

ORIGINAL ARTICLE

Role of Helicobacter pylori Eradication in Preventing Gastric Cancer and Reducing Surgical Burden

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ABSTRACT

Background: *Helicobacter pylori* (*H. pylori*) is a WHO-classified class I carcinogen and the leading modifiable risk factor for non-cardia gastric cancer. Early eradication interrupts the inflammatory cascade responsible for chronic gastritis, atrophy, intestinal metaplasia, and eventual malignancy. In addition to preventing gastric cancer, successful eradication decreases complications of peptic-ulcer disease, potentially reducing the long-term surgical burden. This study evaluates eradication outcomes among adult patients and analyzes the preventive impact on precancerous gastric pathology.

Methods: This descriptive cross-sectional study was conducted at MTI Hayatabad Medical Complex (HMC), Peshawar, and Aziz Bhatti Shaheed Teaching Hospital, Gujrat, Pakistan, from June 2022 to June 2023. A total of 100 adult patients presenting with dyspepsia or suspected *H. pylori* infection were recruited through non-probability consecutive sampling. Diagnosis was confirmed using urea breath test, stool antigen test, or endoscopic biopsy where indicated. Patients received either bismuth-based quadruple therapy or concomitant therapy. Post-treatment eradication was reassessed after four weeks. Endoscopy with histopathology was performed in symptomatic or clinically indicated cases. Data were analyzed using SPSS version 25, with chi-square and t-tests applied where appropriate.

Results: The mean age of participants was 41.8 ± 12.6 years, with males comprising 54% of the sample. Common symptoms included epigastric pain (73%), bloating (52%), and early satiety (38%). The overall eradication success rate was 81%, higher among patients receiving bismuth-based quadruple therapy compared with concomitant therapy. Smoking significantly reduced treatment success (62% vs. 86% in non-smokers). Among 32 patients who underwent endoscopy, chronic active gastritis was found in 68.7%, gastric atrophy in 21.8%, and intestinal metaplasia in 9.3%. Patients with advanced mucosal changes showed lower eradication rates. The findings suggest a clear potential for reducing future gastric cancer incidence and lowering surgical workload through timely eradication.

Conclusion: *H. pylori* eradication is highly effective and represents a central strategy for primary gastric-cancer prevention. Early diagnosis and treatment halt progression toward premalignant lesions and reduce ulcer-related complications, thereby diminishing the need for major upper-gastrointestinal surgeries such as gastrectomy and emergency ulcer repair. Integrating widespread testing, eradication protocols, and patient counseling into routine clinical practice can significantly reduce the long-term surgical burden in high-prevalence regions.

Keywords: *Helicobacter pylori*, gastric cancer prevention, eradication therapy, peptic ulcer, precancerous lesions, surgical burden.

INTRODUCTION

Gastric cancer remains one of the leading causes of cancer-related morbidity and mortality worldwide, with the highest burden reported in East Asia, Eastern Europe, and parts of South America¹. Despite global declines in incidence over recent decades, gastric cancer continues to pose a substantial public-health challenge, primarily because most patients present at advanced stages when curative options are limited and surgical treatment becomes technically demanding, costly, and associated with high morbidity. Therefore, identifying and controlling modifiable risk factors is fundamental to reducing the occurrence of gastric cancer and the subsequent surgical load on healthcare systems².

Among all known risk factors, *Helicobacter pylori* (*H. pylori*) infection stands out as the single most important and well-established cause of non-cardia gastric cancer³. Classified as a Group I carcinogen by the World Health Organization, *H. pylori* initiates a multistep cascade starting from chronic active gastritis and progressing through atrophy, intestinal metaplasia, dysplasia, and ultimately adenocarcinoma. This stepwise "Correa cascade" is strongly driven by persistent bacterial colonization, ongoing mucosal inflammation, host genetic susceptibility, dietary habits, and environmental exposures. Given this clear causal relationship,

eradication of *H. pylori* offers a unique opportunity for primary prevention of gastric cancer before irreversible precancerous lesions develop^{4,5}.

Accumulating evidence from randomized clinical trials, long-term cohort studies, and population-based eradication programs demonstrates that early and successful *H. pylori* eradication significantly reduces the risk of gastric cancer⁶. Countries that have implemented mass screening and eradication initiatives have reported notable declines in cancer incidence, cancer-related deaths, and severe peptic-ulcer complications. The benefits extend beyond cancer prevention: eradication therapy has markedly reduced the recurrence of peptic ulcers, ulcer bleeding, and perforation conditions that historically contributed significantly to emergency surgical admissions⁷.

Reducing the occurrence of gastric cancer and ulcer complications inevitably leads to a measurable decline in major surgical procedures such as gastrectomy, ulcer repair, and emergency laparotomy. In high-burden regions, this shift can substantially lessen surgical workload, reduce postoperative complications, and improve allocation of healthcare resources. As healthcare systems strive to balance increasing patient loads with limited surgical capacity, interventions that prevent disease before surgical care becomes necessary hold high strategic value^{8,9}.

Given the strong scientific consensus and the growing global experience with eradication strategies, understanding the role of *H. pylori* eradication in preventing gastric cancer and reducing surgical burden is increasingly important. This article explores the

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biological basis, clinical evidence, and public-health implications of *H. pylori* eradication, emphasizing its potential to transform gastric-cancer prevention and reshape surgical practice in the coming decades¹⁰.

MATERIALS AND METHODS

Study Design and Setting: This study was designed as a descriptive cross-sectional clinical investigation conducted across two major tertiary-care hospitals in Pakistan. The data were collected simultaneously from MTI Hayatabad Medical Complex (HMC), Peshawar, and Aziz Bhatti Shaheed Teaching Hospital, Gujrat, enabling inclusion of patients from diverse ethnic and socioeconomic backgrounds. Conducting the research in two geographically distinct centers allowed for broader representation and enhanced generalizability of the findings. The study was carried out over a 12-month period, from June 2022 to June 2023, a duration selected to ensure adequate patient recruitment and to account for seasonal variations in gastrointestinal disease patterns.

Study Population: The target population consisted of adult patients presenting to the outpatient gastroenterology and general medicine departments of the participating hospitals with dyspeptic symptoms or clinical suspicion of *Helicobacter pylori* infection. All individuals were evaluated for eligibility based on predefined criteria. A total of 100 patients were enrolled consecutively using a non-probability convenience sampling technique, ensuring that every patient meeting the criteria during the study period was included.

Inclusion and Exclusion Criteria: Patients aged 18 years and above, of either gender, with symptoms suggestive of *H. pylori* infection such as epigastric pain, bloating, nausea, early satiety, or documented peptic ulcer were included. Individuals who tested positive for *H. pylori* on non-invasive or invasive diagnostic modalities were eligible for eradication therapy and follow-up. Exclusion criteria consisted of patients with a previous history of *H. pylori* eradication therapy within the last 12 months, those currently using proton pump inhibitors or antibiotics within two weeks prior to testing, individuals with gastric malignancy already diagnosed, patients with severe comorbidities making participation unsafe, pregnant women, and those unwilling to provide informed consent. These exclusions were applied to ensure data accuracy and to prevent confounding effects from partially treated infections.

Diagnostic Evaluation for *H. Pylori*: All enrolled participants underwent standardized diagnostic testing for *H. pylori*. The diagnostic approach included 13C-urea breath test (UBT) or stool antigen test, depending on availability at the respective hospitals. In patients requiring upper gastrointestinal endoscopy for clinical reasons, biopsy-based tests such as rapid urease test (RUT) and histopathology were performed. Using multiple diagnostic options allowed confirmation of infection status with high sensitivity and specificity. Test choice was aligned with standard international guidelines and institutional protocols.

Eradication Therapy Protocol: Patients confirmed positive for *H. pylori* were prescribed a guideline-based eradication regimen. Most participants received a bismuth-based quadruple therapy, comprising a proton pump inhibitor (PPI), bismuth subsalicylate, tetracycline, and metronidazole for 10–14 days. In cases where bismuth was unavailable, a non-bismuth concomitant therapy (PPI + clarithromycin + amoxicillin + metronidazole) was used as per hospital policy. All medication doses were standardized across both centers to ensure uniformity of treatment. Participants were counseled by the attending physicians regarding drug adherence, potential side effects, and the importance of completing the therapy.

Assessment of Treatment Response: Evaluation of eradication success was performed at least four weeks after completing therapy. Proton pump inhibitors and antibiotics were withheld for two weeks prior to testing to avoid false-negative outcomes. Post-treatment confirmation was carried out using UBT or stool antigen testing. Successful eradication was documented for patients who

tested negative on repeat testing, whereas persistent positivity was considered eradication failure.

Data Collection Procedure: Data collection was conducted using a structured proforma specifically developed for this study. Demographic characteristics (age, gender, residence), clinical presentation, risk factors, diagnostic tests, treatment regimens, and eradication outcomes were recorded. Additional information, such as family history of gastric cancer, smoking status, NSAID use, and comorbidities, was also documented to identify associations relevant to gastric cancer risk. All data were collected by trained medical officers at each site to ensure consistency and reduce inter-observer variation.

Outcome Measures: The primary outcome was the proportion of patients achieving successful *H. pylori* eradication. Secondary outcomes included prevalence of precancerous gastric lesions, history of peptic-ulcer complications, and the potential impact of eradication on reducing the need for surgical intervention. Data were used to evaluate the preventive role of eradication therapy in lowering the long-term risk of gastric cancer and related surgical burden.

Ethical Considerations: The study protocol was reviewed and approved by the Institutional Review Boards (IRBs) of both participating hospitals. Written informed consent was obtained from all patients prior to enrollment. Confidentiality was ensured by assigning coded identification numbers to patients, and all data were stored in secure, password-protected systems accessible only to the research team. The study adhered to the ethical principles outlined in the Declaration of Helsinki.

Data Analysis: All data were entered and analyzed using SPSS version 25.0. Descriptive statistics were calculated for demographic variables and clinical characteristics. Frequencies and percentages were used for categorical variables, while means and standard deviations were computed for continuous variables. Associations between eradication outcomes and potential risk factors were evaluated using chi-square tests for categorical variables and independent t-tests for continuous variables. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

A total of 100 patients were enrolled from MTI Hayatabad Medical Complex, Peshawar, and Aziz Bhatti Shaheed Teaching Hospital, Gujrat, between June 2022 and June 2023. All participants completed baseline evaluation, underwent standardized *Helicobacter pylori* diagnostic testing, and received eradication therapy according to the study protocol. The demographic and clinical characteristics of the study population are summarized in Table 1. The mean age of the study participants was 41.8 ± 12.6 years, ranging from 18 to 70 years, reflecting inclusion of both younger adults with functional dyspepsia and older patients with long-standing gastrointestinal symptoms. Males constituted 54% of the sample, whereas females represented 46%, indicating a nearly balanced gender distribution. Symptom analysis revealed that epigastric pain was the most common presenting complaint, observed in 73% of patients, followed by bloating (52%), early satiety (38%), nausea (35%), and acid reflux (29%), demonstrating the broad clinical spectrum of untreated *H. pylori* infection. A notable proportion (18%) reported a prior history of peptic ulcer disease, while 27% were regular NSAID consumers, both of which are known modifiers of gastric injury and ulcer recurrence. The risk-factor distribution is detailed in Table 1.

Table 1 demonstrates that the majority of patients presented with classical dyspeptic symptoms, whereas a smaller but significant proportion exhibited established risk factors for gastric mucosal injury. The distribution of smoking and positive family history of gastric cancer highlights the background risk environment in which *H. pylori* persists, contributing to chronic gastritis and gradual progression toward precancerous lesions.

Following confirmation of *H. pylori* infection, eradication therapy was administered based on bismuth-based quadruple therapy in 78% of patients, while the remaining 22% received

concomitant therapy due to bismuth unavailability. Treatment adherence was closely monitored, with 93% of participants reporting complete compliance. Post-treatment eradication was reassessed after a minimum washout period of four weeks using urea breath test or stool antigen testing. The overall eradication success rate was 81%, as shown in Table 2. Among those who achieved eradication, the majority belonged to the group that received bismuth-based quadruple therapy, which demonstrated a higher response rate than concomitant therapy.

Table 1: Baseline Characteristics of Study Participants (n = 100)

Variable	Frequency (%) / Mean $\pm$ SD
Age (years)	41.8 $\pm$ 12.6
Gender	
Male	54 (54%)
Female	46 (46%)
Presenting Symptoms	
Epigastric pain	73 (73%)
Bloating	52 (52%)
Early satiety	38 (38%)
Nausea	35 (35%)
Acid reflux/heartburn	29 (29%)
Risk Factors	
NSAID use	27 (27%)
Smoking	21 (21%)
Family history of gastric cancer	12 (12%)
Prior peptic ulcer disease	18 (18%)

Table 2: Treatment Regimens and Eradication Outcomes

Parameter	Frequency (%)
Type of Therapy Administered	
Bismuth-based quadruple therapy	78 (78%)
Concomitant therapy	22 (22%)
Treatment Adherence	
Complete adherence	93 (93%)
Partial adherence	7 (7%)
Eradication Outcome	
Successful eradication	81 (81%)
Treatment failure	19 (19%)

Interpretation of Table 2 indicates that eradication success was significantly associated with adherence, and patients with incomplete adherence had a disproportionately high failure rate of 71%, compared with only 11% among fully adherent individuals. As expected, the quadruple therapy regimen demonstrated superior effectiveness compared to concomitant therapy, consistent with global guidelines that recommend bismuth-based therapy as the preferred first-line regimen in regions with high antibiotic resistance.

Histopathological evaluation was performed in 32 patients who underwent endoscopy due to more severe symptoms or clinician judgment. Among these, chronic active gastritis was observed in 68.7%, while 21.8% exhibited gastric atrophy, and 9.3% demonstrated intestinal metaplasia the latter two being precancerous conditions. These distributions are presented in Table 3. No cases of dysplasia or malignancy were detected at baseline, reinforcing the role of early screening and eradication in preventing cancer progression.

Table 3: Endoscopic and Histopathological Findings Among Patients Who Underwent Endoscopy (n = 32)

Finding	Frequency (%)
Normal mucosa	5 (15.6%)
Chronic active gastritis	22 (68.7%)
Gastric atrophy	7 (21.8%)
Intestinal metaplasia	3 (9.3%)
Peptic ulcer	6 (18.7%)

Analysis of Table 3 reveals that nearly one-third of the endoscoped patients exhibited precancerous lesions (gastric atrophy or intestinal metaplasia). This observation emphasizes the silent but progressive nature of *H. pylori*-induced mucosal injury. Patients with atrophy and intestinal metaplasia were closely

monitored and counseled on the importance of eradication therapy and surveillance to reduce long-term gastric cancer risk.

Further subgroup analyses explored associations between demographic factors, risk behaviors, and eradication outcomes. Smokers demonstrated a significantly lower eradication success rate (62%) compared with non-smokers (86%), highlighting the inhibitory effect of smoking on gastric mucosal recovery and antibiotic responsiveness. Similarly, NSAID users showed slightly reduced eradication success (73%) relative to non-NSAID users (84%), although the difference did not reach statistical significance. Age, gender, and family history of gastric cancer were not significantly associated with eradication outcomes.

Additionally, patients with histopathological findings of intestinal metaplasia had lower eradication success (67%) compared with those with simple gastritis (85%), suggesting that advanced mucosal changes may impair the effectiveness of therapy and reinforce the need for early detection. A detailed distribution of predictive factors for eradication success is presented in Table 4.

Table 4: Factors Associated With Eradication Success

Factor	Successful Eradication (%)	Treatment Failure (%)
Smoking Status		
Smoker	13 (62%)	8 (38%)
Non-smoker	68 (86%)	11 (14%)
NSAID Use		
NSAID user	20 (73%)	7 (27%)
Non-user	61 (84%)	12 (16%)
Histopathology (n = 32)		
Simple gastritis	17 (85%)	3 (15%)
Atrophy	5 (71%)	2 (29%)
Intestinal metaplasia	2 (67%)	1 (33%)

Interpretation of Table 4 highlights that modifiable lifestyle factors particularly smoking significantly influence eradication success, aligning with global evidence that smoking compromises immune response, reduces gastric mucosal perfusion, and interferes with antibiotic efficacy. These findings reinforce the need for integrated lifestyle counseling as part of *H. pylori* eradication strategies.

Overall, the results strongly support the beneficial role of timely *H. pylori* eradication in reducing the burden of chronic gastritis, preventing progression to premalignant lesions, and potentially lowering the long-term incidence of gastric cancer. The high eradication success rate achieved in this study is consistent with international standards and demonstrates the effectiveness of bismuth-based therapy across diverse hospital settings in Pakistan. Furthermore, early identification and treatment may lessen the future need for major surgical interventions associated with advanced gastric disease, thereby reducing the surgical burden on healthcare systems.

DISCUSSION

The present study assessed the role of *Helicobacter pylori* eradication in preventing gastric cancer and reducing the surgical burden associated with chronic gastritis, peptic-ulcer disease, and precancerous gastric lesions¹⁰. Our findings demonstrate a high overall eradication success rate of 81%, achieved primarily through bismuth-based quadruple therapy, and highlight important associations between clinical factors, treatment adherence, and eradication outcomes. These results support the growing global consensus that *H. pylori* eradication is one of the most effective strategies for long-term gastric-cancer prevention and has significant implications for reducing the need for major gastrointestinal surgery¹¹.

In this study cohort, dyspeptic symptoms such as epigastric pain, bloating, and early satiety were highly prevalent, consistent with the well-established association between *H. pylori* infection and functional dyspepsia. The high frequency of classical symptoms emphasizes the importance of early detection,

especially in regions where access to endoscopy is limited and patients often present late in the disease spectrum. Importantly, approximately one-fifth of the patients had a documented history of peptic-ulcer disease, and more than a quarter were regular NSAID users factors known to synergistically exacerbate mucosal injury. These characteristics reflect typical high-risk populations in South Asian clinical settings, underscoring the relevance of eradication therapy in such environments^{12,13}.

One of the notable findings of this study is the presence of atrophy (21.8%) and intestinal metaplasia (9.3%) among the 32 patients who underwent upper GI endoscopy. These lesions represent key steps in the Correa cascade toward gastric adenocarcinoma. The identification of such precancerous changes highlights the silent progression of *H. pylori*-induced mucosal inflammation, especially in patients who present with long-standing dyspepsia or who delay seeking medical care¹⁴. This observation reiterates the importance of eradication therapy as a primary preventive intervention. Evidence from East Asian population-based studies consistently demonstrates that effective eradication before the development of advanced mucosal changes dramatically reduces gastric-cancer risk. The findings from this study align with that body of research, further substantiating the potential benefit of early detection in high-prevalence countries such as Pakistan¹⁵.

Another critical aspect of the findings is the effect of lifestyle behaviors particularly smoking on eradication success. Smokers in our cohort had a significantly lower eradication rate (62%) compared with non-smokers (86%). Smoking impairs gastric mucosal microcirculation, weakens immune response against pathogens, and alters intragastric pH, collectively reducing the efficacy of antibiotic therapy¹⁶. This reduced response among smokers has been repeatedly documented in international literature, and our study reinforces the need for integrated lifestyle modification counseling as part of *H. pylori* management protocols. Similarly, NSAID users demonstrated relatively lower eradication success, although the association did not reach statistical significance. These patterns underscore the multifactorial nature of treatment outcomes and highlight modifiable risk factors that clinicians should address¹⁷.

The eradication success rate of 81% observed in this study is comparable to international standards and reflects the continued effectiveness of bismuth-based quadruple therapy in regions with rising clarithromycin resistance¹⁸. The high adherence rate (93%) also contributed significantly to this success, emphasizing the essential role of patient compliance in determining therapeutic outcomes. Treatment failures were largely clustered among non-adherent patients, suggesting that non-compliance is a major barrier to eradication even when appropriate regimens are used¹⁹.

While the immediate clinical benefits of eradication include relief from dyspeptic symptoms and reduction of ulcer recurrence, the broader significance lies in long-term prevention of gastric cancer. By eliminating a class I carcinogen, eradication halts the chronic inflammatory cascade and prevents progression to atrophy, metaplasia, dysplasia, and ultimately adenocarcinoma. For healthcare systems, this translates into fewer cases of advanced gastric cancer requiring complex surgical interventions such as subtotal or total gastrectomy operations associated with high morbidity, prolonged hospitalization, and substantial postoperative nutritional challenges²⁰.

Furthermore, reducing peptic-ulcer complications directly contributes to lowering emergency surgical workload. Historically, perforated and bleeding ulcers accounted for a considerable proportion of emergency laparotomies¹³. With widespread eradication therapy, global trends have shown significant reductions in ulcer-related hospitalizations, emergency surgeries, and mortality. Our findings, particularly the presence of ulcer disease in 18.7% of endoscoped patients, highlight the potential for similar improvements in Pakistani tertiary-care settings if eradication strategies are routinely integrated into clinical practice¹⁵.

Thus, the implications of this study extend beyond individual patient outcomes. They emphasize a shift toward preventive gastroenterology, where early diagnosis and eradication can reduce the long-term clinical and surgical burden associated with *H. pylori*-induced gastric diseases. When adopted at a larger scale, such strategies can decrease healthcare costs, free surgical resources, and improve overall quality of life at the population level¹⁶.

CONCLUSION

This study demonstrates that *Helicobacter pylori* eradication is an effective and essential intervention for preventing the progression of chronic gastritis to precancerous lesions and ultimately gastric cancer. With an eradication success rate of 81%, particularly among patients receiving bismuth-based quadruple therapy, the findings affirm the efficacy of guideline-recommended regimens in Pakistani clinical settings. The detection of atrophy and intestinal metaplasia in a notable subset of patients underscores the importance of early diagnosis and timely eradication before irreversible mucosal changes occur. Importantly, successful *H. pylori* eradication carries major public-health benefits by reducing the long-term need for complex surgical procedures such as gastrectomy and lowering emergency surgeries related to ulcer complications. By expanding screening, improving patient adherence, and integrating lifestyle counseling, healthcare systems can significantly diminish the surgical burden associated with *H. pylori* infection. In conclusion, systematic implementation of *H. pylori* eradication strategies in high-prevalence regions has the potential to transform gastric-cancer prevention and optimize surgical resource utilization. Policymakers, gastroenterologists, and surgeons should collaborate in developing national protocols to ensure that early detection and eradication become a routine component of gastrointestinal healthcare.

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