RESEARCH PAPER

Role of Gastric Biopsy in the Early Detection and Classification of Gastric Malignancies

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ABSTRACT

Gastric cancer is a major global health concern and remains one of the leading causes of cancer-related mortality worldwide. The prognosis of gastric malignancies is poor primarily due to late diagnosis. Early detection plays a crucial role in improving survival rates. Gastric biopsy, combined with histopathological examination and immunohistochemistry, serves as the gold standard for diagnosis. This study aimed to evaluate the role of gastric biopsy in the early detection and classification of gastric malignancies. A cross-sectional observational study was conducted on 100 gastric biopsy specimens over a period of six months. Routine Hematoxylin and Eosin staining was performed, and immunohistochemistry was applied in selected cases. The mean age of patients was 57 years, with most cases occurring in the 60–80 years age group. Intestinal-type adenocarcinoma was the most common malignancy observed, followed by high-grade dysplasia. Immunohistochemistry significantly improved diagnostic accuracy in challenging cases. Gastric biopsy remains the most reliable method for early detection and classification of gastric malignancies. Integration of histopathology with immunohistochemistry enhances diagnostic precision and contributes to improved patient management and prognosis.

Keywords: Gastric biopsy, Gastric cancer, Histopathology, Immunohistochemistry, Adenocarcinoma.

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INTRODUCTION

Gastric cancer remains one of the most significant global health challenges, ranking as the fifth most common malignancy and the fourth leading cause of cancer-related mortality worldwide. Despite advancements in diagnostic modalities, endoscopic techniques, and targeted therapies, the overall prognosis of gastric carcinoma remains poor, primarily due to delayed diagnosis and the asymptomatic nature of early-stage disease. The burden of gastric cancer is particularly high in East Asia; however, it also represents a considerable health concern in developing countries, including India, where regional and dietary variations influence disease prevalence.

The stomach is a vital organ of the gastrointestinal tract, anatomically situated between the esophagus and the small intestine. It plays a central role in digestion through mechanical and chemical processes. Histologically, the stomach wall is composed of four distinct layers: mucosa, submucosa, muscularis propria, and serosa. The mucosa, which contains specialized epithelial and glandular cells, is the primary site of origin for most gastric malignancies, particularly adenocarcinoma.

Gastric carcinogenesis is a multistep and multifactorial process involving environmental, microbial, and genetic factors. Among these, chronic infection with *Helicobacter pylori* is recognized as the most important etiological agent. This bacterium induces chronic inflammation of the gastric mucosa, initiating a well-established sequence of pathological changes known as the Correa cascade. This progression includes chronic gastritis, atrophic gastritis, intestinal metaplasia, dysplasia, and ultimately invasive carcinoma. Additional risk factors such as smoking, alcohol consumption, high intake of salted and preserved foods, and genetic predisposition further contribute to disease development.

From a histopathological perspective, gastric carcinoma exhibits considerable heterogeneity. The widely accepted Lauren classification categorizes gastric adenocarcinoma into intestinal and diffuse types, each with distinct morphological, epidemiological, and clinical characteristics. The intestinal type is commonly associated with environmental factors and follows the Correa cascade, whereas the diffuse type is often linked to genetic alterations and is characterized by a more aggressive clinical course. The World Health Organization (WHO) classification further refines gastric tumor categorization based on histological and molecular features, aiding in accurate diagnosis and therapeutic planning.

One of the major challenges in managing gastric cancer is the lack of specific symptoms in early stages. Patients often present with nonspecific complaints such as epigastric discomfort, nausea, or mild dyspepsia, which are frequently overlooked or misdiagnosed. As the disease progresses, more alarming symptoms such as weight loss, persistent vomiting, anemia, and gastrointestinal bleeding may appear. Unfortunately, by this stage, the disease is often advanced, limiting treatment options and reducing survival rates.

In this context, early detection becomes critically important. Endoscopic evaluation combined with gastric biopsy remains the gold standard for diagnosing gastric malignancies. Gastric biopsy allows direct visualization and sampling of suspicious lesions, enabling detailed histopathological examination. Routine Hematoxylin and Eosin staining provides essential information regarding tissue architecture, cellular morphology, and tumor differentiation. However, in certain cases, particularly poorly differentiated tumors, histopathology alone may not be sufficient for definitive diagnosis.

Immunohistochemistry has emerged as a valuable adjunct diagnostic tool, enhancing the accuracy of tumor classification and aiding in the identification of tumor origin and subtype. Markers such as cytokeratins (CK7, CK20), CDX2, HER2, chromogranin, synaptophysin, and CD45 are routinely used to differentiate between adenocarcinomas, lymphomas, and neuroendocrine tumors. Furthermore, immunohistochemistry plays a crucial role in guiding targeted therapies, especially in HER2-positive gastric cancers.

The role of the medical laboratory technologist is fundamental in ensuring the reliability and accuracy of histopathological diagnosis. Proper specimen handling, fixation, processing, and staining are critical steps that directly impact diagnostic outcomes. Errors in pre-analytical or analytical phases can lead to misinterpretation and affect patient management.

Given the rising incidence of gastric malignancies and the importance of early detection, this study focuses on evaluating the role of gastric biopsy in the early diagnosis and classification of gastric cancers. By correlating histopathological findings with clinical and endoscopic features, and incorporating immunohistochemical techniques, the study aims to highlight the significance of biopsy as an indispensable tool in modern diagnostic pathology. Early and accurate diagnosis not only improves treatment outcomes but also significantly enhances patient survival and quality of life.

AIM AND OBJECTIVES

The aim of this study was to evaluate the effectiveness of gastric biopsy in the early detection and classification of gastric malignancies. The objectives included identifying the types of gastric malignancies in biopsy specimens, assessing the diagnostic accuracy of gastric biopsy, classifying tumors using histopathology and immunohistochemistry, and correlating histological findings with clinical and endoscopic features.

MATERIALS AND METHODS

Study Design and Setting

This study was conducted as a cross-sectional observational study over a period of six months, from July 2025 to December 2025, in the Department of Pathology at Balvir Singh Tomar Institute of Medical Science and Research. The primary objective was to evaluate the role of gastric biopsy in the early detection and classification of gastric malignancies.

Study Population and Sampling

A total of 100 gastric biopsy specimens were included in the study. Patients presenting with clinical features suggestive of gastric pathology—such as epigastric pain, unexplained weight loss, vomiting, anemia, or gastrointestinal bleeding—were selected. Inclusion criteria comprised patients aged 18 years and above with suspected gastric malignancy who underwent upper gastrointestinal endoscopy and provided adequate biopsy samples. Patients with previously diagnosed or treated gastric carcinoma, as well as those with inadequate or poorly preserved specimens, were excluded. A purposive sampling technique was

employed to select cases that were clinically and endoscopically suggestive of malignancy.

Specimen Collection and Fixation

Gastric biopsy specimens were obtained during upper gastrointestinal endoscopy by trained gastroenterologists. Multiple biopsy samples were taken from suspicious lesions as well as adjacent mucosa to improve diagnostic yield. Immediately after collection, specimens were fixed in 10% neutral buffered formalin to prevent autolysis and preserve tissue morphology. Adequate fixation was ensured by maintaining an appropriate tissue-to-fixative ratio and fixation time.

Histopathological Processing

Fixed tissue specimens were processed using standard histopathological procedures. The samples underwent dehydration through graded alcohol concentrations, followed by clearing in xylene and embedding in paraffin wax. Paraffin-embedded tissue blocks were sectioned into 3–4 µm thick sections using a microtome. The sections were mounted on clean glass slides for staining. Routine Hematoxylin and Eosin (H&E) staining was performed for all cases. Hematoxylin stained cell nuclei blue-black, while eosin-stained cytoplasm and extracellular components in shades of pink, facilitating detailed morphological evaluation.

Special Staining Techniques

- Periodic Acid–Schiff (PAS) stain was used for detection of mucopolysaccharides and signet-ring cells
- Alcian blue stain was used to identify acidic mucins and intestinal metaplasia
- Modified Giemsa stain was used for detection of *Helicobacter pylori* organisms

These stains aided in identifying precancerous lesions and infectious etiologies.

Immunohistochemistry (IHC)

Immunohistochemistry was performed in cases where routine histopathological examination was inconclusive or required further tumor characterization. Paraffin-embedded sections (3–4 µm thick) were mounted on poly-L-lysine-coated slides. Sections were deparaffinized in xylene and rehydrated through graded alcohols. Endogenous peroxidase activity was blocked using hydrogen peroxide. Antigen retrieval was carried out using citrate buffer (pH 6.0) in a microwave oven. Slides were then incubated with primary antibodies, followed by secondary antibodies conjugated with horseradish peroxidase. Diaminobenzidine (DAB) was used as the chromogen to visualize antigen-antibody reactions, producing a brown precipitate. Sections were counterstained with hematoxylin, dehydrated, cleared, and mounted.

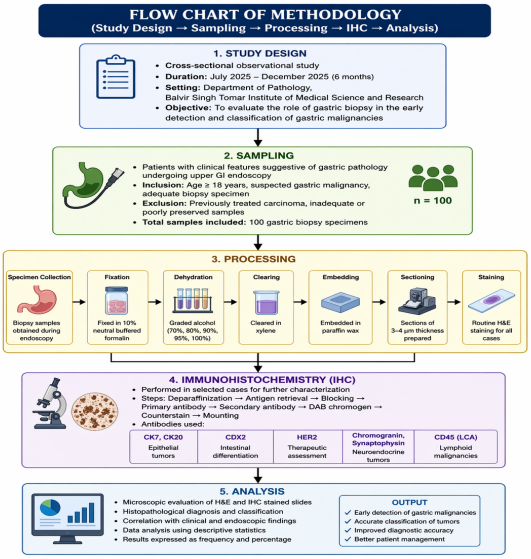
The panel of antibodies used included:

- CK7 and CK20 for epithelial tumors
- CDX2 for intestinal differentiation
- HER2 for therapeutic assessment
- Chromogranin and Synaptophysin for neuroendocrine tumors
- CD45 (LCA) for lymphoid malignancies

Histopathological Evaluation and Classification

All stained slides were examined under a light microscope by experienced pathologists. Diagnosis was based on cellular morphology, architectural patterns, and staining characteristics.

Tumors were classified according to established criteria, including the World Health Organization (WHO) classification of tumors of the digestive system. Lesions were categorized based on histological subtype and degree of differentiation.



RESULTS

The study included 100 patients with an age range of 35 to 78 years, with a mean age of 57 years. The highest number of cases was observed in the age group of 60–80 years.

Gender distribution showed a nearly equal incidence, with 49% males and 51% females.

Histopathological analysis revealed that intestinal-type adenocarcinoma was the most common diagnosis, accounting for 24% of cases. High-grade dysplasia was

observed in 17% of cases, followed by differentiated carcinoma and gastric lymphoma, each accounting for 14%. Diffuse-type adenocarcinoma was seen in 12% of cases, neuroendocrine tumors in 10%, and chronic atrophic gastritis with intestinal metaplasia in 9%.

Immunohistochemistry played a significant role in differentiating tumor types, particularly in distinguishing lymphoma, neuroendocrine tumors, and poorly differentiated carcinomas.

Table 1: Age Distribution of Patients

Age Group (Years)	Number of Cases	Percentage (%)
30–40	16	16%
40–50	19	19%
50–60	18	18%
60–70	22	22%
70–80	25	25%
Total	100	100%

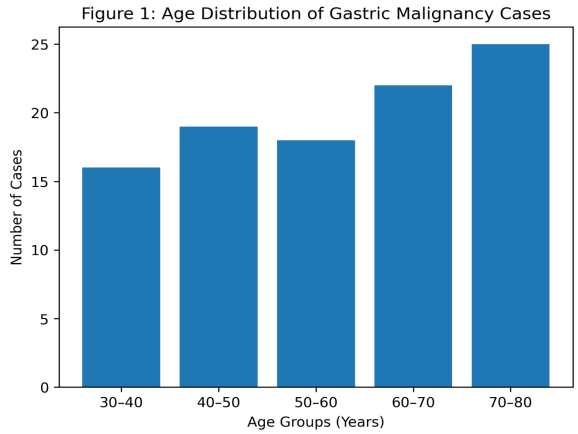


Figure 1: Bar graph showing age-wise distribution of gastric malignancy cases, with the highest incidence in the 70–80 years age group.

Table 2: Gender Distribution

Gender	Number of Cases	Percentage (%)
Male	49	49%
Female	51	51%
Total	100	100%

Figure 2: Gender Distribution of Patients

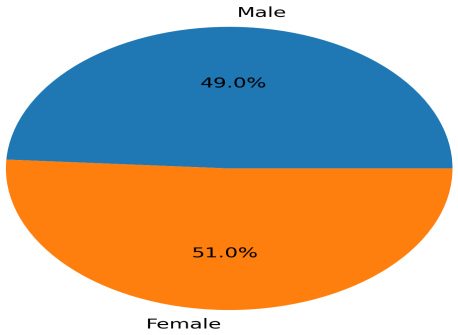


Figure 2: Pie chart illustrating gender distribution of patients, showing nearly equal distribution with slight female predominance.

Table 3: Histopathological Diagnosis

Diagnosis	Number of Cases	Percentage (%)
Intestinal-type adenocarcinoma	24	24%
High-grade dysplasia	17	17%
Differentiated carcinoma	14	14%
Gastric lymphoma	14	14%
Diffuse-type adenocarcinoma	12	12%
Neuroendocrine tumor	10	10%
Chronic atrophic gastritis with metaplasia	9	9%
Total	100	100%

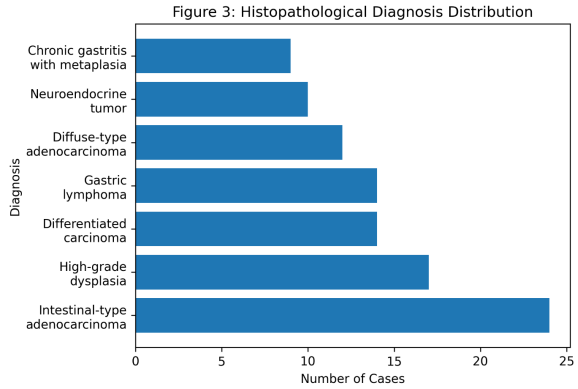


Figure 3: Horizontal bar graph showing distribution of histopathological diagnoses, with intestinal-type adenocarcinoma being the most common.

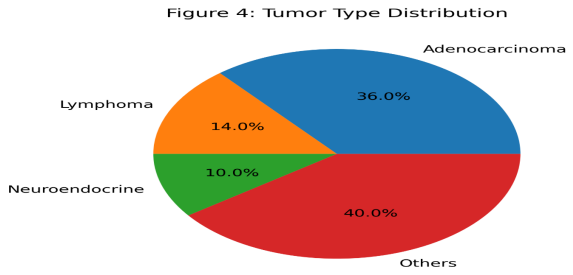


Figure 4: Pie chart representing tumor type distribution, highlighting adenocarcinoma as the most prevalent tumor.

DISCUSSION

The findings of this study highlight the critical importance of gastric biopsy in the early detection and classification of gastric malignancies. The predominance of intestinal-type adenocarcinoma is consistent with global epidemiological data.

The presence of dysplasia and intestinal metaplasia supports the multistep model of gastric carcinogenesis. Early identification of these precancerous lesions is essential to prevent progression to invasive carcinoma. Immunohistochemistry proved to be a valuable adjunct in cases where routine histopathology was inconclusive. It enhanced diagnostic accuracy and provided additional information for tumor classification and treatment planning.

CONCLUSION

Gastric biopsy remains the gold standard for the early detection and classification of gastric malignancies. Histopathological examination, supported by immunohistochemistry, significantly improves diagnostic accuracy and helps guide appropriate clinical management.

Early diagnosis through gastric biopsy plays a vital role in improving patient outcomes and survival rates. A combined approach involving clinical evaluation, endoscopy, histopathology, and immunohistochemistry is essential for effective diagnosis and treatment of gastric cancer.

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