Human Physiology
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Lecture - 01

Hello everyone, welcome to another brand-new class of human physiology. In today's class, we will discuss the general introduction to our digestive system. Hope you enjoy the class. So, what different concepts or topics will be covered in our digestive system? So, we will discuss in general the anatomy of our digestive system. Then the mouth, esophagus, stomach, liver, gallbladder, pancreas, small intestine, and large intestine. Briefly, we will discuss their structure and functions.

So, what is the digestive system? Digestion is defined as the process in which food is broken down into smaller chemical substances. Why is it very important? Because we generally intake complex molecules like fat, protein, or starch, they are not broken down into smaller components. So, our body cannot absorb the nutrients without digestion. So, once we consume this more complex component of the food, it needs to be digested into smaller components, and it becomes easier for our cells to get those nutrients or for the uptake of those nutrients.

Why is digestion important? It provides the energy for cellular function. It supplies the building blocks for growth and repair. It absorbs essential vitamins and minerals. What are the different basic processes of the digestive system? The first is ingestion. What it mostly refers to is the intake of food into the mouth and then the step of digestion where the mechanical and chemical breakdown of food happens.

After that, the absorption of those nutrients into the bloodstream. That can happen through the process of absorption and, finally, the elimination of the unwanted substance, such as waste material, as feces. So, as you see, this is like the overall digestive organ, mostly like the mouth, pharynx, esophagus, stomach, small intestine, large intestine, rectum, and anus; these are the parts of the overall digestive system. So, we basically take the food, right? We consume a lot of complex foods, fats, and proteins from our mouth. So, once the food is consumed, our teeth in the jaw help to chew or break down that food into smaller particles, and slowly those smaller particles go to our intestine through our gastrointestinal tract, where digestive enzymes and acids like HCl are present for digestion, and eventually they get passed to the large intestine and small intestine, and finally all the nutrients are absorbed back into the blood, and all the remaining waste material eventually passes out from the anus.

So, this is overall like a systematic chart of our food processing through the process of digestion. Then what are the different parts of the digestive system? The mouth is very important. So, the mouth contains teeth and salivary glands, right? So, what different types of teeth are present? Mostly, there are four types of teeth we have; for example, we have eight frontal or incisor-type teeth that play an important role in cutting or chewing food. Then we have four canine teeth. They basically help in terms of tearing the food particles or larger food components.

Then we have 8 premolars and 12 molars; they help in terms of grinding the food. So in total, we have about 32, and as a whole, all these teeth participate in different parts of the processing of that food. The main goal is to kind of break down those food particles from a bigger chunk to a smaller chunk. Then we have the tongue, which is mostly a muscle or muscular organ. You can easily manipulate the food, and of course, you can also taste it.

Then we have three types of salivary glands: parotid, submandibular, and sublingual; they produce saliva. Saliva is also a very important component of the mouth. What are the basic functions of the mouth? Mechanical digestion, using mastication or chewing, breaks down food into smaller pieces; chemical digestion. So, salivary glands can have this salivary amylase; they can perform chemical and biochemical reactions to break down complex food structures into smaller, simpler nutrients. The saliva also helps to moisten the food and facilitates the swelling.

And it also contains a lot of enzymes. Then the pharynx and the esophagus. So, this is basically a common pharynx, which is the common passageway for food and air. So, you can see this is the pharynx area, which is the common passage for food and air. And you can see there is this valve.

like structure is present, which is the epiglottis. This is basically a valve or flap that prevents food from entering the trachea. So food should only go to the gastrointestinal area, not the trachea area, because if the food enters the trachea area, it can cause choking. It can become a choking hazard, causing trouble with our breathing. If the choke is not removed in a timely manner, we can face significant challenges as well.

So, this epiglottis, which is like a flap or valve that ensures that food particles from the mouth only enter our gastrointestinal or intestinal area, not the trachea. It connects the pharynx to the stomach. It also helps in terms of the swallowing process by coordinating the muscle contractions. It helps the movement of food. Also, it has a peristalsis-type movement that helps the food move to the stomach.

Then the stomach you can see that is the most important part of our digestive system which contains a lot of acidic enzymes, mostly like the important one is the acidic HCL that basically breaks down a lot of food particles into smaller ones. HCL in our stomach can also destroy a lot of foreign particles. So it also helps to maintain immunity because it can destroy the bacteria or other foreign particles that we consume from food. Anatomy, if you look at the stomach, it has a fundus, body, antrum, and pylorus. So, this is like the antrum area; this is the pylorus area; you can see here, and this part is the fundus area.

And there are different layers of the stomach wall, for example, mucosa, submucosa, muscularis externa, and serosa. So, different types of four layers of stomachs are present. Mucosa mostly has this epithelium lining with lamina. Submucosa has connective tissue with blood vessels and nerves. The muscularis externa has three layers of smooth muscle: oblique, circular, and longitudinal, and the serosa has an outer layer of connective tissue.

So what are the functions of the stomach? If you see, it produces hydrochloric acid, which is mostly produced by the parietal cells. What does it help? It helps in the denaturation of the proteins and activates; it also activates the pepsin. Then pepsinogen, produced by the chief cells, is converted to pepsin, which helps in protein digestion. Then mucus is produced by the goblet cells. It protects the stomach lining.

And then intrinsic factor is also produced by the parietal cells. They are needed for vitamin B12 absorption. And finally, the gastrin, which is produced by the G cells, stimulates the gastric acid secretion. So, these are some of the gastric secretions that happen in the stomach.

The next is the liver. The liver is the largest internal organ, right? It is located in the upper right quadrant of the abdomen. The liver is divided mostly into the right and left lobes, further subdivided into the lobules. So, these lobules are the hexagonal functional units containing the hepatocytes, which are the most important of these liver cells. Right, all these liver cells and the liver, in terms of their participation, play a significant role in the metabolic activity of our body. So, portal triads contain the hepatic artery, hepatic portal vein, and bile duct.

The liver is also important for the production of bile. The liver has copper cells; they contain specialized macrophages within the sinusoids. Bile cannuli, small ducts that collect bile produced by the hepatocytes, and finally, the right and left hepatic ducts merge to form the common hepatic duct. What are the different functions of the liver? The liver helps in terms of bile production. So, the synthesis of bile by hepatocytes is the most important function of the hepatocyte.

These are essential for fat emulsification and fat absorption. Okay then, glucose metabolism, as you know, involves glucose being generally converted to glycogen for future storage, and also by the activity of insulin, which is secreted or produced by the pancreatic beta-islet cells. Additionally, the alpha cells secrete glucagon, which can convert this stored glycogen back to glucose during cases of fasting. So, in this way, glucose homeostasis is maintained in our body. Liver also plays an important role in liver metabolism, protein metabolism, and detoxification.

Storage of glycogen, vitamins A, D, and B12, blood filtration, and synthesis of different clotting factors. You remember we discussed various blood clotting factors, such as 8, 9, 11, and 12. So, different blood-clotting factors are being synthesized in the liver. So, the liver is very important as a digestive organ, and it has several other roles apart from digestion and metabolic activity. The gallbladder is a very important component of the digestive system.

It is basically like a sac-like organ. It is connected to the common bile duct. What is the main function? The bile is stored. It concentrates and stores the bile produced by the liver. So, basically, in this sac, bile can be stored and concentrated.

and eventual bile releases. So, those stored and concentrated bile are eventually released into the duodenum during the digestion step. Pancreas, we just discussed that the pancreas has a lot of endocrine and exocrine functions. So, where is the pancreas located? The pancreas is located in the retroperitoneal space, posterior to the stomach, which extends near the duodenum to the spleen. Mostly it has different regions, such as the head, neck, body, and tail regions. Acinar cells of the exocrine glands perform exocrine-type functions.

They make up the majority of the pancreas. The beta cells and alpha cells, this type of cell performs the endocrine functions, which are also called islets of Langerhans. Then it has pancreatic darts, and it also kind of has a blood supply from the splenic artery. Functions, as we said, the pancreas has both exocrine and endocrine functions. In the case of exocrine functions, there are a lot of pancreatic enzymes produced by the acinar cells.

They produce digestive enzymes like amylase, which breaks down carbohydrates, and proteases like trypsin, chymotrypsin, and carboxypeptidase, which break down different types

of proteins. Then lipase, this type of enzyme, can break down lipids. The nucleus can break down nucleic acid. So, these are exocrine functions or part of the digestive type of functions by the secretion of different types of digestive enzymes; they break down carbohydrates, proteins, and lipids. The acinar cells can also secrete bicarbonate through the secretion of bicarbonate from the duct cells.

They maintain acidity and basicity. So, basically, they have a function to neutralize the acidic chyme in the duodenum and maintain pH regulation in the body. And as you know, the endocrine functions of the pancreas are also very important. They maintain glucose homeostasis in our body. The next is the small intestine.

It has three different segments. One is the duodenum, then the jejunum and ileum. What are the different functions? Initial digestion involves bile and pancreatic enzymes. Then jejunum, mostly the primary site of nutrient absorption, is a very important part because it first participates in digestion and eventually, from this part of the small intestine, the absorption of smaller components of the molecules along with other essential nutrients occurs. So, this is very important, and finally, the absorption of vitamin B12 and bile salts also happens in the small intestine. Then different functions, the major site of nutrient absorption, chemical digestion can happen; segmentation, like mixing, and contraction enhance the absorption; all these functions can happen in the small intestine.

Large intestine, you can see the large intestine has three important components: one is the colon, and then the rectum. Colon, rectum, and anus. So, the colon is very important; it includes the ascending, transverse, descending, and sigmoid sections, which are different areas of the colon. The rectum stores the feces, the anus controls it, and it helps in the elimination of waste products. So, what are the different functions of the large intestine? Large intestine reabsorbs water and electrolytes from the sign.

It concentrates the waste and maintains the fluid and electrolyte homeostasis in our body. It forms feces and also helps with the removal of the feces. With the feces, a lot of toxic components, right, all these toxic components or unwanted components of the food, those we cannot break down into simpler nutrients, can be removed as waste products from the body. Large intestine. So, do you know that the gut microbiome, which is very important to our body, is complex and drives a community of trillions of bacteria? For a proper healthy lifestyle or a healthy physiological condition, the gut microbiome is very important.

All our gut microbiome kind of decides how our lifestyle happens. In cases of imbalance in our gut microbiome, we can significantly experience a lot of challenges in our physiological condition. So, it is very important that each of our human bodies has a unique gut microbiome component. So, even though there are a lot of similar gut microbiome presences, everyone has a unique fingerprint of gut microbiome.

So, this is very important. Activity questions: What should be the pH of the stomach? Right, and why does the stomach have HCl? You can kind of assume what the pH would be if there is a lot of HCl present. Also, can you tell why HCl cannot damage the stomach? So, as you know, HCl is very highly acidic in nature. So, if a certain solution has either high acidity or high basicity, it should damage the cells, right? Because our cells thrive in a neutral condition. But why can HCL then not damage the stomach? Can you tell? You can explore these questions. And if you do not understand, please send your questions to the email.

We will do a lot of activity questions also. So hopefully you enjoyed the digestive organ and the digestive system preliminary class. We thoroughly discussed different digestive components or organs, such as the mouth, liver, stomach, and small and large intestines. So, and we thoroughly discussed like their functions and mechanism.

Hope you enjoyed the class. Thank you again. Let us meet with another class in human physiology very soon. Thank you.