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Original Article

Comparative Study of Routine Haematoxylin and Eosin, PAS and Giemsa Staining Methods for Demonstration of Helicobacter pylori in Gastric Biopsies – In a Tertiary Care Hospital, Chennai, India

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ABSTRACT

Background: Helicobacter pylori is a common microaerophilic Gram-negative organism implicated in chronic gastritis, peptic ulcer disease, and gastric malignancies. Histopathological examination remains a cornerstone for its detection; however, the sensitivity of routine staining varies, especially in cases with low bacterial density. Special stains such as Giemsa and Periodic Acid–Schiff (PAS) are often employed to improve detection rates.

Aim: To comparatively evaluate the effectiveness of routine Hematoxylin and Eosin (H&E), PAS, and Giemsa staining methods in demonstrating H. pylori in gastric biopsy specimens.

Materials and Methods: This retrospective cross-sectional study was conducted on 50 gastric biopsy specimens from patients diagnosed with chronic gastritis at a tertiary care center in Chennai between March 2025 and February 2026. Formalin-fixed paraffin-embedded tissues were sectioned and stained with H&E, PAS, and Giemsa. Slides were evaluated for the presence of H. pylori and associated histopathological changes. Demographic and clinical data were analyzed descriptively.

Results: The majority of patients were aged 21–40 years (52%), with a slight male predominance (56%). Most cases belonged to a lower socioeconomic group (64%). The antrum was the most common biopsy site (58%). Mild inflammation was observed in 72% of cases, while 28% showed moderate inflammation. H. pylori was detected in 16% of cases using Giemsa stain, compared to 10% with H&E and 2% with PAS. Giemsa stain demonstrated the highest sensitivity among the three methods.

Conclusion: Giemsa stain is a superior and reliable method for the detection of H. pylori in gastric biopsies, particularly in cases with low bacterial density. While H&E remains an essential initial screening tool, the use of special stains, especially Giemsa, significantly enhances diagnostic accuracy. PAS stain showed limited utility in identifying the organism. A combined staining approach is recommended for optimal detection in routine histopathological practice.

Keywords: *Chronic gastritis, Giemsa stain, Helicobacter pylori, Histopathology, PAS, Hematoxylin and Eosin.*

INTRODUCTION

Helicobacter pylori (H. pylori) is a prevalent, spiral-shaped, microaerophilic, Gram-negative bacterium that colonizes the gastric mucosa and plays a crucial role in the development of a range of gastric lesions. It is among the most common

chronic bacterial infections worldwide, impacting over 50% of the global population, with a notably higher prevalence in developing countries such as India [1]. The pathogenicity of H. pylori is linked to its ability to survive in the acidic gastric environment through urease production, adhere to epithelial cells, and elicit a sustained inflammatory response. This chronic inflammation results in a series of histopathological changes that begin with superficial gastritis, progress to chronic active gastritis, and in some cases, advance to atrophic gastritis and intestinal metaplasia. Persistent infection has been strongly associated with the development of peptic ulcer disease, particularly duodenal and gastric ulcers, and is recognized as a significant risk factor for gastric adenocarcinoma and mucosa-associated lymphoid tissue (MALT) lymphoma [2]. The sequence of gastric mucosal damage associated with H. pylori infection, often referred to as the Correa cascade, highlights its critical role in gastric carcinogenesis. The bacterium induces epithelial damage through the release of virulence factors such as CagA and VacA, along with immune-mediated injury from the host, leading to mucosal degeneration, glandular atrophy, and dysplastic changes over time. Thus, early detection and eradication of H. pylori infection are essential to prevent the progression to severe gastric lesions and malignancy [3].

Among the various methods available for detecting H. pylori, histopathological assessment stands out as the most dependable approach. It not only reveals architectural details but also exhibits sensitivity and specificity in identifying H. pylori. However, H&E stains may fail to show the organism when its density is low. In contrast, special stains offer greater sensitivity and specificity, allowing for the detection of bacteria even at low densities due to the contrast they provide [4]. Consequently, this study aims to compare the effectiveness of routine H&E, PAS and Giemsa staining techniques in demonstrating H. pylori in gastric biopsy samples collected from patients at a tertiary care hospital in Chennai. Additionally, the study intends to correlate the presence of H. pylori with various gastric mucosal lesions, highlighting its pathological significance.

MATERIALS AND METHODS

The current research was a single-centre; retrospective, cross-sectional study involving 50 patients suffering from chronic gastritis, carried out in the Department of General Pathology at a Tertiary Care Centre. The study commenced after receiving approval from the Institutional Ethical Committee and adhered to both local and global ethical guidelines. It was conducted over a period of one year, from March 2025 to February 2026, utilizing paraffin-embedded tissue blocks from endoscopic biopsies of the stomach, along with clinical and demographic data sourced from the archives. All upper gastrointestinal endoscopic biopsies from chronic gastritis patients aged 20 to 80 years, regardless of gender, were included in this study. Patients who had received antibiotics or proton pump inhibitors within the last 2-4 weeks, those who had previously undergone gastric surgery, individuals in their first and second decades of life, and those over 80 years old, as well as lesions from other parts of the gastrointestinal tract like the oesophagus and lesions beyond the stomach, were excluded from the study. Paraffin-embedded sections of formalin-fixed tissue specimens were obtained from the archives of the Department of General Pathology. Three slides, each containing sections of 5µm from each block, were prepared using a semi-automatic microtome and stained with Haematoxylin and Eosin, PAS, and Giemsa. Each slide was coded according to the stain used. The slides were histopathologically evaluated by a qualified General Pathologist for the presence or absence of H. pylori, as well as for epithelial changes and inflammation. The details regarding age, gender, lesion site, and H. pylori presence were tabulated, and the values were statistically analysed and presented as percentiles.
The current study was a cross-sectional retrospective study conducted on a total of 50 patients who had undergone endoscopic biopsy of stomach. Out of 50 patients 26 (52%) were 21-40yrs of age, 19 (38%) were 41-69yrs of age and only 5 (10%) were above the age range of 60yrs. (Table 1) (Chart 1)

Table 1 showing age distribution of gastric lesions in the study

	Total no of cases (n=50)	Percentage
21-40	26	52%
31-40	19	38%
41-50	5	10%

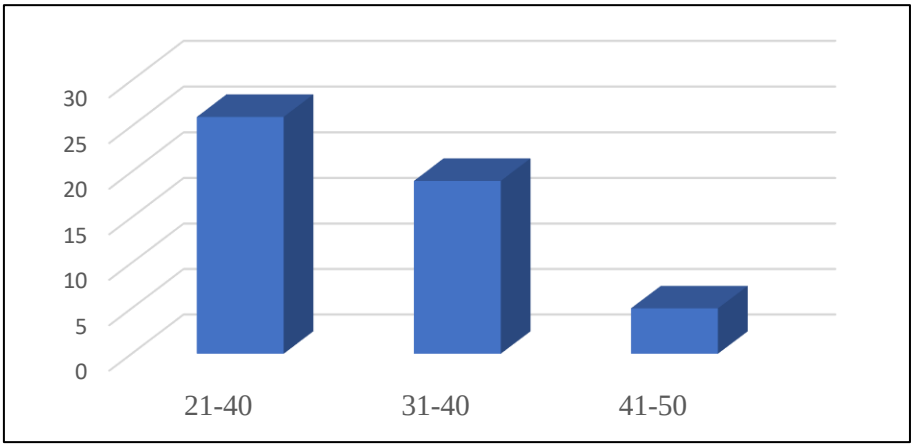


Chart 1 showing distribution of age in the study

The present study was a retrospective cross-sectional study conducted on a total of 50 patients with chronic gastritis who underwent endoscopic incisional biopsies. Out of 50 patients 28 (56%) were males and remaining 22 (44%) were females. (Chart 2)

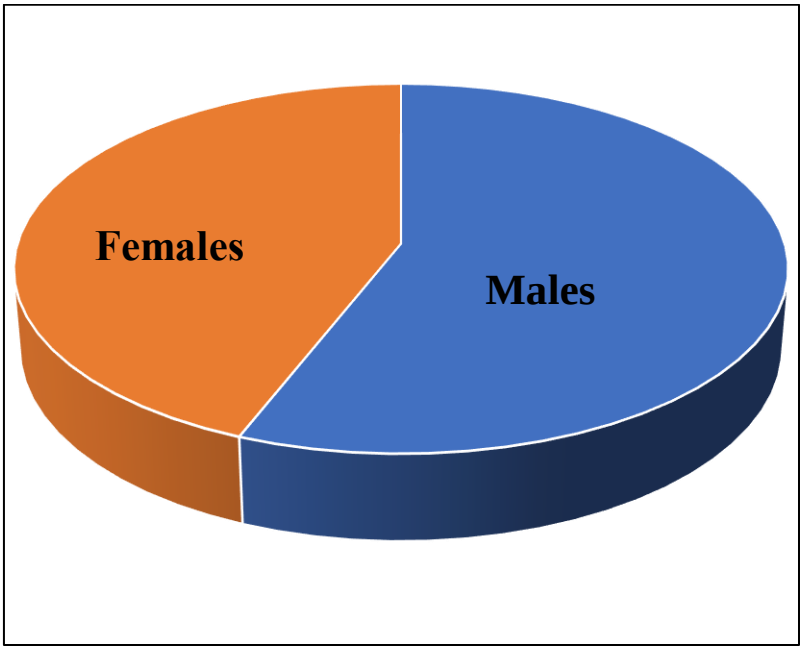


Chart 2 showing gender distribution in the study

Around 32 (64%) of the patients out of 50 were from low socioeconomic background while the remaining 18% (36%) were from middle class income. (Chart 3)

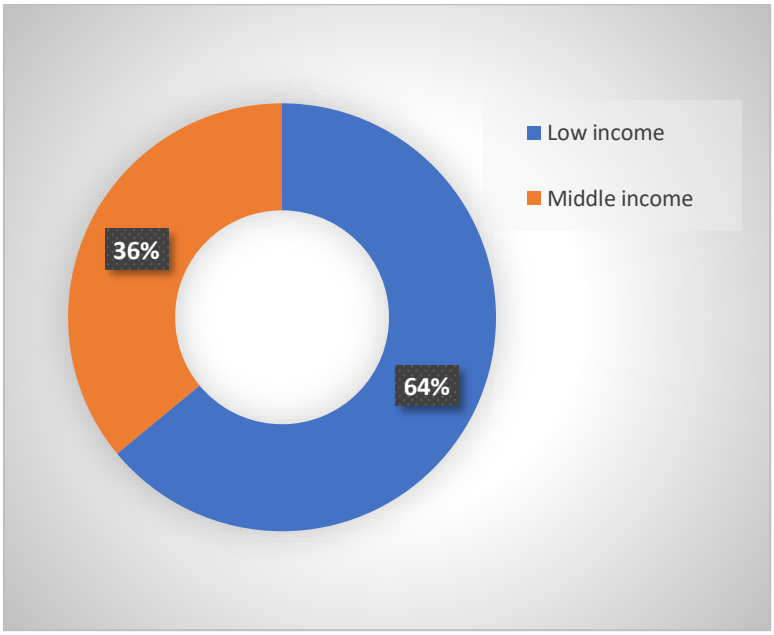


Chart 3 showing distribution of patients based on socio economic status

29 (58%) biopsies obtained were from the antrum followed by fundus in 13(26%) and 8(16%) biopsies were from the body. (Chart 4)

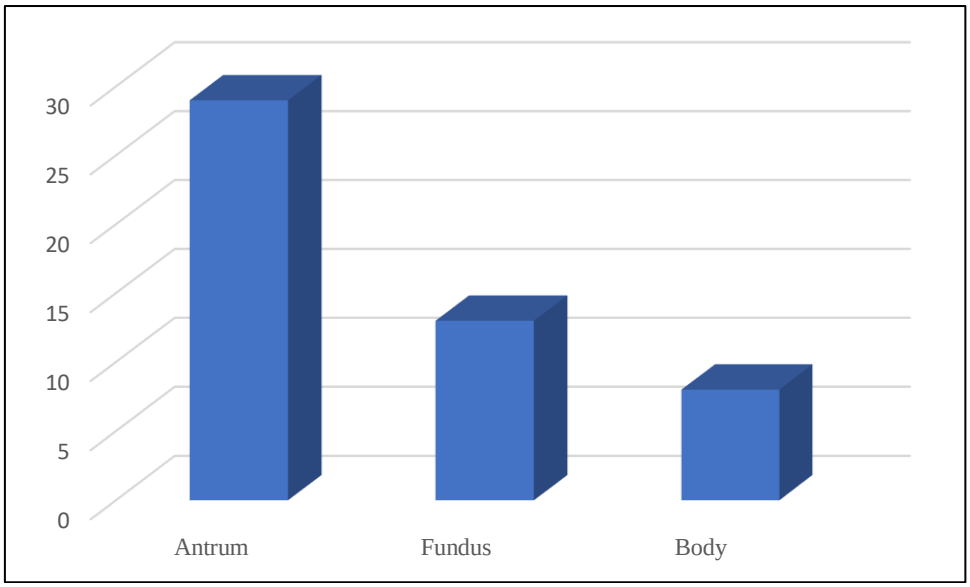


Chart 4 Bar graph showing site of biopsies

Out of 50 cases of biopsies obatiend from patients with chronic gastritis, 36 (72%) cases showed mild inflammation while remaining 14 cases (28%) showed moderate inflammation and there were no cases pof severe inflammation in this study. (Table 2)

Table 2 showing distribution of mild and moderate inflammation in gastric biopsies

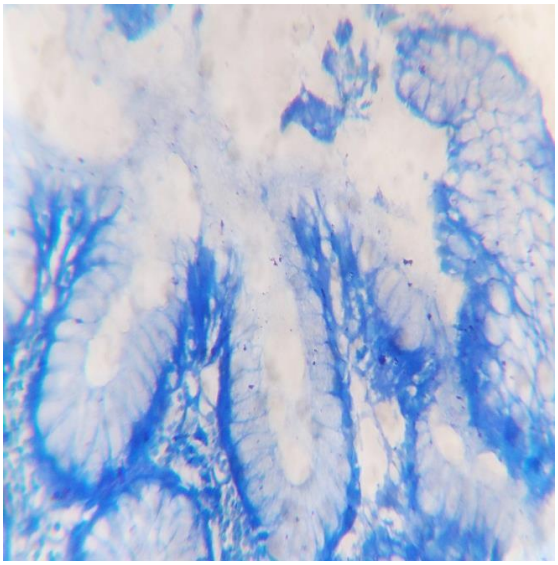
Inflammation	Total no of cases (n=50)	Percentage
Mild	36	72%
Moderate	14	28%

Among epithelial changes noted in the 50 gastric biopsies, metaplasia was noted in 7 cases (14%), 5 cases (10%) showed atrophy and none of the displayed atypia. (Table 3)

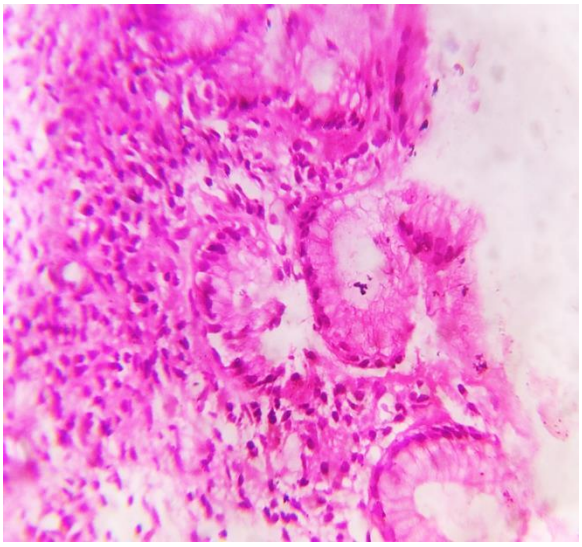
Table 3 showing epithelial changes seen in the gastric biospies

Epithelial changes	Total no of cases (n=50)	Percentage
Atrophy	5	10%
Metaplasia	7	28%
Atypia	0	0%

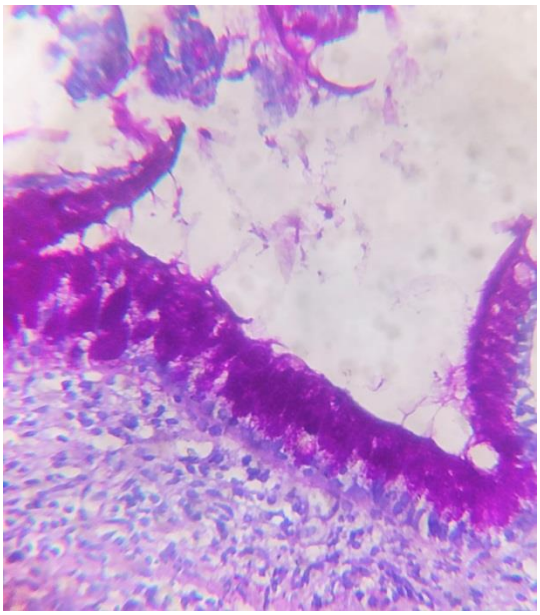
All 50 gastric biospes were stained with 3 stains namely H&E, Giemsa and PAS and it was found that H. pylori was demonstrated in 8 cases (16%) stained with Giemsa [Figure 1] followed by 5 cases (10%) stained with H&E [Figure 2] and only 1 case (2%) with PAS [Figure 3]. (Table 4)



[Figure 1]. H.Pylori noted in the gastric biopsy, Giemsa stain, 40x.



[Figure 2]. H.Pylori noted in the gastric biopsy, H&E stain, 40x.



[Figure 3]. H.Pylori noted in the gastric biopsy, PAS stain, 40x.

Table 4 showing stain demonstrating H. pylori bacteria in gasrtic biopsies

Stain	Total no of cases (n=50)	Percentage
H&E	5	10%
Giemsa	8	16%
PAS	1	2%

DISCUSSION

H. pylori, a member of the Helicobacteraceae family, is not a true colonizer of the gastric mucosa but is considered a contaminant of digested food [5]. This bacterium was first discovered in 1980 by Barry Marshall and Robin Warren, who were awarded the Nobel Prize in 2005 for their work [6]. These bacteria are closely associated with chronic gastritis, peptic ulcer disease, mucosal-associated lymphoid tissue (MALT) lymphoma, and gastric cancer. The World Health Organization has classified H. pylori as a class I carcinogen, which leads to peptic ulcer disease and gastric cancer [7]. H pylori is prevalent worldwide, affecting nearly half of the global population, but its prevalence is dependent on sanitation standards and varies significantly by geographic location, ethnicity, race, age, and socioeconomic status, with higher rates seen in developing countries. In developed countries, the prevalence of H. pylori infection is about 20-25%, while in developing nations, it can be as high as 80-90%. The main transmission routes are faeco-oral and oral-oral [8].

The bacteria's pathogenesis is mediated by the urease enzyme that converts urea into ammonia and carbon dioxide. The resulting ammonia modifies the stomach's acidity to an alkaline level, which is conducive to bacterial growth and survival. Furthermore, these bacteria generate cytotoxin-associated gene A (Cag A) and vacuolating cytotoxin A (Vac A), which

disrupt the mucosal integrity, leading to inflammation and ulceration. A complex interaction among bacterial virulence factors, host genetic predispositions, and environmental conditions is believed to be involved in the pathogenesis [9].

As H. pylori is mostly associated with various pathologies of stomach including gastric carcinoma thus detection of this bacterium may aid in early detection. The accurate detection of H. pylori is essential for appropriate clinical management and represents a significant diagnostic challenge in contemporary gastroenterology practice. Gastroscopy is used for detecting H. pylori but in instances where gastroscopy is not possible the serological testing offers a convenient method for detecting H. pylori infection by identifying circulating antibodies. The disadvantage of serological investigation is its lacks to differentiate between active and previous and harmless colonization of H. pylori. PCR is the vital investigation to detect point mutations linked to antibiotic resistance in H. pylori and it also detects virulence factors like CagA and VacA [10].

Bacteriological investigations serve as excellent confirmatory tests for diagnosing H. pylori; however, they are challenging to culture due to the need for specialized enrichment media, complex incubation techniques, and thorough microbial characterization, which can be time-consuming. Consequently, a simpler and more cost-effective alternative for diagnosing H. pylori is the processing of antral biopsy specimens for histological examination [11]. Various histochemical stains are currently utilized to facilitate the identification of H. pylori, with H&E being the most prevalent stain. While numerous special stains are available, it is essential to compare their sensitivity, specificity, positive predictive value, and negative predictive value across different staining techniques. H&E is the most frequently employed stain, demonstrating excellent sensitivity and specificity for H. pylori detection. The benefits of this stain include its low cost, ease of use, reduced processing time, and high reproducibility of results, which also aids in morphological assessment [12]. Therefore, this study investigates the effectiveness of Giemsa and PAS stains in conjunction with H&E for identifying H. pylori.

Although these novel staining techniques are widely utilized, there is a scarcity of studies that compare their diagnostic effectiveness in detecting H. pylori, indicating a need for further investigation. In the present study, out of 50 patients diagnosed with gastritis, the majority were within the age bracket of 21-40 years, accounting for over 50% of the population. This observation aligns with the results of Sipponen et al. (1997), who indicated that the risk and rate of acquisition are highest among younger individuals [13]. Furthermore, the current study predominantly included female participants, which is consistent with the findings reported by Kaivalya Bhaskar et al. (2025) [14].

However, the results differed from those of Nasar Alwahaibi, who observed a slight male predominance [4]. The majority of participants came from lower socioeconomic backgrounds, aligning with the findings of Natalie L Adams et al. in 2018. Socioeconomic status plays a crucial role in determining health, affecting the incidence, severity, and outcomes of gastric conditions such as gastritis, peptic ulcer disease, and gastric cancers. A lower economic status correlates with a higher prevalence of H. pylori, a significant causal factor for chronic gastritis [15].

The participants in the current study exhibited gastric lesions primarily located in the antral region of the stomach. This observation aligns with the findings of Pentti Sipponen et al. in 2015. Gastric lesions, especially chronic gastritis and peptic ulcer disease, often affect the antral region due to its unique anatomical and physiological features, which include a higher susceptibility to H. pylori colonization and its function in regulating gastric acid secretion [13]. Gastric atrophic lesions are classified histopathologically based on the cellular morphology and histological features of the lesion. Early stages of atrophic gastritis are frequently observed in the natural physiological degeneration of the gastric mucosa in older individuals. At this stage, it is more manageable, making it essential to identify the underlying cause, address it promptly, reduce inflammatory stimuli, and maintain the balance of gastric acid secretion along with the mucus-bicarbonate barrier. In contrast, severe atrophy of the gastric mucosa is often linked to chemical stimulation, autoimmune diseases, genetic factors, and other influences. Gastric atrophies may be associated with papillary proliferation of the epithelium as a compensatory response, metaplastic atrophy as a defensive reactive hyperplasia, hyperplastic atrophy of smooth muscles, and stem cell atrophy. The latter change indicates the chronic nature of atrophic gastric lesions, which is irreversible and carries a significant risk of cancer. Recognizing the stage of gastric atrophy is crucial for early detection and timely management. It also plays a vital role in preventing or halting the onset of malignant transformation [16].

In the current study, the majority of the gastric lesion biopsies evaluated showed mild inflammation, with no instances of severe inflammation. Prior epidemiological and pathological research indicates that the extent, intensity, and distribution patterns of gastric inflammation, in conjunction with gastric atrophy, are consistently associated with the occurrence of gastric cancer [17].

Chronic gastritis is an evolving inflammatory disorder of the gastric mucosa, marked by a range of histopathological alterations, from mild inflammatory infiltrates to significant mucosal injury accompanied by atrophy and intestinal metaplasia. The classification of inflammatory intensity into mild, moderate, and severe is a crucial aspect of histological evaluation and offers important prognostic insights regarding the progression of the disease. As per the Updated Sydney System, the extent of chronic inflammatory cells indicates the level of the mucosal immune response. A mild inflammatory infiltrate is limited and primarily located in the superficial lamina propria, with the mucosal architecture remaining intact; thus, the progression and structural damage are relatively minimal. In contrast, a moderate inflammatory infiltrate presents

a denser accumulation that penetrates deeper into the mucosa, leading to the destruction of glandular structures, indicating a transitional phase. Severe inflammatory infiltrate consists of widespread infiltration that affects the entire thickness of the mucosa, associated with glandular atrophy, epithelial injury, and intestinal metaplasia [18].

Research has shown that increased inflammation speeds up the Correa cascade, which is a process that advances from chronic gastritis to atrophy, intestinal metaplasia, and ultimately carcinoma. Therefore, the early identification of moderate to severe inflammation can facilitate timely diagnosis and treatment interventions [19]. In cases of H. pylori infection, both gastric mucosal atrophy and inflammatory activity are likely to rise, indicating ongoing mucosal damage. The presence of H. pylori infection interferes with the growth of stem cells and results in significant segmental atrophy of the glands located in the lamina propria of the gastric mucosa [20, 21].

Histopathological examination of gastric biopsy specimens remains one of the most reliable and widely used methods for detecting H. pylori and assessing associated mucosal changes. Routine Haematoxylin and Eosin staining (H&E) is commonly employed for evaluating tissue architecture and inflammatory patterns; however, its sensitivity for detecting the organism may be limited, especially in cases with low bacterial load or patchy distribution [22].

To enhance detection rates, specialized staining methods like Periodic Acid–Schiff stain (PAS) and Giemsa stain are commonly employed. PAS emphasizes mucopolysaccharides and can assist in visualizing organisms attached to the gastric epithelium, whereas Giemsa stain specifically targets the bacteria and is generally considered more sensitive, offering improved contrast for identifying the distinctive curved bacilli of H. pylori. Giemsa is a dependable technique for detecting H. pylori due to its affordability, ease of staining, and ability to highlight the bacteria against the background [23].

Giemsa staining revealed the presence of H. pylori in most histological sections of gastric biopsies in this study, followed by haematoxylin and eosin (H&E), while periodic acid–Schiff (PAS) stain showed the lowest detection rate. Despite having these staining techniques available, there is still variability in their diagnostic effectiveness in routine practice, especially in resource-limited environments. Therefore, it is crucial to choose an optimal, cost-effective, and dependable staining method for accurate diagnosis and effective patient management. Given the significant role of H. pylori bacteria in gastric lesions, direct identification of these organisms in histological sections is vital. Accurate detection of H. pylori in gastric biopsies is important due to its well-documented involvement in the development of chronic gastritis, peptic ulcer disease, and gastric carcinoma. The routine use of Haematoxylin and Eosin stain (H&E) acts as the primary screening method; however, it has limited sensitivity, particularly when the bacterial density is low or when the organisms are hidden by mucus or inflammatory exudate. Consequently, special stains improve the visualization of the organism even in cases where the bacterial load is minimal, such as in treated or partially treated patients. Therefore, special stains not only confirm infection with a high level of diagnostic accuracy.

CONCLUSION

Helicobacter pylori detection in gastric biopsies is essential for accurate diagnosis of chronic gastritis. While Haematoxylin and Eosin (H&E) remains a useful initial screening method, it has limited sensitivity in low bacterial density. Giemsa stain demonstrated superior sensitivity and reliability, whereas PAS showed minimal diagnostic utility. The findings of our study suggest that Giemsa is recommended as an adjunct to H&E to improve diagnostic accuracy and ensure appropriate patient management.

Conflict of Interest: Nil

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