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Original Research Article

Factors Influencing Morbidity and Mortality Following Emergency Surgery for Perforated Peptic Ulcer Disease: A Prospective Observational Study.

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Abstract: ***Background:*** Perforated peptic ulcer disease (PPUD) remains one of the most lethal surgical emergencies encountered in general surgical practice, with reported mortality rates ranging between 10% and 25%. Identification of modifiable and non-modifiable prognostic determinants is essential for risk stratification and improvement of postoperative outcomes. ***Objectives:*** To determine the incidence, clinical spectrum, and postoperative outcomes of PPUD, and to identify preoperative and intraoperative variables independently associated with postoperative morbidity and mortality. ***Methods:*** A prospective observational study was conducted at the Department of General Surgery, Sapthagiri Institute of Medical Sciences and Research Centre (SIMSRC), Chikkabanavara, Bengaluru, over a two-month period from 28 April 2026 to 30 June 2026. Forty-five consecutive patients aged ≥18 years diagnosed with perforated peptic ulcer and undergoing emergency laparotomy were enrolled. Demographic, clinical, biochemical, operative, and outcome variables were recorded. The Boey score and ASA physical status were used for preoperative risk stratification. Data were analysed using SPSS version 26.0; the chi-square test, Fisher's exact test, Student's t-test, and multivariable logistic regression were applied, with a p-value <0.05 considered statistically significant. ***Results:*** The mean age of the cohort was 48.5 ± 14.2 years, with a marked male preponderance (84.4%). Duodenal perforation accounted for 77.8% of cases, and Graham's omentopexy was the predominant procedure (86.7%). Overall morbidity was 40.0% (18/45) and mortality was 11.1% (5/45). Surgical site infection (26.7%) was the most frequent complication. On univariate analysis, age >60 years (p=0.021), delayed presentation beyond 24 hours (p=0.008), preoperative shock (p<0.001), Boey score ≥2 (p<0.001), ASA grade ≥III (p=0.003), serum albumin <2.5 g/dL (p=0.014), and perforation size >10 mm (p=0.019) were significantly associated with adverse outcomes. On multivariable logistic regression, preoperative shock (adjusted OR 8.6; 95% CI 1.8–41.2; p=0.007) and Boey score ≥2 (adjusted OR 6.4; 95% CI 1.5–27.9; p=0.013) remained independent predictors of mortality. ***Conclusion:*** Timely referral, aggressive resuscitation, and early operative intervention remain the cornerstones of management in PPUD. The Boey score and ASA grade are simple, reliable tools that identify high-risk patients likely to benefit from intensive perioperative care.

Keywords: Perforated peptic ulcer; peritonitis; Boey score; ASA grade; Graham's omentopexy; emergency laparotomy; morbidity; mortality.

INTRODUCTION

Peptic ulcer disease (PUD) continues to represent a substantial global health burden despite the advent of effective acid-suppressive therapy and the recognition of Helicobacter pylori as a principal aetiological factor. Perforation is among the most feared complications of PUD, occurring in approximately 2–14% of patients with chronic disease, and remains one of the commonest indications for emergency laparotomy in the Indian subcontinent [1, 2].

Perforated peptic ulcer disease (PPUD) is characterised by full-thickness disruption of the gastric or duodenal wall, resulting in spillage of luminal contents into the peritoneal cavity and subsequent chemical and bacterial peritonitis. If not addressed promptly, the resulting inflammatory cascade evolves into systemic inflammatory response syndrome, multiorgan dysfunction, and death. Contemporary series report overall mortality between 6% and 25%, with morbidity rates as high as 30–50% [3, 4].

Several patient-, disease-, and treatment-related factors have been implicated in adverse outcomes. Age greater than 60 years, delayed presentation beyond 24 hours, preoperative shock, coexisting comorbid conditions, hypoalbuminaemia, and large perforations have each been associated with poor prognosis in previous studies [5–7]. The Boey score, first described in 1982, incorporates three simple bedside parameters, preoperative shock, coexisting major medical illness, and duration of perforation exceeding 24 hours, and has been widely validated as a predictor of postoperative outcome [8]. The American Society of Anesthesiologists (ASA) physical status classification remains a robust adjunct to preoperative risk stratification [9].

Despite this body of literature, considerable heterogeneity exists in the demographic and clinical profile of patients with PPUD across geographical regions, and outcome data from tertiary-care centres in southern India remain relatively sparse. Furthermore, changing epidemiological trends, including a decline in H. pylori prevalence, rising use of non-steroidal anti-inflammatory drugs (NSAIDs), and increased consumption of alcohol and tobacco, mandate periodic re-evaluation of prognostic determinants.

Against this background, the present prospective observational study was designed to describe the clinical spectrum of PPUD encountered at a tertiary-care teaching hospital in Bengaluru and to identify preoperative and intraoperative variables independently associated with postoperative morbidity and mortality.

AIMS AND OBJECTIVES

Primary objective: To identify preoperative and intraoperative factors influencing morbidity and mortality following emergency surgery for perforated peptic ulcer disease.

Secondary objectives:

1. To describe the demographic and clinical profile of patients presenting with PPUD.
2. To assess the utility of the Boey score and ASA grade in predicting outcome.
3. To document the pattern of postoperative complications and 30-day mortality.
4. To evaluate the impact of time from perforation to surgery on postoperative outcome.

MATERIALS AND METHODS

Study design and setting

This was a hospital-based, prospective, observational study conducted at the Department of General Surgery, Sapthagiri Institute of Medical Sciences and Research Centre (SIMSRC), Chikkabanavara, Bengaluru – 560090, Karnataka. The study was carried out over a two-month period from 28 April 2026 to 30 June 2026.

Sample size and sampling

The sample size was calculated based on an anticipated proportion of morbidity of 40% (from prior literature), an absolute precision of 15%, and a 95% confidence level, using the formula $n = Z^2pq / d^2$. The minimum calculated sample size was 41, which was rounded upwards. During the two-month study period, 45 consecutive patients meeting the eligibility criteria were enrolled by universal sampling.

Inclusion criteria

1. Patients aged 18 years and above.
2. Clinical, radiological, or intraoperative diagnosis of perforated peptic ulcer.
3. Willingness to provide written informed consent.

Exclusion criteria

1. Perforation due to malignancy (histopathologically confirmed).
2. Perforation due to trauma or foreign body.
3. Patients managed non-operatively.
4. Perforations of the lower gastrointestinal tract or of Meckel's diverticulum.
5. Pregnancy.

Study procedure

All patients underwent detailed history-taking and physical examination on admission. Baseline investigations included complete blood count, renal and liver function tests, serum electrolytes, random blood sugar, coagulation profile, arterial blood gas analysis, and erect abdominal radiography for pneumoperitoneum. Ultrasonography and contrast-enhanced computed tomography were performed selectively. All patients were resuscitated with intravenous crystalloids, broad-spectrum antibiotics (piperacillin–tazobactam and metronidazole), proton-pump inhibitors, nasogastric decompression, and urinary catheterisation. Emergency exploratory laparotomy was performed once haemodynamic

stability was achieved. The surgical procedure was tailored to intraoperative findings, Graham's omentopexy (Cellan-Jones repair) was the standard technique for perforations up to 10 mm in size; larger perforations were managed with primary closure reinforced with a pedicled omental patch; and definitive resection was reserved for selected gastric ulcers with unfavourable local conditions.

Variables studied

Demographic variables (age, sex), clinical variables (duration of symptoms, comorbidities, addictions, use of NSAIDs), vital signs at admission, biochemical parameters (haemoglobin, total leukocyte count, serum urea, creatinine, albumin), imaging findings, operative details (site and size of perforation, surgical procedure), and postoperative outcomes (complications by Clavien–Dindo classification, length of hospital stay, and 30-day mortality) were recorded on a structured proforma.

Definitions

Preoperative shock was defined as systolic blood pressure <90 mmHg on admission. Delayed presentation was defined as symptom onset >24 hours before presentation. The Boey score assigns one point each for the presence of preoperative shock, major concomitant medical illness, and duration of perforation >24 hours (range 0–3). Morbidity was defined as the occurrence of any postoperative complication of Clavien–Dindo grade II or higher within 30 days of surgery. Mortality was defined as death from any cause within 30 days of surgery.

Statistical analysis

Data were entered in Microsoft Excel 2019 and analysed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation or median (interquartile range) and compared using Student's t-test or the Mann–Whitney U test as appropriate. Categorical variables were expressed as frequencies and percentages, and compared using the chi-square test or Fisher's exact test. Variables with a p-value <0.10 on univariate analysis were entered into a multivariable binary logistic regression model with morbidity and mortality as the dependent variables. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were reported. A two-tailed p-value <0.05 was considered statistically significant.

RESULTS

Demographic profile

A total of 45 patients underwent emergency surgery for PPUD during the study period. The mean age of the cohort was 48.5 ± 14.2 years (range 22–74 years); 38 (84.4%) were male and 7 (15.6%) were female, giving a male-to-female ratio of 5.4:1. The age and sex distribution is shown in Figure 1. Most patients (60%) were in the fourth to sixth decades of life. The baseline demographic and risk-factor profile is presented in Table 1.

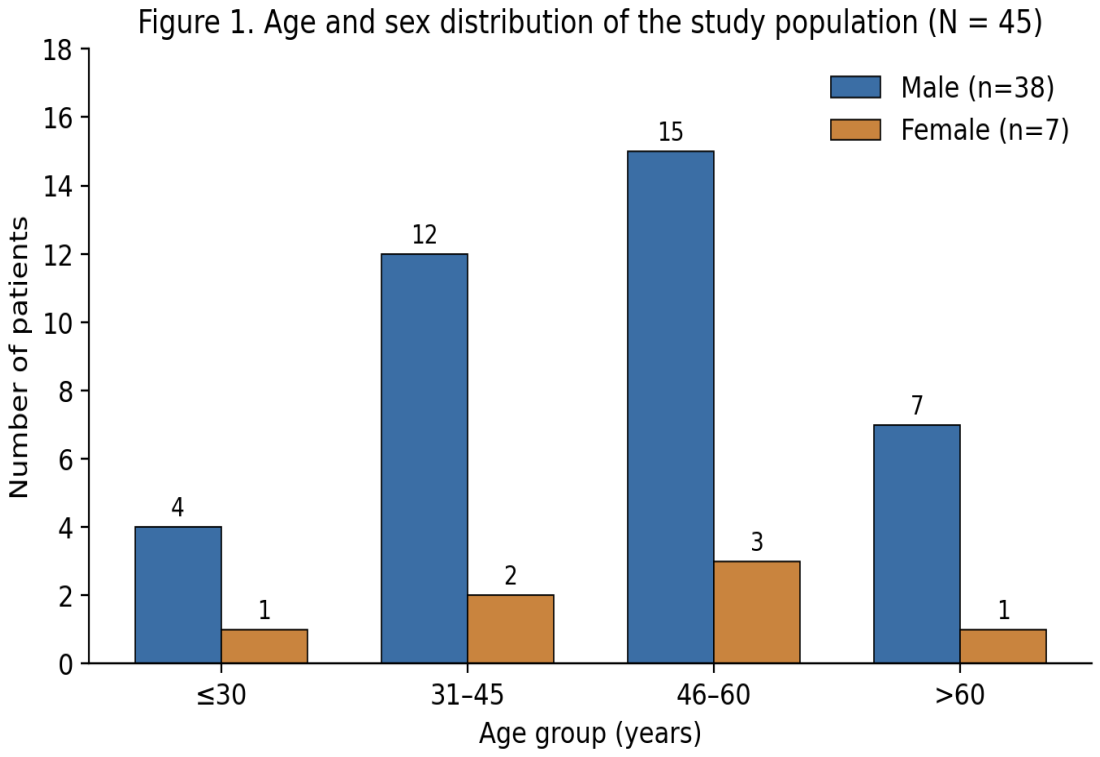

Figure 1. Age and sex distribution of the study population (N = 45).

Table 1. Baseline demographic and risk-factor profile of the study population (N = 45).

Variable	Value
Age (years), mean ± SD	48.5 ± 14.2
Age >60 years, n (%)	11 (24.4)
Male sex, n (%)	38 (84.4)
Rural residence, n (%)	29 (64.4)
Body mass index (kg/m²), mean ± SD	22.4 ± 3.1
Smoking history, n (%)	25 (55.6)
Alcohol consumption, n (%)	23 (51.1)
Chronic NSAID use, n (%)	13 (28.9)
Prior history of PUD, n (%)	20 (44.4)
Diabetes mellitus, n (%)	8 (17.8)
Hypertension, n (%)	10 (22.2)
Chronic pulmonary disease, n (%)	5 (11.1)
H. pylori seropositivity, n (%)	29 (64.4)

SD, standard deviation; NSAID, non-steroidal anti-inflammatory drug; PUD, peptic ulcer disease.

Clinical presentation

All patients presented with acute abdominal pain (100%), followed by guarding or rigidity (93.3%) and absent bowel sounds (75.6%). Twenty-five patients (55.6%) presented within 24 hours of symptom onset, whereas 20 (44.4%) presented later. Preoperative shock (SBP <90 mmHg) was documented in 11 patients (24.4%). Erect abdominal radiography demonstrated gas under the diaphragm in 40 patients (88.9%). The relative frequencies of presenting features are illustrated in Figure 2.

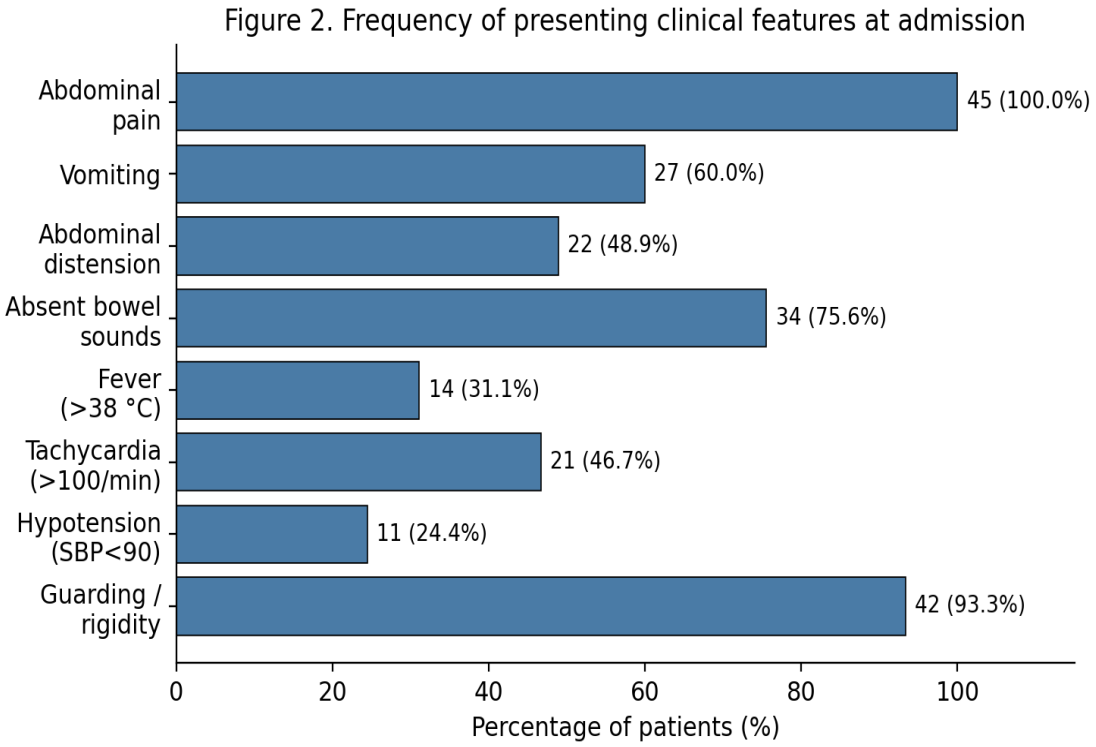

Figure 2. Frequency of presenting clinical features at admission (N = 45).

Operative findings and procedures

Duodenal perforation was the most common intraoperative finding, seen in 35 patients (77.8%), whereas gastric perforation was documented in 10 (22.2%). The mean size of the perforation was 8.2 ± 4.1 mm; 6 perforations (13.3%) exceeded 10 mm. Purulent peritoneal contamination was noted in 17 patients (37.8%) and faeculent contamination in 4 (8.9%). Graham's omentopexy was performed in 39 patients (86.7%), primary closure with a pedicled omental patch in 4 (8.9%), and distal gastrectomy with Billroth II reconstruction in 2 (4.4%). Details are summarised in Table 2.

Table 2. Operative findings and surgical procedures.

Variable	n (%)
Site of perforation	
Duodenal (first part)	35 (77.8)
Prepyloric	4 (8.9)
Gastric (body/antrum)	6 (13.3)
Size of perforation	
≤5 mm	18 (40.0)
6–10 mm	21 (46.7)
>10 mm	6 (13.3)
Nature of contamination	
Bilious	24 (53.3)
Purulent	17 (37.8)
Faeculent	4 (8.9)
Procedure performed	
Graham's omentopexy	39 (86.7)
Primary closure + omental patch	4 (8.9)
Distal gastrectomy + Billroth II	2 (4.4)

Postoperative morbidity and mortality

Overall postoperative morbidity was 40.0% (18/45), and 30-day mortality was 11.1% (5/45). The mean postoperative hospital stay was 10.5 ± 5.6 days. Surgical site infection was the most frequent complication, occurring in 12 patients (26.7%), followed by pulmonary complications (13.3%) and sepsis or septic shock (11.1%). Two patients (4.4%) developed an anastomotic or repair-site leak, both of whom required re-exploration; one died of refractory septic shock. The full distribution of complications is shown in Figure 5.

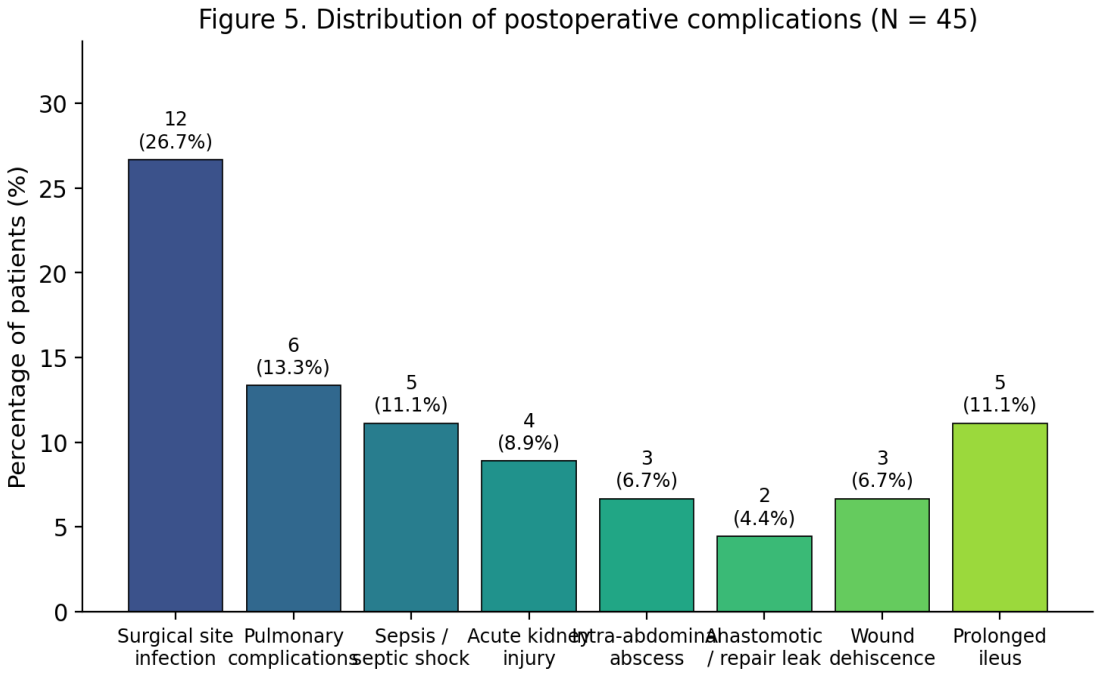

Figure 5. Distribution of postoperative complications (N = 45).

Influence of time to surgery

The interval between symptom onset and surgical intervention was significantly associated with adverse outcome. Patients operated within 24 hours had a morbidity of 28.0% (7/25) and mortality of 4.0% (1/25), whereas those operated after 24 hours had a morbidity of 55.0% (11/20) and mortality of 20.0% (4/20). The relationship is depicted in Figure 3.

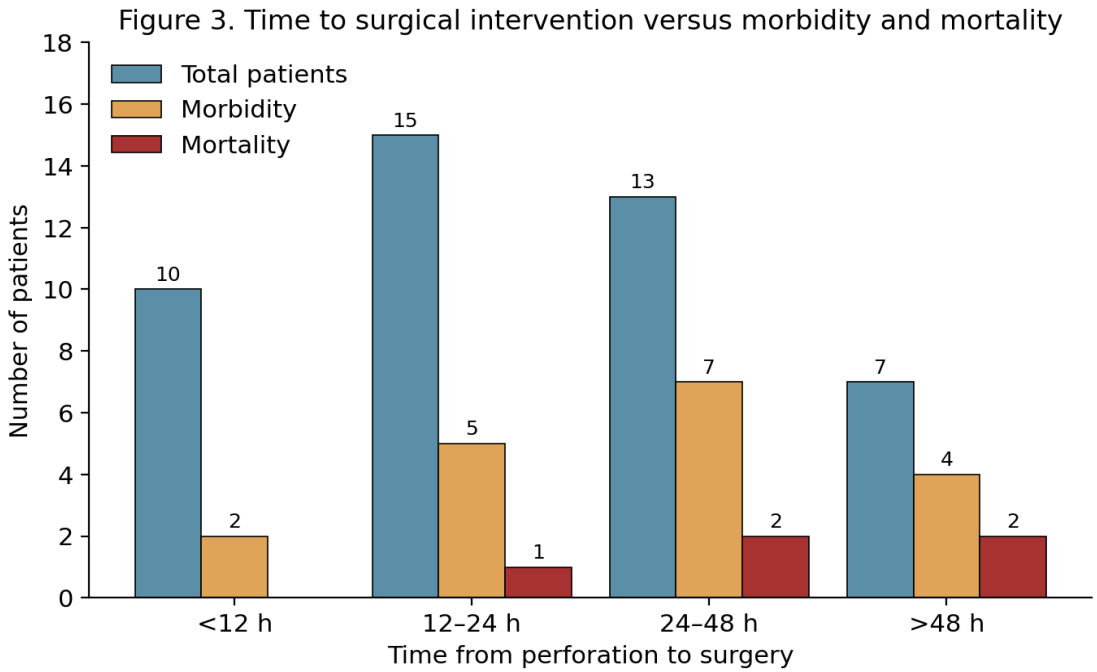

Figure 3. Time to surgical intervention versus morbidity and mortality.

Preoperative risk stratification

The Boey score was calculated in every patient. The distribution was: score 0 in 15 patients (33.3%), score 1 in 18 (40.0%), score 2 in 8 (17.8%), and score 3 in 4 (8.9%). Mortality rose steeply with an increasing Boey score, from 0% at score 0 to 50.0% at score 3 (Figure 4). Similarly, the ASA physical status distribution and its association with mortality are shown in Figure 6.

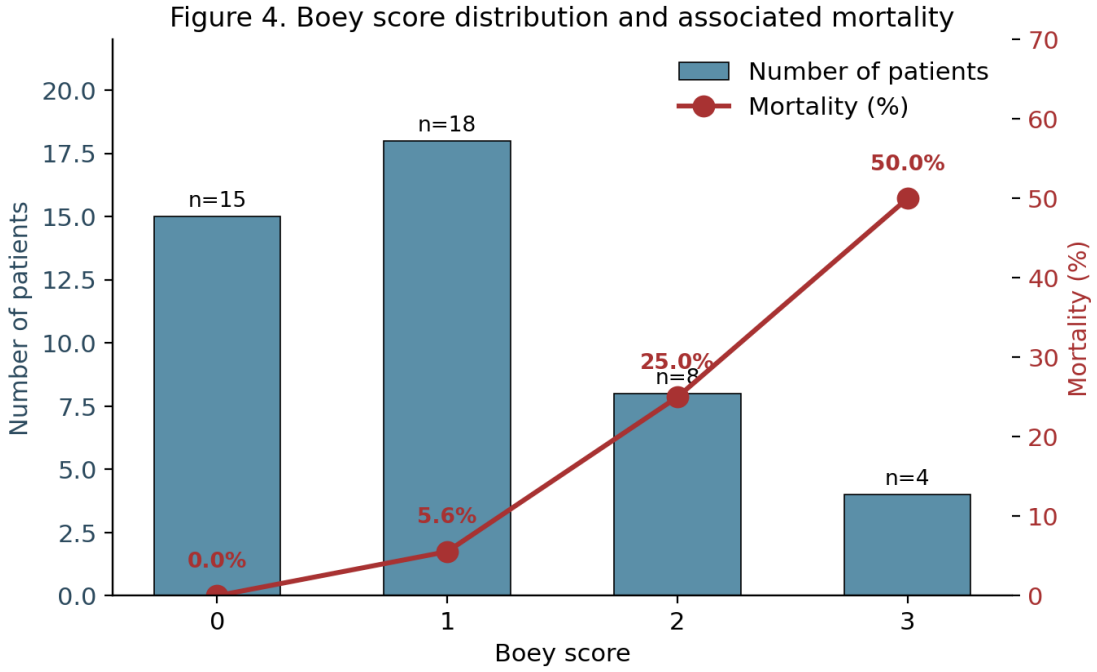

Figure 4. Boey score distribution and associated mortality.

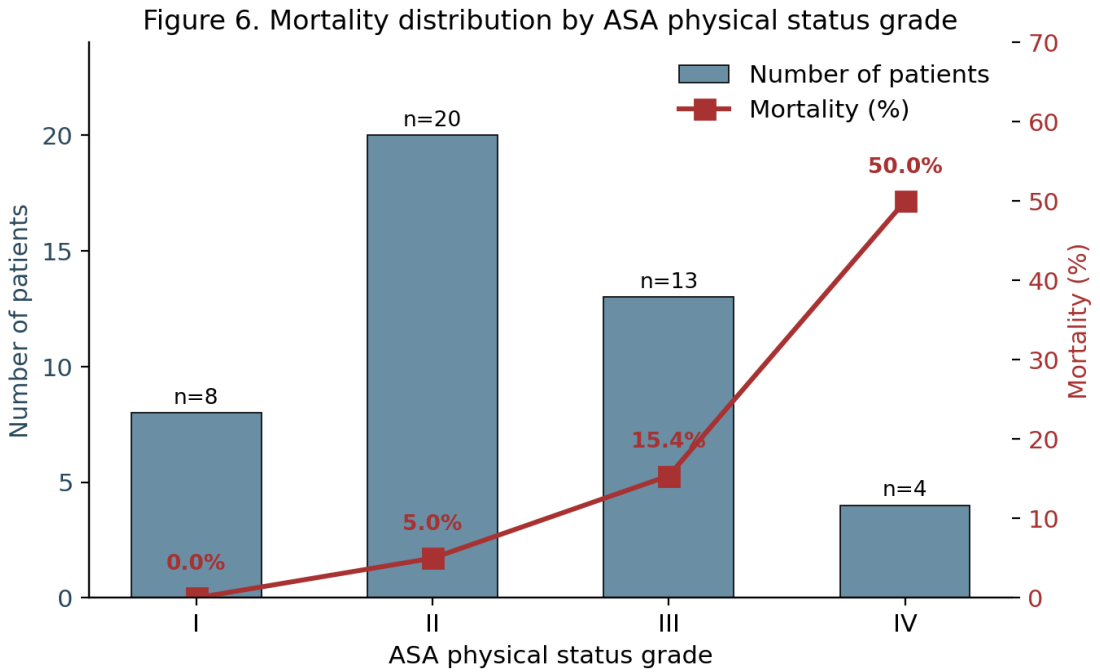

Figure 6. Mortality distribution by ASA physical status grade.

Univariate analysis of prognostic factors

Table 3 presents the univariate analysis of factors associated with postoperative morbidity, and Table 4 presents the univariate analysis of factors associated with 30-day mortality.

Table 3. Univariate analysis of factors associated with postoperative morbidity.

Variable	Morbidity (n=18)	No morbidity (n=27)	p-value
Age >60 years	8 (44.4%)	3 (11.1%)	0.014
Male sex	15 (83.3%)	23 (85.2%)	1.000
Symptoms >24 h	11 (61.1%)	9 (33.3%)	0.068
Preoperative shock	9 (50.0%)	2 (7.4%)	0.001
Serum albumin <2.5 g/dL	9 (50.0%)	4 (14.8%)	0.010
TLC >15,000/mm³	13 (72.2%)	10 (37.0%)	0.020
Perforation size >10 mm	5 (27.8%)	1 (3.7%)	0.026
Faeculent contamination	4 (22.2%)	0 (0%)	0.017
Boey score ≥2	10 (55.6%)	2 (7.4%)	<0.001
ASA grade ≥III	13 (72.2%)	4 (14.8%)	<0.001

TLC, total leukocyte count; ASA, American Society of Anesthesiologists. Bold values indicate $p < 0.05$.

Table 4. Univariate analysis of factors associated with 30-day mortality.

Variable	Died (n=5)	Survived (n=40)	p-value
Age >60 years	4 (80.0%)	7 (17.5%)	0.008
Symptoms >24 h	4 (80.0%)	16 (40.0%)	0.008
Preoperative shock	5 (100%)	6 (15.0%)	<0.001
Serum albumin <2.5 g/dL	4 (80.0%)	9 (22.5%)	0.014
Serum creatinine >1.5 mg/dL	3 (60.0%)	6 (15.0%)	0.038
Perforation size >10 mm	3 (60.0%)	3 (7.5%)	0.019
Boey score ≥2	4 (80.0%)	8 (20.0%)	<0.001
ASA grade ≥III	4 (80.0%)	13 (32.5%)	0.003
Postoperative sepsis	4 (80.0%)	1 (2.5%)	<0.001

Bold values indicate $p < 0.05$.

Multivariable logistic regression

Variables with p<0.10 on univariate analysis were entered into a binary logistic regression model. On multivariable analysis, preoperative shock and Boey score ≥2 emerged as independent predictors of mortality, whereas Boey score ≥2, hypoalbuminaemia, and age >60 years were independently associated with morbidity. Adjusted odds ratios are presented in Table 5.

Table 5. Multivariable logistic regression: independent predictors of morbidity and mortality.

Outcome / Variable	Adjusted OR	95% CI	p-value
Mortality			
Preoperative shock	8.6	1.8 – 41.2	0.007
Boey score ≥ 2	6.4	1.5 – 27.9	0.013
Age > 60 years	3.2	0.6 – 17.4	0.176
Serum albumin < 2.5 g/dL	2.8	0.5 – 15.2	0.229
Morbidity			
Boey score ≥ 2	5.2	1.3 – 20.9	0.020
Serum albumin < 2.5 g/dL	4.1	1.1 – 15.4	0.036
Age > 60 years	3.7	1.02 – 13.6	0.046
Preoperative shock	3.1	0.7 – 13.9	0.140

OR, odds ratio; CI, confidence interval.

Clavien–Dindo grading of complications

The severity of postoperative complications was graded using the Clavien–Dindo classification (Table 6). Grade II complications were most frequent, while five patients (11.1%) had grade V complications (mortality).

Table 6. Postoperative complications by Clavien–Dindo classification.

Clavien–Dindo grade	Definition	n (%)
I	Deviation from normal course; no drug/intervention	3 (6.7)
II	Requiring pharmacological treatment	8 (17.8)
III	Requiring surgical or radiological intervention	2 (4.4)
IV	Life-threatening; ICU management	0 (0)
V	Death of the patient	5 (11.1)
Total morbidity	—	18 (40.0)

DISCUSSION

Perforated peptic ulcer disease remains a formidable surgical emergency worldwide. The overall mortality of 11.1% and morbidity of 40.0% observed in the present cohort are consistent with figures reported by other Indian and international series [3, 5, 10]. Sharma et al. reported an in-hospital mortality of 9.6% and morbidity of 34.5% from a north-Indian tertiary-care centre [3], while Møller and colleagues from the Danish national database reported a 30-day mortality of 21%, reflecting the older demographic profile of European populations [11].

The pronounced male preponderance (84.4%) and mean age of 48.5 years observed in our study mirror trends reported by earlier Indian investigators [2, 5, 12]. The high prevalence of smoking (55.6%), alcohol consumption (51.1%), and chronic NSAID use (28.9%) among our patients highlights the persistent role of modifiable lifestyle factors in the aetiopathogenesis of PPUD [13]. H. pylori seropositivity was documented in 64.4% of cases, in line with contemporary Indian epidemiological data despite the global decline of the organism [14].

Duodenal perforation predominated over gastric perforation in a ratio of nearly 3.5:1, comparable to the ratio reported by Chalya et al. from sub-Saharan Africa and Yadav et al. from India [4, 12]. Graham's omentopexy remained the workhorse technique, employed in 86.7% of our patients, its enduring popularity is attributable to technical simplicity, low leak rate, and applicability across most perforation sizes [15].

Time to intervention emerged as one of the most powerful modifiable determinants of outcome. Patients presenting and operated within 24 hours had a substantially lower mortality (4.0%) than those with delayed presentation (20.0%), a finding consistent with the systematic review by Buck et al., which demonstrated that every hour of delay after 6 hours from perforation increases mortality by up to 2.4% [7]. This underscores the critical importance of early triage, expedited resuscitation, and prompt surgical intervention.

The Boey score performed well as a bedside prognostic tool in our cohort, with mortality rising from 0% at a

score of 0 to 50% at a score of 3. This is congruent with the findings of Lohsiriwat et al., who reported mortality rates of 1.5%, 14.4%, 32.1%, and 100% for Boey scores of 0, 1, 2, and 3 respectively [16]. On multivariable analysis, a Boey score of ≥2 was an independent predictor of both morbidity and mortality, confirming its enduring clinical utility despite the availability of more elaborate scoring systems such as PULP and Mannheim Peritonitis Index [17].

Preoperative shock was the single most powerful predictor of mortality in our study (adjusted OR 8.6). This observation is in accordance with the multivariate analyses reported by Thorsen et al. and Møller et al., in whose series haemodynamic instability at admission conferred a two- to fourfold increase in the risk of death [11, 18]. Hypoalbuminaemia (<2.5 g/dL) was similarly associated with adverse outcome, reflecting the nutritional depletion and catabolic state of these patients, findings echoed by Kim et al. [19].

Postoperative complications in our study followed the pattern typically reported in the literature. Surgical site infection was the commonest complication (26.7%), which is consistent with contemporary Indian and Asian series where wound infection rates range between 20% and 30% [5, 12, 20]. Pulmonary complications, sepsis, and acute kidney injury contributed disproportionately to mortality, echoing observations by Søreide et al. that non-surgical complications now account for the majority of deaths after PPUD [10].

The findings of the present study reinforce the current management paradigm, namely, that outcome after PPUD depends less on the technical choice of operation than on the physiological state of the patient at the time of surgery and the promptness with which intervention is undertaken. Aggressive preoperative resuscitation, judicious perioperative antibiotic stewardship, and early identification of the high-risk patient using simple bedside scores such as Boey and ASA are the most effective strategies to reduce morbidity and mortality.

LIMITATIONS

This study has several limitations. First, it is a single-centre observational study with a modest sample size, which may limit the generalisability of findings and the statistical power to detect small effect sizes. Second, the two-month duration of the study precluded evaluation of long-term outcomes, recurrence, and quality of life. Third, laparoscopic repair, which is being increasingly adopted, was not evaluated. Fourth, H. pylori status was assessed serologically rather than by histology or urea breath test, which may have overestimated true positivity. Finally, adherence to postoperative eradication therapy could not be reliably documented. Multicentric prospective studies with larger cohorts and long-term follow-up are warranted to validate the observations reported here.

CONCLUSION

Perforated peptic ulcer disease continues to carry substantial morbidity and mortality even in the era of modern surgical care. In this prospective study of 45 patients from a tertiary-care centre in Bengaluru, preoperative shock and a Boey score of ≥2 emerged as independent predictors of mortality, while age >60 years, hypoalbuminaemia, and a Boey score ≥2 independently predicted morbidity. Delay in presentation beyond 24 hours was strongly associated with adverse outcome, underscoring the imperative of early recognition, rapid resuscitation, and timely surgical intervention. The Boey score and ASA grade remain simple, robust, and reproducible bedside tools that should be routinely employed for risk stratification and to guide the intensity of perioperative care.

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