10-9.17). The RR value > 1 indicates that a PULP score ≥ cut-off (8.5) increases the risk of mortality of perforated peptic ulcer patients.

DISCUSSION

Characteristics of the Research Subjects

Characteristics based on the age of peptic ulcer perforation patients in this study were obtained with a mean of 68 years. Age over 65 years has been reported in several studies as an independent risk factor for mortality of peptic ulcer perforation patients (Shergill et al., 2018; Thorsen et al., 2014b). The results of the study (Thorsen et al., 2014b) also found that age > 60 years had a significant influence on the incidence of mortality of peptic ulcer patients. Cases of peptic ulcer perforation were found to be more in men than women, besides that the male sex was also found to have more mortality (35%). Research (Thorsen et al., 2014) obtained different results where female gender was found to be more than male but statistically found to be not associated with mortality of peptic ulcer patients with perforation.

BUN levels of perforated peptic ulcer patients in the mortality group were found to have a higher mean (62.4) compared to the survivors. BUN (Blood Urea Nitrogen) is also used as a marker of disease severity, BUN > 40 mg/dl was found to be a risk factor for increased mortality within 30 days post non-cardiac surgery (Søreide, 2016b; Thorsen et al., 2014b).

The albumin level of perforated peptic ulcer patients in the mortality group was found to be lower on average (2.7gr/dl) compared to the living group. Hypoalbuminemia reflects several underlying pathologies such as cancer, severe chronic diseases, and acute diseases that may cause dehydration or be accompanied by infection and sepsis (Søreide, 2016b; Thorsen et al., 2014b).

The creatinine levels of perforated peptic ulcer patients in the mortality group were found to have a higher mean (3.8) compared to the survivors.

High creatinine reflects some of the underlying pathology of the disease along with infection and sepsis (Søreide, 2016b; Thorsen et al., 2014b).

The ASA score of perforated peptic ulcer patients in the mortality group was found to have a higher mean (3.18) compared to the living group. An ASA score >3 has an association with an increased risk of mortality in peptic ulcer patients (Thorsen et al., 2014b). The ASA score showed a sensitivity of 67% and specificity of 94% at a cut-off point > 2 (Elsayed et al., 2023).

The presence of preoperative shock was found to be the same as those without shock with mortality (20%). Halim found that 47.7% of peptic ulcer patients were found with preoperative shock. The presence of shock on arrival at the hospital, as well as a high degree of comorbidity, are important prognostic factors and are associated with mortality of up to 100% (Thorsen et al., 2013).

Symptom onset > 24 hours was found to have less mortality compared to onset < 24 hours (20%). Boey's score is measured by the presence of shock, delay from symptoms to surgery > 24 hours, and the presence of comorbid diseases (Thorsen et al., 2014). Halim found that around 75.4% of peptic ulcer patients with perforation were found with the onset of perforation > 24 hours (Halim et al., 2021).

Results of sensitivity, specificity, positive predictive value, negative predictive value, and validity of POMPP scoring system in predicting mortality of Perforated Peptic Ulcer patients

In the results of this study, it was found that the POMPP scoring (practical scoring system of mortality in patients with perforated peptic ulcer) had a sensitivity of 68.7%, specificity of 95.8%, positive predictive value of 91.6%, negative predictive value of 82.1% with 85% accuracy. In line with (Bhutra et al., 2021; Menekse et al., 2015b) that the POMPP score is a simple quantitative method, and easy to apply to predict postoperative mortality in patients with peptic ulcer perforation. This scoring system is based solely on age, and two routine laboratory tests (Albumin and BUN). The criteria include age > 65 years, blood albumin < 1.5, and Blood Urea Nitrogen > 45gr/dl (Bhutra et al., 2021; Menekse et al., 2015).

The diagnostic test results conducted (IGA Pratama Putra et al., 2022) found the POMPP score had a sensitivity of 80.7%, specificity of 91.6%, positive predictive value of 91.3%, negative predictive value of 81.4% with an accuracy of 86% with an RR value> 1 so that the POMPP score increases the risk of death in peptic ulcer patients.

Sensitivity, specificity, positive predictive value, negative predictive value, and validity of Boey scoring system in predicting mortality of Perforated Peptic Ulcer patients

The results of this study found that the Boey score has a sensitivity of 75%, a specificity of 83.3%, a positive predictive value of 75%, and a negative predictive value of 83.3% with an accuracy of 80%. Research (Thorsen et al., 2014) states that the Boey scoring system is the first scoring system directly aimed at predicting peptic ulcer perforation mortality. In his research, Boey et al stated that delaying surgery after the onset of symptoms for more than 48 hours, the presence of shock upon arrival at the hospital, and a high degree of comorbidity are important prognostic factors and when all three prognostic factors are present together are associated with mortality of up to 100%. Further adjustments were made whereby the delay in operative time from symptom onset was taken as a cut-off value of 24 hours and this scoring system was validated in a Hong Kong cohort (Thorsen et al., 2014).

Boey's scoring does not include the prognostic factors of age and history of medication use that affect peptic ulcers. The exclusion of age as a prognostic factor seems to be because this scoring system was invented more than 3 decades ago. Nowadays, age is important because the incidence of peptic ulcer perforation increases in old age due mainly to the increase in average life expectancy and increased use of NSAIDs in old age (Menekse et al., 2015).

Sensitivity specificity, positive predictive value, negative predictive value, and validity of the PULP scoring system in predicting mortality of Perforated Peptic Ulcer patients

The results obtained a PULP score with a sensitivity of 62.5%, specificity of 95.8%, positive predictive value of 90.9%, and negative predictive value of 79.3% with an accuracy of 82.5%. The PULP (Peptic Ulcer Perforation) scoring system was introduced as a scoring system for peptic ulcer perforation based on a study conducted in Denmark with seven factors and each factor gets its own scoring level. The optimal cut-off point was found to be 7 points, with a positive predictive value (PPV) of 25% at points 0-7 and a PPV of 38% at points 8 or above (Møller et al., 2012).

In a study conducted by (Møller et al., 2012b) the components assessed in the PULP Score included: age > 65 years, active malignancy or AIDS, hepatic cirrhosis, steroid medication use, pre-operative shock, serum creatinine level > 130 µM, time from perforation to hospital arrival > 24 hours and 4 ASA (American Society of Anesthesiologists) score levels (from 2 to 5). Scores 0-7 correspond to a low risk of mortality (≤25%) and scores 8-18 correspond to high mortality (>25%) (Møller et al., 2012a). The accuracy of the PULP score (AUC 0.83) in predicting mortality is better than the Boey score (AUC 0.70) and even the ASA score (AUC 0.78) (Chung and Shelat, 2017b; C Mouly et al., 2013).

Comparison of the accuracy of POMPP, Boey, and PULP scores in predicting mortality of Perforated Peptic Ulcer patients

In the results of this study, it was found that the Boey score has a higher sensitivity than the POMPP and PULP scores, but the POMPP score has a higher

accuracy than the Boey and PULP scores. The POMPP score has a higher RR value compared to the Boey and PULP scores. It is important to understand the scoring system used by surgeons to determine the severity of disease because it can be used to improve the effectiveness of various treatment regimens, select more aggressive surgical management for patients in high-risk groups, provide more adequate care and provide information to families in a more objective manner. Identification of both negative factors and disease severity that provides an objective description of the patient's condition at a specific time is very helpful in improving and increasing knowledge of the problem at hand (Davis et al., 2014). Validation of the ASA, Boey, MPI, and PULP scoring systems has been conducted and found moderate accuracy in predicting mortality with an ROC (area under the receiver operator curve) of 72% - 77.2% (Chung and Shelat, 2017).

The PULP score appears to have the highest predictability of mortality compared to others, but it is too complex and impractical. The Boey score is more practical than PULP but its predictability has been found to be variable across studies. Both scoring systems require a good history to assess the duration of symptoms and comorbidities. Meanwhile, the ASA scoring system is not specific for peptic ulcer perforation, and its predictability was not found to be superior compared to others (Menekse et al., 2015b).

CONCLUSIONS

Comparison of the accuracy of the POMPP, Boey, and PULP scores in predicting mortality of perforated peptic ulcer patients who were operated on found that the Boey score had a higher sensitivity than the POMPP and PULP scores but the accuracy of the POMPP score and the RR value of the POMPP score was higher than the Boey and PULP scores so that the use of the POMPP scoring system was more recommended.

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