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Predictive Value of Boey Score for Postoperative Morbidity and Mortality in Perforated Peptic Ulcer: A Prospective Cohort Study

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Abstract: Background: Perforated peptic ulcer (PPU) remains a critical surgical emergency with substantial morbidity and mortality. The Boey scoring system offers a simple yet powerful risk stratification tool. This study evaluated its predictive accuracy in Iraqi patients. ***Methods:*** Prospective cohort study of 100 patients undergoing emergency surgery for PPU at Al-Yarmouk Teaching Hospital (January 2022-April 2023). Boey score calculated based on: time >24h, preoperative SBP<90mmHg, and comorbidities. Statistical analyses included Chi-square, logistic regression, and ROC curves. ***Results:*** Mean age 32.9±12.7 years, 88% male, 84% duodenal perforation. Morbidity increased progressively with Boey score: 10.2% (score 0), 27.3% (score 1), 66.7% (score 2), 100% (score 3), p<0.001. Overall morbidity 27% (ileus 22%, pneumonia 16%). Three deaths (3%), all Boey score 3. Late admission OR=11.1 (95% CI:2.7-45.0), shock OR=19.1 (95% CI:1.61-226.4). AUC=0.864 (95% CI:0.77-0.95). ***Conclusion:*** Boey score demonstrates excellent predictive accuracy (AUC=0.864) for PPU outcomes. Its simplicity enables routine clinical implementation for risk stratification and resource optimization.

Keywords: Boey score; perforated peptic ulcer; morbidity; mortality; risk stratification; predictive model; emergency surgery

INTRODUCTION

Peptic ulcer disease (PUD) affects 5-10% of the global population, with 8.09 million cases in 2019 (Xie et al., 2022). Despite therapeutic advances with proton pump inhibitors and H. pylori eradication, complications remain significant. Perforated peptic ulcer (PPU) occurs in 2-14% of PUD cases, causing 40% of ulcer-related deaths (Søreide et al., 2015).

In Iraq, H. pylori prevalence ranges 47.8-70.4% (Hussein et al., 2021), contributing to PPU burden. The surgical indication rate increased from 24% (1980) to 76% (2000) in Iraqi centers (Al-Bahrani et al., 2008). PPU carries morbidity rates of 25-40% and mortality of 3-30% (Møller et al., 2012; Tulinský et al., 2022).

Multiple scoring systems predict PPU outcomes: ASA score, Mannheim Peritonitis Index, PULP score, and Boey score (Thorsen et al., 2013). The Boey system, developed in 1982, uses three parameters: time>24h, preoperative shock (SBP<90mmHg), and comorbidities (Boey et al., 1982). Each parameter scores 1 point (range 0-3).

Previous studies showed progressive morbidity with Boey scores: 10%, 46%, 90%, 100% for scores 0-3 (Lohsiriwat et al., 2009). Similar patterns emerged in India (Patel et al., 2019), Ethiopia (Bupicha et al., 2020), Qatar (Saafan et al., 2019), and Somalia (Ali et al., 2022). However, Middle Eastern validation data remain limited.

This study evaluates Boey score accuracy in predicting postoperative morbidity and mortality in Iraqi PPU patients, providing essential regional validation data.

MATERIALS AND METHODS

2.1. Study Design

Prospective cohort study at Al-Yarmouk Teaching Hospital, Baghdad, Iraq (January 1, 2022-April 30, 2023). This tertiary center serves 2 million population with four surgical units providing 24-hour emergency care.

2.2. Participants

Convenience sample of 100 consecutive PPU patients. Inclusion: age ≥16 years, radiologically confirmed PPU, fitness for surgery. Exclusion: conservative management candidates, traumatic/malignant perforations, surgical contraindications, refusal. Written informed consent obtained.

2.3. Data Collection

Standardized forms captured: demographics, vital signs, symptom onset time, comorbidities (diabetes, hypertension, heart disease, COPD, renal/liver disease), behavioral factors (smoking, NSAIDs), laboratory tests, imaging findings. Boey score calculated: time>24h (1 point), SBP<90mmHg (1 point), comorbidities (1 point).

2.4. Surgical Management

Preoperative: NBM, nasogastric decompression, IV fluids, broad-spectrum antibiotics (ceftriaxone 1g + metronidazole 500mg), omeprazole 40mg IV, urinary catheterization. Resuscitation targeted SBP>90mmHg. Procedure: Exploratory laparotomy, peritoneal lavage, Graham omental patch repair (2-0 Vicryl), gastric ulcer biopsy when indicated, subhepatic drain placement.

2.5. Postoperative Care

ERAS-adapted protocols: NGT until ileus resolution, IV antibiotics 5-7 days, drain removal when output<60mL/day×2, oral intake day 3-5, discharge typically day 5-7. H. pylori eradication (amoxicillin+clarithromycin+PPI×14 days) for duodenal ulcers.

2.6. Follow-up

30-day follow-up: Day 0 (consent/baseline), Day 5 (discharge), Day 10 (suture removal), Day 15 (checkup), Day 30 (final assessment). Complications: ileus, pneumonia, wound infection, intra-abdominal abscess, dehiscence, fistula, patch failure, death.

2.7. Statistical Analysis

IBM SPSS v22.0. Continuous variables: mean±SD, t-test/Mann-Whitney. Categorical: frequency/percentage, Chi-square/Fisher exact. Binary logistic regression for predictors (OR, 95% CI). ROC curve for discrimination (AUC, 95% CI). AUC >0.8=excellent. Two-tailed, p<0.05 significant.

2.8. Ethics

Approved by Arab Board Scientific Council and Baghdad-Al-Karkh Health Directorate Ethics Committee. Helsinki Declaration compliance. Written informed consent, data anonymized.

RESULTS

3.1. Patient Demographics

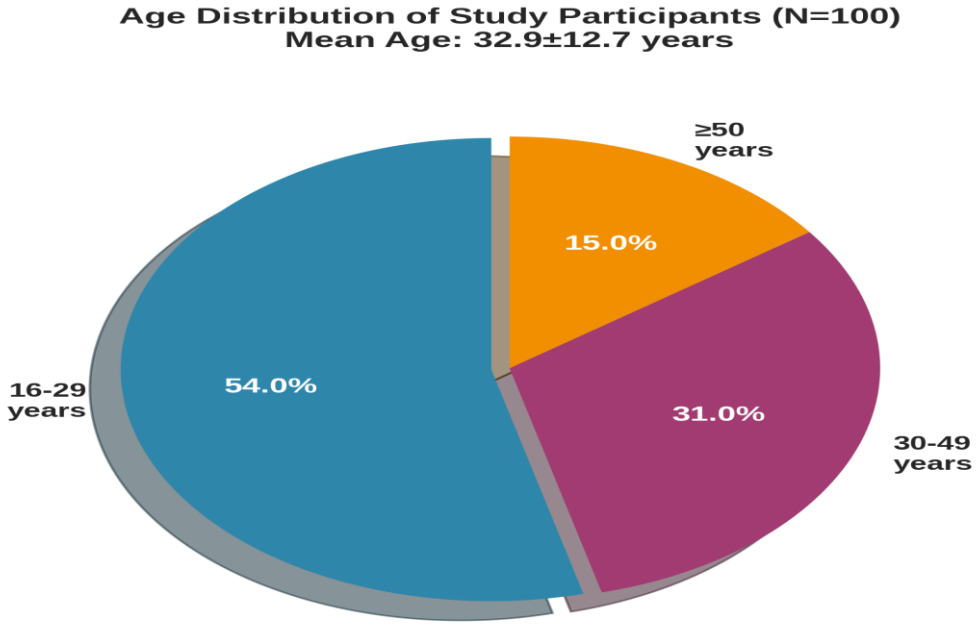
Mean age 32.9±12.7 years (range 16-64), 54% aged <30. Male predominance 88%, female 12%. Duodenal perforation 84%, gastric 16%. NSAID use denied by 80%. Smoking prevalent. Chronic illnesses in 19%: hypertension (n=7), diabetes (n=5), combined HTN+DM (n=3), COPD (n=4).

Table 1 ***Demographics and Clinical Characteristics (N=100)***

Variable	n (%) or Mean ± SD
Age, years	32.9 ± 12.7
16-29 years	54 (54.0)
30-49 years	31 (31.0)
≥50 years	15 (15.0)
Male gender	88 (88.0)
Duodenal perforation	84 (84.0)
Systemic comorbidities	19 (19.0)

Note. SD = standard deviation.

Figure 1. Age Distribution of Study Participants

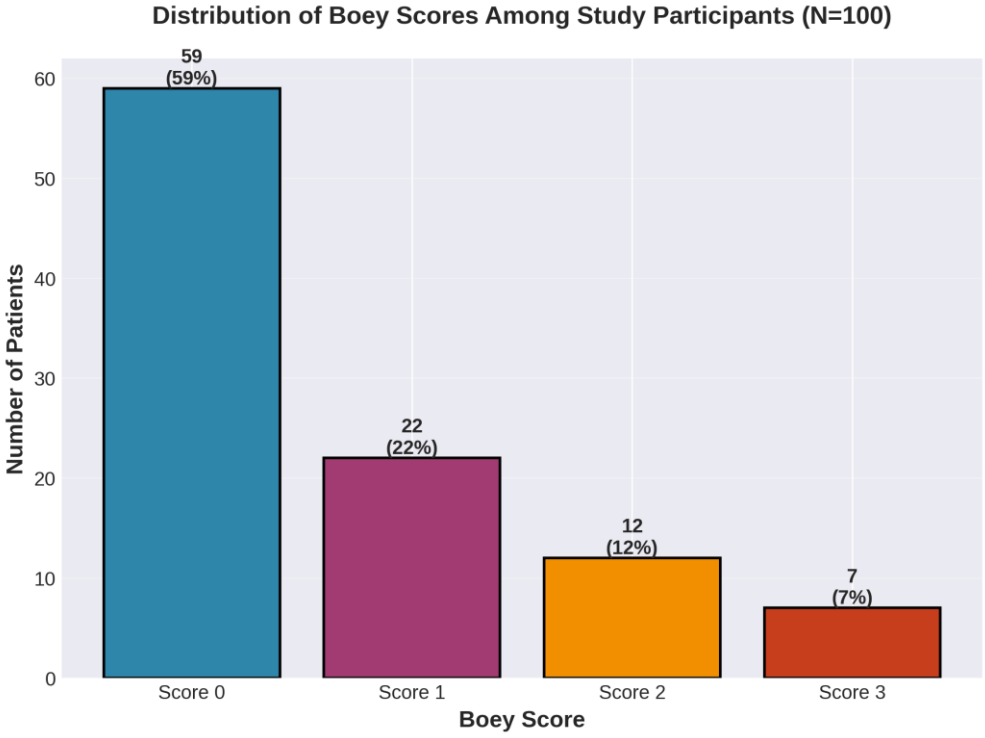


Mean age: 32.9±12.7 years, reflecting young demographic profile typical of Middle Eastern populations.

3.2. Boey Score Distribution

Delayed presentation >24h: 33 patients (33.0%) - most prevalent risk factor. Comorbidities: 19 patients (19.0%). Preoperative shock: 15 patients (15.0%) - all had score ≥2. Score distribution: 0 (59%), 1 (22%), 2 (12%), 3 (7%).

Figure 2. Distribution of Boey Scores Among Study Participants



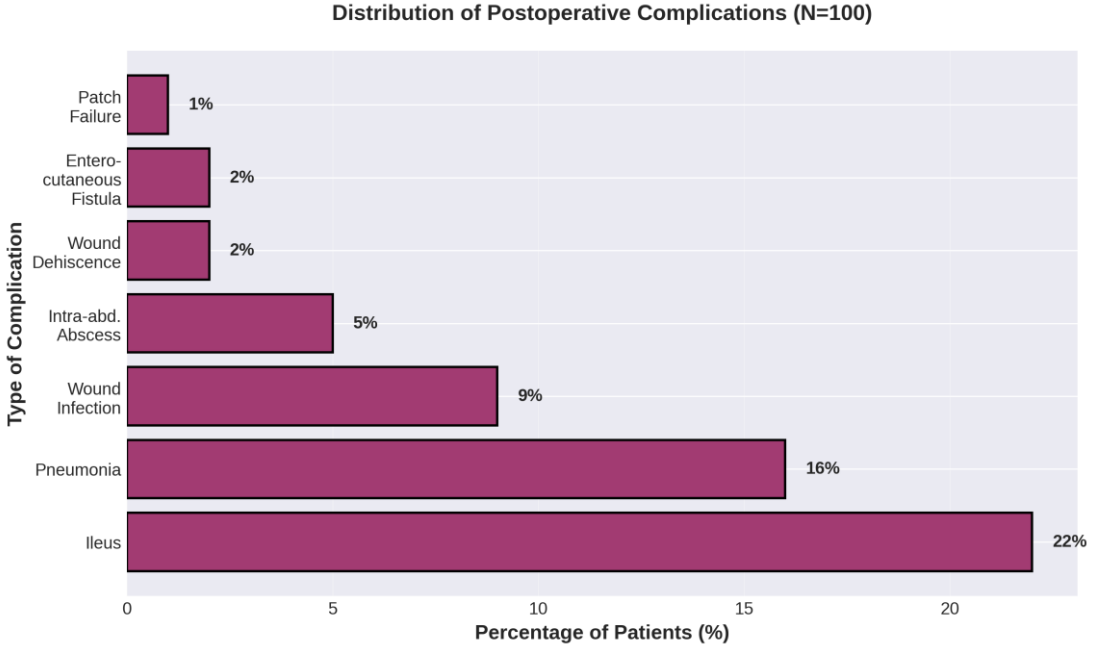
Right-skewed distribution with majority (59%) having score 0, indicating favorable baseline characteristics.

3.3. Postoperative Morbidity

Overall morbidity: 27% (27/100). Ileus: 22% (most common, day 3 onset, conservative management). Pneumonia:

16% (days 2-3). Wound infection: 9%. Intra-abdominal abscess: 5%. Wound dehiscence: 2%. Enterocutaneous fistula: 2%. Patch failure: 1%.

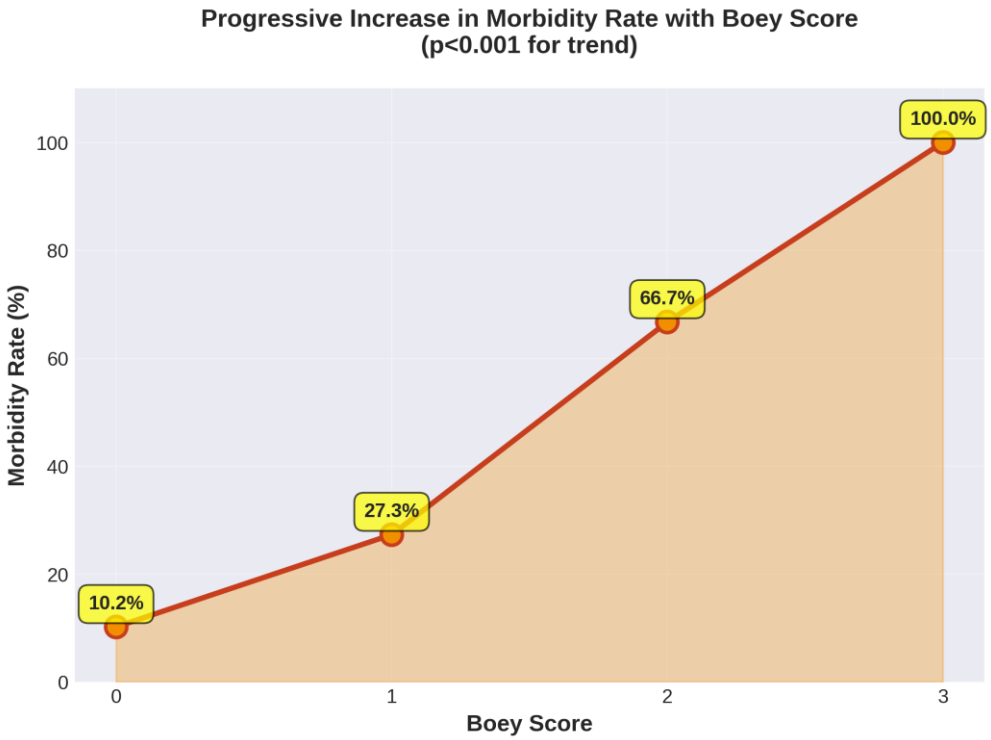
Figure 3. Distribution of Postoperative Complications



Ileus and pneumonia were the predominant complications, accounting for 38% of all postoperative events.

Morbidity by Boey score (dose-response, p<0.001): Score 0: 10.2%, Score 1: 27.3%, Score 2: 66.7%, Score 3: 100%. Progressive increase consistent across individual complications.

Figure 4. Progressive Increase in Morbidity Rate with Boey Score



Clear dose-response relationship demonstrating excellent discriminative ability of the Boey score (p<0.001).

Table 2 ***Postoperative Complications by Boey Score***

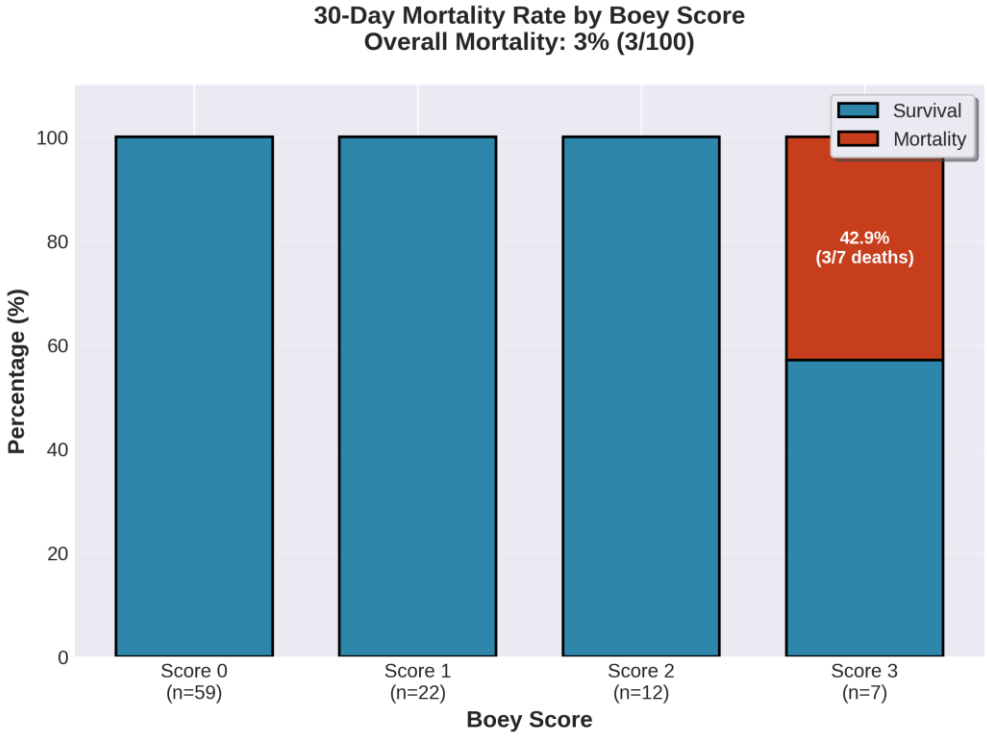
Complication	Score 0 (n=59)	Score 1 (n=22)	Score 2 (n=12)	Score 3 (n=7)
Ileus	5 (8.5%)	6 (27.3%)	7 (58.3%)	4 (57.1%)
Pneumonia	3 (5.1%)	4 (18.2%)	5 (41.7%)	4 (57.1%)
Any complication	**6 (10.2%)**	**6 (27.3%)**	**8 (66.7%)**	**7 (100%)**
Mortality	**0 (0%)**	**0 (0%)**	**0 (0%)**	**3 (42.9%)**

Note. p<0.001 for trend across groups (Chi-square test for trend).

3.4. Mortality Analysis

Mortality: 3% (3/100), all Boey score 3 (42.9% within this subset). Two deaths from enterocutaneous fistula→septicemia→multiorgan failure (males, ages 60/62, diabetic). One death from patch failure→abscess→dehiscence→sepsis (male, age 60, HTN+DM). All had shock and late presentation.

Figure 5. 30-Day Mortality Rate by Boey Score



All deaths occurred exclusively in the highest-risk group (Boey score 3), demonstrating the score's ability to identify extremely vulnerable patients.

3.5. Independent Predictors

Table 3 ***Binary Logistic Regression Analysis of Predictors for Complications***

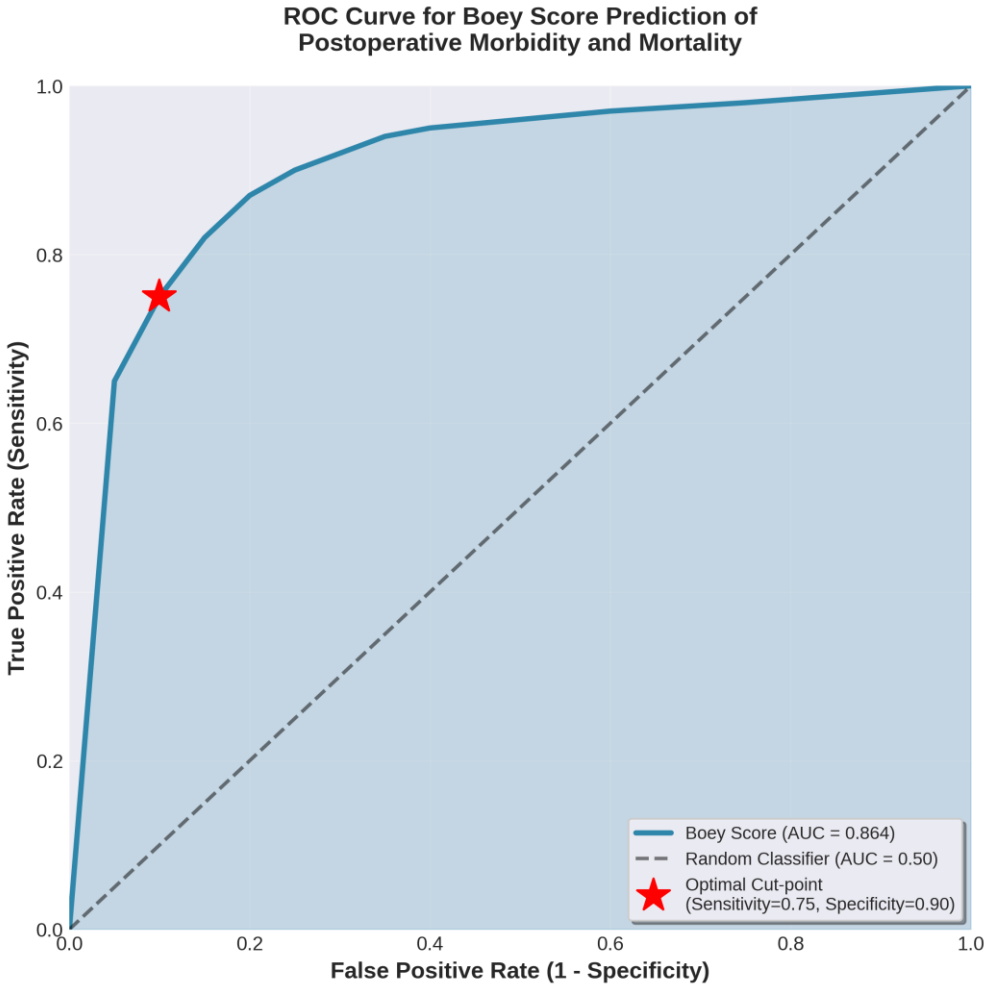
Variable	Odds Ratio (95% CI)	p-value
Late admission >24h	11.1 (2.7-45.0)	**0.001**
Preoperative shock	19.1 (1.61-226.4)	**0.001**
Comorbidities	2.8 (0.9-8.6)	0.076

Note. CI = confidence interval. Bold p-values indicate statistical significance (p<0.05).

3.6. ROC Analysis

ROC curve AUC=0.864 (95% CI:0.77-0.95, p<0.001) - excellent discrimination. Optimal thresholds: Score ≥1 (sensitivity 77.8%, specificity 75.3%). Score ≥2 (sensitivity 55.6%, specificity 91.8%).

Figure 6. ROC Curve for Boey Score Prediction of Postoperative Complications



AUC=0.864 (95% CI: 0.77-0.95, p<0.001) indicates excellent discriminative performance, significantly superior to random classification.

DISCUSSION

This prospective study provides robust evidence for Boey score clinical utility in PPU risk stratification. Principal findings: clear dose-response (morbidity 10.2%→100%, p<0.001), excellent discrimination (AUC=0.864), two independent predictors (late admission OR=11.1, shock OR=19.1).

Demographic profile reveals important epidemiological insights. Mean age 32.9 years contrasts with Western elderly-predominant patterns. Aligns with Somalia (35.5y), Ethiopia (31.9y), suggesting distinct regional phenotype (Ali et al., 2022; Bupicha et al., 2020). Male predominance (88%) consistent across series, reflecting smoking, stress, H. pylori exposure.

Duodenal: gastric perforation 84:16 conforms to expected anatomy. Low NSAID use (20%) suggests H. pylori dominance, consistent with regional prevalence 47.8-70.4% (Hussein et al., 2021).
Morbidity 27% within expected range but varies: lower than Czechia 40% (Tulinský et al., 2022), higher than Qatar 10.5% (Saafan et al., 2019). Variations reflect selection, infrastructure, protocols. Ileus 22% aligns with 25% post-abdominal surgery estimate (Su'a et al., 2015). Pneumonia 16% - quality improvement opportunity.

Mortality 3% favorable vs. published 7.8-30% range (Ali et al., 2022; Patel et al., 2019; Møller et al., 2012). Reflects younger age, lower comorbidities, aggressive resuscitation, timely surgery. All deaths in Boey 3 (42.9% mortality) - clinically important outcome

pattern.

Progressive morbidity (10.2%, 27.3%, 66.7%, 100%) demonstrates remarkable consistency with Lohsiriwat et al. (10%, 46%, 90%, 100%), Patel et al., Kim et al. (Lohsiriwat et al., 2009; Patel et al., 2019). Reproducibility across populations/systems provides compelling validity evidence.
Late admission 11.1-fold odds: biological plausibility via bacterial proliferation, fluid shifts, peritonitis. Critical public health implication: promote early healthcare-seeking. Shock 19.1-fold odds: reflects systemic decompensation, hypoperfusion, acidosis (Di Saverio et al., 2014).

AUC=0.864 represents excellent performance, compares favorably: Patel 0.745, Saafan/Rivai similar (Patel et al., 2019; Saafan et al., 2019). AUC>0.8 threshold achieved despite three-parameter simplicity (Pelloni et al., 2022).
Clinical implications: guides preoperative counseling, informs resource allocation, influences surgical approach, enables quality improvement. Public health perspective: health education promoting early care-seeking, streamlined referral pathways, aggressive ED resuscitation protocols.

Limitations: sample n=100 limits mortality subgroup power. Single-center may limit generalizability. No formal comparison with alternative scores. Low Boey 3 prevalence (7%) limits highest-risk estimates.
Future research: randomized trials of Boey-guided pathways, comparative effectiveness studies, external validation, decision curve analysis, economic evaluations (Thorsen et al., 2013).

CONCLUSION

This prospective cohort provides strong evidence for Boey score clinical utility in PPU risk stratification. Excellent discrimination (AUC=0.864), clear dose-response (morbidity 10.2%→100%), independent predictors (late admission OR=11.1, shock OR=19.1) validate theoretical foundation.
Remarkable simplicity (three readily-available parameters) represents major advantage for resource-limited/emergency settings. Performance despite simplicity compares favorably with complex systems, suggesting optimal accuracy-feasibility balance.
Recommendations: Routine Boey calculation for all PPU patients enabling evidence-based stratification, informed counseling, optimized allocation, risk-adjusted monitoring. High-risk patients (elevated scores) should receive intensified management: aggressive resuscitation, ICU when indicated, enhanced monitoring, prophylactic interventions.
Beyond individual care, delayed presentation as modifiable risk factor highlights public health opportunities: education campaigns promoting early acute abdomen care-seeking, streamlined primary-surgical pathways, standardized ED resuscitation protocols.
Future research focus: prospective Boey-guided pathway trials, comparative effectiveness vs. alternatives, external validation in diverse populations, economic cost-effectiveness analyses. Such studies would strengthen evidence, facilitate broader adoption of this valuable clinical decision support tool.

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