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Research Article

Outcomes and Prognostic Factors in NSAID-related Upper Gastrointestinal Perforations: A Single-center Surgical Experience

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Abstract

Background: Non-steroidal anti-inflammatory drug (NSAID)-induced perforated peptic ulcer (PPU) is a life-threatening surgical emergency, particularly in migrant labor populations with unmonitored over-the-counter access to analgesics.

Aim: To evaluate the clinicopathological profile, operative outcomes, and prognostic utility of the Peptic Ulcer Perforation (PULP) score in patients presenting with NSAID-related gastroduodenal perforations.

Methods: A retrospective cohort study was conducted at Misurata Medical Center between January 2021 and October 2025, enrolling 50 consecutive adult patients who underwent emergency laparotomy for operatively confirmed, NSAID-associated upper gastrointestinal perforations. Demographics, laboratory parameters, operative findings, and postoperative outcomes were extracted. All eight PULP score components were computed, and postoperative outcomes were analyzed across risk categories using univariate two-tailed Fisher's exact tests.

Results: The mean age was 37.0 ± 9.1 years (range: 18–55) with a male predominance (94.0%, n = 47), consisting primarily of migrant manual laborers (60.0% Nigerian, 24.0% Egyptian). Gastric perforations predominated (84.0%, n = 42), with sizes ranging from 15 to 30 mm. Comorbidities were documented in 24.0% (n = 12). Preoperative upright radiographs confirmed pneumoperitoneum in 68.0% (n = 34), computed tomography confirmed the diagnosis in 24.0% (n = 12), and 8.0% (n = 4) required urgent exploratory laparotomy. The mean PULP score was 4.42 ± 3.49; 26.0% (n = 13) were categorized as high risk (score > 7). Assessment of all eight PULP components showed that serum creatinine > 1.47 mg/dL (54.0%, n = 27), surgical delay > 24 hours (50.0%, n = 25), and American Society of Anesthesiologists (ASA) physical status class ≥ III (54.0%, n = 27) were the principal contributors to elevated risk scores, whereas age > 65 years (0.0%) and active malignancy (0.0%) were absent. Overall intensive care unit (ICU) admission was 26.0% (n = 13), postoperative leak requiring relaparotomy was 6.0% (n = 3), and 30-day mortality was 4.0% (n = 2). High-risk PULP status (> 7) was significantly associated with postoperative leak (p = 0.014) and ICU admission (p < 0.001); although both mortalities occurred exclusively within the high-risk cohort (15.4% vs. 0.0%), this difference did not reach statistical significance (p = 0.063).

Conclusion: NSAID-related perforations in this setting characterize a distinct demographic—young, male manual workers presenting with large gastric ulcers and delayed surgical consultation. Preoperative renal dysfunction, higher preoperative ASA class, and diagnostic delays represent the primary drivers of adverse outcomes. In this preliminary cohort, a PULP score > 7 demonstrated significant univariate associations with ICU admission and postoperative repair leak, suggesting potential utility as an adjunct for perioperative critical care triage, although larger multicenter studies are required to validate its independent mortality prediction.

More Information

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Keywords: Peptic ulcer perforation; NSAIDs; PULP score; ASA classification; Omental patch; Surgical delay; Misurata

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Introduction

Over the past three decades, the global epidemiological pattern of peptic ulcer disease (PUD) has changed substantially. While the widespread adoption of eradication therapies has decreased the rate of elective operations for uncomplicated *Helicobacter pylori*-related ulcers, the incidence of life-threatening complications—most notably acute perforation—has remained largely unchanged [1,3,18]. This persistence is primarily driven by the widespread consumption of non-steroidal anti-inflammatory drugs (NSAIDs) and low-dose aspirin [1,2,7]. Globally, PUD affects an estimated 4 million individuals annually, with perforated peptic ulcer (PPU) representing approximately 5% of acute abdominal surgical emergencies and contributing up to 40% of ulcer-related mortalities [1,3,18].

NSAIDs are among the most frequently consumed pharmaceutical classes globally [2,7]. In many developing nations and industrial transit centers, over-the-counter availability of combined analgesic formulations and high-dose anti-inflammatory agents is common, predisposing manual laborers to chronic overuse and severe gastrointestinal mucosal toxicity [3,12]. NSAID-induced perforations present distinct surgical challenges: they often produce extensive transmural tissue necrosis, resulting in large or giant ulcer defects (> 20 mm) that complicate simple primary closure [4,5,14]. In addition, systemic NSAID-mediated prostaglandin inhibition combined with acute third-space fluid sequestration frequently leads to acute kidney injury (AKI) and hemodynamic instability [3,4,12].

Despite the substantial clinical burden of disease, debate persists regarding the optimal operative and perioperative triage strategy in high-risk patients, particularly when large ulcer defects and gross peritonitis are encountered [4,5,9,10]. Furthermore, validated prognostic scoring systems such as the Peptic Ulcer Perforation (PULP) score [8] require targeted assessment within specific subpopulations, such as young manual workers with acute analgesic toxicity [3,15,16]. Given that the PULP score incorporates eight weighted clinical and biochemical variables—some of which, such as advanced age (> 65 years) and active malignancy, may be uncommon in younger working populations—a complete component-level evaluation is essential to clarify its clinical behavior. This study aims to describe the clinicopathological characteristics, operative findings, and postoperative outcomes of NSAID-related upper gastrointestinal perforations treated at Misurata Medical Center, and to evaluate the preliminary prognostic utility of the PULP scoring system and its individual components in this population.

Methods

Study design and setting

A single-center retrospective cohort study was conducted in the Department of General Surgery at Misurata Medical Center (MMC), Misurata, Libya. Medical records of consecutive adult patients treated operatively for acute upper gastrointestinal perforations between January 1, 2021, and October 31, 2025, were reviewed.

Inclusion and exclusion criteria

Adult patients aged ≥ 18 years who underwent emergency laparotomy with intraoperative confirmation of gastric or duodenal ulcer perforation and a documented history of oral NSAID or aspirin ingestion within the preceding 14 days were included. Patients were excluded if the perforation was secondary to histopathologically confirmed gastric malignancy, trauma, or endoscopic instrumentation; if the perforation was contained/sealed and managed non-operatively; or if the patient presented with active malignancy or pregnancy.

Operative technique and perioperative protocol

All patients underwent emergency open laparotomy via an upper midline incision. Repair was standardized using a modified Graham omental patch technique: primary approximation of ulcer margins with interrupted absorbable sutures followed by the placement and fixation of a viable vascularized omental flap [4,5,9,13]. Copious warm isotonic saline peritoneal lavage and closed-suction drainage were systematically performed. Postoperative management included intravenous proton pump inhibitors (PPIs), goal-directed fluid resuscitation, empirical broad-spectrum antimicrobial coverage, and structured 14-day *H. pylori* triple eradication therapy administered once oral intake was re-established [4,18].

Clinical variables and pulp risk stratification

Demographic, clinical, laboratory, and intraoperative parameters were extracted from standardized surgical and anesthesia charts. The PULP score (total range: 0–18 points) was calculated preoperatively for every patient across all eight validated parameters described by Møller et al. [8,15]: (1) age > 65 years (3 points); (2) active malignant disease or AIDS (1 point); (3) comorbid liver cirrhosis (2 points); (4) concomitant systemic steroid therapy (1 point); (5) shock on admission, defined as systolic blood pressure < 100 mmHg and heart rate > 100 beats/min (1 point); (6) time from perforation symptom onset to surgical admission > 24 hours (1 point); (7) preoperative serum creatinine > 1.47 mg/dL [> 130 µmol/L] (2 points); and (8) preoperative American Society of Anesthesiologists (ASA) physical status classification, scored as ASA I (0 points), ASA II (1 point), ASA III (3 points), ASA IV (5 points), and ASA V (7 points). In accordance with original validation thresholds, patients were stratified into a Low-to-Moderate Risk group (PULP score ≤ 7) and a High-Risk group (PULP score > 7) [8].

Statistical analysis

Data were analyzed using IBM SPSS Statistics for Windows,

Version 26.0 (IBM Corp., Armonk, NY, USA) and Python scientific computing libraries (SciPy v1.11). Continuous variables were assessed for distributional normality using the Shapiro-Wilk test. Normally distributed variables are reported as mean ± standard deviation (SD), and non-normally distributed continuous variables are presented as median and interquartile range (IQR). Categorical variables are expressed as absolute frequencies and percentages (n, %). Univariate associations between PULP risk strata (score ≤ 7 *vs.* score > 7) and binary postoperative outcomes—including intensive care unit (ICU) admission, surgical ward management, postoperative omental patch leak, relaparotomy, postoperative hemorrhage, and 30-day mortality—were evaluated using two-tailed Fisher's exact tests. Because of the modest cohort size (N = 50) and the low absolute frequency of primary adverse events (three postoperative leaks and two deaths), multivariable logistic regression modeling was not performed in order to avoid model overfitting and unstable parameter estimates. A two-tailed p - value < 0.05 was considered statistically significant.

Ethical considerations

The study protocol was approved by the Institutional Ethics Review Committee of Misurata Medical Center. Written informed consent was waived due to the non-interventional, retrospective study design, and patient confidentiality was strictly maintained using de-identified alphanumeric study codes.

Results

Patient demographics and baseline characteristics

A total of 50 consecutive patients met the inclusion criteria. The mean cohort age was 37.0 ± 9.1 years (range: 18–55 years; 0.0% aged > 65 years). Males accounted for 94.0% (n = 47) and females for 6.0% (n = 3). Regarding demographic background, foreign migrant laborers comprised the majority of the cohort: Nigerian nationals represented 60.0% (n = 30), Egyptian nationals represented 24.0% (n = 12), and Libyan citizens accounted for 16.0% (n = 8). Most patients (72.0%, n = 36) were aged 18–50 years, while 28.0% (n = 14) were aged 51–55 years. All foreign workers reported engaging in strenuous manual construction or agricultural labor and consuming unmonitored over-the-counter NSAIDs for occupational musculoskeletal pain.

Pre-existing medical comorbidities were documented in 24.0% (n = 12) of the cohort, including type 2 diabetes mellitus in 10.0% (n = 5), chronic arterial hypertension in 8.0% (n = 4), ischemic heart disease in 4.0% (n = 2), and pre-existing renal dysfunction in 2.0% (n = 1). On preoperative anesthesiological assessment, ASA physical status was distributed as ASA I in 16.0% (n = 8), ASA II in 30.0% (n = 15), ASA III in 32.0% (n = 16), ASA IV in 18.0% (n = 9), and ASA V in 4.0% (n = 2) (Table 1).

Diagnostic evaluation and intraoperative findings

Preoperative upright chest radiography demonstrated free subdiaphragmatic air in 68.0% (n = 34) of patients. Contrast-enhanced abdominopelvic computed tomography (CT) confirmed pneumoperitoneum and free peritoneal fluid in an additional 24.0% (n = 12). The remaining 8.0% (n = 4) had inconclusive initial imaging and were diagnosed intraoperatively during urgent exploratory laparotomy performed for clinical signs of generalized peritonitis (Table 2).

Gastric perforations predominated (84.0%, n = 42), whereas anterior duodenal bulb perforations accounted for 16.0% (n = 8). Among gastric perforations, 50.0% (n = 25) were situated on the anterior gastric wall and 34.0% (n = 17) on the posterior gastric wall. Intraoperative ulcer diameters ranged between 15 and 30 mm, qualifying a substantial proportion as large or giant perforations. Generalized chemical or purulent peritonitis was encountered in 82.0% (n = 41), whereas 18.0% (n = 9) exhibited localized peritonitis (Table 2).

Table 1: Baseline Demographic, Clinical, and Preoperative ASA Characteristics of the Study Cohort (N = 50).

Characteristic	Category / Parameter	Value (N = 50)
Age (years)	Mean ± SD (Range)	37.0 ± 9.1 (18–55)
Age Group, n (%)	18–50 years	36 (72.0%)
	51–55 years	14 (28.0%)
	> 65 years	0 (0.0%)
Sex, n (%)	Male	47 (94.0%)
	Female	3 (6.0%)
Nationality, n (%)	Nigerian	30 (60.0%)
	Egyptian	12 (24.0%)
	Libyan	8 (16.0%)
Pre-existing Comorbidities, n (%)	Any documented comorbidity	12 (24.0%)
	Type 2 diabetes mellitus	5 (10.0%)
	Chronic arterial hypertension	4 (8.0%)
	Ischemic heart disease	2 (4.0%)
	Pre-existing renal dysfunction	1 (2.0%)
Preoperative ASA Classification, n (%)	ASA Class I (Normal healthy patient)	8 (16.0%)
	ASA Class II (Mild systemic disease)	15 (30.0%)
	ASA Class III (Severe systemic disease)	16 (32.0%)
	ASA Class IV (Severe life-threatening disease)	9 (18.0%)
	ASA Class V (Moribund patient)	2 (4.0%)

Abbreviations: ASA: American Society of Anesthesiologists; SD: Standard Deviation

Table 2: Preoperative Diagnostic Modalities and Intraoperative Findings (N = 50).

Clinical / Operative Variable	Subcategory	Value (N = 50)
Primary Diagnostic Modality, n (%)	Erect chest radiography (free subdiaphragmatic gas)	34 (68.0%)
	Abdominopelvic CT scan (pneumoperitoneum/fluid)	12 (24.0%)
	Urgent exploratory laparotomy (inconclusive imaging)	4 (8.0%)
Anatomical Perforation Site, n (%)	Gastric perforation (total)	42 (84.0%)
	Anterior gastric wall	25 (50.0%)
	Posterior gastric wall	17 (34.0%)
	Duodenal perforation (anterior bulb)	8 (16.0%)
Perforation Diameter	Intraoperative ulcer size range (mm)	15–30 mm
Peritoneal Contamination, n (%)	Generalized peritonitis	41 (82.0%)
	Localized peritonitis	9 (18.0%)

Abbreviations: CT: Computed Tomography

PULP score distribution and complete component analysis

The mean cohort PULP score was 4.42 ± 3.49 (range: 0–13). Overall, 74.0% (n = 37) of patients were stratified into the Low-to-Moderate Risk category (PULP score ≤ 7), whereas 26.0% (n = 13) were classified into the High-Risk category (PULP score > 7).

A complete breakdown of all eight PULP score components and their respective point weights is presented in Table 3. Because the study population consisted exclusively of young and middle-aged workers (maximum age 55 years) and patients with active malignancy were excluded, the age > 65 years (3 points) and active malignancy/AIDS (1 point) components were present in 0.0% (n = 0) of the cohort. Instead, elevated PULP scores were predominantly driven by preoperative renal dysfunction (serum creatinine > 1.47 mg/dL in 54.0%, n = 27), surgical delay > 24 hours from perforation onset (50.0%, n = 25), and higher preoperative ASA physical status (ASA III in 32.0%, n = 16; ASA IV in 18.0%, n = 9; and ASA V in 4.0%, n = 2). Less frequent contributors included concomitant steroid therapy (18.0%, n = 9), comorbid liver cirrhosis (8.0%, n = 4), and active shock on hospital admission (6.0%, n = 3).

Postoperative outcomes and univariate risk stratification

The mean total hospital length of stay was 5.0 ± 1.8 days. Overall, 26.0% (n = 13) of patients required postoperative ICU admission for hemodynamic or ventilatory support, whereas 74.0% (n = 37) were managed safely on the general surgical ward. Postoperative omental patch breakdown and intra-abdominal leak occurred in 6.0% (n = 3); all three cases presented with high-output purulent or bilious surgical drain effluent (500–700 mL/day) confirmed by contrast extravasation on oral contrast abdominopelvic CT, necessitating urgent relaparotomy (6.0%, n = 3). All three patients who experienced repair breakdown had presented > 48 hours after symptom onset with giant gastric ulcers (> 20 mm). Postoperative gastrointestinal or intra-abdominal hemorrhage was not observed (0.0%, n = 0).

Overall 30-day postoperative mortality was 4.0% (n = 2), resulting from refractory septic shock and multiorgan dysfunction syndrome. Both fatalities occurred in patients presenting with surgical delays > 48 hours, severe preoperative metabolic acidosis, generalized purulent peritonitis, ASA physical status class V, and composite PULP scores > 7.

As detailed in Table 4, univariate cross-stratification demonstrated that a high-risk PULP score (> 7) was statistically significantly associated with postoperative ICU admission (100.0% [13/13] vs. 0.0% [0/37]; p < 0.001) and postoperative omental patch leak requiring relaparotomy (23.1% [3/13] vs. 0.0% [0/37]; p = 0.014). Although 30-day mortality occurred exclusively within the high-risk PULP > 7 cohort (15.4% [2/13] vs. 0.0% [0/37]), this difference did not reach statistical significance on univariate Fisher's exact testing (p = 0.063), reflecting the small absolute number of mortality events (n = 2).

Table 3: Complete Distribution of the Eight Peptic Ulcer Perforation (PULP) Score Components (N = 50).

PULP score component (8 parameters)	Assigned points	Frequency, n (%)
1. Age > 65 years	3	0 (0.0%)
2. Active malignant disease or AIDS	1	0 (0.0%)
3. Comorbid liver cirrhosis	2	4 (8.0%)
4. Concomitant systemic steroid therapy	1	9 (18.0%)
5. Shock on admission (SBP < 100 mmHg and HR > 100 bpm)	1	3 (6.0%)
6. Time from perforation to surgery > 24 hours	1	25 (50.0%)
7. Preoperative serum creatinine > 1.47 mg/dL (> 130 µmol/L)	2	27 (54.0%)
8. Preoperative ASA physical status classification		
ASA Class I (reference category)	0	8 (16.0%)
ASA Class II	1	15 (30.0%)
ASA Class III	3	16 (32.0%)
ASA Class IV	5	9 (18.0%)
ASA Class V	7	2 (4.0%)
Composite PULP Score Summary	Range: 0–18	
Cohort PULP score, Mean ± SD (Observed Range)	—	4.42 ± 3.49 (0–13)
Low-to-Moderate Risk stratum (PULP score ≤ 7)	0–7	37 (74.0%)
High-Risk stratum (PULP score > 7)	8–18	13 (26.0%)

Abbreviations: AIDS: Acquired Immunodeficiency Syndrome; ASA: American Society of Anesthesiologists; bpm: beats per minute; HR: Heart Rate; PULP: Peptic Ulcer Perforation; SBP: Systolic Blood Pressure; SD: Standard Deviation.

Discussion

This study characterizes the clinicopathological profile and operative outcomes of NSAID-related peptic ulcer perforations at a tertiary referral center in North Africa. In contrast to Western epidemiological series—where perforated peptic ulcers predominantly affect elderly patients with multiple chronic comorbidities and malignancy [4,8,11]—our cohort consisted primarily of young and middle-aged male migrant laborers (mean age 37.0 years, 94.0% male, maximum age 55

Table 4: Univariate Comparison of Postoperative Clinical Outcomes Stratified by Peptic Ulcer Perforation (PULP) Risk Category (N = 50).

Postoperative Outcome Measure	Total Cohort (N = 50) n (%)	Low-to-Moderate Risk (PULP ≤ 7, n = 37) n (%)	High Risk (PULP > 7, n = 13) n(%)	p value*
Postoperative ICU Admission	13 (26.0%)	0 (0.0%)	13 (100.0%)	< 0.001
Uncomplicated Surgical Ward Stay	37 (74.0%)	37 (100.0%)	0 (0.0%)	< 0.001
Postoperative Omental Patch Leak	3 (6.0%)	0 (0.0%)	3 (23.1%)	0.014
Unplanned Relaparotomy	3 (6.0%)	0 (0.0%)	3 (23.1%)	0.014
Postoperative Hemorrhage	0 (0.0%)	0 (0.0%)	0 (0.0%)	1.000**
30-Day Postoperative Mortality	2 (4.0%)	0 (0.0%)	2 (15.4%)	0.063

Note: Data are presented as absolute patient counts and column percentages, n (%).
Abbreviations: ICU: Intensive Care Unit; PULP: Peptic Ulcer Perforation.
*Two-tailed Fisher's exact test comparing Low-to-Moderate Risk (PULP score ≤ 7) *vs.* High Risk (PULP score > 7).
**No hemorrhagic events occurred in either group.

years). In this occupational subpopulation, strenuous physical labor combined with unmonitored over-the-counter NSAID ingestion represents a major precipitating factor for acute gastroduodenal perforation [2,3,7].

Gastric perforations were substantially more frequent than duodenal perforations (84.0% *vs.* 16.0%), and all defects measured between 15 and 30 mm, placing a large proportion within the large-to-giant ulcer classification [4,5]. NSAIDs induce gastroduodenal mucosal injury through both direct topical epithelial cytotoxicity and systemic inhibition of cyclooxygenase-mediated prostaglandin synthesis, which impairs mucosal blood flow, mucus-bicarbonate secretion, and epithelial restitution [7,12]. Furthermore, continued analgesic consumption frequently masks early visceral pain, contributing to delayed hospital presentation [3,17]. Consequently, half of our cohort presented > 24 hours after symptom onset, and 82.0% exhibited established generalized peritonitis at laparotomy.

A comprehensive evaluation of all eight PULP score components clarified how this risk instrument operates in a younger occupational cohort [8,15,16]. Although two classic PULP parameters—advanced age (> 65 years) and active malignancy—were entirely absent (0.0%), the composite score still identified a high-risk subgroup (26.0% with PULP > 7) driven primarily by preoperative acute kidney injury (serum creatinine > 1.47 mg/dL in 54.0%), higher preoperative ASA physical status (ASA class ≥ III in 54.0%), and surgical delay > 24 hours (50.0%). Renal impairment in acute NSAID-related perforation reflects a dual pathophysiological insult: severe intravascular volume depletion from third-space peritoneal fluid sequestration and systemic sepsis, compounded by NSAID-induced inhibition of vasodilatory renal prostaglandins and unopposed afferent arteriolar vasoconstriction [4,7,12]. Similarly, elevated ASA scores (classes III–V) captured the cumulative systemic decompensation resulting from delayed presentation (> 24 hours), which remains a pivotal, modifiable determinant of adverse surgical outcomes [17,18].

In univariate analysis, a high-risk PULP score (> 7) was significantly associated with the need for postoperative ICU admission ($p < 0.001$) and omental patch leak requiring relaparotomy ($p = 0.014$). Moreover, both postoperative deaths (4.0%, n = 2) occurred exclusively among patients with PULP scores > 7 (15.4% *vs.* 0.0%). However, it is important to emphasize that the mortality comparison between high-risk and low-to-moderate-risk patients did not achieve formal statistical significance ($p = 0.063$). Because our cohort included only 50 patients with three leaks and two deaths, these findings represent preliminary univariate associations rather than definitive validation of predictive accuracy. Accordingly, while a PULP score > 7 appears useful as a pragmatic clinical adjunct to flag physiologically compromised patients who may benefit from invasive hemodynamic monitoring, aggressive perioperative resuscitation, and postoperative ICU triage, larger adequately powered multicenter studies are necessary to confirm its independent prognostic performance.

From a technical standpoint, emergency open repair using the modified Graham omental patch proved practical and safe, yielding an overall leak rate of 6.0% (n = 3). This rate compares favorably with international surgical series of large and giant peptic ulcer perforations, which report leakage rates ranging from 5% to 15% [5,6,9,10]. Because all three repair breakdowns occurred in patients who presented > 48 hours after symptom onset with giant gastric defects, severe metabolic acidosis, and PULP scores > 7, local margin edema, tissue friability, and systemic hypoperfusion appear to be the primary determinants of patch failure rather than technical inadequacy [4,5,10]. Finally, because acute *H. pylori* diagnostic assays have reduced sensitivity during acute peritonitis and concurrent PPI or antimicrobial therapy, empirical 14-day triple eradication therapy was prescribed prior to discharge [4,18]. This pragmatic approach helps minimize ulcer recurrence, particularly among transient migrant workers for whom long-term endoscopic surveillance is rarely feasible [3,18].

Limitations

This study has several important limitations that warrant cautious interpretation. First, the retrospective, single-center design and modest sample size (N = 50), combined with the very low absolute number of primary adverse events (only three postoperative leaks and two deaths), limited statistical power. As a result, statistical evaluation was restricted to univariate comparisons, and multivariable logistic regression could not be reliably conducted to control for potential confounding variables, nor could statistical significance be reached for 30-day mortality ($p = 0.063$). Second, because all patients were aged ≤ 55 years and patients with active malignancy were excluded, two of the eight PULP score components could not be evaluated in this demographic, limiting generalizability to older, multi-morbid Western populations. Third, all operations were performed via open midline laparotomy, precluding direct comparison with laparoscopic repair techniques [6,9,10,13]. Fourth, post-discharge endoscopic confirmation of mucosal healing and urea breath testing for *H. pylori* eradication were hindered by high rates of loss to follow-up among migrant laborers.

Conclusion

NSAID-related gastroduodenal perforation in this North African industrial and agricultural setting predominantly affects young, male migrant laborers and is characterized by large gastric defects, generalized peritonitis, and frequent presentation delays. Preoperative renal dysfunction, higher ASA physical status, and surgical delays exceeding 24 hours are the primary clinical factors associated with postoperative morbidity. Within the constraints of a 50-patient univariate analysis, a high-risk PULP score (> 7) was significantly

associated with postoperative ICU admission and omental patch leak, while showing a non-significant association with 30-day mortality (p = 0.063). The PULP score may therefore serve as a helpful clinical adjunct to guide early perioperative resuscitation and critical care triage, though larger prospective multicenter cohorts are needed to establish its independent predictive validity. Public health education, improved occupational healthcare access, and stricter regulatory oversight of over-the-counter NSAID dispensing are urgently warranted.

Declarations

Author contributions: M.J.E. formulated the study concept and design. M.J.E. and F.M.E. collected clinical and operative data. F.M.E., M.A.I., and A.B.M. performed the statistical analyses and drafted the manuscript. All authors critically revised the manuscript for important intellectual content and approved the final version for publication.

Ethics approval and consent to participate: The study protocol was reviewed and approved by the Institutional Ethics Review Committee of Misurata Medical Center, Misurata, Libya. The requirement for individual written informed consent was waived due to the retrospective analysis of anonymized clinical records.

Consent for publication: Not applicable (de-identified secondary clinical data).

Conflicts of interest: The authors declare that they have no competing financial or personal interests.

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Data availability statement: The de-identified datasets analyzed during the current study are available from the corresponding author upon reasonable academic request.

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