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**18/MHS03/007**

**ANA 204**

**ANATOMY**

**QUESTION: Describe the microanatomy of the small and large intestine.**

### **SMALL INTESTINE**

The small intestine is an organ in the gastrointestinal tract where most of the end absorption of nutrients and mineral from takes place. It lies between the stomach and large intestine it also receives bile and pancreatic juice through the pancreatic duct to aid in digestion.

### **PARTS/STRUCTURES OF THE SMALL INTESTINE**

The small intestine is divided into subdivisions. From the proximal to distal, these are the duodenum, jejunum and ileum.

The **Deudemum** is a short structure about 20cm in length and shaped like a “C”. it surrounds the head of the pancreas. It receives gastric chyme from the stomach, together with digestive juices from the pancreas (digestive enzymes) and the liver. The digestive enzymes break down proteins and bile emulsifies fats into micelles. The duodenum contains Brunner's glands, which produce a mucus-rich alkaline secretion containing bicarbonate. These secretions, in combination with bicarbonate from the pancreas, neutralize the stomach acids contained in gastric chyme.

The **Jejunum** is the midsection of the small intestine, connecting the duodenum to the ileum. It is about 2.5 m long, and contains the plicaeulares, and villi that increase its surface area. The products of digestion are absorbed into the blood stream here.

The ileum is the final section of the small intestine. It is about 3 m long, it is the longest part of the small intestine and contains villi similar to the jejunum. It absorbs mainly vitamin B12 and bile acids, as well as any other remaining nutrients. The ileum joins to the cecum of the large intestine at the ileocecal junction.

## HISTOLOGY

The wall of the small intestine is composed of the same four layers typically present in the alimentary system. However, three features of the mucosa and submucosa are unique. These features, which increase the absorptive surface area of the small intestine more than 600-fold, include circular folds, villi, and microvilli. These adaptations are most abundant in the proximal two-thirds of the small intestine, where the majority of absorption occurs. It is lined by simple columnar epithelium.

### **Circular folds**

Also called a plica circular, a **circular fold** is a deep ridge in the mucosa and submucosa. Beginning near the proximal part of the duodenum and ending near the middle of the ileum, these folds facilitate absorption. Their shape causes the chyme to spiral, rather than move in a straight line, through the small intestine. Spiralling slows the movement of chyme and provides the time needed for nutrients to be fully absorbed.

### **Villi**

Within the circular folds are small (0.5–1 mm long) hair like vascularized projections called **villi** that give the mucosa a furry texture. There are about 20 to 40 villi per square millimeter, increasing the surface area of the epithelium tremendously. The mucosal epithelium, primarily composed of absorptive cells, covers the villi. In addition to muscle and connective tissue to support its structure, each villus contains a capillary bed composed of one arteriole and one venule, as well as a lymphatic capillary called a **lacteal**. The breakdown products of carbohydrates and proteins (sugars and amino acids) can enter the bloodstream directly, but lipid breakdown products are absorbed by the lacteals and transported to the bloodstream via the lymphatic system.

## **Microvilli**

As their name suggests, **microvilli** are much smaller ( $1\ \mu\text{m}$ ) than villi. They are cylindrical apical surface extensions of the plasma membrane of the mucosa's epithelial cells, and are supported by microfilaments within those cells. Although their small size makes it difficult to see each microvillus, their combined microscopic appearance suggests a mass of bristles, which is termed the **brush border**. Fixed to the surface of the microvilli membranes are enzymes that finish digesting carbohydrates and proteins. There are an estimated 200 million microvilli per square millimeter of small intestine, greatly expanding the surface area of the plasma membrane and thus greatly enhancing absorption.

## **FUNCTION**

### **Digestion**

The small intestine is where most chemical digestion takes place. Many of the digestive enzymes that act in the small intestine are secreted by the pancreas and liver and enter the small intestine via the pancreatic duct. Pancreatic enzymes and bile from the gallbladder enter the small intestine in response to the Hormone cholecystikinin, which is produced in the small intestine in response to the presence of nutrients. Secretin, another hormone produced in the small intestine, causes additional effects on the pancreas, where it promotes the release of bicarbonate into the duodenum in order to neutralize the potentially harmful acid coming from the stomach.

### **Absorption**

Digested food is now able to pass into the blood vessels in the wall of the intestine through either diffusion or active transport. The small intestine is the site where most of the nutrients from ingested food are absorbed. The inner wall, or mucosa, of the small intestine, is lined with simple columnar epithelial tissue. The individual epithelial cells also have finger-like projections known as microvilli. The functions of the plicae circulares, the villi, and the microvilli are to increase the amount of surface

area available for the absorption of nutrients, and to limit the loss of said nutrients to intestinal fauna.

### **Immunological**

The small intestine supports the body's immune system. The presence of gut flora appears to contribute positively to the host's immune system. Peyer's patches, located within the ileum of the small intestine, are an important part of the digestive tract's local immune system. They are part of the lymphatic system, and provide a site for antigens from potentially harmful bacteria or other microorganisms in the digestive tract to be sampled, and subsequently presented to the immune system.

## **LARGE INTESTINE**

The large intestine is the last part of the gastrointestinal tract and of the digestive system in vertebrates. Water is absorbed here and the remaining waste material is stored as feces before being removed by defecation.

### **PARTS/STRUCTURES OF THE LARGE INTESTINE**

The large intestine runs from the appendix to the anus. It frames the small intestine on three sides. Despite its being about one-half as long as the small intestine, it is called large because it is more than twice the diameter of the small intestine, about 3 inches.

### **SUBDIVISIONS**

The large intestine is subdivided into four main regions: the cecum, the colon, the rectum, and the anus. The ileocecal valve, located at the opening between the ileum and the large intestine, controls the flow of chyme from the small intestine to the large intestine.

The **Cecum** is the first section of the colon involved in digestion, while the appendix which develops embryologically from it, is a structure of the colon, not involved in digestion and considered to be part of the gut-associated lymphoid tissue. The function of the appendix is uncertain, but some sources believe that the appendix has a role in housing a sample of the colon's microflora, and is able to help to repopulate the colon with bacteria if the microflora has been damaged during the course of an immune reaction. The appendix has also been shown to have a high concentration of lymphatic cells. The cecum blends seamlessly with the colon.

Upon entering the **Colon**, the food residue first travels up the ascending colon on the right side of the abdomen. The colon consists of four parts:

- Ascending colon: Using muscle contractions, this part of the colon pushes any undigested debris up from the cecum to a location just under the right lower end of the liver.
- Transverse colon: Food moves through this second portion of the colon, across your front (or anterior) abdominal wall, traveling from left to right just under your stomach.
- Descending colon: The third portion of colon pushes its contents from just near the spleen, down to the lower left side of your abdomen.
- Sigmoid colon: The final S-shaped length of the colon, curves inward among the coils of your small intestine, then empties into the rectum.

The **Rectum** is the last section of the large intestine. It holds the formed feces awaiting elimination via defecation.

Some sources exclude the anal canal as part of the large intestine but lets discuss it.

The anal canal, which is located in the perineum, completely outside of the abdominopelvic cavity. This 3.8–5 cm structure opens to the exterior of the body at the anus. The anal canal includes two sphincters. The internal anal sphincter is made of smooth muscle, and its contractions are involuntary. The external anal sphincter is made of skeletal muscle, which is under voluntary control. Except when defecating, both usually remain closed.

## **HISTOLOGY**

There are several notable differences between the walls of the large and small intestines. For example, few enzyme-secreting cells are found in the wall of the large intestine, and there are no circular folds or villi. Other than in the anal canal, the mucosa of the colon is simple columnar epithelium made mostly of enterocytes (absorptive cells) and goblet cells. In addition, the wall of the large intestine has far more intestinal glands, which contain a vast population of enterocytes and goblet cells. These goblet cells secrete mucus that eases the movement of faeces and protects the intestine from the effects of the acids and gases produced by enteric bacteria. The enterocytes absorb water and salts as well as vitamins produced by your intestinal bacteria.

## **FUNCTION**

There are 4 major functions of the large intestine:

- Reabsorption of water and mineral ions such as sodium and chloride
- Formation and temporary storage of faeces
- Maintaining a resident population of over 500 species of bacterial
- Bacterial fermentation of indigestible materials

