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Original article

Clinical Spectrum, Endoscopic Findings, and Eradication Outcomes of *Helicobacter pylori* Infection in Eastern Libya

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Abstract
Helicobacter pylori (H. pylori) is a highly prevalent global infection and a major cause of gastrointestinal morbidity. Despite its high endemic burden in Libya, localized data regarding clinical characteristics, endoscopic findings, and treatment outcomes following standardized eradication therapy remain limited. To evaluate the demographic characteristics, clinical presentations, upper gastrointestinal endoscopic findings, and treatment outcomes among patients diagnosed with H. pylori infection in Derna, Libya. A prospective observational study was conducted between 2024 and 2025, involving 55 consecutive patients (aged ≥15 years) with confirmed H. pylori infection diagnosed via stool antigen testing. All patients received a 14-day first-line triple therapy (amoxicillin, clarithromycin, lansoprazole). Patients with persistent infection received a 10-day second-line bismuth-based quadruple therapy. Eradication success was confirmed via follow-up stool antigen testing at least four weeks post-treatment. Clinical symptoms and upper endoscopic findings were systematically recorded and analyzed. The mean age of the cohort was 26.6 ± 9.0 years, with a near-equal sex distribution (52.7% female). Epigastric pain (76.4%) and nausea (52.7%) were the most frequent presenting symptoms. First-line triple therapy achieved an eradication rate of 85.5% (47/55 patients), with a highly significant reduction in post-treatment stool antigen titers (median: 4.0 to <1.0; p < 0.001). Treatment efficacy showed no significant difference between sexes (p = 1.000). The remaining 14.5% (8 patients) were successfully transitioned to second-line bismuth quadruple therapy. Among the 47.3% of patients who underwent endoscopy, atrophic gastritis was the predominant finding (38.5%), followed by esophagitis (23.1%). Baseline endoscopic pathology did not significantly influence therapeutic success. In eastern Libya, H. pylori infection predominantly affects young adults presenting with dyspeptic symptoms. A 14-day standard triple therapy demonstrates a clinically acceptable eradication rate comparable to regional and global averages. Stool antigen testing proves highly effective for both initial diagnosis and eradication confirmation. These findings provide valuable real-world data to support and optimize current H. Pylori management strategies in resource-limited Libyan settings.
Keywords. *Helicobacter Pylori, H. Pylori Eradication, Stool Antigen Test, Triple Therapy.*

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Introduction

Helicobacter pylori (*H. pylori*) is a spiral-shaped, Gram-negative, microaerophilic bacterium that colonizes the gastric mucosa and remains one of the most prevalent chronic bacterial infections worldwide. Approximately half of the world's population is estimated to be infected, although prevalence varies considerably according to geographical region, socioeconomic conditions, sanitation, and living standards. The infection remains particularly common in developing countries, including those in Africa and the Middle East, where prevalence frequently exceeds 60%. Despite improvements in hygiene and healthcare, *H. pylori* continues to pose a major public health challenge because of its association with significant gastrointestinal morbidity and the growing problem of antimicrobial resistance [1–4]. The pathogenicity of *H. pylori* depends on its remarkable ability to survive within the highly acidic gastric environment. This is achieved primarily through the production of urease, which hydrolyzes urea into ammonia and carbon dioxide, creating a locally neutral pH that facilitates bacterial colonization.

Several virulence factors, including cytotoxin-associated gene A (CagA), vacuolating cytotoxin A (VacA), and outer membrane adhesins, contribute to persistent gastric inflammation and progressive mucosal damage. Chronic infection may lead to chronic active gastritis, peptic ulcer disease, gastric mucosal atrophy, intestinal metaplasia, mucosa-associated lymphoid tissue (MALT) lymphoma, and gastric adenocarcinoma. Consequently, the International Agency for Research on Cancer continues to classify *H. pylori* as a Group I human carcinogen [2,5–7]. The clinical manifestations of *H. pylori* infection are highly variable. Although many infected individuals remain asymptomatic, others develop dyspeptic symptoms including epigastric pain, nausea, vomiting, abdominal bloating, early satiety, heartburn, and regurgitation. More severe complications such as upper gastrointestinal bleeding, perforated peptic ulcers, iron deficiency anemia, and gastric malignancy may occur in untreated cases.

Disease expression depends on complex interactions among bacterial virulence, host immune response, genetic susceptibility, environmental exposures, dietary habits, and lifestyle factors [3,6,8]. Accurate diagnosis of *H. pylori* infection is essential for effective management and prevention of long-term complications. Both non-invasive and invasive

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diagnostic methods are currently available. Non-invasive tests include the stool antigen test, urea breath test, and serological assays, whereas invasive approaches involve upper gastrointestinal endoscopy with gastric biopsy for histopathology, rapid urease testing, culture, or molecular techniques. Stool antigen testing has become widely recommended because of its high sensitivity, specificity, affordability, and usefulness for both initial diagnosis and post-treatment confirmation of eradication.

Endoscopy remains the preferred investigation in patients presenting with alarm symptoms or suspected complications because it permits direct visualization of gastric pathology and biopsy collection [1,4,9]. Successful eradication of *H. pylori* substantially reduces the recurrence of peptic ulcer disease and lowers the risk of gastric cancer and MALT lymphoma. However, the increasing prevalence of resistance to clarithromycin, metronidazole, and levofloxacin has significantly reduced the effectiveness of conventional triple therapy in many regions. Contemporary international guidelines therefore recommend susceptibility-guided therapy whenever possible and increasingly favor optimized bismuth-based quadruple therapy in areas with high clarithromycin resistance. Confirmation of eradication at least four weeks after treatment using stool antigen testing or the urea breath test is strongly recommended to ensure therapeutic success [1,3,4,10]. Although numerous international studies have investigated *H. pylori* infection, published evidence from Libya remains relatively limited.

Most available local studies have focused primarily on prevalence, while comparatively little information exists regarding patients' clinical characteristics, treatment outcomes, and upper gastrointestinal endoscopic findings following standardized eradication therapy. Local epidemiological data are essential for evaluating the effectiveness of current treatment strategies and for guiding evidence-based clinical practice within the Libyan healthcare system [4,8,11]. Therefore, the present study aimed to evaluate the demographic characteristics, clinical presentation, treatment outcomes, and upper gastrointestinal endoscopic findings among patients diagnosed with *H. pylori* infection. Furthermore, the study assessed the effectiveness of first-line triple therapy and second-line bismuth-based quadruple therapy using stool antigen testing to confirm eradication. The findings are expected to provide valuable local evidence that may contribute to improving the clinical management of *H. pylori* infection and support future treatment guidelines in Libya.

Methods

Study Design and Setting

This was a prospective observational study conducted between 2024 and 2025 to evaluate the clinical presentation, treatment outcomes, and upper gastrointestinal endoscopic findings among patients diagnosed with *Helicobacter pylori* (*H. pylori*) infection. The study was carried out at a gastroenterology outpatient clinic in Derna, Libya. Data were collected from patients' medical records, laboratory reports, and endoscopy reports throughout the study period. The study was conducted in accordance with the principles of the Declaration of Helsinki for research involving human participants.

Study Population

The study included 55 consecutive patients with confirmed *H. pylori* infection. Eligible participants were male and female patients aged 15 years or older who had a positive stool antigen test for *H. pylori* and completed the prescribed eradication therapy with subsequent follow-up testing. Inclusion Criteria**:** Patients were included if they: had laboratory-confirmed *H. pylori* infection by stool antigen testing; were aged ≥15 years; had completed first-line eradication therapy; had undergone follow-up stool antigen testing at least four weeks after completion of treatment; and had complete clinical records available for analysis. Exclusion Criteria: Patients were excluded if they: had incomplete medical records; failed to complete the prescribed treatment regimen; did not attend post-treatment follow-up; had previously received *H. pylori* eradication therapy before enrollment; or had severe systemic illnesses that could interfere with treatment assessment.

Diagnosis of Helicobacter pylori Infection

The diagnosis of *H. pylori* infection was established using a stool antigen test, which served as the primary diagnostic method. Stool samples were collected according to standard laboratory procedures and analyzed using commercially available immunochromatographic assays. A positive test result was considered diagnostic of active infection.

Treatment Protocol

All patients initially received standard first-line triple therapy consisting of amoxicillin, clarithromycin, and lansoprazole. The treatment was administered for 14 consecutive days. Patients who remained stool antigen-positive four weeks after completing first-line therapy were considered treatment failures and subsequently received second-line bismuth-based quadruple therapy consisting of pantoprazole, bismuth subsalicylate, metronidazole, and tetracycline. The second-line regimen was administered for 10 days. Treatment success was confirmed by repeat stool antigen testing performed at least four weeks after completion of therapy.

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Clinical Data Collection

Demographic and clinical information was extracted from patients' medical records using a standardized data collection form. The following variables were recorded: age, sex, presenting gastrointestinal symptoms, pre-treatment stool antigen titer, post-treatment stool antigen result, treatment outcome, requirement for second-line therapy, and upper gastrointestinal endoscopy findings. Clinical symptoms evaluated included epigastric pain, nausea, vomiting, regurgitation, heartburn, dyspepsia, abdominal bloating, halitosis, loss of appetite, melena, and hematemesis.

Upper Gastrointestinal Endoscopy

Upper gastrointestinal endoscopy was performed in patients when clinically indicated, particularly in those presenting with persistent symptoms or alarm features. Endoscopic examinations were performed by experienced gastroenterologists using standard video endoscopes. The observed pathological findings were documented and categorized as: Atrophic gastritis, Erosive gastritis, Esophagitis, and Duodenal ulcer. Patients who did not undergo endoscopy were recorded separately.

Outcome Measures

The primary outcome was successful eradication of *H. pylori*, defined as a negative stool antigen test performed at least four weeks after completion of therapy. Secondary outcomes included: frequency of presenting clinical symptoms, distribution of upper gastrointestinal endoscopic findings, comparison of eradication rates according to sex, association between stool antigen titers and endoscopic findings, and requirement for second-line eradication therapy.

Statistical Analysis

Data were entered, cleaned, and analyzed using IBM SPSS Statistics software (Version 26.0; IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro–Wilk test and are presented as mean ± standard deviation (SD) or median with interquartile range (IQR), as appropriate. Categorical variables are presented as frequencies and percentages. Comparisons between categorical variables were performed using the Chi-square test or Fisher's exact test whenever appropriate. The Wilcoxon signed-rank test was used to compare paired pre-treatment and post-treatment stool antigen titers because the data were not normally distributed. Differences in stool antigen titers among multiple endoscopic diagnostic groups were analyzed using the Kruskal–Wallis test. All statistical tests were two-tailed, and a p-value <0.05 was considered statistically significant.

Results

A total of 55 patients with confirmed *Helicobacter pylori* infection were included in the study. The mean age of the participants was 26.6 ± 9.0 years (range: 15–47 years), indicating that the study population consisted predominantly of young adults. Females accounted for 52.7% (n = 29) of the cohort, while males represented 47.3% (n = 26), with no statistically significant difference in sex distribution (χ^2 = 0.16, p = 0.688). When participants were stratified by age, the largest proportions were observed in the ≤20-year and 21–30-year age groups, each comprising 36.4% (n = 20) of the study population. Patients aged 31–40 years represented 18.2% (n = 10), whereas only 9.1% (n = 5) were 41–47 years of age. No statistically significant difference was observed in the distribution of pre-treatment stool antigen titers among the different age groups (Kruskal–Wallis H = 6.24, p = 0.101). The median pre-treatment stool antigen titer was 4.0 (interquartile range [IQR]: 2.1–7.8), with a mean value of 5.74 ± 4.77 and an overall range of 1.1–23.0 (Table 1).

Table 1. Baseline Demographic and Clinical Characteristics of H. pylori Patients (N=55)

Variable	n (%)	Statistical Value
Total patients	55 (100%)	—
Sex: Male	26 (47.3%)	χ^2 = 0.16, p = 0.688
Sex: Female	29 (52.7%)	
Age: mean ± SD (years)	26.6 ± 9.0	Range: 15–47
Age group ≤20 years	20 (36.4%)	
Age group 21–30 years	20 (36.4%)	Kruskal–Wallis
Age group 31–40 years	10 (18.2%)	H = 6.24, p = 0.101
Age group 41–47 years	5 (9.1%)	
Pre-treatment titer: median (IQR)	4.0 (2.1–7.8)	Mean 5.74 ± 4.77
Pre-treatment titer range	1.1 – 23.0	

IQR = Interquartile Range; SD = Standard Deviation; χ^2 = Chi-square; NS = Not Significant

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The clinical manifestations of *H. pylori* infection varied among patients, although dyspeptic symptoms predominated. Epigastric pain was the most frequently reported symptom, affecting 42 patients (76.4%), followed by nausea in 29 patients (52.7%) and vomiting in 13 patients (23.6%). Regurgitation was reported by 10 patients (18.2%), while indigestion and heartburn were observed in 9.1% and 7.3% of patients, respectively. Less common symptoms included abdominal bloating and halitosis, each reported by 3 patients (5.5%). Evidence of upper gastrointestinal bleeding was uncommon but clinically relevant, with melena documented in three patients (5.5%) and hematemesis in two patients (3.6%). Loss of appetite was reported by two patients (3.6%). The complete distribution of presenting symptoms is summarized in (Table 2).

Table 2. Frequency Distribution of Clinical Symptoms (N=55)

Symptom	n	%
Epigastric pain	42	76.4%
Nausea	29	52.7%
Vomiting	13	23.6%
Regurgitation	10	18.2%
Indigestion	5	9.1%
Heartburn	4	7.3%
Bloating	3	5.5%
Bad Breath	3	5.5%
Melena (black stool)	3	5.5%
Loss of appetite	2	3.6%
Vomiting blood (hematemesis)	2	3.6%

Following administration of the standard first-line triple therapy, successful eradication of *H. pylori* was achieved in 47 of the 55 patients, corresponding to an eradication rate of 85.5%. The remaining eight patients (14.5%) had persistent infection confirmed by follow-up stool antigen testing and subsequently received second-line bismuth-based quadruple therapy. Comparison of stool antigen titers before and after treatment demonstrated a marked reduction following therapy. The median pre-treatment titer was 4.0 (IQR: 2.1–7.8), whereas the post-treatment median decreased to <1.0. This reduction was highly statistically significant according to the Wilcoxon signed-rank test ($W = 0$, $p < 0.001$), indicating excellent microbiological response to treatment. Treatment success was comparable between male and female patients. Eradication was achieved in 22 of 26 males (84.6%) and 25 of 29 females (86.2%), with no statistically significant difference between the two groups ($\chi^2 = 0.00$, $p = 1.000$). These findings indicate that patient sex had no measurable influence on treatment outcome (Table 3).

Table 3. H. pylori Treatment Outcomes: First-line and Second-line Therapy (N=55)

Outcome	n	%	Statistical Test
Eradicated after 1st-line therapy	47	85.5%	Wilcoxon W=0
Required 2nd-line therapy	8	14.5%	p < 0.001
Pre-treatment titer: median	4.0	IQR 2.1–7.8	—
Post-treatment titer: median	< 1	—	—
Eradication by sex: Male	22/26	84.6%	$\chi^2 = 0.00$
Eradication by sex: Female	25/29	86.2%	p = 1.000

Upper gastrointestinal endoscopy was performed in 26 patients (47.3%), while the remaining 29 patients (52.7%) did not undergo endoscopic evaluation. Among patients who underwent endoscopy, atrophic gastritis was the most common pathological finding, occurring in 10 patients (38.5%), followed by esophagitis in six patients (23.1%). Both duodenal ulcer and erosive gastritis were identified in five patients each (19.2%). Analysis of pre-treatment stool antigen titers across different endoscopic diagnoses demonstrated no statistically significant differences (Kruskal–Wallis $H = 6.74$, $p = 0.081$), although a trend toward variation was observed. Furthermore, the presence of abnormal endoscopic findings was not significantly associated with eradication success following treatment ($\chi^2 = 0.30$, $p = 0.582$), suggesting that baseline endoscopic pathology did not influence therapeutic response (Table 4).

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Table 4. Upper Gastrointestinal Endoscopy Findings (N=55)

Endoscopic Finding	n	% (of scoped)	% (total N=55)	P- Value
Atrophic Gastritis	10	38.5%	18.2%	
Esophagitis	6	23.1%	10.9%	
Duodenal Ulcer	5	19.2%	9.1%	
Erosive Gastritis	5	19.2%	9.1%	
Total scoped patients	**26**	**100%**	**47.3%**	
Not scoped / normal	29	—	52.7%	
Kruskal–Wallis (test by finding)	H = 6.74			p = 0.081

Discussion

The mean age of our patients was 26.6 ± 9.0 years, with nearly three-quarters (72.8%) of the cohort being 30 years of age or younger. This predominance of younger adults is a recurrent feature of *H. pylori* studies conducted in North Africa and the broader MENA region, where infection is commonly acquired during childhood and becomes clinically apparent during young adulthood. This skew toward younger adults is a recurrent feature of *H. pylori* studies conducted in North Africa and the broader MENA region, where infection is typically acquired during early childhood under conditions of household crowding and limited sanitation, then remains latent until dyspeptic symptoms prompt medical attention in young adulthood. A 2024 cross-sectional study from Benghazi Medical Center similarly documented *H. pylori* in over 60% of symptomatic adults using multiple diagnostic methods, reinforcing the high endemic burden among working-age Libyans [12]. In contrast, a 2023 Irish hospital study found peak infection in the 46-55-year age group, reflecting the epidemiological transition seen in developed settings where childhood acquisition has declined, and the infected pool has aged [13]. The near-equal sex distribution observed here (52.7% female, 47.3% male; p = 0.688) is consistent with most Libyan and North African reports that do not demonstrate a strong sex predilection for infection when a symptomatic clinical population is enrolled [14].

Epigastric pain dominated the symptom profile (76.4%), followed by nausea (52.7%) and vomiting (23.6%), a pattern that closely mirrors findings from comparable regional studies. A clinicopathological series from India (2022-2024) reported epigastric pain in 76.1% of H. pylori-positive dyspeptic patients, while a Pakistani hospital study (2023) documented it in 86.4%, with nausea in 60.6% [15, 16]. The small proportions presenting with melena (5.5%) and hematemesis (3.6%) are a clinical reminder that even in a predominantly young cohort, *H. pylori* carries a meaningful risk of upper gastrointestinal hemorrhage when left untreated. The 2024 First Lagos Consensus of the African Helicobacter and Microbiota Study Group has rightly emphasized that symptom profiles across Africa are dominated by dyspepsia and that confirmatory testing remains essential because clinical features alone cannot reliably distinguish H. pylori-associated disease from other upper GI conditions [17]. The first-line 14-day triple therapy (amoxicillin, clarithromycin, lansoprazole) achieved an eradication rate of 85.5%, a result that compares favorably with the global experience. A 2025 systematic review spanning 13 studies found that classic triple therapy produces eradication rates between 61.9% and 88.8%, with the lower end concentrated in regions where clarithromycin resistance exceeds 15–20% [18]. Our rate sits comfortably within this range and above the pooled African average of 22.3–79% reported in a 2024 meta-analysis, a wide and sobering spread driven largely by antibiotic resistance, inconsistent treatment duration, and poor adherence across the continent [17]. The 14-day duration used in this study is almost certainly a contributor to this favorable outcome; current ACG and European guidelines consistently recommend 14-day courses of triple therapy over shorter ones, citing a clinically meaningful gain in eradication probability [1, 3]. The significant reduction in stool antigen titers post-treatment (median from 4.0 to < 1.0; Wilcoxon W = 0, p < 0.001) further validates the microbiological effectiveness of the regimen and highlights the practical value of quantitative follow-up testing in settings where culture-based resistance profiling is unavailable.

Eradication rates were identical across sexes (males 84.6%, females 86.2%; p = 1.000), consistent with the current evidence base indicating that biological sex does not independently influence treatment response when standardized 14-day regimens are prescribed [1]. The 14.5% of patients who required second-line bismuth-based quadruple therapy represent a clinically expected failure proportion given the absence of pre-treatment susceptibility testing. Bismuth quadruple therapy is the rescue regimen of choice endorsed by both the 2024 Maastricht VI/Florence Consensus and the 2023 WGO Global Guideline, and a 2025 meta-analysis of 43 randomized trials (n = 9,162) confirmed that bismuth-based quadruple regimens achieve significantly higher eradication than triple therapy (84.8% versus 74.1%; OR = 2.02) [3, 4, 19]. Among the 47.3% of patients who underwent upper GI endoscopy, atrophic gastritis was the predominant finding (38.5%), followed by esophagitis (23.1%) and duodenal ulcer (19.2%). The high prevalence of atrophic change in a population with a mean age under 30 years is noteworthy and likely reflects prolonged asymptomatic infection, an expected consequence in a country where, as early studies established, seroprevalence already exceeds 80% by adolescence [20]. Importantly, neither the type of endoscopic lesion nor titer level significantly predicted eradication outcome, suggesting that the standard regimens used here are broadly effective irrespective of the underlying mucosal pathology.

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Limitations

This study has several limitations that should be considered when interpreting the findings. The sample size of 55 patients, while adequate for descriptive analysis, limits statistical power for subgroup comparisons, particularly the endoscopic subanalyses. Pre-treatment antibiotic susceptibility testing was not performed, so the contribution of clarithromycin or metronidazole resistance to the 14.5% first-line failure rate cannot be quantified. Endoscopy was performed selectively rather than in all participants, which may introduce bias into the endoscopic findings. Data on potential confounders, including prior antibiotic use, smoking, NSAID consumption, and dietary habits, were not collected. Finally, post-eradication follow-up was limited to four weeks, precluding any assessment of reinfection, which occurs at approximately 3–5% per year in comparable MENA settings. Despite these limitations, the study provides valuable real-world evidence on H. pylori management in eastern Libya, where published clinical data remain scarce.

Conclusion

This study demonstrates that *H. pylori* infection in Derna, Libya, predominantly affects young adults with dyspeptic symptoms, and that a 14-day clarithromycin-based triple therapy achieves a clinically acceptable eradication rate of 85.5%, comparable to the upper range of outcomes reported across Africa and the MENA region. Treatment response was equivalent between sexes, and the pattern of endoscopic findings, with atrophic gastritis predominating even in this young cohort, underscores the consequences of long-standing untreated infection. Second-line bismuth-based quadruple therapy provided an effective rescue strategy for treatment failures. These findings support the continued use of stool antigen testing for both diagnosis and eradication confirmation in resource-limited Libyan settings, and highlight the need for larger multicenter studies incorporating susceptibility testing to guide evidence-based, locally tailored treatment guidelines.

Conflict of interest. Nil

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