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Histological and Histochemical Study of Small Intestine in Adult Stage of Cats

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ABSTRACT: This study was performed to detect histological and histochemical structure of the bowel in adult cats.was approved on six mature cats the body masses it between 3 to 3.5 Kg, which occur in College of Veterinary Medicine, University of Baghdad. Killing euthanized by injection of an overdose of sodium pentobarbital intra-cardiac. Tissue sections from duodenum, jejunum and ileum were treated, sectioned and exposed to specific dyes to detected histological details. small intestine of adult cats is lined by simple columnar epithelium with goblet cells. The general architecture was like to other mammals with few differences.: the shape of the villi various from leaf-similar in the duodenum, pointed in jejunum and leaf-formed in the ileum due to the type nutrition. The Brunner's gland is currently in the initial portion and caudal part of the duodenum and initial part of the jejunum which acts to neutralize the acidity of the food coming from of the stomach with foods. The few numbers of Paneth cells are exhibited with epithelial cells in duodenum. Peyer's spot is current at the termination of jejunum and ileum. Goblet cells were able to secrete a high amount of slimy mucous into the lumen of the bowel small intestine shown the found of non-sulfated acidic mucin in the crypts and intestinal glands while the neutral & sulfated acidic mucins found in the villi and superficial epithelium.

Keywords: Duodenum, Jejunum, Ileum, adult, Histology

1. INTRODUCTION

A domestic cat "*Felis catus*" is part of the genus *Felis*, which is a cluster of small cats containing about seven classes. The cat (*Felis catus)* is a domestic species of small carnivorous animal (1). The

digestive system was played a vital role in food processing and absorption (2). In carnivores the digestive tract appeared shorter in comparison to the herbivore's digestive tract due to the gastrointestinal adaptation to different diets and feeding habits (3,4). Intestine is considered the caudal portion of the alimentary canal which subdivided into a small intestine beginning at the pyloric ending at cecum and the large intestine starting at the cecum and ending at the anus (5,6). A small intestine consist of three portions "duodenum, jejunum and ileum" (7). Microscopically, small intestine is containing many finger-similar projections named villi which act to rise the intestinal surface zone to assist in nutrient absorption process (8).

2. AIMS OF THE STUDY

Study the small intestine parts in adult period of cats, to provide a database for researchers in the field of nutrition and care aimed to the
following:

1. Study histomorphological structure each portion of the small intestine during adult period.
2. Identification of the reaction of the cells and glands in the small intestine with special histochemical stain during the adult period.

3. MATERIALS AND METHODS

Healthy six cats are obtained from Baghdad local market and transported and kept in animal house in the department of anatomy and histology at the College of Veterinary Medicine/University of Baghdad. The animals were kept in this location under observation for seven days then euthanized through intra-heart injection of an overdose of sodium pentobarbital. The representative samples of one centimeter were cut from three part of small intestine. The specimens of small intestine parts were rinse by cold ordinary saline and then directly soaked in neutral buffered formalin10% used for 48 hour Samples were treated by routine histological procedure then 6 µm paraffin segments were gotten by rotary microtome (9). Specimens of adult cats were stained with Harris's Hematoxylin and Eosin and Masson's trichrome stains for general histological feature and for micro morphometric measurements such as epithelial height and thickness of it. The combination of PAS-AB stain was used to staining and detected the glands and cells of small intestine (10).

4. RESULTS AND DISCUSSION

4.1Duodenum

The wall duodenum made from 4 tunics; tunica mucosa, tunica submucosa, tunica muscularis and tunica serosa (Fig1). mean thickness of mucosa was 996.71±10.1µm, the thickness of tunica mucosa was thicker than other tunics created the wall of duodenum this result corresponding with (7). The tunica mucosa of duodenum was having number villi, differ in length, its lined via simple columnar epithelial with striated free margins, the villous was slender leaf molded structure. A microscopic measurement in the duodenum was, the height of epithelial was 32.47±0.52µm, the mucosal villi length was535.45±4.5µm and width villi was 120.52±1.48µm, the Crypt depth was 406.84±5.1 µm (Table1). The average length of villi is higher up to the length of the villi of the jejunum and ileum. This result same as reported by (11) in rabbits. In this study the Goblet cells are located spread among columnar absorptive epithelial cells this result disagree with (12) mention the different number of goblet cells ranging few to medium in end part of the descending duodenum of ewes. The lamina propria underneath the epithelium consist of central of the villi, collagen &reticular fibers, fibrocytes cells, numerous lymphocytes, and mast cells blood capillaries. The muscularis mucosa formed from smooth muscle fiber that separates the mucosal layer from the underlying submucosa (Fig2). This result same like observations had been reported by (13) in some animals. The intestine glands "crypts of Lieberkuhn" were located in the lamina propria and open between the foundations of the villi. This glands They were simple branched tubular forms lined with cuboidal to low columnar epithelium with nucleus position basely and eosinophilic cytoplasm, and were present throughout the duodenum. (Fig2). The deepness of crypts in duodenum was meaningfully over the jejunum & ileum "Table 1". This result corresponding with (7) in neonatal cats. The variations were identical for each part of the small intestine. Parallel villous growth was described before in the intestinal mucosa of local rabbits by (14), (15) and (16).

The thickness of tunica submucosa was 147.60±1µm. Tunica submucosa made from collagen fibers and reticular fibers, fibrocytes, blood vessels and lymphocytes cells. large part of submucosal tissue was contain Brunner’s gland that was specially found in the duodenum (13) in domestic animals mention. The mean thickness of submucosal layer was meaningfully more than that of the jejunum &less than ileum (Table1) that might be because of the occurrence of Brunner’s glands in the tunica submucosa of duodenum whereas it was not found along tunica submucosa of jejunum amount of paneth cells were noted in the bases of the intestinal crypts (Fig2) as same as the result by (17,18) in indigenous gazelle, and (18) in Angora rabbits.

the mean thickness of tunica muscularis was 271.83±1.75µm.The Auerbach's plexuses similar beads dispersed linearly in the connective tissue existed among the inner layer and outer layers of tunica muscularis. The tunica muscularis involved of two layer of involuntary smooth muscle fiber, dense internal circular layer & thin external longitudinal smooth muscle layers(Fig3). Among the two muscle layers fiber myenteric nerve plexuses, was found (Fig3)this result is closer to persons noted before in the bowel of indigenous rabbit, rat, *Caviaporcellu* &mice (19).A tunica serosa consist of collagen and little elastic fibers. Similar observations were mention by (12) in sheep.

4.2 Jejunum

wall of the jejunum in adult's cats consist from the following tunics:

"Tunica mucosa, tunica submucosa, tunica muscularis and tunica serosa" (Fig7). tunica mucosa had villi of various forms &dimension lined by simple columnar epithelial had little goblet cells(Fig5). the mean thickness of tunica mucosa was 856.41±13.1µm (Table1).the mean of height epithelium was 30.37±0.32µm, Villi length, Villi width and Crypt depth were 455.45±42.5µm,165.52±4.48 µm and 306.74±5.1µm respectively(Table1) In agreement with the findings of (7) in neonatal cats they were mentions the coating epithelial was simple columnar with striated free margins and goblet cells same as duodenum. A villi were tip sharp and elongated in its forward portion whereas villi were wide and blunted designed in posterior portion near ileum part (Fig5). number of goblets cells varied from few to moderate since cranial to caudal termination of the jejunum. Muscularis mucosa made from smooth muscle filaments& parted the tunica mucosa from the underlying tunica submucosa. (20) they mention similar observations in the jejunum of the. indigenous Gazelle, at limited place it was interrupted because of the presence of great amount of lymphoid tissue and extension of crypts of lieberkuhn. The crypts of Lieberkuhn glands were like in construction to those notice in the duodenum and were current in the length of the jejunum (Fig6). This result same was reported by(21)in Oryctolagus Cuniculus. The tunica submucosa was made from loose irregular, connective tissue , cells, tiny blood capillaries along with elastic collagen and reticular fiber, the Brunner glands less number than the duodenum which was found in the cranial part of the jejunum and decrease toward the ileum(Fig5), the mean thickness of tunica submucosa was 137.50±2.28 µm (Table1) These consequences were similar to the opinion in pigs and large herbivores by (22), and in rabbits by (23) who observed that the Brunner glands were scattered to begin from the pylori-duodenal connection reach to the jejunum. Payer's spots were current towards the caudal termination of the jejunum and at Jejuno-ileal connection. This result corresponded with (24) in cats.

Tunica muscular was created by inner circular layer and outer longitudinal layer of smooth muscles fibers , in the middle of these layers there were blood vessels, nerves bundle (Fig7) the mean thickness of it was 271.73±11.75 µm. that had non-significant difference with that of the duodenum however was significantly fewer than that of the ileum (Table1). among the two muscle layers, myenteric plexuses was present this results were similar with (25,26).

Tunica serosa was included of loose irregular connective tissue having white, yellow and lymphatic fibers along with variable quantity of fatty tissue(fig). which parallels the histological component to the observation by (7) in indigenous rabbits

4.3 Ileum

Histological structure of ileum same like to notice in individually duodenum and jejunum. villi were leaf shape as like of duodenum villi compared to the shaped villi of jejunum (Fig9), this result corresponding with (21) in Oryctolagus Cuniculus. The coating epithelium was simple columnar with many goblet cells. Depth of the crypts in ileum was significantly smaller than in the duodenum and jejunum because of the more superficial arrangement of the mucosal glands in individually the jejunum and ileum, whereas this glands position in several layer in duodenum wall. (27) mention the ileal villi of Angora rabbits were spindle-shaped. The lining epithelium was simple columnar with many goblet cells. (Fig9). ileal crypts depth was significantly fewer than the duodenum and jejunum that might be because of the more superficial arrangement of mucosal glands in individually the jejunum and ileum however not in case of duodenum where the glands were situated in several layers(7).the mean thickness of tunica mucosa was 776.71±11.1µm, the mean height of epithelial was 28.47±0.42 µm, the Villi length, Villi width and Crypt depth were 395.45±3.5µm,130.52±8.48µm and 356.84±5.1µm respectively. A aggregation of lymphocytes were located in the first part of the ileum (Fig10) which were called (Peyer's patch). The tunica submucosa was made from loose irregular, connective tissue, cells, fine blood capillaries along with yellow, white and reticular fiber the mean thickness of it was157.60±6.18µm. The thickness of tunica submucosa raises meaningfully higher than that of the jejunum due to the occurrence of accumulation of lymph nodules in this tunica to form Peyer's patch (Fig10). microfold cells found in the follicles of Peyer patch with epithelial cells (Fig12),(14) also mention the occurrence of great accumulated lymphatic nodules "Peyer's patch" in the tunica submucosa of ileum in other animals. Cylindrical projections, which are round folds of the mucosal mucosa and submucosa were detected on the ileal layers "plica circularis"(Fig9).Tunica muscularis made from 2 layers of smooth muscles fibers "inner circular muscles layer and outer longitudinal muscles layer" (Fig11),the mean thickness of it was

291.83±4.75µm(Table1) The mean thickness of tunica muscularis revealed significant raise in its thickness than that of the duodenum and jejunum due to that the ileum work as temporary termination area for the chymes so that it could make prepared the intestinal contents for cecum absorption. The myenteric nerve plexuses, (Auerbach's) were well advanced and upper in quantity in ileum than noticed in other parts of small intestine this result corresponding with (11).

4.4 Histochemical

The Goblet cells and Brunner's glands be present able to discharge a high amount of slimy material into the cavity of the small intestine. The spreading of liquid secretion through goblet cells distinguishes by histochemical dyes, which showed the manifestation of neutral slimy mucin in the mucosal lining of the small intestine in neonatal (Fig4,8,12). The sulfated acidic mucin was abundant in the neonatal kittens the non-sulphated [carboxylated] mucin was the main kind. The response of combined PAS–AB shown the incidence of mixed mucin (neutral and acidic) in adult cats and in the brush margin of all small intestinal parts (duodenum, jejunum and ileum). Recent results were in agreement with **(28)** in New Zealand and (29) in adult cat.

Table (1): Micro morphometric measurement of duodenum, jejunum and ileum in adult aged of cats, Mean ± Standard error (M±SE).

Parameter	Duodenum	Jejunum	Ileum
Tunica mucosa	996.71±10.1 a	856.41±13.1 c	776.71±11.1 b
Height of epithelial	32.47±0.52 a	30.37±0.32 a	28.47±0.42 b
Villi length	535.45±4.5 a	455.45±42.5 c	395.45±3.5 b
Villi width	120.52±1.48 b	165.52±4.48 a	130.52±8.48 c
Crypt depth	406.84±5.1 a	306.74±5.1 b	356.84±5.1 c
Tunicasubmucsa	147.60±1 c	137.50±2.28 b	157.60±6.18 a
Tunicamuscularis	271.83±1.75 b	271.73±11.75 b	291.83±4.75 a

The similar letters represent no significant differences between two groups at P<0.05.

The different letters represent significant differences between two groups.

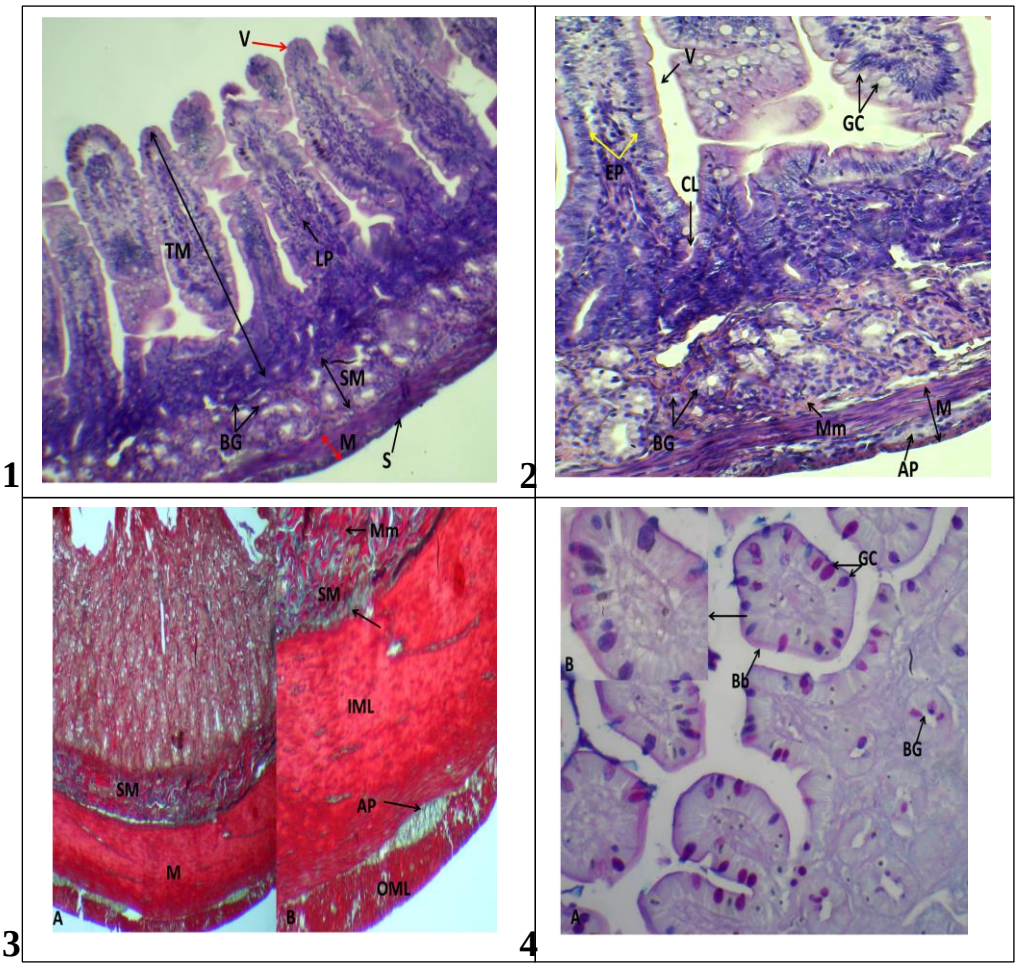

Figure1:show the tunics of duodenum: tunica mucosa(TM), lamina propria, villi(V), (LP)tunica submucosa(SM),tunica muscularis (M),tunica serosa(S). Brunner glands(BG),.H&E.X40.

Figure2: show the villi of duodenum(V) the epithelial lining of mucosa(EP).lamina propria (LP).Brunner glands (BG),Crypt of liberkuhan(CL),Goblet cells(GC),muscularis mucosa (Mm),tunica muscularis (M),Aurebach plexuses (AP).H&E.X100.

Figure3 A Micrograph to the duodenum in adult cats shows: tunica submucosa (SM), tunica muscularis (M).X40.**B** Micrograph to the duodenum in adult cats shows :Muscularis mucosa (Mm), tunica submucosa (SM),Henle's plexus (black arrow).Inner muscular layer (IML), Auerbach's plexuses (AP),outer muscular layer(OML).X100 Masson's trichrom stain.

Figure 4A: Microphotograph demonstrations the stain of goblet cells in duodenal mucosa of cats shows: Brunner gland(BG),Brush border and goblet cells stained magenta with PAS and blue colored goblet cell with AB, X100 Combined Alcian blue and PAS stain. B: magnification section in villus. X400

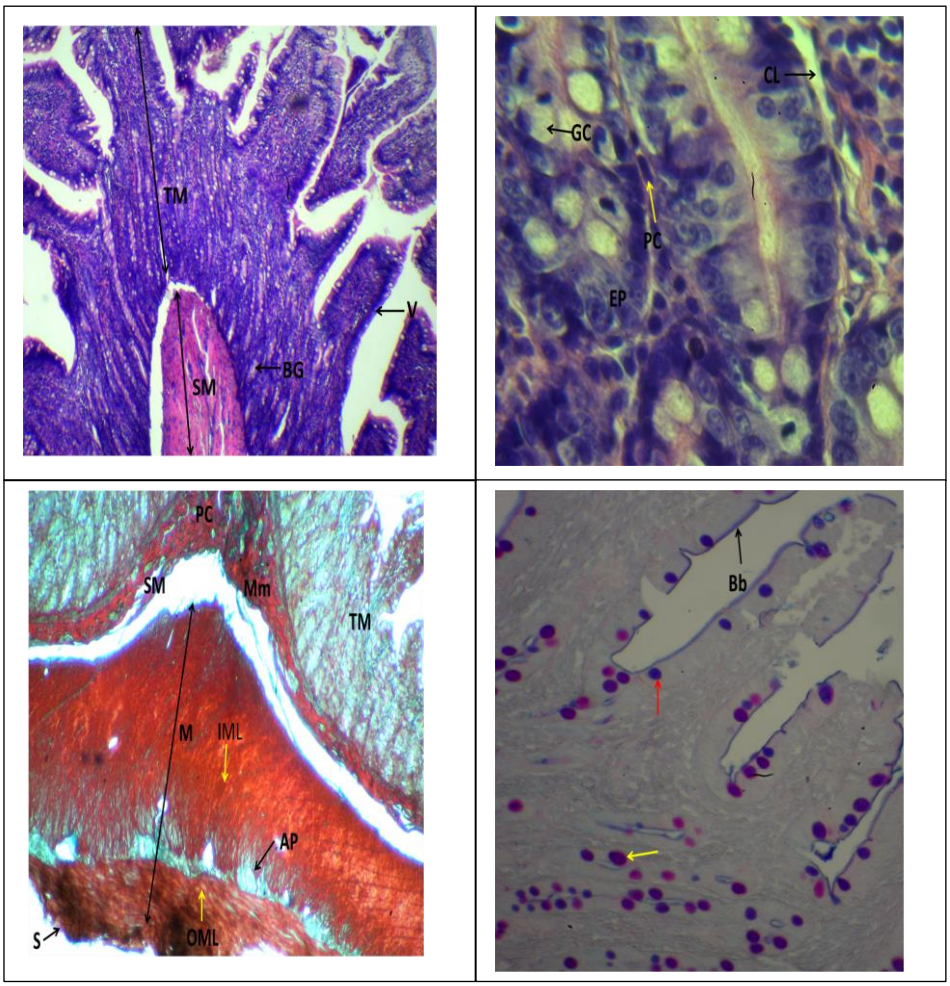

Figure5: Micrograph to the jejunum in adult cats shows: mucosa(TM),Villi (V),Brunner gland(BG), tunica tunica submucosa (SM). X100.H &E stain.

Figure6: Micrograph to the jejunum in adult cats shows: Paneth Cell (PC), Goblet cell (GC),Epithlial cell(EP),Crypt of Lieberkühn. X400.H &E stain.

Figure7: Micrograph to the jejunum in adult cats shows: plica circularis (PC), tunica mucosa (TM),tunica submucosa(SM), Muscularis mucosa (Mm),tunica muscularis(M),innar muscular layer(IML),outer muscular layer (OML), Auerbach's plexuses (AP),tunica serosa(S). X100. Masson's trichrom stain.

Figure8: Micrograph to the jejunum in adult cats shows: positive reaction goblet cells stained magenta with PAS (yellow arrow) and blue colored goblet cell with AB (red arrow),Brush border (Bb). X100. Combined Alcian blue and PAS stain.

In conclusion, the histomorphological observations of an adult cat's small intestine look just like that of the carnivores to which it belongs.

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