SANI NANA FATIMA

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MEDICAL LABORATORY SCIENCES

ANA 204

- **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.**

MICROANATOMY OF SMALL AND LARGE INTESTINE.

SMALL INTESTINE.

Functions:

- The main work of digestion takes place here.
- Lined with **villi** and **Microvilli** to increase surface area and absorption of nutrients.
- Completes digestion of food.
- Receives Secretions from the pancreas and the liver to aid in digestion.
- Secretion of hormones cholecystokinin(CCK) and secretin.

Segment.

- The small Intestine has three dinstinct regions- the duodenum, jejunum, and ileum.
- **The duodenum**, the shortest, is where preparation for absorption through small fingerlike protrusions called Villi begins. The first part of the small intestine that starts at the lower end of the stomach and extending to the jejunum.
- **The Jejunum:** specialized for the absorption through its lining by ***enterocytes***;

particles which have been digested by ***enzymes*** in the duodenum. The last, and usually the longest, division of the small intestine; the part between the jejunum and large intestine.

- **Ileum:** Absorbs Vitamin B_{12}, bile salts, and the others are not absorbed by the jejunum. small intestine: The upper part of the intestine, between the stomach and the large intestine, that is divided into the duodenum, the jejunum, and the ileum.

LAYERS.

The small intestine has four tissue layers;

- **The serosa** is the outermost layer of the intestine. The serosa is a smooth membrane consisting of a thin layer of cells that secrete serous fluid, and a thin layer of connective tissue. Serous fluid is a lubricating fluid that reduces friction from the movement of the muscularis.
- **The muscularis** is a region of muscle adjacent to the submucosa membrane. It is responsible for gut movement, or peristalsis. It usually has two distinct layers of smooth muscle: circular and longitudinal.

  The submucosa is the layer of dense, irregular connective tissue or loose connective tissue that supports the mucosa, as well as joins the mucosa to the bulk of underlying smooth muscle.
- **The mucosa** is the innermost tissue layer of the small intestines, and is a mucous membrane that secretes digestive enzymes and hormones. The intestinal villi are part of the mucosa.

The three sections of the small intestine look similar to each other at a microscopic level, but there are some important differences. The jejunum and ileum do not have Brunner's glands in the submucosa, while the ileum has Peyer's patches in the mucosa, but the duodenum and jejunum do not.

Brunner's Glands

Brunner's glands (or duodenal glands) are compound tubular submucosal glands found in the duodenum. The main function of these glands is to produce a mucus-rich, alkaline secretion (containing bicarbonate) in order to neutralize the acidic content of chime that is introduced into the duodenum from the stomach, and to provide an alkaline condition for optimal intestinal enzyme activity, thus enabling absorption to take place and lubricate the intestinal walls.

Peyer's Patches

Peyer's patches are organized lymph nodules. They are aggregations of lymphoid tissue that are found in the lowest portion of the small intestine, which differentiate the ileum from the duodenum and jejunum.

Because the lumen of the gastrointestinal tract is exposed to the external environment, much of it is populated with potentially pathogenic microorganisms. Peyer's patches function as the immune surveillance system of the intestinal lumen and facilitate the generation of the immune response within the mucosa.

Intestinal Villi

This is a low-magnification micrograph of small intestinal mucosa that shows villi.

Intestinal villi (singular: villus) are tiny, finger-like projections that protrude from the epithelial lining of the mucosa. Each villus is approximately 0.5–1.6 mm in length and has many microvilli (singular: microvillus), each of which are much smaller than a single villus.

Villi increase the internal surface area of the intestinal walls. This increased surface area allows for more intestinal wall area to be available for absorption. An increased absorptive area is useful because digested nutrients (including sugars and amino acids) pass into the villi, which is semi-permeable, through diffusion, which is effective only at short distances. Small intestine, a long, narrow, folded or coiled tube extending from the stomach to the large intestine; it is the region where most digestion and absorption of food takes place. It is about 6.7 to 7.6 metres (22 to 25 feet) long, highly convoluted, and contained in the central and lower abdominal cavity.

EPITHELIUM

The epithelium of the small intestine lines the luminal surface. There are a number of components to the epithelium:

- **Enterocytes** – Tall columnar cells, which have an absorptive function. They contain brush border enzymes on the surface which have an important digestive function.
- **Goblet cells** – Exocrine glands which secrete mucin.
- **Crypts of Lieberkuhn**

The Crypts of Lieberkuhn are glands found in the epithelial lining. They contain numerous cells such as stem cells to produce new cells to replenish the cells lost due to abrasion, as well as enteroendocrine cells to synthesise

and secrete hormones.

To protect from pathogens, there are Paneth cells which secrete protective agents (such as defensins and lyzozymes) and Peyer's patches which are only found in the ilium. Peyer's patches contain mucosal-associated lymphatic tissue (MALT) which house white blood cells and lymphocytes. These cells can produce antibodies to further protect the small intestine from infection.

LARGE INTESTINE.

Function:

- Receives food and fluids from Small Intestine.
- Absorbs water from solid wastes.
- Eliminates waste by evacuation of bowels.
- Linked with the lungs.
- Ability to let go of old patterns, habits, things.
- Channel influences sinuses, jaw, teeth.
- Energy of characteristics like; honor, duty, respect, fairness, responsibility.

Segment

- **Appendix:** An inner organ without any known use that can become inflamed.
- **Cecum:** A pouch, usually peritoneal, that is considered to be the beginning of the large intestine.
- **Colon:** The part of the large intestine that is the final segment of the digestive system, after (distal to) the ileum and before (proximal to) the anus.

Layers.

- The innermost layer, known as the mucosa, is made of simple columnar epithelial tissue. The mucosa of the large intestine is smooth, lacking the villi found in the small intestine. Many mucous glands secrete mucus into the hollow lumen of the large intestine to lubricate its surface and protect it from rough food particles.
- Surrounding the mucosa is a layer of blood vessels, nerves and connective

tissue known as the submucosa, which supports the other layers of the large intestine.

- The muscularis layer surrounds the submucosa and contains many layers of visceral muscle cells that contract and move the large intestine. Continuous contraction of smooth muscle bands in the muscularis produces lumpy, pouch-like structures known as haustra in the large intestine.

Finally, the serosa forms the outermost layer. The serosa is a thin layer of simple squamous epithelial tissue that secretes watery serous fluid to lubricate the surface of the large intestine, protecting it from friction between abdominal organs and the surrounding muscles and bones of the lower torso.

The large intestine performs the vital functions of converting food into feces, absorbing essential vitamins produced by gut bacteria, and reclaiming water from feces. A slurry of digested food, known as chyme, enters the large intestine from the small intestine via the ileocecal sphincter. Chyme passes through the cecum where it is mixed with beneficial bacteria that have colonized the large intestine throughout a person's lifetime. The chyme is then slowly moved from one haustra to the next through the four regions of the colon. Most of the movement of chyme is achieved by slow waves of peristalsis over a period of several hours, but the colon can also be emptied quickly by stronger waves of mass peristalsis following a large meal.

General Features.

The large intestine is the final section of the gastrointestinal tract that performs the vital task of absorbing water and vitamins while converting digested food into feces. Although shorter than the small intestine in length, the large intestine is considerably thicker in diameter, thus giving it its name. The large intestine is about 5 feet (1.5 m) in length and 2.5 inches (6-7 cm) in diameter in the living body, but becomes much larger postmortem as the smooth muscle tissue of the intestinal wall relaxes.

The large intestine wraps around the border of the abdominal body cavity from the right side of the body, across the top of the abdomen, and finally down the left side.

Epithelium:

- **columnar epithelium:** Epithelial cells whose heights are at least four times their width.
- **mucin:** A family of high molecular weight, heavily glycosylated proteins (glycoconjugates) produced by the epithelial tissues in most metazoans.
- **goblet cells:** Glandular, simple, columnar epithelial cells whose sole function is to secrete mucin, which dissolves in water to form mucus.

The large intestine, or large bowel, is the last part of the digestive system in

vertebrate animals. Its function is to absorb water from the remaining indigestible food matter, and then to pass the useless waste material from the body. The large intestine consists of the cecum, colon, rectum, and anal canal.

It starts in the right iliac region of the pelvis, just at or below the right waist, where it is joined to the bottom end of the small intestine. From here it continues up the abdomen, across the width of the abdominal cavity, and then it turns downward, continuing to its endpoint at the anus.

The large intestine differs in physical form from the small intestine in being much wider. The longitudinal layer of the muscularis is reduced to three strap-like structures known as the taeniae coli—bands of longitudinal muscle fibers, each about 1/5 in wide. These three bands start at the base of the appendix and extend from the cecum to the rectum. Along the sides of the taeniae are tags of peritoneum filled with fat; these are called epiploic appendages, or appendices epiploicae. The wall of the large intestine is lined with simple columnar epithelium.

Instead of having the evaginations of the small intestine (villi), the large intestine has invaginations (the intestinal glands). While both the small intestine and the large intestine have goblet cells that secrete mucin to form mucus in water, they are abundant in the large intestine.

Sigmoid colon: A photograph of the large bowel (sigmoid colon) that shows multiple diverticula on either side of the longitudinal muscle bundle (Taenia coli).

In histology, an intestinal crypt—called the crypt of Lieberkühn—is a gland found in the epithelial lining of the small intestine and colon. The crypts and intestinal villi are covered by epithelium that contains two types of cells: goblet cells that secrete mucus and enterocytes that secrete water and electrolytes.

The enterocytes in the mucosa contain digestive enzymes that digest specific food while they are being absorbed through the epithelium. These enzymes include peptidases, sucrase, maltase, lactase and intestinal lipase. This is in contrast to the stomach, where the chief cells secrete pepsinogen. In the intestine, the digestive enzymes are not secreted by the cells of the intestine. Also, new epithelium is formed here, which is important because the cells at this site are continuously worn away by the passing food. The basal portion of the crypt, further from the intestinal lumen, contains multipotent stem cells.

During each mitosis, one of the two daughter cells remains in the crypt as a stem cell, while the other differentiates and migrates up the side of the crypt and eventually into the villus. Goblet cells are among the cells produced in this fashion. Many genes have been shown to be important for the differentiation of intestinal stem cells. The loss of proliferation control in the crypts is thought to lead to colorectal cancer.