HUMAN ANATOMY & PHYSIOLOGY-II- BP201T

UNIT: 2 (DIGESTIVE SYSTEM)

CLASS: 04

TOPIC: SMALL INTESTINE

Small intestine is the part of gastrointestinal (GI) tract, extending between the pyloric sphincter of stomach and ileocecal valve, which opens into large intestine. It is longer than large intestine. Its length is about 6 meter. Important function of small intestine is absorption.

SMALL INTESTINE ′ responsible for the complete digestion of all macromolecules ′ and the absorption of their component molecules E.g ′ glucose ′ Glycerol ′ fatty acids ′ amino acids ′ nucleotides

PARTS OF SMALL INTESTINE ′ The small intestine is made up of three parts ′ duodenum ′ Jejunum ′ ileum

1. DUODENUM ′ The first part is the duodenum, u-shaped organ. ′ approximately 30 cm in length. ′ This area completes most of the digestion processes. ′ Enzymes are secreted into the duodenum form the pancreas and the gall bladder. The duodenum is lined by folds of tissue called villi. ′ The villi are covered by fine brush-like microvilli. ′ These folds increase the surface area of the small intestine increase the rate of absorption.

2. JEJUNUM ′ The jejunum is approximately 2.5 m long. ′ Although some digestion is completed here, it has more villi and microvilli; its role is absorption o nutrients.

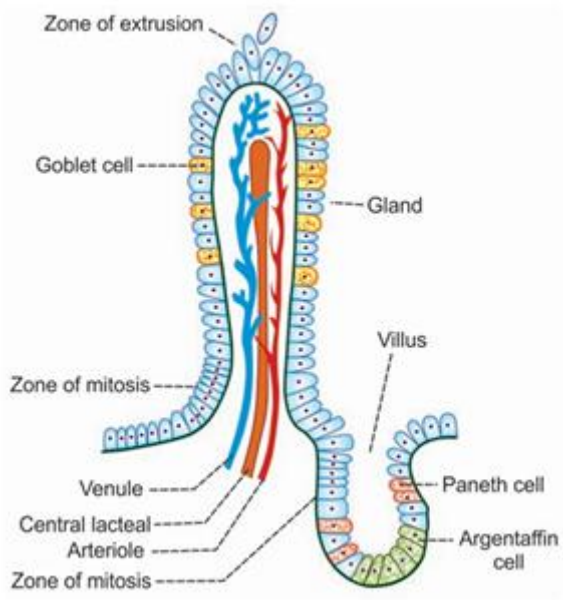
3. Ileum The ileum, is approximately 3m long. o has fewer villi and microvilli than the other two parts. o Although absorption also occurs here, it is responsible for pushing the waste materials into the large intestine.

INTESTINAL VILLI AND GLANDS OF SMALL INTESTINE

INTESTINAL VILLI: Mucous membrane of small intestine is covered by minute projections called villi. The height of villi is about 1 mm and the diameter is less than 1 mm. Villi are lined by columnar cells, which are called enterocytes. Each enterocyte gives rise to hair-like projections called microvilli. Villi and microvilli increase the surface area of mucous membrane by many folds. Within each villus, there is a central channel called lacteal, which opens into lymphatic vessels. It contains blood vessels also.

CRYPTS OF LIEBERKÜHN OR INTESTINAL GLANDS

Crypts of Lieberkühn or intestinal glands are simple tubular glands of intestine. Intestinal glands do not penetrate the muscularis mucosa of the intestinal wall, but open into the lumen of intestine between the villi. Intestinal glands are lined by columnar cells. Lining of each gland is continuous with epithelial lining of the villi. Epithelial cells lining the intestinal glands undergo division by mitosis at a faster rate. Newly formed cells push the older cells upward over the lining of villi. These cells which move to villi are called enterocytes. Enterocytes secrete the enzymes. Old enterocytes are continuously shed into lumen along with enzymes. Types of cells interposed between columnar cells of intestinal glands: 1. Argentaffin cells or enterochromaffin cells, which secrete intrinsic factor of Castle 2. Goblet cells, which secrete mucus 3. Paneth cells, which secrete the cytokines called defensins.



BRUNNER GLANDS In addition to intestinal glands, the first part of duodenum contains some mucus glands, which are called Brunner glands. These glands penetrate muscularis mucosa and extend up to the submucus coat of the intestinal wall. Brunner glands open into the lumen of intestine directly. Brunner gland secretes mucus and traces of enzymes.

Secretion from small intestine is called **succus entericus**.

PROPERTIES OF SUCCUS ENTERICUS

Volume : 1800 mL/day, Reaction : Alkaline, pH : 8.3

COMPOSITION OF SUCCUS ENTERICUS Succus entericus contains water (99.5%) and solids (0.5%). Solids include organic and inorganic substances. Bicarbonate concentration is slightly high in succus entericus.

FUNCTIONS OF THE SMALL INTESTINE ′ 90% of the digestion and absorption of food occurs ′ other 10% taking place in the stomach and large intestine. ′ The main function of the small intestine is absorption of nutrients and minerals from food. Digestion of proteins ′ Proteins, peptides and amino acids are acted upon by enzymes such as trypsin and chymotrypsin, secreted by the pancreas. This breaks them down to smaller peptides.

DIGESTION OF LIPIDS ′ Enzymes, like lipases secreted from the pancreas, act on fats and lipids in diet. ′ lipase can break them into the smaller parts that can enter the intestinal villi for absorption. Digestion of carbohydrates ′ Carbohydrates are broken down to simple sugars and monosaccharides like glucose. ′ Pancreatic amylase breaks down some carbohydrates to oligosaccharides as well. ′ Some carbohydrates and fibers pass undigested to the large intestine where they may, depending on their type, be broken-down by intestinal bacteria.

ABSORPTION IN THE SMALL INTESTINES ′ the nutrients are absorbed by the inner walls of the small intestine into the blood stream. ′ The nutrients are absorbed by processes of simple/passive diffusion, facilitated diffusion, primary active transport, or secondary active transport. ′ For transport, nutrients commonly rely upon ′ Lipids – undergo passive or simple diffusion ′ Short-chain fatty acids – diffusion ′ Amino acids – primary active transport ′ Glucose – secondary active transport ′ Fructose – facilitated diffusion

ABSORPTION IN THE SMALL INTESTINES ′ Other absorbed substances in the small intestines include: 1.Water ′ 80% is absorbed by the small intestine ′ 10% by the large intestine ′ remaining 10% excreted in the faeces. 2.Electrolytes 3.Vitamins and minerals

REGULATION OF SECRETION OF SUCCUS ENTERICUS

Secretion of succus entericus is regulated by both nervous and hormonal mechanisms. **NERVOUS REGULATION** Stimulation of parasympathetic nerves causes vaso dilatation and increases the secretion of succus entericus. Stimulation of sympathetic nerves causes vasoconstriction and decreases the secretion of succus entericus. But, the role of these nerves in the regulation of intestinal secretion in physiological conditions is uncertain. However, the local nervous reflexes play an important role in increasing the secretion of intestinal juice. When chyme enters the small intestine, the mucosa is stimulated by tactile stimuli or irritation. It causes the development of local nervous reflexes, which stimulate the glands of intestine. **HORMONAL REGULATION** When chyme enters the small intestine, intestinal mucosa secretes enterocrinin, secretin and cholecystokinin, which promote the secretion of succus entericus by stimulating the intestinal glands.

LARGE INTESTINE

COMPONENTS OF LARGE INTESTINE ′ The large intestine is composed of several very distinctive parts: ′ Cecum: ′ Colon:. The colon consists of four parts: θ Ascending colon θ Transverse colon θ Descending colon θ Sigmoid colon ′ Rectum

CECUM ′ first section of your large intestine ′ looks like a pouch, ′ two inches long. ′ ROLE ′ taking in digested liquid from the ileum(small intestine) & ′ passes it on to the colon.

COLON : ′ major section of the large intestine ′ Function: ′ the principal place for water reabsorption, ′ absorbs salts when needed. ′ Components : ′ The colon consists of 4 parts: ϖ Ascending colon ϖ Transverse colon ϖ Descending colon ϖ Sigmoid colon

COMPONENTS OF COLON ′ Ascending colon: ′ 1st portion of the colon ′ pushes any undigested debris up from the cecum ′ just under the right lower end of the liver. ′ Transverse colon: ′ 2nd portion of the colon ′ Food traveling from left to right just under your stomach.

COMPONENTS OF COLON ′ Descending colon: ′ 3rd portion of colon ′ pushes its contents from down to the lower left side of your abdomen ′ Sigmoid colon: ′ final ′ S-shaped length of the colon, ′ empties into the rectum.

RECTUM ′ The final section ′ measures from 1 to 1.6 inches (or 2.5 to 4 cm). ′ Leftover waste collects there ′ expanding the rectum ′ emptied through anus

FUNCTION OF LARGE INTESTINE ′ 1. Absorb Water ′ One of the primary functions is to absorb water ′ prepare the waste as a solid stool that will be expelled from the body. ′ 2. Absorb Vitamin ′ beneficial bacteria ′ role in breaking down undigested sugars and fibers into fatty acids. ′ produce many vitamins, of which are Vitamin K and Biotin that are absorbed back into the body.

FUNCTION OF LARGE INTESTINE(LI) ′ 3. Reduce Acidity The fatty acids cause acidic environment. The LI produces alkaline solutions reduce the acidity and balance the pH in the LI ′ 4.Protect from Infections The mucous lining of the large intestine acts as a protective layer prevents harmful bacteria from being reabsorbed into the body.

FUNCTION OF LARGE INTESTINE(LI) ′ 5. Produce Antibodies also produces antibodies help to boost immunity. It is believed that the appendix may have been a major producer of antibodies at some point in the evolutionary process

THE ACCESSORY ORGANS: ′ support the digestive system BUT are not part of the digestive tract ′ These organs secrete fluids into the digestive tract, and are connect by ducts. ′ The accessory organs include ′ liver ′ gall bladder ′ pancreas.

1. LIVER ′ largest of these organs ′ mass of about 1.5 kg. ′ liver produces bile ′ bile greenish yellow pigment made up bile pigments and bile salts ′ it breaksdown old red blood cells.

2. GALL BLADDER ′ a storage sac. ′ The bile is secreted into it ′ The bile is stored here. ′ HOW IT WORKS ¬ food containing fat enters the digestive tract ¬ salts are secreted into the small intestine to digest fats. ¬ The bile emulsifies fats in partly digested food ¬ thereby assisting their absorption

3. PANCREAS ′ The pancreas secretes a number of different enzymes into the small intestine] ′ Role is to digest carbohydrates lipids & proteins completely. ′ It also secretes bicarbonate ions ′ Role : neutralize the HCl from the stomach change the pH of the small intestine to a pH of 8. ′ The pancreas will secrete about 1.0 L. of pancreatic fluids per day.

REGULATION OF PANCREATIC SECRETION