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**18/MHS03/008**

**DEPARTMENT OF HUMAN ANATOMY**

**ANA 204**

**QUESTION**

Describe the microanatomy of small and large intestine. Note: you are expected to state the functions, segment, layers, general features and epithelium of each part of the small and large intestine.

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| --- | --- | --- |
| **Basis of comparison** | **Small intestine** | **Intestine intestine** |
| Size | Small intestine measures around 4.5 - 7.0 m in size.  It is narrow in width of around 3.5 - 4.5 cm. | Large intestine measures around 1.5 m in size. |
| Parts | It has three parts, which are duodenum, jejunum and ileum. | It has four parts, which are colon, rectum, caecum and anal canal. |
| Circular folds | Internal surface of small intestine has circular folds, also called as 'palicae circulares'. | Circular folds are absent. |
| Presence of villi | Villi are present | Villi are absent |
| Peter patches | Peter patches are present | Peter patches are absent |
| Muscle bands | It forms the layer of continuous bands of muscles around it. | It is reduced to three types of muscles bands called as taeniae coli. |
| Hastura | Absent | Present |
| Epiploic appendages | Epipolic apppedages is absent in small intestine. | Epipolic appendages are present |

**Large intestine**

Consists of the cecum, colon, anal canal and rectum.• The colon is further subdivided on the basis of its anatomic location into • ascending colon • transverse colon• descending colon

• sigmoid colon. • The four layers characteristic of the alimentary canal are present throughout.

• However, several distinctive features exist at the gross level

Teniae coli represent three narrowed, thickened, equally spaced bands of the outer longitudinal layer of the muscularis externa.• They are primarily visible in the cecum and colon and they are absent in the rectum, anal canal and vermiform appendix.• • Haustra coli are visible sacculations between the teniae coli on the external surface of the cecum and colon.• • Omental appendices are small fatty projections of the serosa, observed on the outer surface of the colon.

**Cecum and colon**

The mucosa of the cecum and colon lacks villi and posseses no special folds.

The epithelium of the cecum and colon is simple columnar with many goblet cells, numerous absortbtive cells and some DNES cells.

The lamina propria posseses lymphoid nodules, blood and lymph vessels, and closely packed crypts of Lieberkühn, which lack Paneth cells.

B)The muscularis external consists of an inner circular and an outer longitudinal layer of smooth muscle cells.

B) The submucosa of the cecum and colon consists of fibroelastic connective tissue.

D) External layer of the cecum and colon

Aventicia covers the ascending and descending portions of the colon

Serosa covers the cecum and the remaining part of the colon.

**The rectum and the Anal canal**

Is similar to the colon but contains fewer and deeper crypts of Lieberkühn

The anal mucosa displays longitudinal folds called anal columns (or rectal columns of Morgagni), which join each other to form anal valves

The regions between adjacent valves are known as anal sinuses.

(A) Epithelium of the anal canal

(I) is simple columnar changing to simple cuboidal proximal to the anal valves.

(ii) is stratified squamous nonkeratinized distal to the anal valves.(iii) changes to stratified squamous keratinized (epidermis) at the anus.

(B) The lamina propria is composed of fibroelastic connective tissue and contains sebaceous glands, circumanal glands, hair follicles, and large veins.

(3)The muscularis mucosae consists of an inner circular and an outer longitudinal layer of smooth muscle, both of which terminate at the anal valves.The anal submucosa is composed of dense, irregular fibroelastic connective tissue that houses large veins. The anal muscularis externa is composed of an inner circular and an outer longitudinal layer of smooth muscle. The inner circular layer forms the internal anal sphincter.Anal adventitia attaches the anus to surrounding structures.The external anal sphincter is composed of skeletal muscle whose superficial and deep layers invest the anal canal. It exhibits continuous tonus, thus maintaining a closed anal orifice. The degree of tonus is under voluntary control, so the retention or evacuation of feces normally can be controlled at will.

**Small intestine**

Consists of 3 parts;

Duodenum

Jejunum

Illeum

Duodenum (25 cm long) is the first, shortest, and widest part of the small intestine. It begins at the pylorus of the stomach and ends at the duodenojejunal junction.• Jejunum (2.5 m long) begins at the duodenojejunaljunction and constitutes the upper two fifths of the small intestine.

• It gradually changes its morphologic characteristics to become the ileum• Ileum (3.5 m long) is a continuation of the jejunum and constitutes the lower three fifths of the small intestine.• It ends at the ileocecal junction, the union of the distal ileum and cecum

FUNCTIONS The small intestine is the the principal site for the digestion of food, nutrient absorption, and endocrine secretion.

The processes of digestion are completed in the small intestine, where the nutrients are absorbed by cells of the epithelial lining.

Chyme from the stomach enters the duodenum, where enzymes from the pancreas and bile from the liver are also delivered to continue the solubilization and digestion process.• Enzymes, particularly disaccharidases and dipeptidases are also located in the glycocalyx of the microvilli of the enterocytes, the intestinal absorptive cells. • These enzymes contribute to the digestive process bycompleting the breakdown of most sugars and proteins to monosaccharides and amino acids, which are then absorbed• Water and electrolytes that reach the small intestine with the chyme and pancreatic and hepatic secretions are alsoreabsorbed in the small intestine, particularly in the distal portion**.**

**Luminal surface modifications**• possesses plicae circulares, intestinal villi, and microvilli, which collectively increase the luminal surface area by a factor of 400 to 600.• a. Plicae circulares or circular fold (valves of Kerckring) are permanent spiral folds of the mucosa and submucosa that are present in the distal half of the duodenum, the entire jejunum and the proximal half of the ileum.• Plicae circulares increase the surface area twofold tothreefold.• b. Intestinal villi are permanent evaginations that possess, in their connective tissue (lamina propria), numerous plasma cells and lymphocytes

**Mucosa of the small intestine**

(A)The epithelium of the mucosa of the small intestine is simple columnar.

It is composed of goblet cells, surface absorptive cells, and some DNES cells

(1) Goblet cells

Interspersed between the absorptive cells.

They are less abundant in the duodenum and more numerous in the ileum.

These cells produce glycoprotein mucins that are hydrated and cross-linked to form mucus, whose main function is to protect and lubricate the lining of the intestine.

Have their nucleus and other organelles in the basal region

(2) Surface absorptive cellsAre tall columnar cells with numerous mitochondria, smooth endoplasmic reticulum (SER) and RER, and a Golgicomplex.

a layer of closely packed microvilli (striated or brush border) on their free apical surface.

a glycocalyx, which overlies the microvilli and binds various enzymes, including disaccharidases and dipeptidases. Disaccharidases and peptidases secreted by these cells and bound to the microvilli hydrolyze the disaccharides and dipeptides into monosaccharides and amino acids that are easily absorbed through active transport.

Digestion of fats results from the action of pancreatic lipase and bile.

In humans, most of the lipid absorption takes place in the duodenumand upper jejunum Have well-developed tight junctions and zonula adherens. (3) DNES cells produce and secrete gastrin, cholecystokinin, gastric inhibitory peptide and several other hormones (diffuse neuroendocrine system)

(4) Paneth cells

Are located in the basal portion of the intestinal crypts below the stem cells They are exocrine cells with large, eosinophilic secretory granules in their apical cytoplasm.

Paneth cell granules undergo exocytosis to release lysozyme, phospholipase A2, and hydrophobic peptides called defensins, all of which bind and breakdown membranes of microorganisms and bacterial walls..

Paneth cells have an important role in innate immunity and in regulating the microenvironment of the intestinal crypt ( regulation of normal bacterial flora of the small intestine ).

(5) M (microfold) cells are specialized epithelial cells in the ileum overlying the lymphoid follicles of Peyer patches.These cells are characterized by the presence of basal membrane invaginations or pockets containing many intraepithelial lymphocytes and antigen-presenting cells. M cells selectively endocytose antigens and transport them to the underlying macrophages and lymphocytes, which then migrate to lymph nodes where immune responses to foreign antigens are initiated.

M cells thus serve as sampling stations where material in the lumen of the gut is transferred to immune cells of the MALT in the lamina propria. The basement membrane under the M cells is porous, facilitating transit of cells between the lamina propria and the pockets of M cells

**(B). Lamina propria through Serosa**

(1) occupies the cores of the villi and the interstices between the numerous glands (crypts) of Lieberkühn .

(2) consists of loose connective tissue with lymphoid cells, fibroblasts, mast cells, smooth muscle cells, nerve endings, and lymphoid nodules.

(3) Smooth muscle fibers inside the villi are

responsible for their rhythmic movements, which areimportant for efficient absorption.

The muscularis mucosae also produces local movements of the villi and plicae circulares

(4) also contains lacteals (blind-ended lymphatic vessels) and capillary loops.

**Submucosa of the small intestine**(A). consists of fibroelastic connective tissue containing blood and lymphatic vessels, nerve fibers, and Meissner plexus.(B). also houses Brunner glands, which are present only in the duodenum.

These glands produce an alkaline fluid and urogastrone.

The former protects the duodenal epithelium from the acidic chyme; the latter is a polypeptide hormone (human epidermal growth factor) that enhances epithelial cell division and inhibits gastric HCl production.

C. Fats are degraded by pancreatic lipase into monoglycerides, free fatty acids, and glycerol in the lumen of the small intestine

1. Absorption of lipid digestion products occurs primarily in the duodenum and upper jejunum.

(A) salts act on the free fatty acids and monoglycerides, forming watersoluble micelles.

(B) and glycerol then enter the surface absorptive cells.

2. Formation of chyle

(A)Triglycerides are resynthesized from monoglycerides and free fatty acids within the SER.(B) Chylomicrons are formed in the Golgi complex by the complexing of the resynthesized triglycerides with proteins. Chylomicrons are transported to the lateral cell membrane and released by exocytosis; after crossing the basal lamina, they enter lacteals in the lamina propria to contribute to the formation of chyle

Chyle enters the submucosal lymphatic plexus by contraction of smooth muscle cells in the intestinal villi.