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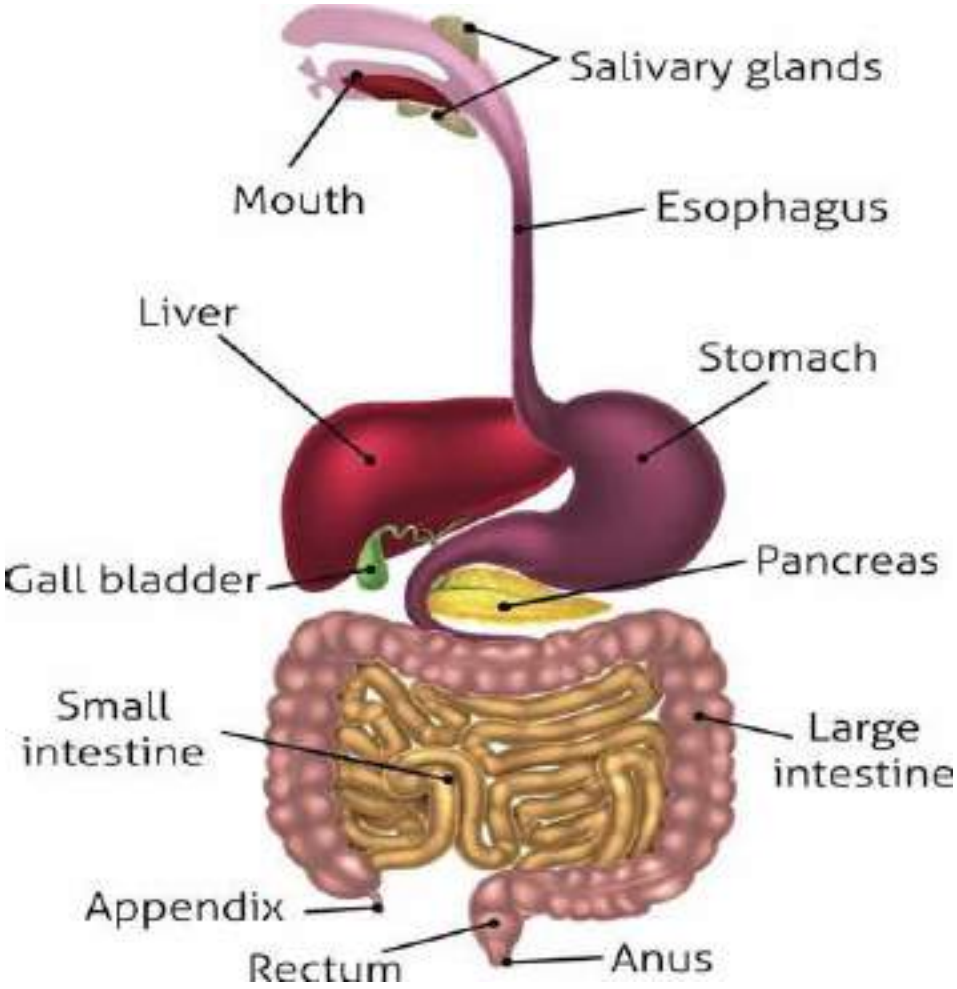
Human digestive system

Digestion is defined as the process by which food is broken down into simple chemical substances that can be absorbed and used as nutrients by the body. Most of the substances in the diet cannot be utilized as such.



These substances must be broken into smaller particles, so that they can be absorbed into blood and distributed to various parts of the body for utilization. Digestive system is responsible for these functions.
Digestive process is accomplished by mechanical and enzymatic breakdown of food into simpler chemical compounds. A normal young healthy adult consumes about 1 kg of solid diet and about 1 to 2 liter of liquid diet every day.
All these food materials are subjected to digestive process, before being absorbed into blood and distributed to the tissues of the body.

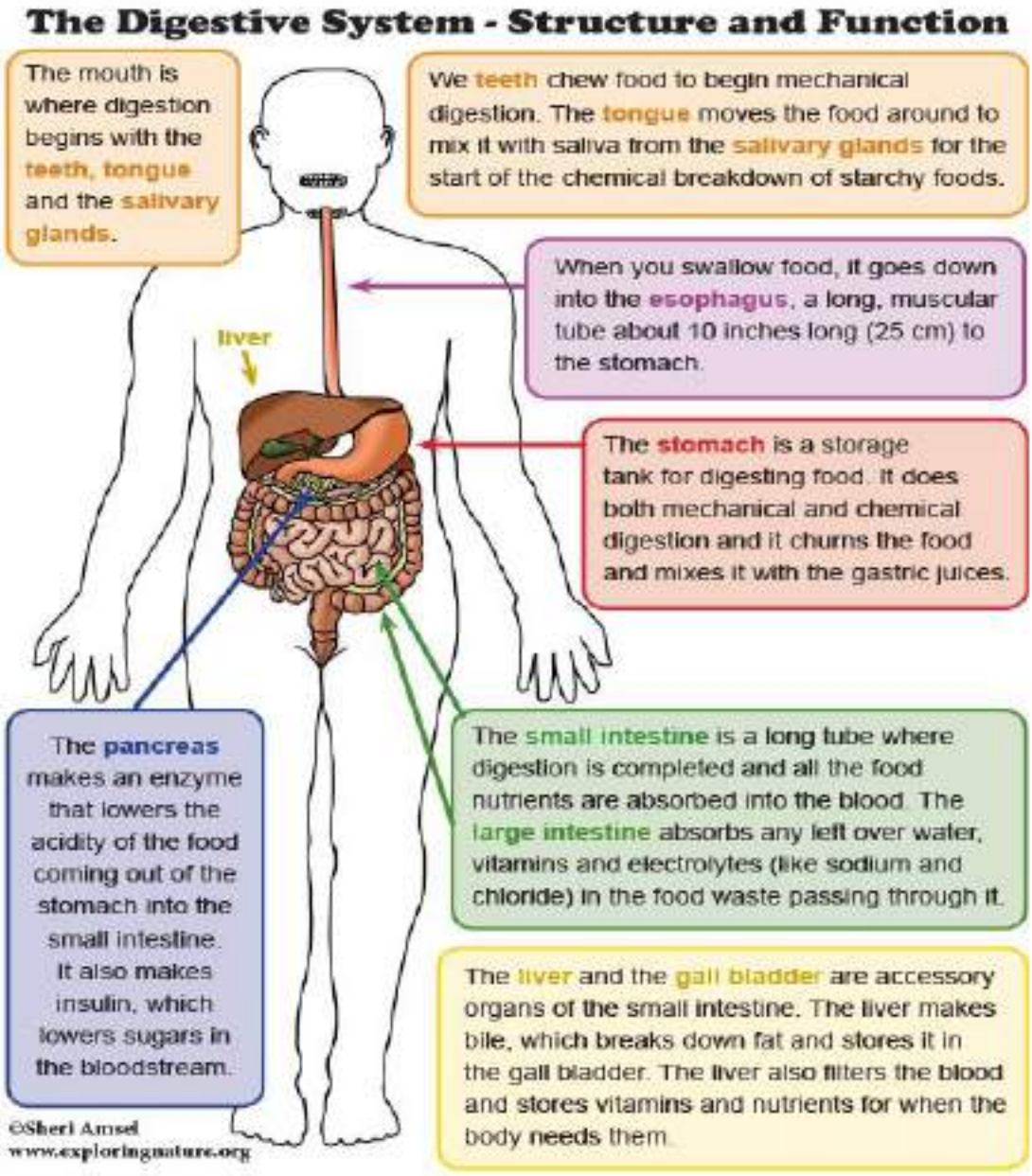
Digestive system plays the major role in the digestion and absorption of food substances.

Thus, the functions of digestive system include:

1. Ingestion or consumption of food substances
2. Breaking them into small particles
3. Transport of small particles to different areas of the digestive tract
4. Secretion of necessary enzymes and other substances for digestion
5. Digestion of the food particles
6. Absorption of the digestive products (nutrients)
7. Removal of unwanted substances from the body.

Functional Anatomy OF Digestive System

Digestive system is made up of gastrointestinal tract (GI tract) or alimentary canal and accessory organs, which help in the process of digestion and absorption GI tract is a tubular structure extending from the mouth up to anus, with a length of about 30 feet. It opens to the external environment on both ends.



GI tract is formed by two types of organs:

1. Primary digestive organs.
2. Accessory digestive organs.

1- Primary Digestive Organs

Primary digestive organs are the organs where actual digestion takes place.
Primary digestive organs are:

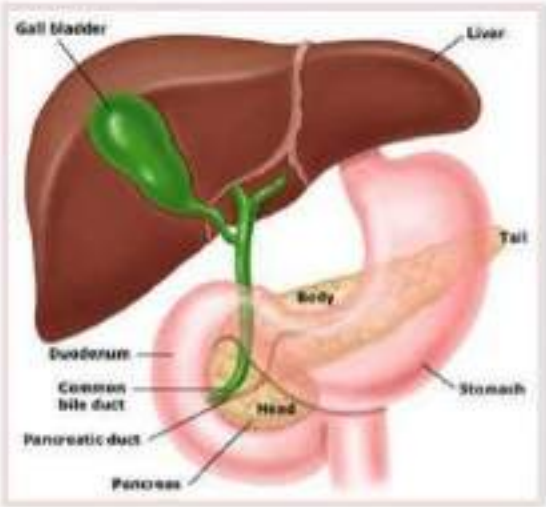
i. Mouth
ii. ii. Pharynx
iii. iii. Esophagus
iv. Stomach
v. Small intestine
vi. Large intestine.

2-Accessory Digestive Organs

Accessory digestive organs are those which help primary digestive organs in the process of digestion..
Accessory digestive organs are:

i. Teeth
ii. Tongue
iii. Salivary glands
iv. Exocrine part of pancreas
v. Liver
vi. Gallbladder.

Accessory Digestive Organs



Pancreas
- Secretes digestive enzymes into the small intestine to digest protein, fats, and carbohydrates

Liver
- Makes and secretes bile
- Purifies the blood of many impurities

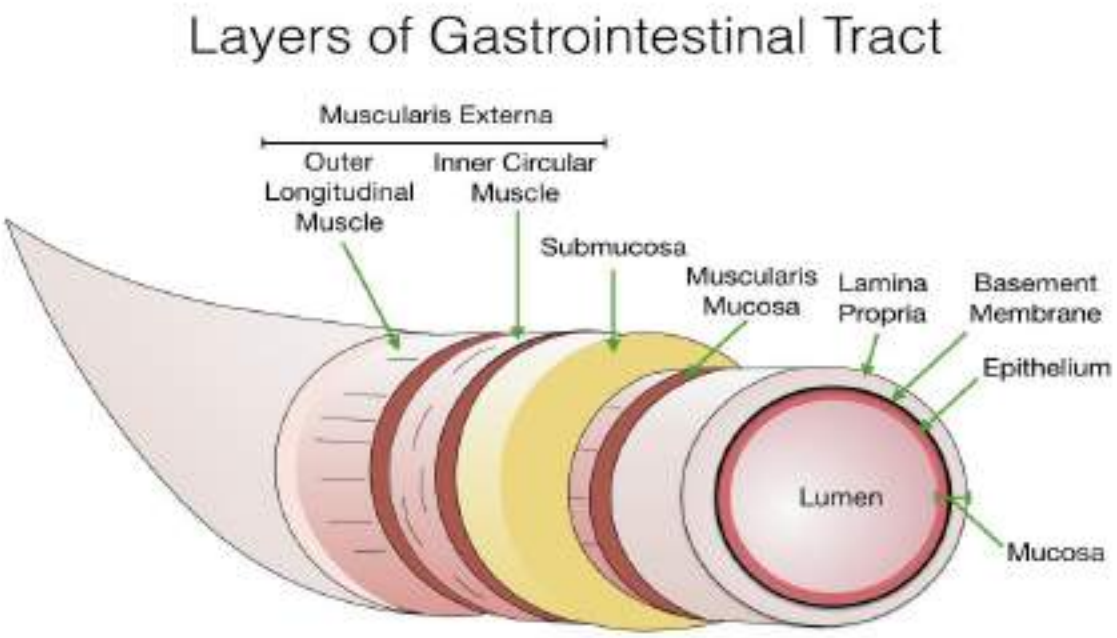
Gallbladder
- Stores excess bile made in the liver
- Bile helps to break down fats and carry waste from the liver

YOUNG LIVING

Wall OF Gastrointestinal Tract

In general, wall of the GI tract is formed by four layers which are from inside out:

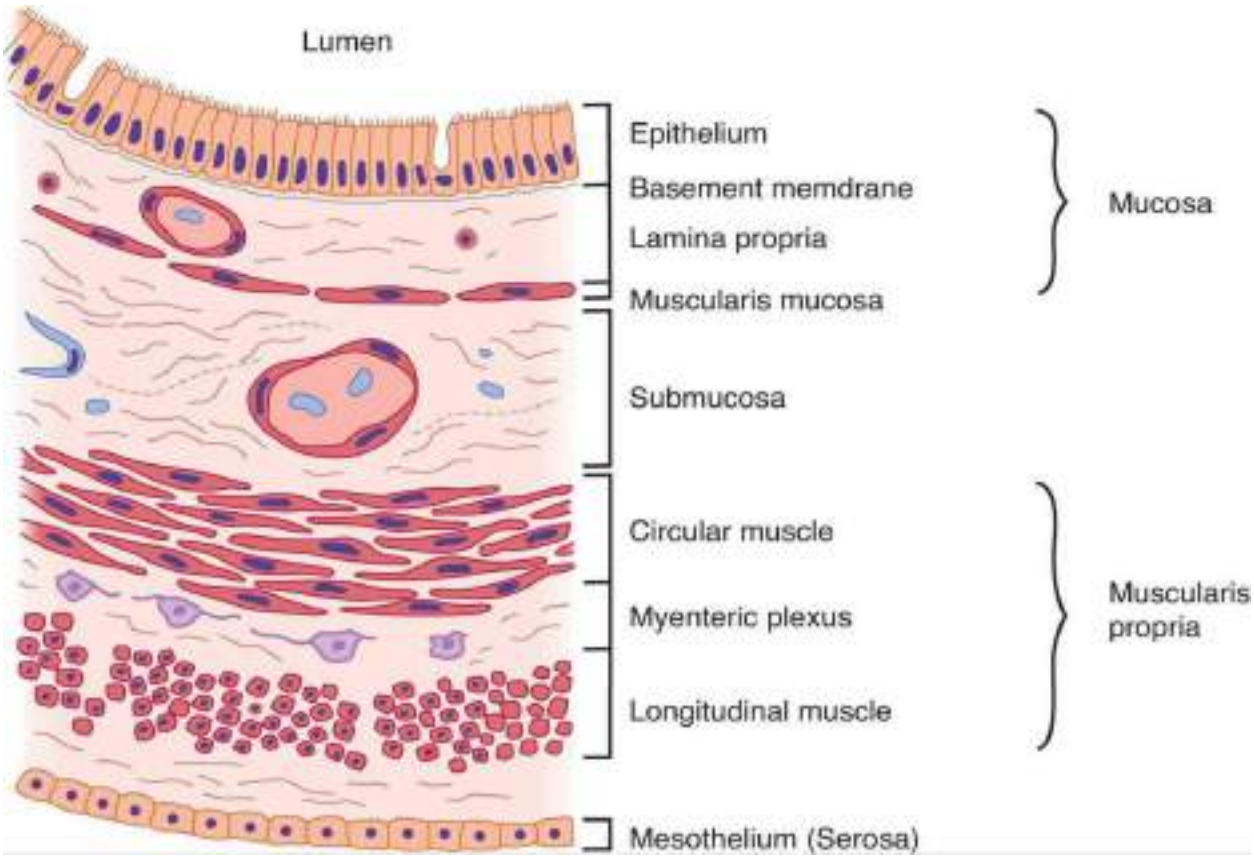
1. Mucus layer
2. Submucus layer
3. Muscular layer
4. Serous or fibrous layer.



1. Mucus Layer

Mucus layer is the innermost layer of the wall of GI tract. It is also called gastrointestinal mucosa or mucus membrane. It faces the cavity of GI tract.

Mucosa has three layer of structures:
i. Epithelial lining
ii. Lamina propria
iii. Muscularis mucosa.



Epithelial Lining

Epithelial lining is in contact with the contents of GI tract. The type of cells in this layer varies in different parts of GI tract.

The inner surface of mouth, surface of tongue, inner surface of pharynx and esophagus have stratified squamous epithelial cells.

However, mucus membrane lining the other parts such as stomach, small intestine and large intestine has columnar epithelial cells.

Lamina Propria

Lamina propria is formed by connective tissues, which contain fibro blasts, macrophages, lymphocytes and eosinophils.

Muscularis Mucosa

Muscularis mucosa layer consists of a thin layer of smooth muscle fibers. It is absent in mouth and pharynx.It is present from esophagus onwards.

„ 2. Sub Mucus Layer

Sub mucus layer is also present in all parts of GI tract, except the mouth and pharynx. It contains loose collagen fibers, elastic fibers, reticular fibers and few cells of connective tissue. Blood vessels, lymphatic vessels and nerve plexus are present in this layer..

„ 3. Muscular Layer

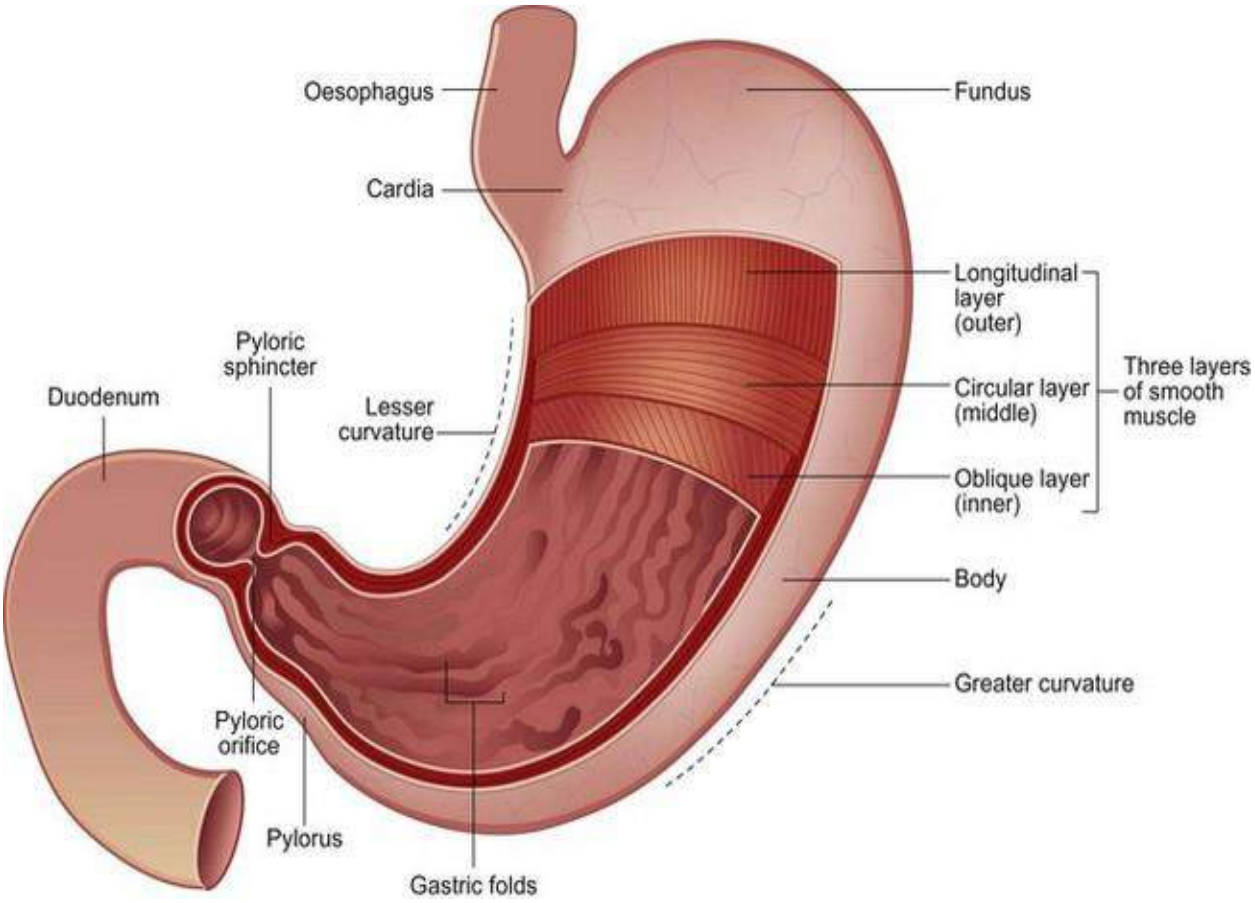
Muscular layer in lips, cheeks and wall of pharynx contains skeletal muscle fibers. The esophagus has both skeletal and smooth muscle fibers.

Wall of the stomach and intestine is formed by smooth muscle fibers. Smooth muscle fibers in stomach are arranged in three layers:

i. Inner oblique layer
ii. Middle circular layer
iii. Outer longitudinal layer.

Smooth muscle fibers in the intestine are arranged in two layers:

i. Inner circular layer
ii. Outer longitudinal layer.



Auerbach nerve plexus is present in between the circular and longitudinal muscle fibers.
The smooth muscle fibers present in inner circular layer of anal canal constitute internal anal sphincter. The external anal sphincter is formed by skeletal muscle fibers.

4. Serous Or Fibrous Layer

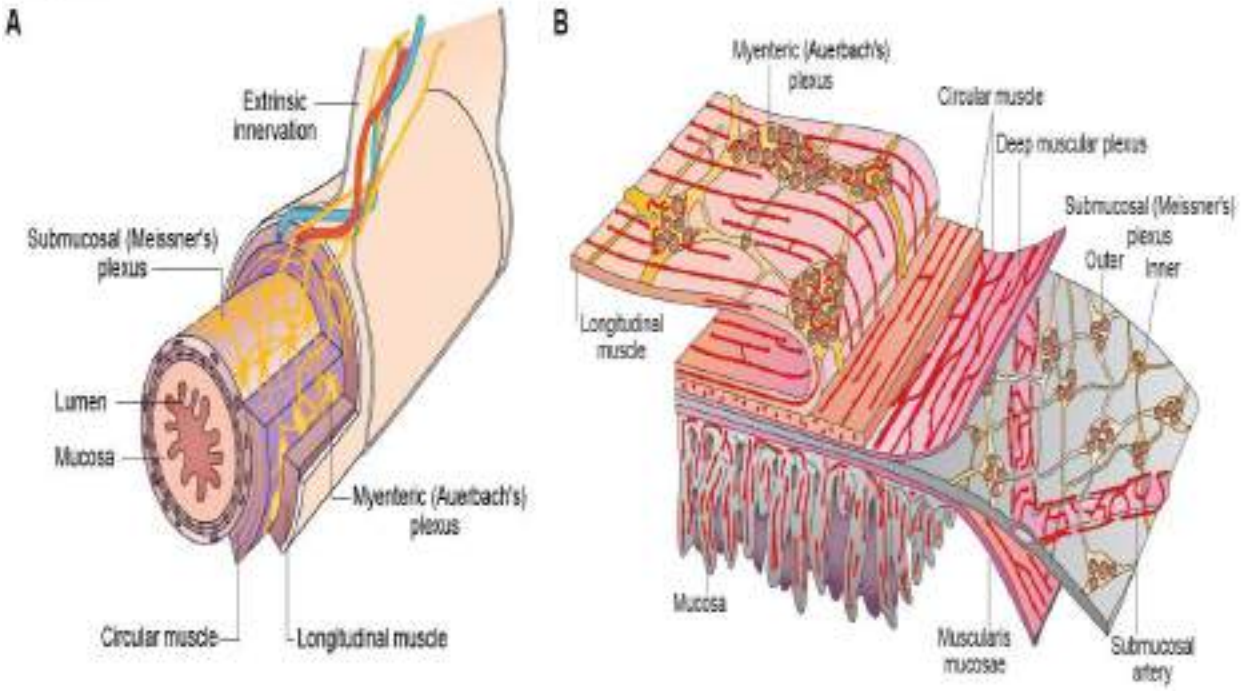
Outermost layer of the wall of GI tract is either serous or fibrous in nature. The serous layer is also called serosa or serous membrane and it is formed by connective tissue and mesoepithelial cells.

It covers stomach, small intestine and large intestine.
The fibrous layer is otherwise called fibrosa and it is formed by connective tissue. It covers pharynx and esophagus.

Nerve Supply To Gastrointestinal Tract

GI tract has two types of nerve supply:
I. Intrinsic nerve supply
II. Extrinsic nerve supply.

Figure 1



Intrinsic Nerve Supply –Enteric Nervous System

Intrinsic nerves to GI tract form the enteric nervous system that controls all the secretions and movements of GI tract. Enteric nervous system is present within the wall of GI tract from

esophagus to anus.Nerve fibers of this system are interconnected and form two major networks called

1. Auerbach plexus
2. Meissner plexus.

These nerve plexus contain nerve cell bodies, processes of nerve cells and the receptors. The receptors in the GI tract are stretch receptors and chemoreceptors. Enteric nervous system is controlled by extrinsic nerves.

1. Auerbach Plexus

Auerbach plexus is also known as myenteric nerve plexus. It is present in between the inner circular muscle layer and the outer longitudinal muscle layer.

Functions of Auerbach plexus

Major function of this plexus is to regulate the movements of GI tract. Some nerve fibers of this plexus accelerate the movements by secreting the excitatory neurotransmitter substances like acetylcholine, serotoninand substance P. Other fibers of this plexus inhibit the GI motility by secreting the inhibitory neurotransmitters such as vasoactive intestinal polypeptide (VIP), neurotensin and enkephalin.

2. Meissner Nerve Plexus

Meissner plexus is otherwise called submucus nerve plexus. It is situated in between the muscular layer and submucosal layer of GI tract.

Functions of Meissner plexus

Function of Meissner plexus is the regulation of secretory functions of GI tract. These nerve fibers cause constriction of blood vessels of GI tract.

Extrinsic Nerve Supply

Extrinsic nerves that control the enteric nervous system are from autonomic nervous system. Both sympathetic and parasympathetic divisions of autonomic nervous system innervate the GI tract

Sympathetic Nerve Fibers

Functions of sympathetic nerve fibers

Sympathetic nerve fibers inhibit the movements and decrease the secretions of GI tract by secreting the neurotransmitter noradrenaline. It also causes constriction of sphincters.

Parasympathetic Nerve Fibers

Functions of parasympathetic nerve fibers

Parasympathetic nerve fibers accelerate the movements and increase the secretions of GI tract. The neurotransmitter secreted by the parasympathetic nerve fibers is acetylcholine (Ach).

Digestive Diseases

Some digestive diseases and conditions are acute, lasting only a short time, while others are chronic, or long-lasting.

1-Irritable Bowel Syndrome (IBS)

Irritable bowel syndrome (IBS) is a common disorder that affects the stomach and intestines, also called the gastrointestinal tract. Symptoms include cramping, abdominal pain, bloating, gas, and diarrhea or constipation, or both. IBS is a chronic condition that you'll need to manage long term.

Only a small number of people with IBS have severe symptoms. Some people can control their symptoms by managing diet, lifestyle and stress. More-severe symptoms can be treated with medication and counseling.IBS doesn't cause changes in bowel tissue or increase your risk of colorectal cancer.

Symptoms

Symptoms of IBS vary but are usually present for a long time. The most common include:

1-Abdominal pain, cramping or bloating that is related to passing a bowel movement

2-Changes in appearance of bowel movement

3-Changes in how often you are having a bowel movement

Other symptoms that are often related include sensation of incomplete evacuation and increased gas or mucus in the stool.

Causes

The exact cause of IBS isn't known. Factors that appear to play a role include:

1-*Muscle contractions in the intestine*. The walls of the intestines are lined with layers of muscle that contract as they move food through your digestive tract. Contractions that are stronger and last longer than usual can cause gas, bloating and diarrhea. Weak contractions can slow food passage and lead to hard, dry stools.

2-Nervous system. Issues with the nerves in your digestive system may cause discomfort when your abdomen stretches from gas or stool. Poorly coordinated signals between the brain and the intestines can cause your body to overreact to changes that typically occur in the digestive process. This can result in pain, diarrhea or constipation.

3-*Severe infection*. IBS can develop after a severe bout of diarrhea caused by bacteria or a virus. This is called gastroenteritis. IBS might also be associated with a surplus of bacteria in the intestines (bacterial overgrowth).

4-*Early life stress*. People exposed to stressful events, especially in childhood, tend to have more symptoms of IBS.

5-*Changes in gut microbes*. Examples include changes in bacteria, fungi and viruses, which typically reside in the intestines and play a key role in health.

Triggers

Symptoms of IBS can be triggered by:

- ***Food.*** The role of food allergy or intolerance in IBS isn't fully understood. A true food allergy rarely causes IBS. But many people have worse IBS symptoms when they eat or drink certain foods or beverages. These include wheat, dairy products, citrus fruits, beans, cabbage, milk and carbonated drinks.
- ***Stress*.** Most people with IBS experience worse or more-frequent symptoms during periods of increased stress. But while stress may make symptoms worse, it doesn't cause them.

Complications

Chronic constipation or diarrhea can cause hemorrhoids.In addition, IBS is associated with:

- ***Poor quality of life***. Many people with moderate to severe IBS report poor quality of life. Research indicates that people with IBS miss three times as many days from work as do those without bowel symptoms.
- ***Mood disorders***. Experiencing the symptoms of IBS can lead to depression or anxiety. Depression and anxiety also can make IBS worse.

2- Crohn's Disease

Crohn's disease is a type of inflammatory bowel disease (IBD). It causes swelling of the tissues (inflammation) in your digestive tract, which can lead to abdominal pain, severe diarrhea, fatigue, weight loss and malnutrition.

Inflammation caused by Crohn's disease can involve different areas of the digestive tract in different people, most commonly the small intestine. This inflammation often spreads into the deeper layers of the bowel.Crohn's disease can be both painful and debilitating, and sometimes may lead to life-threatening complications.

Symptoms

In Crohn's disease, any part of your small or large intestine can be involved. It may involve multiple segments, or it may be continuous. In some people, the disease is only in the colon, which is part of the large intestine.

Signs and symptoms of Crohn's disease can range from mild to severe. They usually develop gradually, but sometimes will come on suddenly, without warning. You may also have periods of time when you have no signs or symptoms (remission).

When the disease is active, symptoms typically include:

Diarrhea , Fever ,Fatigue ,Abdominal pain and cramping ,Blood in your stool, Mouth sores, Reduced appetite and weight loss ,Pain or drainage near or around the anus due to inflammation from a tunnel into the skin (fistula)

Causes

The exact cause of Crohn's disease remains unknown. Previously, diet and stress were suspected, but now doctors know that these factors may aggravate, but don't cause, Crohn's disease. Several factors likely play a role in its development.

- ***Immune system*.** It's possible that a virus or bacterium may trigger Crohn's disease; however, scientists have yet to identify such a trigger. When your immune system tries to fight off an invading microorganism or environmental triggers, an atypical immune response causes the immune system to attack the cells in the digestive tract, too.
- ***Heredity.*** Crohn's disease is more common in people who have family members with the disease, so genes may play a role in making people more likely to have it. However, most people with Crohn's disease do not have a family history of the disease.

Complications

Crohn's disease may lead to one or more of the following complications:

*1-**Bowel obstruction***. Crohn's disease can affect the entire thickness of the intestinal wall. Over time, parts of the bowel can scar and narrow, which may block the flow of digestive contents, often known as a stricture.

2-Ulcers. Chronic inflammation can lead to open sores (ulcers) anywhere in your digestive tract, including your mouth and anus, and in the genital area (perineum).

*3-**Fistulas***. Sometimes ulcers can extend completely through the intestinal wall, creating a fistula — an abnormal connection between different body parts. When fistulas develop inside the abdomen, it may lead to infections and abscesses, which are collections of pus.

4-*Anal fissure*. This is a small tear in the tissue that lines the anus or in the skin around the anus where infections can occur. It's often associated with painful bowel movements and may lead to a perianal fistula.

5-*Malnutrition.* Diarrhea, abdominal pain and cramping may make it difficult for you to eat or for your intestine to absorb enough nutrients to keep you nourished. It's also common to develop anemia due to low iron or vitamin B-12 caused by the disease.

6-*Colon cancer*. Having Crohn's disease that affects your colon increases your risk of colon cancer. General colon cancer screening guidelines for people without Crohn's disease call for a colonoscopy at least every 10 years beginning at age 45. In people with Crohn's disease affecting a large part of the colon, a colonoscopy to screen for colon cancer is recommended about 8 years after disease onset and generally is performed every 1 to 2 years afterward. Ask your doctor whether you need to have this test done sooner and more frequently.

7-*Skin disorders.* Many people with Crohn's disease may also develop a condition called hidradenitis suppurativa. This skin disorder involves deep nodules, tunnels and abscesses in the armpits, groin, under the breasts, and in the perianal or genital area.

8-*Other health problems*. Crohn's disease can also cause problems in other parts of the body. Among these problems are low iron (anemia), osteoporosis, arthritis, and gallbladder or liver disease.

9-*Medication risks.* Certain Crohn's disease drugs that act by blocking functions of the immune system are associated with a small

risk of developing cancers such as lymphoma and skin cancers. They also increase the risk of infections.

Corticosteroids can be associated with a risk of osteoporosis, bone fractures, cataracts, glaucoma, diabetes and high blood pressure, among other conditions.

10-*Blood clots*. Crohn's disease increases the risk of blood clots in veins and arteries.

3-Celiac Disease

Celiac disease is an illness caused by an immune reaction to eating gluten. Gluten is a protein found in foods containing wheat, barley or rye.

Symptoms

The symptoms of celiac disease can vary greatly. They also may be different in children and adults. Digestive symptoms for adults include:

Diarrhea, Fatigue, Weight loss, Bloating and gas, Abdominal pain, Nausea and vomiting, Constipation.

Causes

When the body's immune system overreacts to gluten in food, the reaction damages the tiny, hairlike projections, called villi, that line the small intestine. Villi absorb vitamins, minerals and other nutrients from the food you eat. If your villi are damaged, you can't get enough nutrients, no matter how much you eat.

Complications

Celiac disease that is not treated can lead to:

- ***Malnutrition.*** This occurs if your small intestine can't absorb enough nutrients. Malnutrition can lead to anemia and weight loss. In children, malnutrition can cause slow growth and short stature.
- ***Bone weakening.*** In children, malabsorption of calcium and vitamin D can lead to a softening of the bone, called osteomalacia or rickets. In adults, it can lead to a loss of bone density, called osteopenia or osteoporosis.
- ***Infertility and miscarriage***. Malabsorption of calcium and vitamin D can contribute to reproductive issues.
- ***Lactose intolerance***. Damage to your small intestine might cause you abdominal pain and diarrhea after eating or drinking dairy products that contain lactose. Once your intestine has healed, you might be able to tolerate dairy products again.
- ***Cancer***. People with celiac disease who don't maintain a gluten-free diet have a greater risk of developing several forms of cancer, including intestinal lymphoma and small bowel cancer.
- ***Nervous system conditions***. Some people with celiac disease can develop conditions such as seizures or a disease of the nerves to the hands and feet, called peripheral neuropathy.

4-Bowel Control Problems

Fecal incontinence, also called accidental bowel leakage, is the accidental passing of solid or liquid stools from your anus. You may have a strong urge to have a bowel movement and not be able to control it. You may have bowel leakage and not know it.

Symptoms

The symptoms of fecal incontinence include a strong urge for a bowel movement and not being able to control it, and passing solid or liquid stool without knowing it. Fecal incontinence has many causes, including digestive tract disorders and chronic diseases.

Causes

Common causes of fecal incontinence include:

- diarrhea
- constipation
- problems with muscles or nerves
- Hirschsprung's disease
- congenital malformations of the anorectal area, like imperforate anus
- neuropathic conditions like spina bifida

5- Diarrhea

Diarrhea — loose, watery and possibly more-frequent bowel movements — is a common problem. Sometimes, it's the only symptom. At other times, it may be associated with other symptoms, such as nausea, vomiting, abdominal pain or weight loss.

Symptoms

Symptoms associated with diarrhea (loose, watery stools) may include:

Belly cramps or pain., Bloating, Nausea, Vomiting, Fever, Blood in the stool, Mucus in the stool.

Causes

A number of diseases and conditions can cause diarrhea, including:

- ***Viruses.*** Viruses that can cause diarrhea include Norwalk virus (also known as norovirus), enteric adenoviruses, astrovirus, cytomegalovirus and viral hepatitis. Rotavirus is a common cause of acute childhood diarrhea.

- ***Bacteria and parasites***. Exposure to certain bacteria, such as E. coli or parasites through contaminated food or water, leads to diarrhea. When traveling in developing countries, diarrhea caused by bacteria and parasites is often called traveler's diarrhea.

- ***Medicines.*** Many medicines, such as antibiotics, can cause diarrhea. Antibiotics get rid of infections by killing bad bacteria, but they also kill good bacteria. This disturbs the natural balance of bacteria in your intestines, leading to diarrhea or an infection.

- ***Lactose intolerance.*** Lactose is a sugar found in milk and other dairy products. People who have trouble digesting lactose have diarrhea after eating dairy products. Lactose intolerance can increase with age because levels of the enzyme that helps digest lactose drop as you get older.

- ***Fructose***. Fructose is a sugar found naturally in fruits and honey. It's sometimes added as a sweetener to certain beverages. Fructose can lead to diarrhea in people who have trouble digesting it.

- ***Artificial sweeteners***. Sorbitol, erythritol and mannitol — artificial sweeteners are nonabsorbable sugars found in chewing gum and other sugar-free products — can cause diarrhea in some otherwise healthy people.
- ***Surgery***. Partial intestine or gallbladder removal surgeries can sometimes cause diarrhea.

- ***Other digestive disorders*.** Chronic diarrhea has a number of other causes, such as IBS, Crohn's disease, ulcerative colitis, celiac disease, microscopic colitis and small intestinal bacterial overgrowth (SIBO).

Complications

Diarrhea can cause dehydration, which can be life-threatening if untreated. Dehydration is particularly dangerous in children, older adults and those with weakened immune systems.

6- Lactose intolerance

Lactose intolerance is caused by a lessened ability or a complete inability to digest lactose, a sugar found in dairy products. Humans vary in the amount of lactose they can tolerate before symptoms develop.

Symptoms may include abdominal pain, bloating, diarrhea, flatulence, and nausea. These symptoms typically start thirty minutes to two hours after eating or drinking something containing lactose,

with the severity typically depending on the amount consumed. Lactose intolerance is due to the lack of the enzyme lactase in the small intestines to break lactose down into glucose and galactose.

Symptoms

The signs and symptoms of lactose intolerance usually begin from 30 minutes to two hours after eating or drinking foods that contain lactose. Common signs and symptoms include:

1-Diarrhea
2-Nausea, and sometimes, vomiting
3-Stomach cramps
4-Bloating
5-Gas

Causes

Lactose intolerance occurs when your small intestine doesn't produce enough of an enzyme (lactase) to digest milk sugar (lactose).

Normally, lactase turns milk sugar into two simple sugars — glucose and galactose — which are absorbed into the bloodstream through the intestinal lining.