Airo International Journal
Peer-Reviewed
Multidisciplinary

ISSN: 2320-3714
Volume: 4 Issue: 1
October 2025
Impact Factor: 10.1
Subject: Histopathology

# AN INVESTIGATION INTO ENDOSCOPIC GASTRIC BIOPSIES TO EVALUATE THE EFFECTIVENESS OF HEMATOXYLIN AND EOSIN STAINING IN THE HISTOPATHOLOGICAL EVALUATION OF UPPER GASTROINTESTINAL LESIONS

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## ABSTRACT

This study investigated the effectiveness of Hematoxylin and Eosin (H&E) staining in the histopathological evaluation of upper gastrointestinal lesions obtained through endoscopic gastric biopsies. A total of 100 biopsy specimens were analyzed to assess staining quality, diagnostic clarity, and clinical relevance. The results revealed that chronic gastritis was the most common diagnosis (40%), followed by gastric ulcers (20%), precancerous lesions (15%), and gastric carcinoma (18%). H&E staining provided excellent nuclear and cytoplasmic differentiation in 70% of cases, with adequate staining quality in another 20%, ensuring reliable morphological assessment. Definitive diagnoses facilitating clear clinical management were achieved in 85% of specimens, while 10% required additional special stains or molecular testing, and 5% remained inconclusive due to technical limitations. These findings underscore the pivotal role of H&E staining as a cost-effective, reliable, and essential diagnostic tool in gastrointestinal pathology, while highlighting the need for standardized staining protocols to enhance diagnostic accuracy.

**Keywords:** Hematoxylin and Eosin staining, Upper gastrointestinal lesions, Endoscopic gastric biopsy, Histopathological evaluation, Gastric pathology

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## 1. INTRODUCTION

A wide range of stomach illnesses, such as gastritis, gastric ulcers, and cancers, depend on the precise histological assessment of upper gastrointestinal (GI) lesions for diagnosis, treatment, and prognosis. An essential diagnostic procedure, endoscopic stomach biopsies provide tissue samples for microscopic analysis and conclusive pathological evaluation. Hematoxylin and Eosin (H&E) staining is still the most popular and fundamental staining technique in histopathology because of its ease of use, affordability, and diagnostic potential.

The gold standard for routine tissue evaluation was established in the late 19th century with the introduction of hematoxylin and eosin staining. Cell nuclei are stained a distinctive purplish-blue by the basic dye hematoxylin, which binds specifically to nucleic acids and highlights chromatin patterns and nuclear morphology. Differentiating cellular components and tissue architecture is made possible by the acidic dye eosin, which gives the cytoplasm and extracellular matrix contrasting pink hues. Because of this contrast, pathologists can detect minute morphological changes in tissue samples, which is essential for spotting abnormal changes.

Even with its extensive use, H&E staining's effectiveness in assessing upper gastrointestinal samples needs to be continuously evaluated to guarantee the best possible diagnostic precision. Staining procedure uniformity, tissue preservation, and interpretation issues, such as over- or under-staining of nuclear or cytoplasmic components, can all have an impact on the histological slide's clarity and diagnostic output. For a thorough pathological evaluation, particularly in the intricate milieu of the stomach mucosa, precise differentiation of various cell types, including parietal cells, chief cells, lymphoid cells, and mucin content, is crucial.

Investigating the efficacy of Hematoxylin and Eosin staining in the histological assessment of upper gastrointestinal lesions acquired through endoscopic gastric biopsies is the goal of this study. Through a methodical examination of staining quality, nuclear and cytoplasmic distinction, and diagnostic clarity, this study aims to highlight the significance of H&E staining as a vital tool in gastrointestinal pathology. To improve clinical decision-making in pathology and gastroenterology, the study also aims to investigate the difficulties encountered during typical staining and interpretation procedures and suggest standardizing approaches.

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This study improves patient outcomes by advancing histological techniques that facilitate prompt and precise diagnosis of stomach disorders. It is essential to comprehend the subtleties and possible drawbacks of H&E staining in upper gastrointestinal lesions because it is still the first step in pathology before taking into account more sophisticated or supplementary staining and diagnostic techniques.

## 2. LITERATURE REVIEW

**Parikh et al. (2024)** used endoscopic biopsies to perform a thorough investigation into the histological range of lesions in the upper gastrointestinal tract. Their study brought to light the variety of pathological states, from inflammatory to neoplastic diseases, found in stomach tissue samples. They underlined how important histological analysis is to correctly identifying these lesions and directing therapeutic treatment. Their results reaffirmed the value of regular biopsies and careful tissue staining methods in enhancing diagnostic results.

**Krishnappa et al. (2013)** conducted a thorough examination of endoscopic samples of the upper gastrointestinal tract in order to describe the histological patterns seen in a wide range of patients. Numerous stomach and esophageal lesions, such as cancers, ulcers, and chronic gastritis, were reported in their investigation. They emphasized how important histology is for differentiating between benign and malignant illnesses as well as for spotting early lesions that need to be treated right away.

**Anim et al. (2000)** examined several staining techniques for endoscopic stomach samples in order to identify Helicobacter pylori. Their evaluation contrasted traditional stains with specialized staining methods, emphasizing the benefits and drawbacks of each approach with regard to sensitivity and specificity. According to their research, specialist stains were frequently required for the accurate detection of H. pylori, a significant contributor to the pathophysiology of numerous gastric disorders, even though hematoxylin and eosin staining was helpful for general histological examination.

**Venkatesh and Thaj (2019)** conducted a retrospective investigation in a tertiary care facility to examine the histological spectrum of gastrointestinal lesions from endoscopic biopsies. According to their research, inflammatory lesions were significantly more common than premalignant and malignant diseases. In order to increase diagnostic precision and better

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patient care, they also talked about the diagnostic difficulties related to biopsy interpretation and emphasized the use of standardized staining procedures, such as Hematoxylin and Eosin.

## 3. RESEARCH METHODOLOGY

### 3.1. Study Design

In order to assess the efficacy of Hematoxylin and Eosin (H&E) staining in the histopathological analysis of upper gastrointestinal lesions acquired using endoscopic gastric biopsies, this study was planned as a descriptive observational study.

### 3.2. Sample Size and Sampling

Patients undergoing upper gastrointestinal endoscopies at a tertiary care institution had 100 gastric biopsy specimens collected sequentially. Specimens were chosen based on the presence of clinically suspected stomach lesions that required histological examination. The sampling was done intentionally to include inflammatory, precancerous, and malignant lesions, as well as a representative variety of stomach disorders.

### 3.3. Specimen Collection

Standard flexible endoscopy techniques were used by skilled gastroenterologists to perform endoscopic stomach biopsies. Several biopsy samples were taken from aberrant mucosal regions or suspected lesions to guarantee sufficient tissue representation for histological examination

### 3.4. Tissue Processing and Staining

The biopsy samples were treated using conventional paraffin-embedding methods after being promptly fixed in 10% neutral buffered formalin. For staining, sections with a thickness of three to five micrometers were produced. In accordance with established laboratory procedures, hematoxylin and eosin (H&E) staining was carried out. Eosin was used for cytoplasmic and extracellular matrix staining, and hematoxylin was applied for nuclear staining. To maximize nuclear and cytoplasmic distinction, particular care was taken to maintain uniformity in staining durations, pH values, and reagent quality.

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### 3.5. Histopathological Evaluation

Pathologists with experience carefully inspected the stained slides under a light microscope. Histopathological diagnoses were established using specific morphological criteria, such as the assessment of nuclear and cytoplasmic properties, cellular and tissue architecture, and the detection of pathology alterations like inflammation, dysplasia, or cancer. Three separate grades were applied to the Hematoxylin and Eosin (H&E) staining quality: excellent nuclear and cytoplasmic differentiation, adequate differentiation with slight understaining or overstaining, and poor differentiation due to technical irregularities. For precise histopathological interpretation, this grade assisted in assessing the staining's dependability and clarity.

### 3.6.Data Recording and Analysis

The histological diagnosis of each biopsy specimen was meticulously recorded, encompassing classifications such as chronic gastritis, gastric ulcer, precancerous lesions, stomach carcinoma, or normal/non-specific findings. Along with the clinical implications of the diagnosis—which were categorized as clear diagnosis, the necessity for additional testing, or inconclusive results—the staining quality and cellular differentiation were also noted. To provide a summary of the different diagnostic categories, staining quality, and clinical relevance, the gathered data were methodically tallied and examined using frequency and percentage distributions. Hematoxylin and Eosin staining's diagnostic effectiveness was then assessed, and possible areas for procedural improvement were identified, by interpreting these data.

## 4. RESULTS AND DISCUSSION

The significant frequency of inflammatory gastric diseases in the population under study is demonstrated by the fact that 40% of the gastric biopsy specimens stained with H&E were identified as chronic gastritis.

**Table 1:** Distribution of Histopathological Diagnosis Based on H&E Staining

| Diagnosis Category | Frequency (F) | Percentage (%) |
|---|---|---|
| Chronic Gastritis | 40 | 40.0 |
| Gastric Ulcer | 20 | 20.0 |

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|---|---|---|
| Precancerous Lesions (e.g., Dysplasia) | 15 | 15.0 |
| Gastric Carcinoma | 18 | 18.0 |
| Normal/Non-specific Findings | 7 | 7.0 |
| **Total** | **100** | **100.0** |

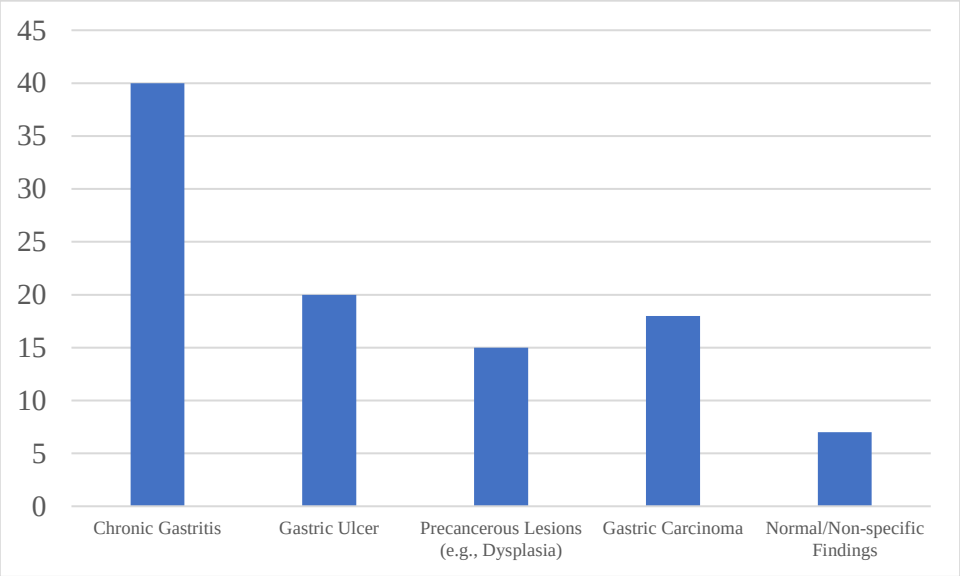


**Figure 1:** Graphical Representation on the percentage of Diagnosis Category

20% of the cases were gastric ulcers, and 15% were precancerous lesions. This highlights the significance of histological evaluation in the early identification of possible malignant change. In 18% of instances, gastric cancer was found, highlighting how important H&E staining is for confirming malignancy. Only 7% of biopsies had normal or non-specific histology, which could indicate early or non-pathological conditions.

**Table 2:** Distribution of Staining Quality and Cellular Differentiation by H&E

| **Staining Quality Parameter** | **Frequency (F)** | **Percentage (%)** |
|---|---|---|
| Excellent nuclear and cytoplasmic differentiation | 70 | 70.0 |
| Adequate differentiation with minor overstaining | 20 | 20.0 |

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| Poor differentiation due to overstaining or understaining | 10 | 10.0 |
| **Total** | **100** | **100.0** |

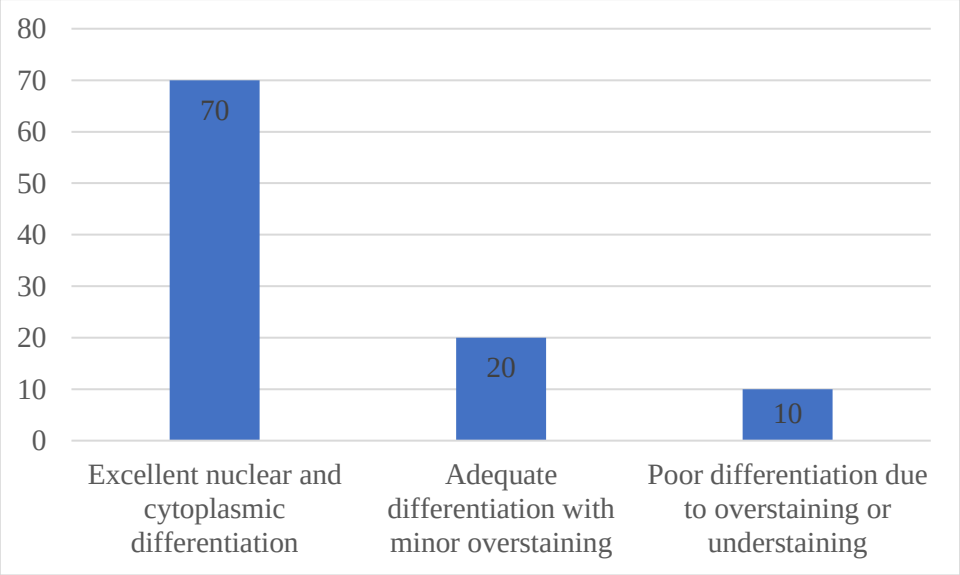


**Figure 2:** Graphical Representation on the percentage of Staining Quality Parameter

H&E staining produced good nuclear and cytoplasmic distinction in 70% of cases, making it easier to identify the tissue architecture and cellular morphology required for a precise diagnosis. 20% of specimens, however, had mild overstaining, which made it a little harder to see well but still permitted accurate interpretation. The necessity of rigorous protocol adherence and standardization to prevent diagnostic errors is highlighted by the 10% of cases where poor staining quality affected distinction.

**Table 3:** Distribution of Clinical Implication of H&E Staining Results

| Clinical Implication | Frequency (F) | Percentage (%) |
|---|---|---|
| Clear diagnosis leading to definitive clinical management | 85 | 85.0 |

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| Diagnosis requiring supplementary special stains or tests | 10 | 10.0 |
| Inconclusive diagnosis due to staining or sampling issues | 5 | 5.0 |
| **Total** | **100** | **100.0** |

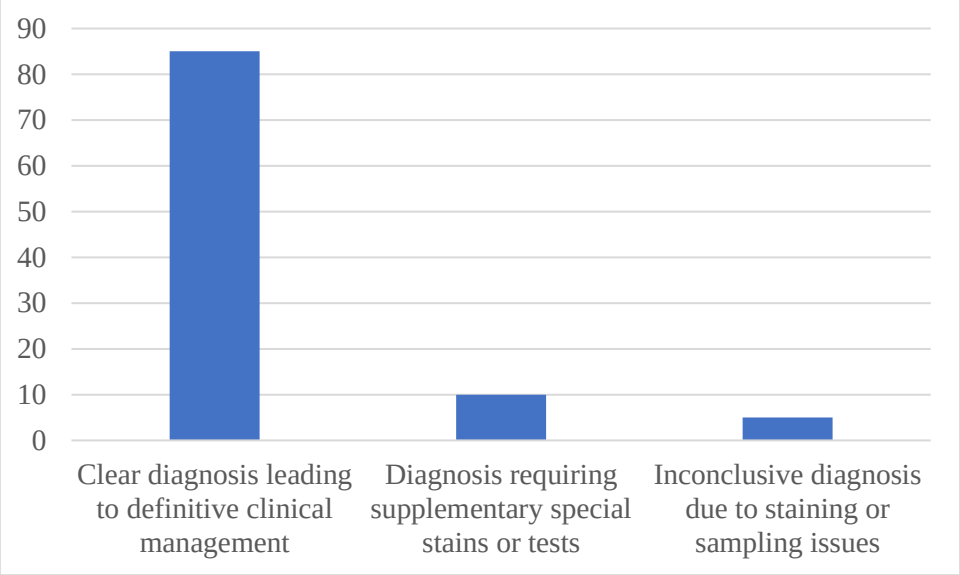


**Figure 3:** Graphical Representation on the percentage of Clinical Implication

In 85% of cases, the histological investigation with H&E staining produced a clear and conclusive diagnosis, which directly aided in making the right clinical decisions and managing the patient. Ten percent of samples had preliminary H&E results that suggested additional special staining or molecular testing was necessary to confirm or improve the diagnosis, especially in cases that were worrisome or borderline. Due to technical or sample restrictions, only 5% of cases were found to be inconclusive, highlighting the significance of staining consistency and the use of the best biopsy procedures.

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## 5. CONCLUSION

According to the study, hematoxylin and eosin staining is still a crucial technique for the histological assessment of upper gastrointestinal diseases, and it can be used to help diagnose inflammatory, precancerous, and malignant gastric disorders. The significance of routine biopsy and careful histological evaluation in clinical practice is underscored by the high prevalence of chronic gastritis and other gastrointestinal diseases found. A small percentage of instances needed additional testing or were inconclusive, highlighting opportunities for technical improvement, even though the majority of cases had outstanding staining quality that allowed for definite diagnoses. The diagnostic yield of H&E staining can be further increased by ensuring uniform staining protocols and ideal tissue handling. All things considered, this study reaffirms how important H&E staining is for directing clinical judgment and enhancing patient outcomes in gastroenterology.

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