

# A Comparison of Boey Score and American Society of Anesthesiologists (ASA) Score in Predicting the Outcome of Perforated Peptic Ulcer

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## ABSTRACT

**Background:** Variety of prognostic factors and rules have been proposed to predict morbidity and mortality following peptic ulcer perforation. Identification of patients with high risk of post-operative adverse outcomes is crucial for clinical decision-making. This study evaluates the efficacy of Boey Score and American Society of Anaesthesiologist (ASA) Score as clinical prediction rules for patients of perforated peptic ulcer.

**Methods:** A total of 35 patients with peptic ulcer perforation were included in the study. Boey and ASA score were applied to each patient. Ability of the two clinical scoring systems to distinguish survivors from non-survivors (discrimination ability) was evaluated. The parameters used were 30-day mortality, morbidity, septic shock and intensive care unit (ICU) admission.

**Results:** The area under the receiver operating characteristic curve of the two scoring systems with respect to 30-day mortality was 0.734 for Boey score and 0.781 for ASA score. With reference to septic shock and ICU admission, the Boey score was significantly associated with ICU admissions, while the ASA score was significantly associated with both the endpoints. Positive predictive values of both the scoring systems were low for 30-day mortality (15-25%) while negative predictive values of both scores were high (100% for Boey score  $\geq 1$  and 95.83% for ASA score  $\geq 3$ ). Boey score had a sensitivity of 100% and specificity of 34.37% for predicting 30-day mortality, where as the ASA score demonstrated a sensitivity of 66.67% and specificity of 71.87% for the same. ASA score was significantly more accurate than Boey score in predicting of 30-day mortality, morbidity and septic shock. Both scores predicted ICU admission accurately.

**Conclusion:** The Boey score and the ASA score demonstrated a variable accuracy in predicting the outcome of perforated peptic ulcer. They may assist in risk stratification and identify the need for early intervention and prompt treatment in high risk patients.

**Key words:** Perforated peptic ulcer, Boey score, American Society of Anesthesiologists (ASA) score, 30-day mortality, morbidity, septic shock, ICU admission, outcome prediction

**Abbreviations:** *ASA* – American Society of Anesthesiologists; *AUC* - Area under the Receiver Operating Characteristic curve; *ICU* – Intensive care unit

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## Introduction

Gastro-duodenal perforation is a common but serious complication of peptic ulcer disease [1]. The mortality and morbidity following peptic ulcer perforation are substantial and mortality rates as high as 25% to 30% have been reported [2]. Several prognostic factors and scoring systems have been proposed for prediction of the outcome [3-7]. At present, clinical scoring systems are

not routinely used in peptic perforation patients. Identification of patients with a high risk of adverse outcomes is crucial for clinical decision-making. A reliable, easy-to-calculate, scoring system will enable better counselling of patients and relatives regarding the final outcome. This study evaluates the comparative efficacy of the Boey score and ASA score in predicting the outcome of perforated peptic ulcers.

## Methods

This prospective study was conducted at a tertiary healthcare centre from July 2013 to May 2015. Consecutive sampling was done. All patients with perforated peptic ulcer were included in the study. Written informed consent was obtained from all patients before study enrolment. All of them were clinically examined and subjected to necessary diagnostic investigations. Radiological demonstration of gas under diaphragm was considered as confirmative evidence of perforation peritonitis. On establishing the diagnosis nasogastric tube and urinary catheter were inserted. Cefixime 1g 12 hourly, Metronidazole 500mg 8 hourly, Gentamycin 80 mg 8 hourly (depending on renal function) were intravenously administered. Boey and ASA score were applied for each patient (Tables 1 and 2).

**Table 1: Modified Boey Scoring system [4]**

| Criteria                          | Score      |   |
|-----------------------------------|------------|---|
| Number of hours since perforation | < 24 hrs   | 0 |
|                                   | >24 hrs    | 1 |
| Pre-operative Systolic BP         | >100 mm Hg | 0 |
|                                   | <100 mm Hg | 1 |
| Any one or more systemic illness  | Absent     | 0 |
|                                   | Present    | 1 |

**Table 2: American Society of Anaesthesiologist (ASA) Scoring system [5]**

| Criteria                                 | Score |
|------------------------------------------|-------|
| No significant co-morbidities            | 1     |
| Mild systemic illness                    | 2     |
| Severe systemic illness                  | 3     |
| Life threatening severe systemic illness | 4     |
| Moribund patient not expected to survive | 5     |

Standard surgical guidelines were followed in all the patients which included perforation closure with Graham's patch omentoplasty, antibiotic cover and commencement of oral feeds on the return of bowel sounds. The parameters used for prediction of operative outcome were: 30-day mortality, morbidity, development of septic shock as defined at the 2001 International Sepsis Conference [8], postoperative admission to ICU within 30 days of surgery.

All the data were analyzed using SPSS. Fischer exact test and the Mann-Whitney rank sum test were used to calculate statistical significance. Statistical significance was fixed at p value less than 0.05. Discrimination ability of the two clinical scoring systems in identifying survivors and non-survivors was evaluated by AUC with the optimal AUC being close to 1.

## Results

A total of 35 patients with peptic ulcer perforation were included in the study. The average age of the patient was 37.4 years  $\pm$  16.83 SD with range of 18 - 68 years. There were 33 (94%) males and 2 (6%) females. The score wise distribution of cases is depicted in figures 1 and 2. Among the study cohort 20 had a Boey score of 2 and 22 cases had an ASA score of 3. The AUC with respect to 30-day mortality was 0.734 (95% CI 0.48 – 0.99) for Boey score and 0.781 (95% CI 0 - 1) for ASA score. (Table 3) With reference to septic shock and ICU admission, the Boey score was significantly associated with ICU admissions, while the ASA score was significantly associated with both the endpoints (Table 4). The positive predictive values of both the scoring systems were low for 30-day mortality (15-25%) while the corresponding negative predictive values were high: Boey score  $\geq$ 1: 100% and ASA score  $\geq$ 3: 95.83%. The Boey score had a sensitivity of 100% and specificity of 34.37% for predicting 30-day mortality, where as the ASA score demonstrated a sensitivity of 66.67% and specificity of 71.87% for the same (Table 3). The ASA score predicted 30-day mortality with a statistical significance ( $p < 0.01$ ) as compared to the Boey score which predicted 30-day mortality but with no statistical significance ( $p > 0.05$ ). The ASA score significantly predicted morbidity. The Boey score did not show any statistical significance for the same. Septic shock was significantly predicted by Systolic BP < 100 and Serum Creatinine (Table 5). ASA score predicted septic shock significantly as compared to Boey score. ICU

**Table 3: Comparison of ASA and Boey scores with regard to 30-day mortality**

| Score      | 30-day mortality |    |
|------------|------------------|----|
|            | Yes              | No |
| Boey score |                  |    |
| $\geq$ 1   | 3                | 21 |
| <1         | 0                | 11 |
| ASA Score  |                  |    |
| >3         | 2                | 9  |
| $\leq$ 3   | 1                | 23 |

For Boey score Fisher exact test = 0.54; For ASA score Fisher exact test = 0.23

**Table 4: Comparison of Mean scores of Boey and ASA systems**

|                                | Boey Score* | ASA Score*  |
|--------------------------------|-------------|-------------|
| <b>30-day mortality</b>        |             |             |
| Yes                            | 2.33 + 0.58 | 4.33 + 1.16 |
| No                             | 1.75 + 0.62 | 3.28 + 0.58 |
| <b>Morbidity</b>               |             |             |
| Yes                            | 1.92 + 0.67 | 3.75 + 0.87 |
| No                             | 1.74 + 0.2  | 3.17 + 0.49 |
| <b>Septic shock</b>            |             |             |
| Yes                            | 2.17 + 0.75 | 4.17 + 0.98 |
| No                             | 1.72 + 0.59 | 3.21 + 0.49 |
| <b>Need for ICU Admissions</b> |             |             |
| Yes                            | 2.15 + 0.56 | 3.77 + 0.83 |
| No                             | 1.59 + 0.59 | 3.14 + 0.47 |

\* Values are mean + standard deviation



Fig 1: Distribution of Boey score in study population

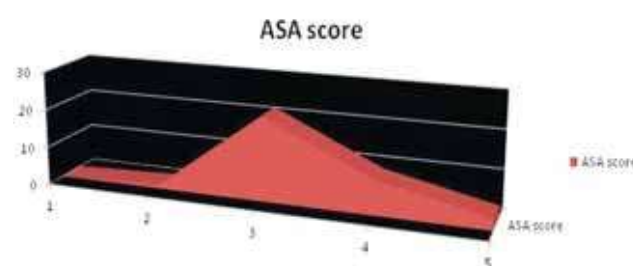


Fig 2: Distribution of ASA score in study population

**Table 5: Correlation between risk factors and outcome events**

|                      | Heart Rate >100 | Systolic BP <100 | Creatinine >1.3 † | Delay >24 hrs* |
|----------------------|-----------------|------------------|-------------------|----------------|
| <b>Septic shock</b>  |                 |                  |                   |                |
| Yes                  | 4               | 5                | 3                 | 5              |
| No                   | 13              | 13               | 1                 | 17             |
| <b>ICU admission</b> |                 |                  |                   |                |
| Yes                  | 8               | 9                | 4                 | 11             |
| No                   | 9               | 9                | 0                 | 11             |

† Serum level of creatinine

\* Delay between onset of symptoms and surgical closure of perforation

admission was significantly predicted by serum creatinine and perforation-to-operation delay. Boey score and ASA score predicted ICU admission significantly.

## Discussion

Globally the incidence of peptic ulcer disease has fallen in recent years. However, the number of patients admitted with peptic ulcer complications has not undergone a similar decline, and peptic ulcer perforations remain a substantial healthcare problem. Although intraoperative parameters have been recognised as significant predictors of mortality in duodenal perforation, an accurate scoring system is lacking. Scoring systems dependant on sophisticated investigations may not be applicable to developing countries [9].

During the last decade, fast-track surgery and evidence based in-hospital care have been implemented in various fields of surgery, leading to a reduction in mortality and morbidity [10]. In patients with perforated peptic ulcer, mortality has been reduced considerably by implementation of such evidence-based protocols [1]. Early and precise identification of high-risk patients is needed to plan and target the level of perioperative monitoring and treatment. For this purpose, a clinical scoring system with ability to predict adverse outcome with a high degree of precision is desirable. This study evaluates the performances of Boey and ASA scoring systems for patients of peptic ulcer perforation. The study reports 34.3% morbidity, 8.6% 30-day mortality, with 17% developing septic shock and 37% requiring ICU

admission.

In the present study, the Boey score had an AUC of 0.73 which poorly discriminated survivors with non-survivors with a low positive predictive value and high negative predictive value which was not statistically significant to predict 30-day mortality. A similar outcome was seen in a study done by Buck et al [11], where the AUC for the Boey score was even low, being 0.63. The Boey score was developed from a study population with a median age of 51 [4]. However in recent studies age has also been shown to be an isolated predictor of mortality [3, 6, 12]. Buck et al [11] pointed out that defining shock with a systolic blood pressure of < 90 mm of Hg could be a weakness of Boey's original study. In the present study shock has been defined according to the guidelines laid down in the 2001 Sepsis Conference as systolic blood pressure < 100 mm of Hg and tachycardia > 100 beats per min [8]. Thus Boey score may vary according to definitions used. The Boey score has not useful in predicting mortality as reported by Lohisiriwat et al [13]. Despite these concerns it is simple and easy to use.

In a study from Chicago [14], the Boey score predicted mortality, but failed to predict morbidity. Subedi et al [15], have reported that the time delay between perforation-to-operation, preoperative blood urea and serum creatinine, size of perforation and peritoneal contamination, presence of co-morbid conditions and the need for postoperative ICU support are important predictors of outcome in peptic ulcer perforation,

The ASA score is simple to calculate but has been criticised for its subjectivity and wide spread inter-observer variability [11]. The ASA score was not originally designed to be a predictor of perforated peptic ulcer. In a study by Thorsen et al [16], the ASA score predicted mortality well with AUC values varying from 0.73 to 0.91. A similar outcome has been recorded in the present study with ASA score having AUC value of 0.78. The ASA score predicted 30-day mortality (p < 0.01), septic shock (p < 0.001) and ICU admission (p < 0.01) with statistical significance.

## Conclusion

Boey and ASA scores demonstrated variable accuracy in predicting the outcome of perforated peptic ulcer. The ASA scoring system has significant correlation with prediction of morbidity, 30-day mortality, septic shock and ICU admission. It balances practicality and accuracy, especially if combined with another variable such as age or operative urgency. The Boey score though created specifically for patients with perforated peptic ulcers, does not comprise of any prognostic factor related to patient age or concomitant medication use. These systems may be useful in risk stratification of perforated peptic ulcer patients and identify the need for early

intervention and prompt treatment for better patient outcome.

**Conflicts of Interest** : Nil

**Ethics** : Compliance with ethical principles declared

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