Human Physiology
Dr. Sudip Mukherjee
School of Biomedical Engineering
IIT(BHU), Varanasi
Week - 06
Lecture - 05

Welcome, everyone, to another new class of Human Physiology. In the last few classes, we discussed different anatomy of our digestive organs. We discussed how the basic digestion and absorption process happens for carbohydrates, proteins, and lipids. In this class, we will see if any irregularities happen or what happens if any disorder occurs in our digestive organs, and then what type of disease can form. So, this is very important. This will be a very straightforward class, not too much about mechanisms, but we will try to look at some diseases, how to identify those diseases, what the symptoms would be, and what general therapies might be available if the disease occurs.

So, let us start with that. So, what are the different concepts that will be covered in cases of digestive diseases or digestive disorders? We will see different digestive disorders; we will discuss their causes and symptoms, we will examine their pathophysiology, and we will explore how to diagnose them and some treatment options. So, this would be, like I said, a straightforward class with a lot of information. So, carefully go through those; if you have further questions, discuss them with us during the live interactive sessions.

You can also drop us your questions in an email, you can read those textbooks which we generally refer to, you can go through various web content as well, but if you have any questions, please contact us immediately. So, for the first one, it is like gastroesophageal reflux disease, or GERD. So, first we have to understand what actually happens in cases of our stomach; as you see, when any food particle comes, it can be a complex food particle with a lot of carbohydrates, proteins, or lipids. What our stomach basically does is produce hydrochloric acid for digestion or breaking down those molecules. So, you can see that near our esophagus, there is this lower esophageal sphincter, which is also called LES.

So, there is this transient lower esophageal sphincter, which is also called the LES or transient LES. It has a very important role to play. What the LES or the esophageal sphincter does is prevent any backflow of this molecule because there are a lot of acidic components or HCl in our stomach. So, eventually, if this HCL or a certain molecule combined with the HCL has a backflow to another area of our body. So, basically, this esophagus will get damaged.

So, an acidic environment is highly specific to the stomach of our body, and in case this type of acid molecule is released from the stomach, it can completely destroy other parts, specifically the esophagus. So, this is a normal situation, but what happens in cases like gastroesophageal reflux disease, as you can see in cases of the disease, is that the lower esophageal sphincter has a malfunction. So, this LES may abruptly open, causing the acid molecules like HCl and other acidic components to eventually go inside our esophagus, causing damage to the cell wall. So, how will we initially understand that if any type of GERD occurs, there would be heartburn, there would be chest pain, and there can also be chronic cough, asthma, or dental erosion? Basically, this is like a condition whenever this acid reflux happens,

right? Acid reflux happens. We can also clinically diagnose this condition by doing endoscopy or pH monitoring.

There are different ways to manage the disease. Of course, we have to modify our lifestyle. We can change our diet. Of course, we can do exercises to reduce our weight. We can improve our sleep cycle.

Apart from that, there can also be pharmacological interventions; for example, antacids can be prescribed, histamine blockers can be given, and proton pump inhibitors can be given to reduce proton secretion and production. So, in this way, GERD, or gastroesophageal reflux disease, can be managed. Then the next disease we will discuss is peptic ulcer disease, or PUD. You see, in cases in our small intestine, sometimes this type of corrosion can happen or an ulcer can form, right? So, this is called peptic ulcer disease. What happens basically in these cases is that the disruption of the mucosal lining of the stomach or duodenum causes ulcer formation.

It can also happen due to a bacterial infection. So, you can see that this H. pylori type of bacteria is the most common form of infection that can cause the formation of peptic ulcer disease. How would it be understood what different types of clinical presentations there would be? You can have epigastric pain; it can be a symptom of nocturnal pain, along with nausea or vomiting. So, through endoscopy or with the biopsy, apart from the urea breath test, can also be done.

And then serology or the stool antigen test can also give an idea of whether the patient is suffering from peptic ulcer disease. And in terms of therapy, there can be an antibiotic prescription for the elimination of this H. pylori type of bacteria. Apart from that, to reduce those ulcer symptoms, hydrogen or proton, like H plus, or the proton pump inhibitor can be prescribed; histamine blockers can be prescribed to reduce the inflammatory responses. Apart from that, if there is any bleeding, certain hemostatic agents can also be prescribed to reduce the bleeding.

The next gastric disorder we will discuss is IBS, which is irritable bowel syndrome. So, it happens whenever there is a functional gastrointestinal tract disorder with highly significant abdominal pain and altered bowel habits. So, how can it be understood in relation to the pathophysiology of visceral hypersensitivity and altered gut motility? You can understand there are pathophysiological changes that are caused by conditions like irritable bowel syndrome. And these are different classes of IBS; for example, diarrhea-predominant IBS-D, constipation-predominant IBS-C, and mixed IBS, such as IBS-M. There are different management or treatment options, of course, like diet, which is one of the important components, and gluten is a very crucial molecule or component that causes this IBS.

So, a gluten-free diet should be recommended to this patient. Apart from that, cognitive behavioral therapies can also be used, and different drugs, such as antidepressants, probiotics, and prebiotics, can also be prescribed. So, this is like, in general, different management options can be given to take care of the IBS. Another very important and significant GI-related disease is inflammatory bowel disease, or IBD, which is also called Crohn's disease. This is a chronic inflammatory condition that can affect our gastrointestinal tract.

It can happen due to genetic predisposition or even immune dysregulation. Significant pro-inflammatory factors like IL-2 and TNF-alpha, due to their overactivity and oversecretion, can cause a terrible situation of inflammation, itching, and allergic-type symptoms in the bowel.

So, in the case of clinical observation, you can see that extraintestinal manifestations or even arthritis can also happen. Complications can occur that develop into fistulas or abscesses. There are different diagnoses that can be done using procedures like colonoscopy, biopsy, endoscopy, and MRI.

C-reactive protein, or CRP, can be a very important clinical marker to diagnose IBD. Different treatment options can be present; for example, immunosuppressants, corticoids, or steroids can be given, but as you know, steroids and corticoids are not good long-term therapeutic options because they are immunosuppressants and can suppress your immunity long-term. A lot of modern therapeutic approaches are also coming into expression and clinical trials. Some of them are anti-inflammatory cytokines, such as IL-10. So, for example, IL-10 is a very important anti-inflammatory cytokine.

So, researchers and clinicians are trying to develop a therapy using the IL-10 cytokine directly or with cells that can produce IL-10. Apart from that, surgical interventions can also be taken. So, you can see that after the inflammatory bowel disease, we can, and we will further go to the celiac disease. This is also a very crucial and important type of autoimmune disorder that generally gets triggered by gluten sensitivity. So, celiac disease is highly sensitive due to the overactivity of gluten.

So, those patients who have a gluten allergy or sensitivity can eventually develop this deadly condition like celiac disease. In cases of this autoimmune disorder, as you know, activation of T cells also occurs in other autoimmune disorders, and they continuously release inflammatory cytokines, which can further cause diarrhea, abdominal pain, and significant weight loss; even anemia and osteoporosis can occur. So, this is a very significant type of disease that can not only cause a digestive disorder, it can also affect various components of our other body parts. Anti-IGA or similar antibody testing can be done to identify an overactive immune system in our body. A biopsy can be done to identify and, apart from genetic testing, for example, genes like HLA-DQ2 and DQ8, this type of genetic testing can also be done to predetermine whether the patients are predisposed to this type of cellular disease or not.

Basically, this type of patient has to completely avoid gluten-rich food. So, mostly they have to follow a strict gluten-free dietary management. Then lactose intolerance is, you know, like many of us are lactose intolerant. So, whenever there is a lactose-rich food, the patient can experience significant abdominal pain, gas formation, and other types of itching and inflammation. It can also be due to a genetic disorder.

So, it can be due to a cognitive genetic disorder by birth. Apart from that, it can be due to the presence of primary lactase deficiency or secondary lactase deficiency, which eventually downregulate lactase expression, and in cases of overactive lactose, it can significantly cause inflammation. What are the various types of symptoms it can cause? It can cause cramping; it can cause diarrhea. So, different types of diagnostic techniques are present; for example, the hydrogen breath test, lactose tolerance test, and eventually, for the patient, the best way to control this lactose intolerance is to reduce the amount of lactose in their diet. Or the best would be to completely remove the lactose from their diet.

And the patient can also increase the probiotic content to improve his or her lifestyle. Then gallstones, or gallbladder stones, are another commonly known type of condition or disorder related to our overall digestive system, where you can see solid forms of stones inside the gallbladder that can form and basically reduce the space of the gallbladder. The gallbladder is

important because it acts as a storage for bile. Storage of bile. So, if there is a stone formation in the gallbladder, the storage place of the bile will be reduced; there can be itching and significant pain, and the patient may experience significant pain.

There are certain risk factors, for example, female gender and obesity; high obesity can actually trigger gallbladder stones, and these stones can be of different types. These gallbladder stones can be of different types; for example, it has mostly been seen that cholesterol deposition can create this type of gallbladder stone. Apart from that, there can also be bilirubin stones. So, these are basically like pigment stones, and pigment and cholesterol together can also create a mixed stone. So, what are the different types of therapies that can be presented? Stones can be surgically removed.

Apart from that, like ursodeoxycholic acid, they are very good drugs in terms of cholesterol stones. Basically, they dissolve or break down this cholesterol. In this way, urosodeoxycholic acid can be removed. Reduce the pain from the gallbladder stone by dissolving or degrading the cholesterol. Then another deadly condition of our pancreas is called pancreatitis.

This is basically an inflammatory disorder of the pancreas that leads to auto-digestion and tissue damage of the pancreas. So, what happens basically in cases of pancreatitis is the premature activation of pancreatic enzymes, which can cause the autodigestion or destruction of the pancreatic cells and tissues. There can be a lot of different imaging options, like CT scans, MRIs, and ultrasounds, that can be done to diagnose the condition of pancreatitis. Apart from that, serum amylase levels and lipase levels can also be monitored as biomarkers. Different clinical management can be taken; for example, in cases of acute pancreatitis, supportive care such as pain management or nutritional support can be given.

In cases of chronic pancreatitis, the same pain management or pancreatic enzyme replacement therapy can also be prescribed. Then, as we all know, constipation can be a significant challenge where infrequent bowel movements occur. And in this case, even difficulty can occur when passing stool. So, significant difficulty in passing stool can cause a situation called constipation. And there can be different risk factors, for example, age, female gender, and even dehydration, which can cause infrequency of bowel movements, leading to constipation.

So, different diagnostic tests can be performed. For example, a colonoscopy can be done, and different management or clinical interventions are available for constipation. For example, a doctor can prescribe to increase fiber and fluid intake. This will help ease the bowel to have a proper bowel movement and allow the feces and stool to pass properly. Then another significant condition that can occur due to various viral or bacterial infections, food contamination, or food poisoning is diarrhea.

Diarrhea is a condition in which too much bowel movement with fluid-like feces can cause dehydration in the body. And there are different types of diarrhea situations in our body; for example, osmotic diarrhea, secretory diarrhea, or inflammatory diarrhea. And different clinical management strategies can be taken to tackle the diarrhea condition. For example, oral rehydration therapy can be given, and dietary modifications can also be prescribed. To tackle the bacterial infection related to diarrhea, antibiotics can be prescribed to eliminate the infection.

Food poisoning can occur from different types of contaminated food, such as viral contamination, bacterial contamination, or parasitic contamination. Additionally, various

toxins can also contaminate food, and all these factors together can lead to a situation called food poisoning, where the patient may experience significant vomiting, diarrhea, and abdominal cramps. Even dehydration, electrolyte imbalance, and a continuous situation of this type of diarrhea and food poisoning can eventually be deadly as well. So, in terms of intervention, we should properly ensure that the food we are consuming is free from any contaminants and properly cooked. In cases of food poisoning, different treatments can be given.

For example, in cases of bacteria-related infections, antibiotics can be prescribed. Apart from that, oral rehydration can be given to maintain the hydration level in the body. Another significant cause or disorder that occurs with our digestive tract is the formation of piles or hemorrhoids. Basically, what happens in the case of a pile-like swelling of the anus or rectum can happen. So, for example, the swelling can form inside the rectum or the anus, or it can sometimes eventually happen outside as well.

So, what are the different pathophysiologies of hemorrhoids? Of course, it would cause increased pressure in the lower rectum. And also during the pregnancy, there would be significant constipation-related issues, and weakening of supportive tissues can also be seen. There can be mostly two types, as I said; it can be either internal or external. In cases of the internal, it generally develops inside the rectum. And in cases of external piles, hemorrhoids develop under the skin around the anus.

And there can be painful or painless bleeding that can also be associated with the piles. It also causes irregularities or difficulties in bowel movements, and it can be easily diagnosed with the external case, specifically with the swelling around the anus. Different treatment options can be given; for example, a high-fiber diet and high fluid content can be given to the patient to improve bowel movements and reduce dehydration. Apart from that topical type of treatment, for example, different creams and ointments can be provided to reduce the pain or swelling caused by this hemorrhoid formation. And then laseroscopy or surgical removal of those hemorrhoids or piles can be another option to remove those swollen glands.

Then another significant disorder related to our digestive tract is colon polyps or colon cancer. And as you can see, in cases inside our colon, small polyps can form, which are called hyperproliferation, and then they can slowly grow from small to large polyps. These are mostly disorders associated with our colon where abnormal growth forms in the lining of the colon cell wall. But this becomes more dangerous in the case of abnormal cell growth or tumor cell growth that is termed colon cancer. So, as you can see, initially the formation of polyps happens, which are mostly benign in nature, but eventually there can be abnormal cancerous cell growth that can also have a condition of metastasis, which means that these cells can eventually come out of the cell wall of the colon and can spread to various parts of our body.

So, in terms of other cancers, colon cancer is also highly common, very risky, and influenced by genetic factors; food habits and overall environmental pollution can all contribute to colon cancer. In terms of detection, screening colonoscopy can be done; different types of imaging can be performed, for example, CT scan, ultrasound, or even MRI scan. Regular screening and a healthy diet can reduce the risk of colon cancer. In cases like this type of polyp formation, these polyps can be locally removed by surgery. But in terms of cancer formation, of course, surgery can be an initial option, but mostly radiation therapy and different chemical drugs in the form of chemotherapy can be given to the patient, especially in the early stages of the cancer.

In the late stages of cancer, chemotherapy can also be combined with immunotherapy. But as you know, if the cancer is detected at stage 3 or 4, it becomes very difficult for overall patient survival. So, like cancer in other organs, colon cancer is also deadly unless it is detected very early. So, hopefully you saw different disorders; some of them can be very important digestive-related disorders, as we said. Unlike inflammatory bowel disease (IBD), celiac disease can occur, and even the colon can experience the formation of polyps or cancer.

Apart from hemorrhoids and lactose intolerance, all these things, including diarrhea and constipation, can happen. So, these are some types of disorders you have to be well aware of, and whenever there is an experience in our body, we should take proper precautions and measures, and in case of serious complications, we should consult with the doctor for the right treatment approach. So, do you know that vomiting is the involuntary and forceful expulsion of the food components, right, that happens mostly from the upper intestine through the mouth? It is a complex reflex action that is there to protect our body by removing various contaminated food particles. So, through vomiting, we can remove initial contaminants, toxins, or any type of foreign particles that can be either microbes, bacteria, or parasites. So, activity question: if bile contains excessive cholesterol, then what will happen? So, can you tell if our bile contains excessive cholesterol, then what type of disease we can experience? So, hopefully you enjoyed this class of human physiology where we discussed different digestive disorders.

And as we said, some of the digestive disorders are very common, and we can experience them maybe on a regular basis due to our bad food habits or overall wrong lifestyle. But some of them can be highly complicated, including certain conditions like autoimmune disorders or cancer. And in those cases, if it is not detected early, it can cause a significant risk of mortality and patient survival. So, hopefully, you like this class. Please discuss with us if you have any questions during the live session.

Apart from that, you can also drop us questions in the email. Hopefully, you enjoyed the overall class on digestive organs and the digestion of carbohydrates, proteins, lipids, and different digestive disorders that were also discussed in last week's discussion. Hopefully, we will meet with you very soon in another new class of human physiology. Thank you again.