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Original Article

Correlation between histopathological and endoscopic findings of non-malignant gastrointestinal lesions

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ABSTRACT

Background: Gastrointestinal tract endoscopy along with biopsy is an established procedure for investigating a wide range of gastrointestinal conditions especially inflammatory and malignant diseases. The aim was to study and categorizing the morphological lesions of non-malignant origin at various sites of gastrointestinal tract and to compare with its endoscopic findings.

Materials and Methods: This study was conducted on 280 benign gastrointestinal biopsies received in the Department of Pathology of Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, Punjab, India.

Results: Maximum cases (39%) were observed in the age group of 41-60 years. Male patients outnumbered the females (male to female ratio was 1.4:1). Most common esophageal lesion was non-specific esophagitis with least common being Barrett's esophagus. Correlating the results of endoscopic and histopathological features of acute and chronic gastritis a positive predictive value of 80% with sensitivity of 44.4% was seen. Correlation of endoscopic and histopathological findings in celiac disease revealed a sensitivity of 50% and positive predictive value of 42.86%. In both sigmoid colon and rectum, non-specific colitis was the commonest diagnosis followed by ulcerative colitis. Endoscopic findings were correlated with the histopathological features in ulcerative colitis, revealing a sensitivity of 57.14% along with the positive predictive value of 80%.

Conclusion: Histopathology remains the gold standard for diagnosing a case along with endoscopic findings and endoscopic findings alone cannot make the final diagnosis.

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INTRODUCTION

The disorders of gastrointestinal tract (GIT) are responsible for a great deal of morbidity and mortality and are one of the most commonly encountered problems in clinical practice. GIT endoscopy along with biopsy is an established procedure for investigating a wide range of gastrointestinal conditions especially inflammatory and malignant diseases. It is not only used to diagnose malignant and inflammatory lesions but is also used for monitoring the course, extent of the disease, response of the therapy and early detection of complications.[1]

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Table 1: Histopathological features of esophageal lesions

Histopathological changes	Non-specific esophagitis	Eosinophilic esophagitis	GERD	Barett's esophagus
Hyperplasia	12	2	0	1
Ulceration	3	0	4	1
Spongiosis	7	0	4	1
Blood vessel proliferation	5	0	2	0
Acute inflammation	8	2	4	0
Acute & chronic inflamm	11	0	3	1
Chronic inflammation	3	0	4	0
Marked eosinophilia	5	2	0	0
Capillary ectasia	1	0	0	0
Dysplastic changes	1	0	4	1
Goblet cells presence	0	0	0	1
Fungal hyphae	3	0	2	1

A good correlation in diagnosis can be achieved by complementing endoscopic findings with histology of biopsy specimens. The gastrointestinal flexible fiber optic endoscope was first used in 1968 and proved to be a major breakthrough in the diagnosis of gastrointestinal lesions.[2]

Although studies in the past have been done delineating spectrum of lesions on endoscopies (which include both benign and malignant lesions) but not much work has been done exclusively in field of benign lesions of GIT. The current study was undertaken at a tertiary care teaching hospital in Northern part of India to study the various non-malignant lesions at different sites of GIT and to classify and study these lesions according to their detailed histological findings. An attempt was also made to compare the histopathological findings with endoscopic findings wherever possible by the means of statistical analysis.

MATERIALS AND METHODS

The present study included endoscopic biopsies taken from both the upper and lower GIT of patients attending the Gastroenterology outpatient division of Medicine department of Sri Guru Ram Das Institute of Medical Sciences & Research, Amritsar, Punjab, India, during the period from January 2014 to December 2016. The study protocol had been approved by the institute's committee on human research. All benign conditions of upper and lower gastrointestinal tract were included in the study.

Exclusion criteria

1) All lesions of mouth and anal canal were rejected from the study.

2) Inadequate biopsies.

3) All malignant conditions.

The biopsies were taken by a well-experienced endoscopist after assessing the clinical condition of the patient. The biopsy specimens that were obtained were mounted on filter paper keeping the mucosal surface with superior orientation and transported in 10% formalin. After adequate period of fixation the biopsies were processed in an automatic processor and embedded in paraffin keeping in mind the superior orientation of the mucosa.4-5 µm thick sections were cut and mounted on slide and stained with Haematoxylin and Eosin (H&E) stain and studied under microscope.

The endoscopic findings were meticulously recorded on gross visualization and correlated with histopathological parameters, the formats of which were designed before the start of the study. Special stains were also done wherever needed. The results thus obtained were statistically analyzed and recorded.

RESULTS

A total of 410 gastrointestinal biopsies were received, out of which 280 biopsies were benign in pathology. These 280 biopsies were included in the study.

Age group, gender and site distribution

There were 161 males and 119 females with a male: female ratio of 1.3:1. Majority of the cases were in the age group of 41-60 years. Rectum was the most common site to be sampled followed by duodenum with least number of cases coming from sigmoid colon region. Following were the observations recorded at individual anatomical sites -

Esophageal lesions

Esophageal biopsies comprised of 33 cases with 41-60 years being the most common affected age group having an equal male: female ratio. Chronic regurgitation and heart burn

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Table 2: Endoscopic features of esophageal lesions

Endoscopic features	Fundic gland polyp	Ulcer	Adenoma-low grade	Eosinophilic gastritis	Acute/ chronic gastritis	H. pylori	Candidiasis	Leiomyoma	Non-contributory
Polypoidal lesions	3	0	0	0	0	0	0	0	0
Hemorrhage	1	7	1	0	8	1	1	1	3
Erosions	7	9	1	2	12	2	1	1	6
Erythema	3	1	0	1	1	1	0	0	4
Mucosal irregularities	0	2	1	0	0	0	0	0	0

Table 3: Histopathological features of gastric lesions

Histopathological changes	Fundic gland polyp	Ulcer	Adenoma-low grade	Eosinophilic gastritis	Acute/ chronic gastritis	H. pylori	Candidiasis	Leiomyoma
Denudation of mucosa	4	8	1	2	6	0	0	0
Parietal cell hyperplasia	8	0	0	0	0	0	0	0
Foveolar cell hyperplasia	3	0	0	0	2	1	0	0
acute/chronic inflammation	9	7	1	0	19	2	1	0
Neutrophilic collection	1	0	0	0	1	1	0	0
Eosinophilic collection	0	0	0	2	0	0	0	0
Dilated glands	9	4	0	0	6	0	0	0
Congested BV	2	0	1	1	5	0	0	1
Fibroblast proliferation	0	2	0	0	8	0	0	0
Nuclear spindling	0	0	0	0	0	0	0	1
Edema	1	0	0	2	9	0	0	1
Necrosis	0	0	0	0	7	0	1	0
Atypia/mitosis	2	0	0	0	2	1	0	0
Yeast/fungal hyphae	0	0	0	0	0	0	1	0

were the chief complaints of the patients along with chest pain, dysphagia, vomiting, pain abdomen and consistent cough. Amongst the various lesions most common lesion was non-specific esophagitis with least common being Barrett's esophagus. Eosinophilic esophagitis was also seen in a significant proportion of patients accounting for 6% (fig.1A). The characteristic histomorphological findings were recorded and tabulated in all the individual lesions. (Table 1)

Endoscopic features of gastroesophageal reflux disease (GERD) maximally included areas of hemorrhage and erosions/ulceration along with the areas of erythema and friability of the mucosa. In eosinophilic esophagitis white pinpoint papules were characteristically present in all the cases.(fig.1A) Barrett's esophagus featured columnar metaplasia. (Table 2)

No statistical correlation could be elicited between histopathological and endoscopic findings in non-neoplastic esophageal lesions.

Gastric Lesions

It comprised a total of 54 cases. The most common lesions were seen in the age group of 41-60 years and accounted for 33 males and 21 females. Most common complaints were those of pain in epigastrium, vomiting and pain abdomen along with dyspepsia, nausea, weight loss, fecal blood loss/ melena, and bloody vomitus. Acute or chronic gastritis was the most commonly diagnosed lesion (37%) with least common cases seen of adenoma-low grade, H. pylori, leiomyoma and candidiasis accounting for one case each. Histomorphological parameters in all the individual cases were recorded.(Table 3) (fig.1B,C &D)

Correlation of endoscopic findings and histopathology in gastritis

On endoscopy; stomach ulcers showed erosion and hemorrhage in superficial mucosa, along with erythema and mucosal irregularities. Eosinophilic gastritis was mainly characterized by the presence of erosions and erythema of

Table 4: Histopathological features of duodenal lesions

Histopathological changes	Celiac disease	Ulcerative colitis	Granulomatous	Duodenal polyp	Duodenal ulcer	Non-specific duodenitis
Normal villi	0	2	2	1	2	20
Partial atrophy of villi	10	0	0	1	0	3
Complete atrophy of villi	2	0	0	0	0	5
Inflammation	11	2	2	0	2	45
IELs	9	2	0	0	0	2
Crypt hyperplasia	10	0	0	0	0	4
Brunner's gland	0	0	0	1	0	1
Ulceration	2	1	1	1	2	54
Edema	1	1	1	1	2	44
Destruction of glands	1	0	0	1	1	53

the mucosa. Majority cases of the acute and chronic gastritis also showed presence of erosions and hemorrhage of the mucosa along with its erythema.

Correlating the results of endoscopic and histopathological data it was observed that the positive predictive value of the correlation between the two was 80%, however sensitivity was low (44.4%).

Duodenal lesions

A total of 83 duodenal biopsies were analyzed. Majority of the cases were in age group of 41-60 years (40%), with least number of cases seen below 20 years (6%). Male to female ratio was 1.1:1. Pain abdomen was the most common complaint of the patients along with other complaints such as loss of appetite, weight loss, diarrhea, vomiting and fever.

The most commonly diagnosed lesion was non-specific duodenitis (73%) followed by celiac disease (17.4%). (Table 4) (fig.2A)

Correlation of endoscopic findings and histopathology in celiac disease

Atrophy of villi (partial) with crypt hyperplasia and increase in intraepithelial lymphocytes in cases of celiac disease were taken as the histopathological features which were correlated with endoscopic features of scalloping or loss of folds. This correlation was only 50% sensitive with positive predictive value of 42.86% when measured statistically.

Sigmoid colon lesions

This group comprised a total of 23 cases with majority lying

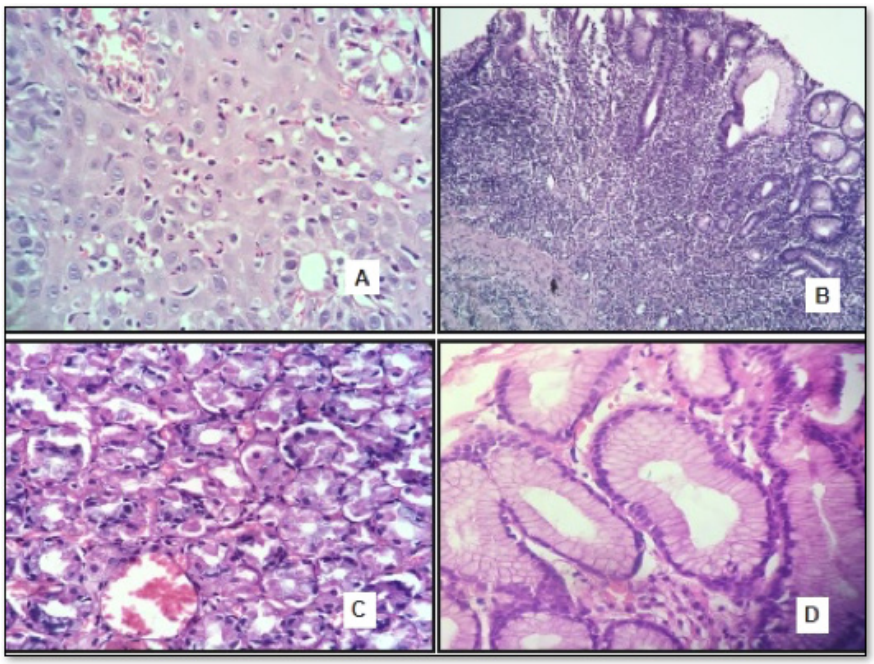

Figure 1: *A. Microphotograph showing eosinophilic esophagitis (HE stain; X400). B. Chronic gastritis with diffuse lymphoplasmacytic infiltrate (HE stain; X100). C. Fundic gland polyp showing parietal cell hyperplasia (HE stain; X400). Stomach biopsy showing Helicobacter pylori infestation (HE stain; X400).*

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Table 5: Histopathological features of sigmoid lesions

Histopathological lesions	Ulcerative colitis	Hirschsprung disease	Retention polyp	Non-specific colitis
Ulceration	2	0	0	6
Crypt hyperplasia	3	0	0	4
Destruction of glands	2	0	0	12
Erythema	4	0	0	4
Hemorrhage	2	0	1	9
Inflammation	5	2	1	14
Polypoidal lesions	0	0	1	1

in the age group of 21-40 years and the least number of the cases were seen below 20 years. Male outnumbered females by a ratio of 1.3:1. Most common chief complaints in the pathologies of this region were pain abdomen, rectal bleeding, vomiting, diarrhea, fever, weight loss and fecal urgency. The maximum number of cases were in the category of non-specific colitis (70%) followed by ulcerative colitis (22%). On microscopy, ulcerative colitis was characterized by erythema, crypt hyperplasia, ulceration, destruction of glands, hemorrhage and inflammation.(Table 5) (fig.2B)

On endoscopy, ulcerative colitis was characterized by the erythematous and friable mucosa with mucosal granularity. No statistical correlation however could be elicited in sigmoid colon lesions.

Rectal Lesions

Of the 87 rectal biopsies, majority of the cases were in age group of 21-40 years with a male preponderance (male to female ratio of 1.6:1). Most common complaint in the patient was of pain abdomen. Patients who commonly complained of straining during defecation were diagnosed as the case of solitary rectal ulcer syndrome (SRUS).(fig.2C) Children mostly presenting with rectal bleeding were diagnosed as juvenile rectal polyp. Non-specific colitis (53%) was the most common diagnosis amongst the rectal biopsies followed by ulcerative colitis (20%). However, there was a single case of eosinophilic colitis.(fig.2D) The detailed histopathological and endoscopic findings are detailed in Table 6.

Correlation of endoscopic findings and histopathology in ulcerative colitis

Active inflammatory infiltrate and ulceration which were characteristic findings in histopathological evaluation were correlated with the endoscopic features of erythematous mucosa and granularity of the mucosa. Sensitivity of the

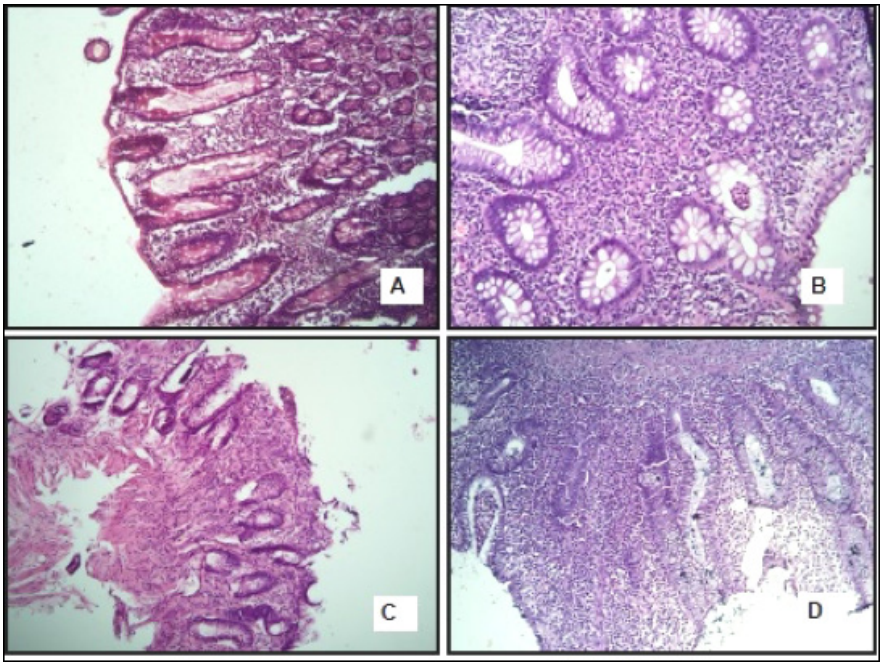

Figure 2: *A. Microphotograph of celiac disease showing flattening of villi (HE stain; X100). B. Ulcerative colitis showing crypt abscess (HE stain; X100). C. Microphotograph of Solitary Rectal Ulcer Syndrome showing splaying of muscularis mucosa with increased fibroblastic activity (HE stain; X100). D. Eosinophilic colitis showing dense collection of eosinophils (HE stain; X100).*

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Table 6: Histopathological features of rectal lesions

Histopathological lesions	Ulcerative colitis	SRUS	Juvenile rectal polyp	Adenomatous polyp	Hirschsprung disease	Pseudomembranous colitis	Eosinophilic colitis	Non-specific colitis
Denudation of mucosa	0	2	0	0	0	1	0	25
Crypt abscess	17	0	0	3	0	0	0	12
Cryptitis	17	0	0	0	0	0	0	11
Crypt destruction	12	0	0	0	0	0	0	9
Collagen deposition	0	5	0	0	0	0	0	0
Splaying of muscularis mucosae	0	5	0	0	0	0	0	0
Inflamm infiltrate (acute & chronic)	12	3	7	4	1	1	1	43
Lymphoplasmacytic infiltrate	13	0	0	0	0	0	0	14
Eosinophilic collection	0	0	0	0	0	0	1	0
Ulceration	15	1	2	3	0	0	1	38
Dilatation of glands	0	0	9	2	0	1	0	32
Destruction of glands	9	2	0	4	0	0	0	21
Fibroblastic activity	0	4	0	0	0	0	0	0
Lymphoid collection	0	0	0	0	0	0	0	22
Absence of ganglion cells	0	0	0	0	2	0	0	0
Mixed mucin and fibrinous material	0	0	0	0	0	1	0	0
Mild cytological atypia	0	0	0	5	0	0	0	0

correlation came out to be 57.14% along with the positive predictive value of 80 percent. Overall, out of the total endoscopic and histopathological correlation 26 cases were completely correlating with both the diagnostic modalities.

DISCUSSION

The present study was a prospective one carried out over a period of 2 years studying in details the non-malignant lesions of the GIT and sub-typing them according to the histopathological findings. An attempt was also made to establish a correlation between the histopathological and its endoscopic findings.

Esophageal Lesions

The most common lesion recorded out of the non-neoplastic esophageal biopsies was non-specific esophagitis (79%) with the least common being Barrett's esophagus (3%). Other studies have found that incidence of Barrett's esophagus varies from 2.6% to 23%.[3] Of all the histopathological findings characterizing esophageal lesion of GERD ulceration, spongiosis and inflammatory infiltrate were the commonest findings. This is corroborated by the work conducted by Odze RD and other researchers who have also documented these as the commonest findings in GERD.[4] The most common histopathological finding on light microscopy for eosinophilic esophagitis was hyperplasia of the covering epithelium and marked eosinophilia (15-20/HPF). The similar findings have also been recorded by Chang F et al, Collins MH and Furuta GT et al.[5-7]

Most of the biopsies in the present study were diagnosed as non-specific esophagitis where no etiology could be identified. This is the prevalent picture in countries such as ours where specific cause is often not found owing to scarcity of medical diagnostic and economic resources.[8]

Gastric Lesions

In the present study acute or chronic gastritis (37%) followed by fundic gland polyp and ulcers (18% each) were the most recognized entities in the present study. The incidence of acute (hemorrhagic) gastritis in a study conducted by Genta RM, on patients of intensive care unit was 20% whereas the study conducted by Haber MM et al and Wolf MM et

al on the incidence of acute gastritis due to NSAIDS was significantly higher.[9-11] Study conducted by Brown LM also suggests that the incidence of individuals who eventually develop chronic gastritis was 20 percent.[12]

On endoscopy the sub-mucosal hemorrhages and erosions (the commonest findings to diagnose acute/chronic gastritis) had a high positive predictive value of 80% and a low sensitivity of 44.4% when comparing with histopathology. It was hence noted in the present study that correlation of histopathology and endoscopy was good when a positive diagnosis was made on endoscopy and correlation was poor when negative diagnosis was made on endoscopy. Similar observations have been reported by Morsan and Dawson, who had concluded that in gastric lesions there was a poor correlation between endoscopy and histopathology especially when endoscopy is negative.[13] Therefore many authors such as Kazi JI had recommended that an endoscopist should convey the endoscopic findings to the pathologists along with the biopsy sent prior to making a comprehensive diagnosis on endoscopy alone.[14]

Duodenal Lesions

Out of a total of 83 duodenal biopsies analyzed in the present study, the most common were non-specific duodenitis (73%) followed by celiac disease (17.4%). The reported prevalence rate of celiac disease by Makharia GK et al was relatively high (1 in 96) in the North Indian community.[15] But the study conducted by Kagnoff MF concluded that the prevalence rate of celiac disease was relatively low (0.75-1%) in western hemisphere (USA and Europe).[16] The commonest histopathological features recorded in duodenal biopsies were inflammatory infiltrate, ulceration and destruction of glands followed by atrophy of villi, intraepithelial lymphocytes and crypt hyperplasia. Similar histological findings have been reported by Bhasin TS et al.[17] On endoscopy the loss of scalloping or folds of mucosa (the commonest findings to diagnose celiac disease) had a positive predictive value of 42.86% and a sensitivity of 50% when comparing with histopathology. Hence, in the present study it was concluded that endoscopy has limited diagnostic utility in correctly predicting the diagnosis of celiac disease alone despite it being correct in half of the cases as a screening tool. This is in contrast by observations made by Bonatto MW et al and Dickey W who had concluded in their studies that the changes in the duodenal mucosa were significantly and positively associated with histopathologic findings.[18,19] Our findings are similar to those conducted by Kazi JI et al[14] who have also concluded similar results as in the present study of poor predictive value of endoscopy alone in comparison to histopathological examination.

Sigmoid Colon and Rectal Lesions

In both rectum as well as sigmoid colon, non-specific colitis (56%) was the commonest diagnosis rendered on histology followed by ulcerative colitis (20%). The reported rates by researchers such as Danase S et al had shown almost similar incidence and prevalence rates (1.2 to 20.3 cases per 100,000 per 1 year and 7.6 to 246.0 cases per 100,000 per year respectively).[20]

The commonest histopathological features recorded in rectal biopsies were inflammatory infiltrate (acute/chronic), ulceration and dilatation of glands. Similar histopathological findings had also been reported by many researchers such as Ali S et al and Ullman T et al.[21,22] On endoscopy the erythematous and granular mucosa (the commonest findings to diagnose ulcerative colitis) had a high positive predictive value of 80% and sensitivity of 57.14% when comparing with histopathological features of active inflammatory infiltrate and ulceration. It was hence noted in the present study that correlation of histopathology and endoscopy was good when a positive diagnosis of ulcerative colitis was made on endoscopy and it was even a reasonably good screening tool in more than half of the cases in this scenario. However; more than the diagnosis, the treatment of ulcerative colitis depends upon the disease progression and activity. This is also stated by Simsek HD et al and Lemmens B et al who had concluded that neither the histopathology nor endoscopy was a better technique for evaluating disease activity. They have recommended having a particular timely follow-up of patients to determine the treatment of the patients.[23, 24]

The present study highlights the correlation of endoscopic findings such as erythema, edema, exudates, loss of scalloping and mucosal granularity with the histopathology findings for reaching at the correct diagnosis.

CONCLUSION

Thus it is concluded that as evident especially in case of gastritis, celiac disease and ulcerative disease which had a sufficient number of cases, on correlation of histopathology with endoscopy findings a positive predictive value varying from 42.86%-80% and sensitivity varying from 44%-57.14% was obtained, thus emphasizing that histopathology remains the gold standard for diagnosing a case along with endoscopic findings and endoscopic findings alone cannot make the final diagnosis.

Conflict Interest: None

REFERENCES

1. Rashmi K, Horakerappa MS, Karar A, Mangala G. A study on histopathological spectrum of upper gastrointestinal tract endoscopic biopsies. Int J Med Res Health Sci. 2013;2:418-24. Crossref

2. Memon F, Baloch K, Memon AA. Upper gastrointestinal endoscopic biopsy; morphological spectrum of lesions. Professional Med J. 2015;22:1574-9. Crossref

3. Wani IR, Showkat HI, Bhargav DK, Samer M. Prevalence and Risk Factors for Barrett's Esophagus in Patients with GERD in Northern India; Do Methylene Blue-directed Biopsies Improve Detection of Barrett's Esophagus Compared the Conventional Method? Middle East J Dig Dis. 2014;6:228-36. Crossref

4. Greenson JK, Odze RD. Inflammatory disorders of the Large Intestine. In: Odze RD, Goldblum JR, editors. Surgical Pathology of the GI Tract, Liver, Biliary Tract and Pancreas. 2nd Ed. Philadelphia:Saunders;2009. Crossref

5. Chang F, Anderson S. Clinical and pathological features of eosinophilic esophagitis: a review. Pathology. 2008;40:3-8. Crossref

6. Collins MH. Histopathologic features of eosinophilic esophagitis. Gastrointest Endosc Clin N Am. 2008;18:59-71. Crossref

7. Furuta GT, Liacouras CA, Collins MH, et al. Eosinophilic esophagitis in children and adults: a systemic review and consensus recommendations for diagnosis and treatment. Gastroentrol. 2007;133:1342-63. Crossref

8. Goyal G, Sultania S, Meena B, Nijhawan S. Refractory benign esophageal strictures. J Dig Endosc. 2016;7:1-5. Crossref

9. Genta RM. Differential diagnosis of reactive gastropathy. Semin Diagn Pathol. 2005;22:273-83. Crossref

10. Haber MM, Lopez I. Gastric histologic findings in patients with nonsteroidal anti-inflammatory drug-associated gastric ulcer. Mod Pathol 1999;12:592-8. Crossref

11. Wolfe MM, Lichtenstein DR, Singh G. Gastrointestinal toxicity of nonsteroidal antiinflammatory drugs. N Engl J Med 1999;340:1888-99. Crossref

12. Brown LM. Helicobacter pylori: epidemiology and routes of transmission. Epidemiol Rev. 2000;22:283-97. Crossref

13. Day DW, Jass JR, Price AB. Morson and Dawson's Gastrointestinal Pathology. J Clin Pathol. 2003;56:399. Crossref

14. Kazi JI, Alam SM, Kazi AM, Anwar A, Shamsi Z. Correlation of endoscopic and histopathological diagnosis in Upper Gastrointestinal Lesions. J of Pak Med Assoc. 1990;40:281-3. Crossref

15. Makharia GK, Verma AK, Amarchand R, et al. Prevalence of celiac disease in the northern part of India: a community based study. J Gastroenterol Hepatol. 2011;26:894-900. Crossref

16. Kagnoff MF. Overview and pathogenesis of celiac disease. Gastroenterology. 2005;128:S10-8. Crossref

17. Bhasin TS, Mannan R, Malhotra V, Sood M, Sood A, Bhatia PK. Histological recovery profiles of patients with Coeliac disease- An Indian prospective. J Clin Diagn Res. 2010;4:2217-25.

18. Bonatto MW, Kotze L, Orlandoski M, Tsuchyia R, Carvalho CA, Lima D et al. Endoscopic evaluation of celiac disease severity and its correlation with histopathological aspects of the duodenal mucosa. Endosc Int Open. 2016;4:E767-E77. Crossref

19. Dickey W. Endoscopic markers for celiac disease. Nat Clin Pract Gastroenterol Hepatol. 2006;3:546-51. Crossref

20. Danese S, Fiocchi C. Ulcerative Colitis. N Engl J Med. 2011;365:1713-25. Crossref

21. Ali S, Tamboli CP. Advances in epidemiology and diagnosis of inflammatory bowel diseases. Curr Gastroenterology Rep. 2008;10:576-84. Crossref

22. Ullman T, Odze R, Farraye FA. Diagnosis and management of dysplasia in patients with ulcerative colitis and Crohn's disease of the colon. Inflamm Bowel Dis. 2009;24:469-74.

23. Simsek HD, Basyigit SB, Aktas BB, et al. Assessment of the Correlation between Endoscopic Activity and Histological Activity in Ulcerative Colitis Patients. Med Princ Pract. 2016;25:378-84. Crossref

24. Lemmens B, Arijs I, Van Assche G, Sagaert X. Correlation between the endoscopic and histologic score in assessing the activity of ulcerative colitis. Inflamm Bowel Dis. 2013;19:1194-201. Crossref