Original Research Article

Comparison of BOEY and PULP (Peptic Ulcer Perforation) SCORE in Assessing Post OP 30-Day Mortality in Gastric Perforation Patients at Moewardi Hospital, Surakarta

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Background: Gastric perforation is a serious complication of gastric ulcers. It is essential to group patients into different categories based on possible morbidity and mortality so that high-risk patients can receive more intensive care.

Aims: To compare the risk assessment of postoperative 30-day mortality in patients with gastric perforation using Boey and PULP scoring

Study design: Observational analytic study.

Place and Duration of Study: Department of Surgery at Dr. Moewardi Hospital, Surakarta, Indonesia, from 1 May - 30 June 2020.

Methodology: 10 gastric perforation patients were involved as our research subjects. All Boey and PULP scoring variables were taken through medical records. The ROC analysis test was used to obtain the AUC number, cut-off sensitivity, and specificity. All data were analyzed using SPSS for Windows version 25.

Results: Based on the ROC analysis, the AUC score for Boey scoring was 0.781 (95% CI 0.505-1.000). The AUC result for PULP scoring was 0.797 (95% CI 0.466-1.000). Boey's cut-off scoring was at number 2 with a sensitivity of 75% and a specificity of 75%. The cut-off scoring for PULP was at 7 with a sensitivity of 75% and a specificity of 87.5%.

Conclusion: Boey and PULP scores were statistically proven to predict mortality 30 days after gastric perforation surgery, and there was no significant difference between Boey and PULP scores.

Keywords: PULP, Boey, Mortality, Gastric Perforation

1. INTRODUCTION

Gastric perforation is a serious complication of gastric ulcers. Patients with gastric perforation have acute abdominal symptoms and a high risk of mortality and morbidity. The characteristic feature of gastric perforation is sudden onset/abdominal pain with worsening. Tachycardia is common when there are gastroduodenal discharge and severe pain in the patient. Abdominal pain with sudden onset, tachycardia, and abdominal stiffness is the classic triad of gastric perforation. In general, the symptoms felt by patients never really subside even though general treatment has been carried out, so patients must immediately get special medical treatment such as surgery. (1).

To manage gastric perforated patients and improve cure rates, it is crucial to group patients into different categories based on possible morbidity and mortality so that high-risk patients can receive more intensive care. Several risk assessments to predict outcome in gastric perforation patients have been developed.

The Boey scoring system is one of the most commonly used risk assessments due to its simplicity and ability to have a high predictive value for gastric perforated patient mortality (2). The Boey score is calculated based on the presence of shock, delay in surgery > 24 hours, and high rates of comorbidities, such as chronic obstructive pulmonary disease, heart failure, and active cancer (defined as cancer during curative treatment or incurable cancer) (3).

Besides, a Peptic Ulcer Perforation Score (PULP) has also been introduced as a scoring system for gastric perforations ranging from 0 to 18. Based on the cut-off PULP score, patients were divided into a low-risk group with a risk of mortality of ≤ 25% (score 0-7) and a high-risk group with a risk of mortality of > 25% (score 8-18) (4).

In this study, we wanted to compare the risk assessments of postoperative 30-day mortality in patients with gastric perforation using Boey scoring and PULP scoring. The existence of this study is expected to provide recommendations for determining the type of scoring that is more accurate in the management of gastric perforation patients.

2. MATERIAL AND METHODS

This study was an observational analytic study with a prospective cohort study approach to study the difference between Boey and PULP scores as a predictive factor for postoperative 30-day mortality in gastric perforated patients from 1 May to 30 June 2020. This study's population was all patients with gastric perforation who went to the Emergency Department (IGD) and digestive surgery clinic of Dr. Moewardi Hospital (RSDM) between 1 May and 30 June 2020. The subject size was obtained using the formula, namely ten subjects. All data were obtained through the patient's medical record covering all the Boey and PULP scoring criteria.

2.1 Statistical Analysis
Receiver Operating Characteristics (ROC) analysis was used to obtain the AUC number and cut-off point from each scoring system. Using the ROC analysis results, the sensitivity and specificity figures of each scoring system were obtained. The minimum difference expected is 15%. All data were analyzed using SPSS for Windows version 25.

3. RESULTS AND DISCUSSION

This research was conducted from 1 May to 30 June 2020 at the Department of Surgery RSDM, Surakarta. The study subjects were all patients with gastric perforations who went to the Emergency Room (IGD) and the digestive surgery clinic of RSDM with the distribution based on age, sex, and the results of Boey and PULP scoring shown in tables and graphs.

Table 1.   Characteristics of research subjects

| Variable	Frequency	30-day mortality	
		Alive	**Died**
Age (years)	61.17 ± 14.85	56.00±14.90	71.50 ±8.81
Gender			
Male	9 (75.0%)	6 (50.0%)	3 (25.0%)
Female	3 (25.0%)	2 (16.7%)	1 (8.3%)
Boey score			
0	2 (16.7%)	2 (16.7%)	0 (0.0%)
1	5 (41.7%)	4 (33.3%)	1 (8.3%)
2	5 (41.7%)	2 (16.7%)	3 (25.0%)
3	0 (0.0%)	0 (0.0%)	0 (0.0%)
PULP score			
≤7	10 (83.3%)	8 (66.7%)	2 (16.7%)
>7	2 (16.7%)	0 (0.0%)	2 (16.7%)

The research subjects in this study had a mean age of 61.17 ± 14.85 years. The mean age of patients who were still alive after 30 days of surgery was 56.00 ± 14.90, while the mean age of patients who died after 30 days of surgery was 71.50 ±8.81.

For gender characteristics, nine subjects are male (75%) and three female (25%). The total mortality for male subjects was three subjects with six alive subjects. The total mortality for female subjects was one subject with two other subjects living 30 days postoperatively. A total of four patients died after 30 days of surgery. The characteristics of the subjects who died can be seen in the following table.

Table 2. Characteristics of subjects who died.

Variable	Age (years)	Duration of Treatment (days)	Scoring		Cause
			Boey	**PULP**	
Mr. DW	61	5	1	3	Respiratory Failure
Mr. M	69	7	2	11	Sepsis
Ms. T	82	7	2	12	Sepsis
Mr. WS	74	4	2	7	Sepsis

The AUC analysis shows that the AUC results shown in Table 3 for the Boey scoring are 0.781 (95% CI 0.505-1.000). The AUC result for PULP scoring is 0.797 (95% CI 0.466-1.000). The difference between the AUC scores is smaller than the expected minimum difference (15%). Thus, there is no clinical difference in AUC between the two scoring systems in predicting mortality.
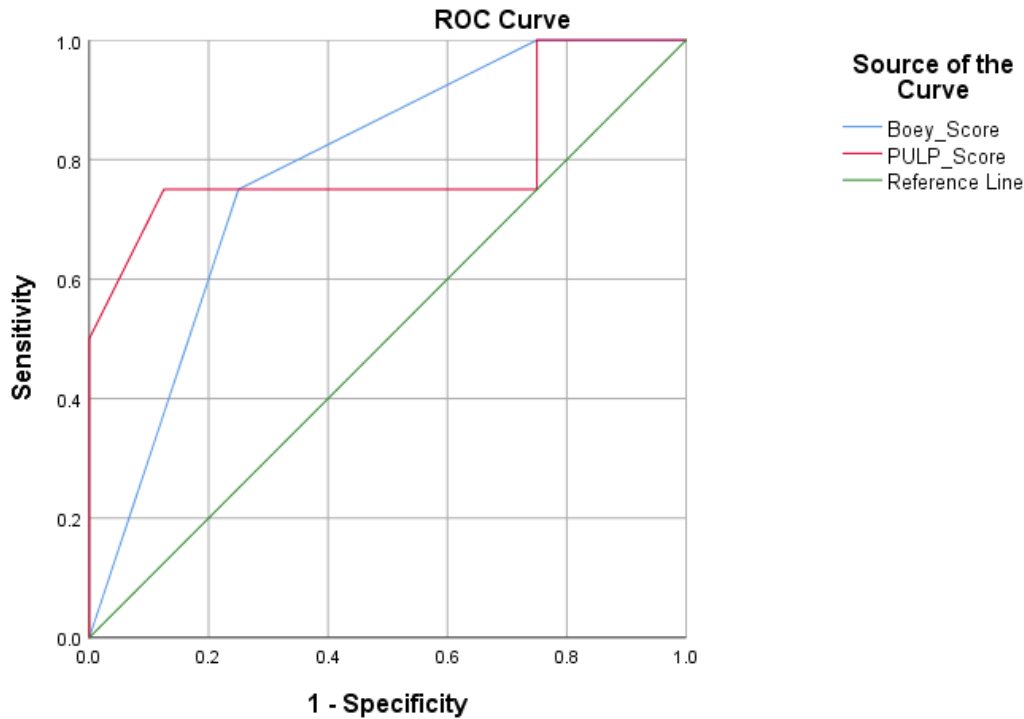
Diagonal segments are produced by ties.

Figure 1. ROC curve for determining AUC value on Boey and PULP scoring

Based on the ROC analysis, the Boey scoring variable has a cut-off value of 2 with a sensitivity of 75% and a specificity of 75%. Meanwhile, the ROC analysis found that the PULP scoring variable had a cut-off value of 7 with a sensitivity of 75% and a specificity of 87.5%.

Table 3. Results of AUC determination, sensitivity, specificity, and the cut-off point for Boey and PULP scoring.

Variable	AUC	Sensitivity	Specificity	Cut-off Value
Boey Scoring	0,781	75,0%	75,0%	≥2
PULP scoring	0,797	75,0%	87,5%	≥7

4. DISCUSSION

Based on the ROC curve results, the AUC analysis showed that the AUC results shown in Table 3 for Boey scoring were 0.781 (95% CI 0.505-1.000) and for PULP scoring 0.797 (95% CI 0.466-1.000). The AUC value can be interpreted as follows: 90 - 100% = excellent; 80 - 90% = good; 70 - 80% = fair; 60 - 70% = bad; 50 - 60% = failed (5). Boey and PULP scoring can be said to be fair enough in the prognosis of patient mortality 30 days post-surgery. AUC values below the expected minimum difference indicate that Boey scoring and PULP scoring are not statistically different in patient mortality prognosis.

The AUC figure obtained was 0.781, close to the AUC number in other studies, namely: 0,75 (3), 0,70 (4), and 0,63 (6). This variable AUC number is due to several factors, such as the

age at which the Boey scoring was developed from a population study with an average age of 51 years (7), but the mean age of the current study subjects was 61 years. Existing studies show that the 30-day mortality is at least 14% when the mean age is > 60 years (8–11), in contrast to the reduction in mortality that exists of 3% to 14% in patients with a mean age < 60 years (2,12,13). It may make Boey scoring less suitable for older patients than for younger patients.

Moreover, in their research, Buck *et al.* (2012) showed that there is a weakness in the definition of Boey shock scoring where shock has a definition of systolic blood pressure < 90 mmHg (6). In contrast, a shock is usually defined as a combination of systolic blood pressure and tachycardia, usually defined as pulsations $\geq$ 100 per minute(4). Thus, this causes the Boey score to vary because of the definition used. However, several studies have shown that Boey score is a good predictor of mortality in gastric perforated patients (2,4).

Boey scoring is explicitly designed for patients with peptic ulcer disease, and although the definition is a concern of its own, the simplicity of Boey scoring makes it easy and fast to use, which is a distinct advantage. On a separate note, the Boey score does not show sufficiently good results in predicting morbidity in patients (2,7). The Boey score does not take into account other well-established prognostic factors such as age, gender, concomitant intake of steroids/NSAIDs, or renal impairment and leads to accuracy in predicting the risk of death (4,14).

On the other hand, PULP scoring was developed to predict mortality (3,4,14,15). The AUC results from PULP scoring in previous studies were 83% (4), 79% (3), 80,4% (16), and 75% (14). The ideal scoring system requires diagnostic indicators that are effective in identifying cases, and the AUC results show the level of accuracy in diagnostic testing because of its discriminatory ability to classify patients (17), where the AUC analysis of 70 - 80% is considered a fair level of accuracy (5).

The research conducted by Patel *et al.* (2019) shows that PULP scoring has special advantages, such as the calculation of elevated serum creatinine levels, which can increase the risk of mortality 30 days postoperatively (OR = 17,124). It could be because elevated serum creatinine levels indicate previous renal failure or acute kidney injury due to sepsis or dehydration caused by peptic ulcers (18).

The PULP scoring itself also has drawbacks such as in the context of defining 'delay' where the PULP scoring only considers the time from perforation to hospital admission > 24 hours while Boey scoring defines 'delay' as the time when symptoms of onset occur until the perforation is treated > 24 hours. It is crucial because, in the study of Buck *et al.* (2012), it is very crucial to reduce the time after perforation to surgery because the increase every hour worsens prognosis (6). It may cause confounding factors that can affect the time the perforation reaches the patient in surgery, such as delays in handling surgery in the hospital and others. It also causes demographic factors to become another influencing factor where hospitals in areas have poor infrastructure so that the longer travel time from primary facilities in rural areas to the hospital will increase the risk of mortality significantly (3).

In this study, the PULP score achieved a higher AUC score than the Boey score, which can be explained by the inclusion of several objective predictors related to the patient's current health status and acute disease severity in the PULP score compared to the Boey score. However, this more clinically complex assessment is a drawback of the PULP score and therefore is not easy to use (19).

4. CONCLUSION

Boey and PULP scores were statistically proven to predict postoperative 30-day mortality in gastric perforated patients at Dr. Moewardi Hospital, Surakarta, without any significant differences between the two scores.

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