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A Prospective Observational Study of Diagnostic Accuracy of White Light Endoscopy and Narrow Band Imaging in Diagnosis of Helicobacter Pylori Infection by Examination of Gastric Mucosal Pattern

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Abstract

Background:

Helicobacter pylori (H. pylori) infection remains a major cause of chronic gastritis, peptic ulcer disease, and gastric carcinoma worldwide. Conventional biopsy-based histopathology is invasive and may yield false negatives due to sampling error. Narrow Band Imaging (NBI), an optical enhancement technique, enables real-time visualization of mucosal microvasculature, offering a potential non-invasive diagnostic alternative. This study aimed to evaluate the diagnostic accuracy of NBI compared with White Light Imaging (WLI) and histopathology .

Methods:

A prospective observational study was conducted at SRM Medical College Hospital & Research Centre from december 2024. One hundred twenty-six adults with dyspepsia underwent upper gastrointestinal endoscopy using both WLI and NBI. Endoscopic findings—including Regular Arrangement of Collecting Venules (RAC), diffuse redness, mucosal edema, and map-like redness—were documented and compared with histopathological results. Sensitivity, specificity, predictive values, and diagnostic accuracy were calculated.

Results:

Of 126 patients, H. pylori infection was histologically confirmed in 68 (54%). NBI correctly identified 94.1% of biopsy-positive cases, demonstrating superior diagnostic accuracy compared with WLI (80.8%). NBI achieved sensitivity of 93.4%, specificity of 89.2%, and overall accuracy of 91% ($p < 0.05$). Following eradication therapy, 92% of patients showed reappearance of RAC and resolution of mucosal redness and edema .

Conclusion:

NBI provides an accurate, real-time, and non-invasive diagnostic tool for H. pylori-associated gastritis. It enhances mucosal visualization, reduces biopsy dependence, and enables efficient post-eradication assessment .

Highlights

- NBI demonstrates >90 % accuracy in diagnosing H. pylori gastritis .

- Key NBI findings—loss of RAC, mucosal redness, and edema—correlate strongly with active infection .
- Post-eradication healing is reliably visualized by RAC reappearance .
- NBI is a cost-effective, non-invasive, real-time alternative to biopsy .

Introduction

Helicobacter pylori is a Gram-negative, spiral-shaped bacterium that colonizes the gastric mucosa, leading to chronic inflammation and potential malignant transformation (1,2). Globally, it infects over half the population, with prevalence exceeding 70% in developing countries (3). In India, H. pylori remains a leading cause of dyspepsia and peptic ulcer disease (4).

Histopathological biopsy remains the diagnostic gold standard but is invasive, costly, and subject to sampling variability (5). Non-invasive tests such as the urea breath test and stool antigen test are useful but less practical in routine hospital settings. Therefore, a reliable, real-time, and minimally invasive diagnostic alternative is needed.

Narrow Band Imaging (NBI) enhances mucosal contrast using narrow-spectrum blue (415 nm) and green (540 nm) light, improving the visibility of superficial microvascular and surface structures (6). Loss of RAC, mucosal redness, edema, and map-like redness are endoscopic hallmarks of H. pylori infection, whereas reappearance of RAC signifies mucosal healing after eradication (7,8). The present study evaluates the diagnostic efficacy of NBI relative to WLI and histopathology in dyspeptic patients (9).

Materials and Methods

This prospective observational study was conducted in the Department of General Surgery, SRM Medical College Hospital & Research Centre, Tamil Nadu, India, from December 2024. Ethical clearance was obtained (SRMIEC- ST1124-1745), and written informed consent was secured from all participants.

Adults aged 18–60 years with dyspepsia for more than three months, no previous H. pylori eradication therapy, and the ability to provide informed consent were included. Exclusion criteria comprised prior gastric surgery, recent proton pump inhibitor or antibiotic use (within four weeks), coagulopathy, systemic illness, or suspected malignancy (9,10).

Upper gastrointestinal endoscopy was performed using an Olympus HQ 190 system. Each patient underwent sequential WLI and NBI evaluation. The antral and corpus mucosae were examined for loss of RAC, mucosal redness, edema, and map-like redness. Targeted biopsies from the antrum and body were obtained for histopathological confirmation (10).

Patients positive for H. pylori received standard triple therapy (proton pump inhibitor, amoxicillin, and clarithromycin) for 14 days. Follow-up endoscopy was performed four weeks after therapy to assess mucosal recovery based on the reappearance of RAC and disappearance of inflammatory features (11).

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Quantitative variables were expressed as mean ± SD, and categorical variables as frequencies and percentages. Statistical significance was set at $p < 0.05$ (12).

Results

The baseline demographics and symptom profile of the 126 patients are summarized in Table 1. The mean age was 43.5 ± 10.2 years (range 21–67), with a male-to-female ratio of 1.2:1. Most presented with epigastric pain or bloating lasting over six months.

On WLI, mucosal abnormalities—loss of RAC, redness, and edema—were seen in 55/68 biopsy-positive patients (accuracy 80.8%). However, subtle vascular changes were missed under WLI

NBI revealed distinct mucosal patterns; 64/68 biopsy-positive patients (94.1%) showed loss of RAC, diffuse redness, and edema. Among biopsy-negative patients, 36/38 (94.7%) had normal RAC. The diagnostic indices for each modality are detailed in Table 2. NBI achieved sensitivity 93.4%, specificity 89.2%, and overall accuracy 91%, significantly outperforming WLI ($p = 0.02$).

After eradication, 92% of patients demonstrated RAC reappearance and resolution of redness/edema. The distribution of NBI features across infection phases is summarized in Table 3, showing strong correlation between endoscopic features and infection status.

Table 1
Demographic and clinical characteristics of the study population (n = 126)

Parameter	Number (n)	Percentage (%)	Remarks
Age (years)	Mean ± SD = 43.5 ± 10.2	—	Range: 21–67 years
Gender			
Male	69	54.8	
Female	57	45.2	
Duration of dyspepsia			
3–6 months	47	37.3	
>6 months	79	62.7	
Comorbidities			
Diabetes mellitus	19	15.1	
Hypertension	15	11.9	
Hypothyroidism	10	7.9	

Table 2
Diagnostic Accuracy Comparison (WLI vs NBI vs Biopsy)

Diagnostic Modality	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	p Value
White Light Imaging (WLI)	78.3	75.5	80.8	73.6	77.0	0.02
Narrow Band Imaging (NBI)	93.4	89.2	91.7	90.9	91.0	—
Histopathology (Biopsy)	100	100	—	—	—	—

Table 3
Correlation of NBI Findings with H. pylori Status

NBI Feature	Naïve (uninfected) n = 38	Infected n = 68	Post-eradicated n = 20	Diagnostic Correlation (%)	Interpretation
Regular Arrangement of Collecting Venules (RAC)	36 (94.7%) present	4 (5.9%) present	18 (90%) reappeared	91.2	Indicator of healthy mucosa
Diffuse mucosal redness	2 (5.3%)	61 (89.7%)	3 (15%)	90.1	Sign of active infection
Mucosal edema	1 (2.6%)	54 (79.4%)	2 (10%)	88.5	Resolves post-therapy
Map-like redness	0 (0%)	10 (14.7%)	5 (25%)	83.0	Marker of post-infective healing

Discussion

This study demonstrates that NBI provides a high degree of diagnostic accuracy for detecting H. pylori infection, approaching biopsy standards. The superiority of NBI stems from enhanced visualization of mucosal microvasculature and surface patterns, enabling identification of subtle inflammatory changes undetectable by WLI (1,3,4).

Loss of RAC and mucosal edema are early inflammatory markers, while map-like redness indicates post-inflammatory remodeling (5,6). These features allow differentiation between active, healed, and uninfected mucosa in real time, without histopathologic delay.

Prior studies by Yagi et al. and Kato et al. confirmed strong correlations between NBI findings and histological H. pylori status (7,8). Leung et al. also validated NBI for post-eradication surveillance, detecting early mucosal normalization before symptom relief (9).

Clinically, NBI reduces the need for multiple biopsies, minimizes patient discomfort, and shortens diagnostic time. It also facilitates on-table decision-making and reliable monitoring of mucosal recovery following therapy.

In the present study, NBI achieved sensitivity > 90% and specificity ≈ 89%, consistent with global data (10–12). The post-treatment disappearance of redness and reappearance of RAC support its role in dynamic mucosal evaluation (13).

Future integration of artificial intelligence and image-recognition algorithms could improve diagnostic precision, standardize interpretation, and reduce inter-observer variability (14,15). Overall, NBI represents a powerful adjunct to conventional endoscopy for both diagnosis and follow-up of H. pylori gastritis.

Limitations and Future Directions

This study was conducted at a single tertiary-care center with a modest sample size, which may limit generalizability. The analysis did not include inter-observer variability or cost-effectiveness assessment. Histopathology served as the gold standard, but sampling bias could persist. Larger, multi-center prospective studies incorporating quantitative image-analysis algorithms are warranted to validate these results.

Future work should focus on integrating artificial intelligence for automated recognition of NBI mucosal patterns, enabling rapid, objective, and reproducible diagnosis. Comparative trials with other image-enhanced modalities such as Blue Laser Imaging or Linked Color Imaging could further refine endoscopic strategies for H. pylori detection and monitoring.

Conclusion

Narrow Band Imaging substantially improves the accuracy and efficiency of H. pylori diagnosis. It provides a reproducible, real-time, and non-invasive alternative to routine biopsy, allowing precise assessment of infection and post-treatment healing (11–15). Integrating NBI into routine endoscopic evaluation may enhance diagnostic confidence and optimize patient management.

Declarations

Ethics approval and consent to participate

This prospective observational study was conducted in accordance with the ethical principles of the Declaration of Helsinki and approved by the Institutional Ethics Committee of SRM Medical College Hospital and Research Centre, SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu, India (IEC Approval No.: SRMIEC- ST1124-1745). Written informed consent was obtained from all participants prior to enrollment in the study.

Consent for publication

Not applicable. This manuscript does not contain any individual participant data, photographs, videos, or other identifying information.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available because they contain potentially identifiable patient information but are available from the corresponding author on reasonable request.

Competing interests

ST, SR, and MM declare that they have no competing interests.

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Authors' contributions

ST contributed to study conceptualization, data collection, patient recruitment, statistical analysis, literature review, manuscript drafting, and manuscript revision.

SR contributed to study design, supervision of the research, interpretation of data, critical revision of the manuscript, and final approval of the version to be published.

MM contributed to methodology development, data interpretation, critical review of the manuscript, and final approval of the manuscript.

All authors read and approved the final manuscript.

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References

1. Memon HL, Yaseen RT, Khalid MA, et al. Diagnostic accuracy of narrow-band imaging in predicting Helicobacter pylori gastritis in patients with dyspepsia. Cureus. 2024;16(2):e54756.

2. Özgür T, Bozkurt TB, Ekiz G, et al. Diagnostic value of endoscopic narrow-band imaging in children with Helicobacter pylori gastritis. Turk J Gastroenterol. 2015;26:112–6.

3. Cho JH, Kim YT, et al. Clinical applicability of gastroscopy with narrow-band imaging. World J Gastrointest Oncol. 2020;12(7):456–65.

4. Yagi K, Saka A, Kato T, et al. Clinical usefulness of NBI magnifying endoscopy in diagnosis of H. pylori gastritis. J Gastroenterol Hepatol. 2002;17:39–45.

5. Kato T, Yagi K, Kamata T, et al. Endoscopic diagnosis of H. pylori infection using magnifying NBI. Dig Endosc. 2013;25:508–18.

6. Machado RS, et al. Endoscopic findings predictive of H. pylori infection. Dig Liver Dis. 2008;40:68–72.

7. Leung WK, et al. Endoscopic patterns after H. pylori eradication using NBI. Gastroenterology. 2018;155:67–75.

8. Tahara T, Yamazaki J, Tahara S, et al. Magnifying NBI of gastric mucosal morphology predicts H. pylori-related field defect. Sci Rep. 2017;7:40361.

9. Gamel KAEM, Abdel Razek WM, Allam MH, et al. Role of NBI in diagnosis of H. pylori gastritis. Int J Med Arts. 2024;6(11):5134–41.

10. Horiuchi Y, et al. AI-assisted NBI for H. pylori diagnosis. Endoscopy. 2023;55(1):45–53.

11. Asada M, et al. Visual diagnosis of H. pylori gastritis using NBI. Endosc Int Open. 2020;8:E1192–E1200.

12. Dohi O, et al. Clinical relevance of microvascular patterns on NBI for H. pylori gastritis. Digestion. 2016;94:40–48.

13. Kikuchi D, et al. Comparison between magnifying endoscopy and histopathology for H. pylori assessment. Gastrointest Endosc. 2017;86:698–706.

14. Yanagisawa K, et al. AI-driven NBI detection of H. pylori infection. Gastroenterology. 2022;163:580–592.

15. Tsai Y, et al. Future perspectives of NBI and AI in gastroenterology. World J Gastrointest Endosc. 2023;15(1):25–34.