Original Research Article

Utility of mucin stains in the diagnosis of gastrointestinal tract diseases

Ajay S Wani[1*], Shilpi Sahu[2]

[1]Consultant Pathologist, Calcutta Heart Clinic and Hospital, Kolkata, India
[2]Professor and HOD, Department of Pathology, MGM Medical College, Navi Mumbai, India
[*]Corresponding author email: **drajay1984@live.com**

International Archives of Integrated Medicine, Vol. 7, Issue 3, March, 2020.

Available online at http://iaimjournal.com/
ISSN: 2394-0026 (P) **ISSN: 2394-0034 (O)**
Received on: 14-02-2020 **Accepted on:** 20-02-2020
Source of support: Nil **Conflict of interest:** None declared.
How to cite this article: Ajay S Wani, Shilpi Sahu. Utility of mucin stains in the diagnosis of gastrointestinal tract diseases. IAIM, 2020; 7(3): 20-28.

Abstract

Background: Mucin secretions reflect the functional changes in the mucosa of the gastrointestinal tract (GIT) in health and disease. Demonstration of mucin is important in the assessment of various gastrointestinal carcinomas.
Aim: To know the mucin distribution of GIT in normal and pathological lesions and to find out the difference in types of mucin and their response in normal and pathological lesions in GIT.
Materials and methods: A cross sectional observational study was carried out at a tertiary level hospital in Navi Mumbai over a period of two years. A total number of 100 cases of surgically resected specimens and biopsies were studied. All the specimens and biopsy samples sent to the Department of Histopathology were stained with mucin stains (PAS with and without diastase, alcian blue, mucicarmine).
Results: Out of the 100 cases, 42 cases were clinically diagnosed to be malignant. There were 14 cases of SCC, 1 case of adenocarcinoma of oesophagus, 2 cases of SCC and 8 cases of adenocarcinoma of stomach. Adenocarcinoma of duodenum was 3 in number. 14 cases of colorectal carcinomas were found. Neutral mucin was the most prominent type of mucin in oesophageal and gastroesophageal carcinomas while acidic mucin was the most prominent type of mucin in carcinomas of colon, rectum and stomach.
Conclusion: Though the special stains concept seems to be simple, yet its diagnostic importance is of great significance particularly in cases of malignancy. It is a cost-effective tool for the diagnostic histopathology and for the researchers in histology.

Key words

Gastrointestinal tract (GIT), Alcian blue, Periodic acid Schiff (PAS), PAS with diastase, Mucicarmine.

Introduction

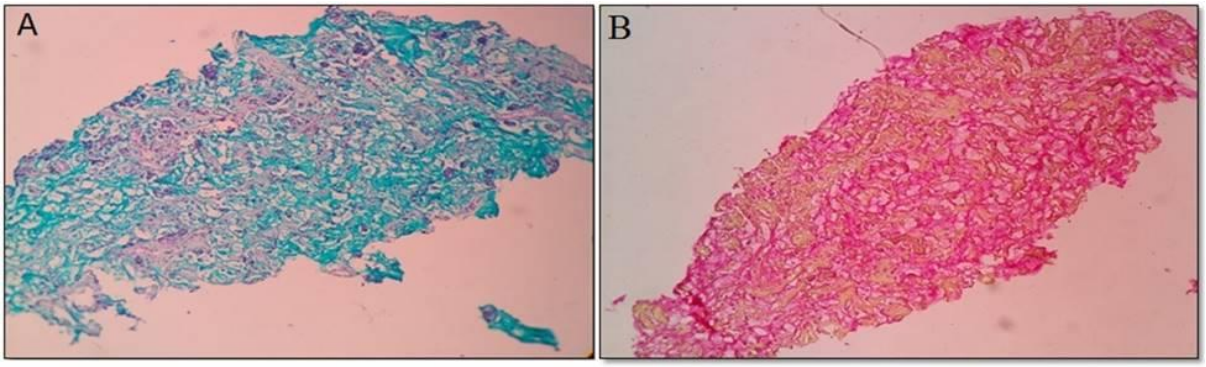
Mucins are high molecular weight glycoproteins that are synthesized, stored and secreted by the epithelial mucosal cells of GIT [1, 2]. Mucin provides protection for the cell surface against pathogens and toxins [3, 4]. Mucins are classified into neutral and acidic mucins; the latter include sulpho and sialomucins. In the GIT, both neutral and acidic mucin are present at specific locations and their production is increased or reversed in various diseases and malignancies of GIT [5, 6].

Several staining techniques can be used in the clinical histology to demonstrate mucin [7]. Alcian Blue is used to demonstrate acid mucins and combined with PAS staining procedure to demonstrate both acid and neutral mucin; Alcian Blue will stain acidic mucin blue and PAS stains neutral mucin magenta color. PAS Stains glycogen as well as mucin, but tissue can be pre-digested with diastase to remove glycogen [8]. Mucicarmine will stain acidic mucin red and is very specific for epithelial mucins including adenocarcinomas [9].

Materials and methods

This cross sectional observational study was carried over a period of two years at MGM Medical College and Hospital, Navi Mumbai, Kamothe. All the GIT biopsies and surgically resected specimens sent to the histopathology section in the laboratory were included. Inadequate samples were excluded. Hence, a total of 100 cases were included in the present study. Mucin was confirmed by staining with alcian blue, PAS with diastase and without diastase and mucicarmine. Patients' clinical data was collected from the medical records. Clinico-pathological co-relation was done. Specimens were fixed in 10% neutral buffered formalin, processed and embedded according to standard protocol. All the cut sections were stained with H & E followed by special histochemical stains i.e. Alcian blue (pH 2.5), Periodic acid Schiff with and without diastase, Mucicarmine. The data was collected in a specially designed proforma for the study and analyzed (**Figure – 1 to 5**).

Figure - 1: Adenocarcinoma oesophagus showing predominance of acidic mucin: A**.** Alcian blue stain X 40; B. Mucicarmine stain, 40X.



Results

A total of 100 cases were enrolled during the entire study period. In our study of 100 GI cases 66% were males and 34% were females with male to female ratio of 1.94:1. Patients with upper GI lesions presented in the age range of 2nd to 7th decade. The mean age group for upper GI lesions was 53.79 years. Patients with lower GI lesions presented in the age range of 1st to 7th decade. The mean age group for lower GI lesions was 44.87 years. Lower GI lesions were more than upper GI lesions with a ratio of 1.17:1. Most of the cases were from large intestine (32%) followed by small intestine (25%), stomach and oesophagus. The predominant non neoplastic lesions were from small intestine followed by large intestine and most common neoplastic lesion was from large intestine followed by small intestine and stomach.

Figure - 2: Barrett's oesophagus: A. Mucicarmine stain (400X) showing acidic mucin in goblet cells; B. PAS with Diastase stain (100X) showing neutral mucin in columnar cells.

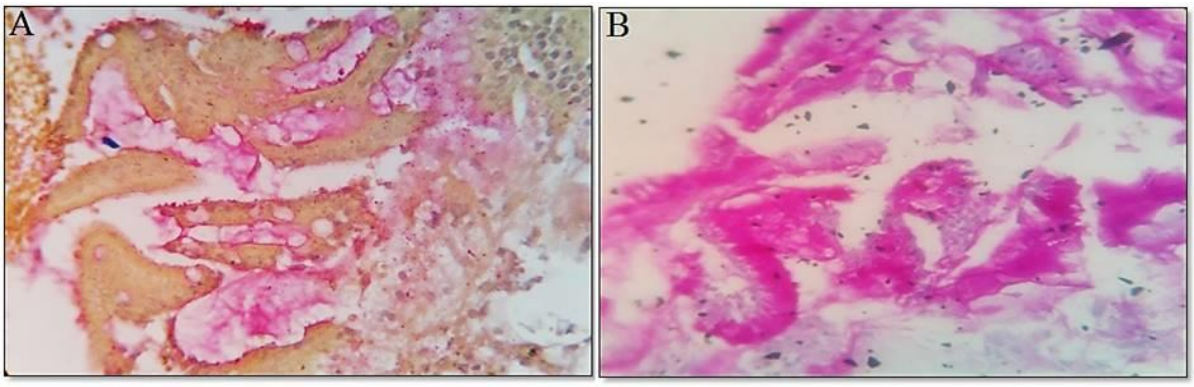


Figure - 3: Adenocarcinoma stomach with signet ring cells: A. PAS stain (400X) showing neutral mucin; B. Alcian blue stain (400X) showing acidic mucin.

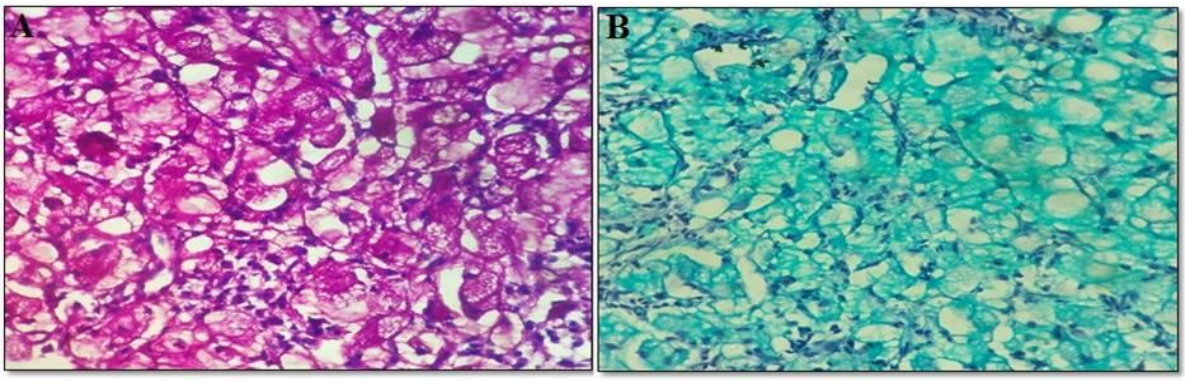
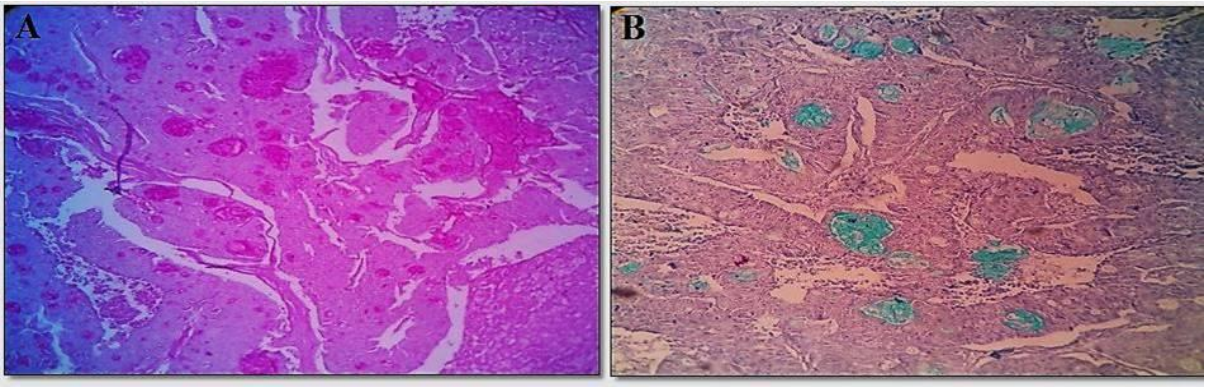


Figure - 4: Adenocarcinoma duodenum: A. PAS with Diastase stain (100X) showing neutral mucins in goblet cells; B. Alcian blue stain (100X) showing acidic stain.



Mucin histochemical reaction of normal oesophageal glands and various pathological lesions are shown in **Table - 1**. The predominant lesion of Oesophagus was squamous cell carcinoma followed by Barrett's oesophagus. Normal oesophageal glands have neutral mucin (PAS+). Combination of acidic and neutral mucins was found in inflammatory lesions of oesophagus. In Barretts Oesophagus, columnar cells showed weakly to moderately positivity for PAS, PAS with Diastase and goblet cells were moderately positive for Alcian blue and Mucicarmine stains suggesting the presence of both acidic and neutral mucins. Oesophagus showed acidic mucins (Alcian blue+) in cases of adenocarcinomas. Squamous cell carcinomas do not show mucin production.

Figure - 5: Adenocarcinoma colon: A. Alcian blue stain (100X) showing extracellular acidic mucin; B. Mucicarmine stain (100X) showing acidic mucin; C. PAS stain (100X) showing neutral mucin.

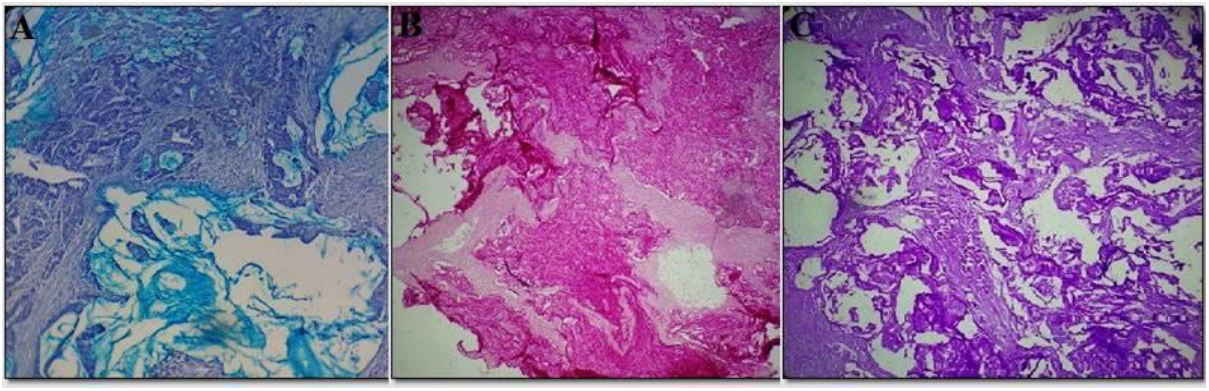


Table - 1: Mucin histochemical reactions of normal oesophageal glands and various lesions of oesophagus.

Lesions	No. of cases	PAS	PAS with Diastase	Alcian Blue	Mucicarmine
Normal oesophageal glands		+++	+++	_	_
Non-specific Esophagitis	2	+++ (2)	++ (2)	-	-
Barrett's Oesophagus	3	++ (3)	+ (3)	++ (3)	++ (3)
Dysplasia of Mid-Oesophagus	2	-	-	-	-
Adenocarcinoma of lower oesophagus	1	+++ (1)	++ (1)	++++ (1)	+++ (1)
SCC of Oesophagus	14	-	-	-	-

Table - 2: Mucin histochemical reactions of normal gastric glands and various lesions of stomach.

Lesions	No. of cases	PAS	PAS with Diastase	Alcian Blue	Mucicarmine
Normal gastric mucosa		+++	+	-	-
Gastric Ulcer	1	+ (1)	+ (1)	-	-
Chronic Gastritis	6	+++ (6)	+++ (6)	+ (1)	+ (1)
Gastric Polyp - Adenomatous polyp	1	+++ (1)	+++ (1)	++ (1)	++ (1)
SCC stomach	2	-	-	-	-
Adenocarcinoma stomach	8	+++ (8)	+++ (8)	+++ (8)	+++ (8)

Mucin histochemical reaction of normal gastric glands and various pathological lesions are shown in **Table - 2**. The most common lesion in stomach was gastric ulcer (44%) followed by chronic gastritis (33%), squamous cell carcinoma (11%) followed by polyp (6%) and adenocarcinoma (6%). Surface epithelial foveolar cells, cardiac and antral glands were found to have neutral mucins (PAS+). There is no change in type of mucin expression in ulcerated lesions and inflammatory lesions of the stomach. However the number of glands expressing the neutral mucins was decreased. Long standing chronic gastritis associated with intestinal metaplasia is recognized by the presence of goblet cells showing positivity for acidic mucins (Alcian blue+) which may increase the risk of future gastric adenocarcinoma. In gastric adenocarcinomas neutral and acidic mucins both were found. The presence of acidic mucin suggests that the tumor arose from areas of intestinal metaplasia.

Mucin histochemical reaction of normal small intestinal glands and various pathological lesions are shown in **Table - 3**. Normal small intestinal

mucosal glands showed acidic mucins and there was no change in type of mucin expression in ulcerated lesions and inflammatory lesions of the small intestine. However the number of glands expressing the acidic mucins was decreased. In FAP, acidic mucins (Alcian blue+) were profoundly seen in the glands, though few glands had neutral mucins (PAS+). Both acidic and neutral mucins were present in IBD. However in ulcerative colitis there was reduction in number of mucin producing glands. In Adenocarcinoma of duodenum mixed mucin were found.

Table - 3: Mucin histochemical reactions of normal small intestinal glands and various lesions of small intestine.

Lesions	**No. of cases**	**PAS**	**PAS with Diastase**	**Alcian Blue**	**Mucicarmine**
Small intestinal goblet cells		++	++	+++	+++
Non specific duodenitis	1	++ (1)	+ (1)	++ (1)	++ (1)
Celiac disease of duodenum	1	++ (1)	+ (1)	+ (1)	+ (1)
Duodenal Ulcer	1	-	-	-	-
Jejunal diverticula	1	++ (1)	++ (1)	++ (1)	++ (1)
Non- specific jejunitis	2	+ (2)	+ (2)	+ (2)	+ (2)
Gangrene – jejunum	1	-	-	-	-
Meckel's diverticulum	1	+ (1)	+ (1)	+ (1)	+ (1)
FAP	1	++ (1)	++ (1)	+++ (1)	+++ (1)
Typhoid – ileum	2	-	-	-	-
Adenocarcinoma of SI	3	++ (3)	++ (3)	+++ (3)	+++ (3)
Tuberculosis of Intestine (Ileum)	2	-	-	-	-
IBD	3	+/++ (3)	+/++ (3)	+/++ (3)	+/- (3)
Perforation of intestine – ileum	2	+++ (2)	+++ (2)	+++ (2)	+++ (2)
Stricture	1	-	-	-	-

Table - 4: Mucin histochemical reactions of normal large intestinal glands and various lesions of colon.

Lesions	**No. of cases**	**PAS**	**PAS with Diastase**	**Alcian Blue**	**Mucicarmine**
Colonic goblet cells		+++	+++	++++	++++
Ulcerative colitis	2	+++ (2)	+++ (2)	+++ (2)	+++ (2)
Non-specific colitis	11	+++ (11)	+++ (11)	+++ (11)	+++ (11)
Granulomatous colitis	2	- (2)	- (2)	+++ (2)	+++ (2)
Adenomatous polyp	1	+++ (1)	+++ (1)	+++ (1)	+++ (1)
Tubulovillous Adenoma of colon	2	+++ (2)	+++ (2)	+++ (2)	+++ (2)
Adenocarcinoma – Colon	12	+/++ (12)	++ (12)	++++ (12)	++++ (12)

Mucin histochemical reaction of normal large intestinal glands and various pathological lesions are shown in **Table - 4**. The most common lesion in large intestine was adenocarcinoma of colon (40.1%) followed by non-specific colitis (36.8%), ulcerative colitis (6.6%), granulomatous colitis (6.6%), villous adenoma colon (6.6%) and polyp (3.3%). Normal colonic mucosa shows predominance of acidic mucins. In colonic adenocarcinomas though there is predominance of acidic mucins, presence of neutral mucins was also observed suggesting dysplasia.

Mucin histochemical reaction of normal rectal glands and various pathological lesions are shown in **Table - 5**. The most common lesion

found in rectum and anal canal was fistula in ano (28.6%) followed by adenocarcinoma of rectum (28.6%) and proctitis, tuberculosis (14.3%) each. Normal rectal mucosa showed predominance of neutral mucins. In well differentiated rectal adenocarcinomas though neutral mucins predominated, acidic mucins were also present significantly in the malignant glands.

Table – 5: Mucin histochemical reactions of normal rectal glands and various lesions of rectum and anal canal.

Lesions	No. of cases	PAS	PAS with Diastase	Alcian Blue	Mucicarmine
Rectal goblet cells		+	+	+	+
Proctitis	1	-	-	-	-
TB – anal canal	1	-	-	-	-
Fistula – in – ano	3	-	-	-	-
Adenocarcinoma – rectum	2	+/+++ (2)	+/+++ (2)	+/+++ (2)	+/+++ (2)

Discussion

The distribution and amount of mucin varies in different regions of the GIT. Mucosa of the GIT has been found to have some qualitative as well as quantitative changes in the non-neoplastic and neoplastic lesions compared to normal mucosa by mucin histochemistry. In this scenario, an institutional based cross-sectional observational study was done to know the mucin distribution of GIT in normal and pathological lesions and to find out the difference in types of mucin and their response in normal and pathological lesions in GIT.

M:F ratio of 1.94:1 is mostly comparable with studies of Silva, et al. [6], Krishnappa, et al. [10] and Prathima S, et al. [2]. The gender ratio favoring males could be reflective of the fact that the males are exposed to more risk factors than females and gastrointestinal malignancies are more common in males according to JC Paymaster, et al. [11]. Mean age group (53.7 years) of upper GI lesions was almost similar to study of Silva, et al. [6], Krishnappa, et al. [10] and Prathima S, et al. [2] in which there was predominance of upper gastrointestinal tract disease between the age groups of 51-60 years.

Oesophageal diseases

Non-specific oesophagitis showed absence of acidic mucin in our study which correlated with Prathima, et al. [2] while it showed predominance of neutral mucin which was in contrast to the study done by Prathima S, et al. [2]. Barrett's oesophagitis showed acidic mucins in intestinal metaplastic cells which correlated with the finding of Prathima, et al. [2] and Sandick JW [12]. No mucins were detected in squamous dysplasia of oesophagus which correlated with the findings of Prathima S, et al. [2]. Acidic mucins were predominant in adenocarcinoma of oesophagus which correlated with the findings of Nithya R, et al. [13] and GAD, et al. [14].

The PAS staining was high in normal esophageal tissue and it was gradually decreased in the progressive stages of esophageal adenocarcinoma. Alcian blue was gradually increased from the normal to adenocarcinoma stages of the esophageal tissue which correlated with study done by Nithya R, et al. [13] and GAD, et al. [14].

Alcian Blue and PAS staining increases the sensitivity in detecting the intestinal metaplasia of the Barrett's oesophagus in the pre-neoplastic condition of esophageal adenocarcinoma which was similar to finding by Nandurkar, et al. [15] and Gottfried, et al. [16].

Gastric disorders

Long standing chronic gastritis leads to significant loss of parietal cell mass and

associated with intestinal metaplasia recognized by the presence of goblet cells showing positivity for acidic mucins and is strongly associated with increased risk of gastric adenocarcinoma [17]. 75% cases of chronic gastritis were PAS positive which is in contrast to finding of Prathima, et al. [2] which can be interpreted as whatever cases were PAS positive were detected in early stages of gastritis in our study. Gastric polyp showed predominance of neutral mucins more than acidic mucins which correlated with studies done by Prathima S, et al. [2] and Goldman H, et al. [18]. In adenocarcinoma of stomach all the stains were positive suggesting the presence of both neutral and acidic mucins with slight predominance of neutral mucins which correlated with A GAD, et al. [14] and Prathima S, et al. [2]. In squamous cell carcinoma of stomach, no mucins were detected. Therefore all the stains were negative.

Small intestinal disorders

75% of the celiac disease and jejunal diverticula glands were positive for acidic mucin. Duodenal polyp showed moderate amount of neutral and acidic mucins which was in contrast to study done by Prathima S, et al. [2] where both types of mucins were weakly positive. In duodenal ulcer no mucin was detected by alcian blue stain in the ulcerated area. Meckel's diverticulum showing pancreatic mucosa was negative for all other acidic mucin stains while areas containing normal small intestinal glands showed acidic mucins. In Familial adenomatous polyposis 90% of the glands were positive for acidic mucin which was similar to study done by Prathima S, et al. [2]. In typhoid and Tuberculosis mucin production was decreased therefore Alcian blue stain was negative. In IBD 25-50% of the glands were Alcian blue positive suggesting the role of acidic mucins in pathogenesis of the disease. In perforation site of the intestine increased mucin production was noted which was Alcian blue positive while in stricture mucin appeared to be reduced. In duodenitis 25% glands were Alcian blue positive which was in contrast to study done by prathima et al which showed 50 % Alcian blue positive glands. In well differentiated adenocarcinoma around 90% glands were alcian blue positive which was similar to findings of Prathima, et al. study [2] suggesting the presence of mixed mucins still showing predominance of acidic mucins more than neutral mucins.

Colo-rectal diseases

In colorectal carcinoma, reversal of mucin patterns was observed which was in accordance with the findings of Usman Ali and colleagues [19]. Predominance of acidic mucin was observed in contrast to normal colon, which had predominance of neutral mucin. Mucinous adenocarcinoma showed lakes of mucin pools and tumor cells float in it. PAS stain for colorectal carcinoma gave mild reaction as focal magenta staining suggestive of presence of few neutral mucosubstances to reduced neutral mucosubstances as compared to normal colon. These observations were correlated with various workers as Shah and Shrikhande [20], Subbuswamy SG [21], Gad A [14], Filipe MI [22] and Ganga GM [23]. PAS- diastase used for confirmation gave mild to moderate reaction as magenta color confirms presence of few PAS positive mucin. For acidic mucin, in all colonic tumors Alcian Blue pH 2.5 was carried out which gave strong reaction as blue color. This is suggestive of presence of both acidic mucins i.e. carboxylated as well as sulphated. According to GAD, et al. [14], carcinoma of colon and rectum gave comparable results. The higher the degree of differentiation in carcinoma of colon and rectum the more closely mucosubstances resemble the normal.

In adenocarcinoma of colon all types showed almost 100% of the glands showed alcian blue positivity in the columnar cells and goblet cells which correlated with the study done by Nikumbh RD, et al. [24] whereas in carcinoma rectum only 25% of alcian blue positivity was noted in contrast to study done by Nikumbh RD, et al. [24] which showed 100% positivity. Comparison of our study with Eiman Awad, et al. [25] study was as per **Table – 6**.

Inference of mucin study in various GIT carcinomas

The main result in the study of Eiman, et al. [25] shows that both types of mucin were almost similar in distribution in most parts of GIT. Neutral mucin was the most prominent in esophageal and gastro esophageal carcinomas while acid mucin was most prominent in colorectal carcinoma which was similar to results our study. According to JASS, et al. [26] esophageal adenocarcinomas well differentiated type secreted sulphomucins and poorly differentiated ones secreted sialomucins and neutral mucins which was similar to our study results.

Table – 6: Comparison of our study with Eiman Awad, et al. [24] study.

Carcinomas	Neutral Mucins - Our study	Neutral mucins - Eiman Awad, et al. [25]	Acidic Mucins - Our study	Acidic mucins – Eiman Awad, et al. [25]
Esophageal adenocarcinoma	100%	60%	100%	40%
Gastric adenocarcinoma	100%	53%	75.00%	60%
Duodenal adenocarcinoma	100%	-	66.66%	-
Colon Adenocarcinomas	66.66%	48%	83.33%	55%
Rectal adenocarcinoma	100%	52%	50%	52%

According to Prathima, et al. [2] most cases of gastric adenocarcinomas secreted both neutral and acidic mucins. Ganesh IM, et al. [27] found significant staining of acidic mucins and mild staining of neutral mucins in gastric carcinomas compared to normal gastric mucosa. Eiman Awad, et al. [25] showed that gastric adenocarcinomas secreted both neutral and acidic mucins with predominance of acidic mucins (sialomucins) which was similar to our study findings.

Mirna HF, et al. [28] reported that colorectal mucinous adenocarcinomas showed a higher tumor grade than non- mucinous adenocarcinomas. Eiman Awad, et al. [25] and Usman Ali, et al. [19] showed that acidic mucins in colorectal carcinomas predominate over neutral mucin which was in concordance with our study.

Conclusion

Thus from our study, it can be concluded that demonstration and identification of different types of mucin in GIT carcinomas can assist in their classification and predicting prognosis and behavior of the tumor.

References

1. Cookes EM, Felipe NL, Dawson IMP. The production of autoantibodies in rabbits by immunization with Eischerechia coli. J. Pathol. Bacteriol., 1958.
2. Prathima S, Harendra Kumar M L. Mucin profile of Upper Gastrointestinal tract lesions. J Clin Biomed Sci., 2012; 2(4).
3. Ryder NM, Ko CY, Hines OJ, Gloor B, Reber HA. Primary Duodenal Adenocarcinoma: A 40- year experience. Arch Surg., 2000; 135: 1070-1075.
4. McCashland TM, Brand R, Lyden E, et al. Gender differences in colorectal polyps and tumors. Am J Gastroenterol., 2001 Mar; 96(3): 882-886.
5. Wei WQ, Abnet CC, Lu N, Roth MJ, Wang GQ, Dye AB, et al. Risk factors for oesophageal squamous dysplasia in adult inhabitants of a high risk region of china. Gut, 2005; 54: 759-763.
6. Silva S, Filipe MI, Pinto A. Variants of intestinal metaplasia in evolution of chronic atrophic gastritis and gastric ulcer. A follow up study. Gut, 1990; 31: 1097-1104.
7. Lee SB, Kang HY, Kim KI, Ahn DH. The diagnostic accuracy of endoscopic biopsy for gastric dysplasia. J Gastric cancer, 2010; 10(4): 175-181.
8. Ljubicic N, Kujundzic M, Roic G, Banic M, Cupic H, Doko M, et al. Benign epithelial

gastric polyps- Frequency, Location and age and sex distribution. Coll Antropol., 2002; 26(1): 55-60.
9. Sivaram Gunisetty, Santosh Kumar Tiwari, Avinash Bardia, et al. The epidemiology and prevailance of ulcerative colitis in south of India. Open journal of Immunology, 2012; 2: 144-148.
10. Krishnappa Rashmi, Horakerappa MS, et al. A study on histopathoogical spectrum of upper gastrointestinal tract endoscopic biopsies. Int J Med Res Health Sci., 2013; 2(3): 418-424.
11. Paymaster JC, Sanghvi LD, Ganghadaran P. Cancer of gastrointestinal tract in western India. Cancer, 1968; 21: 279-87.
12. Van Sandick JW, Van Lanschot JJB, Kuiken BW, Tytgat GNJ, Offerhaus GJA, Obertop H. Impact of endoscopic biopsy surveillance of Barrett's oesophagus on pathological stage and clinical outcome of Barrett's carcinoma. Gut, 1998; 43: 216-22.
13. Nithya Regupathi, Halagowder Devaraj. Histochemical study of Mucin in the Adenomatic Transformation of Barrett's Oesophagus in Human Esophageal Epithelium. Zoology, 2014; 3(7): 520-522.
14. A. Gad. A histochemical study of human alimentary tract mucosubstances in health & disease. 1. Normal & tumors. Br J Cancer, 1969 Mar; 23(1): 52-63.
15. Nandurkar S., Talley N., Martin C., Ng T., Adams S. Short segment Barrett's oesophagus: Prevailance, diagnosis and associations. Gut, 1997; 40(6): 710-715.
16. Gottfried M., Mcclave S., Boyce H. Incomplete intestinal metaplasia in the diagnosis of columnar lined oesophagus (Barrett's Oesophagus). Am J Clin Pathol., 1989; 92(6): 741-746.
17. Turner JR. The gastrointestinal Tract. In: Kumar V, Abbas KA, Fausto, Aster JC. Pathologic Basis of the Disease. 8th edition, Philadelphia: Saunders Elseiever, 2010; p. 763-832.
18. Goldman H, Ming SC. Mucins in normal and neoplastic gastrointestinal epithelium. Arch Pathol., 1985; 85: 580-86.
19. A. Usman, A H Nagi, Naseem, E. Ullah. Mucin histochemistry in tumors of colon, ovaries and lung. J Cytol Histol., 2012; 3: 163.
20. Shah M, Shrikhande SS. Mucin histochemistry of lower gastrointestinal tract. Indian Jr Gastroenterol., 1989; 8(2): 87-88.
21. Subbuswamy SG. Patterns of mucin secretion in human intestinal mucosa. Jr Anat., 1971; 108(2): 291-93.
22. Filipe MI, Munoz N, Matko I, Kato I, Pompe- Kirn V, Jutersek A, et al . Intestinal metaplasia types and risk of gastric cancer: A cohert study in Slovenia. Int J Cancer, 1994; 57: 324-9.
23. Ganga GM. Study of mucin histochemistry in stomach and large intestine of human foetuses and its comparison with normal adult and malignant epithelial tumors of large intestine. PhD Cell Biology, Thesis, Shivai University, Maharashtra, India, 2003.
24. Nikumbh RD, Nikumbh DB, Umarji BN. Mucin histochemical study of the colon in normal and malignant lesions. Int J Health Sci Res., 2012; 2(7): 20-32.
25. Eiman A, Raheem EMA. Demonstration of Mucins in Gastrointestinal Tract Carcinoma Lesions in Sudanese Patients. Int. J. Pure Appl. Sci. Technol., 2014; 21(2): 28-31.
26. Jass J. Mucin Histochemistry of columnar epithelium of Oesophagus: A retrospective study. J clin pathol., 1981; 34(8): 866-870.
27. Ganesh IM, Duraibabu S, Devavaraj H. Mucin glycoarray in gastric and gallbladder epithelia. Journal of Carcinogenesis, 2007; 6: 10.
28. Mirna HF, Kassem AB, Ayman NT, Doha MI, Hassan AH. Effect of mucin production on survival in colorectal carcinoma: A case-controlled study. World J Gastroenterol., 2008; 14: 6981-6985.