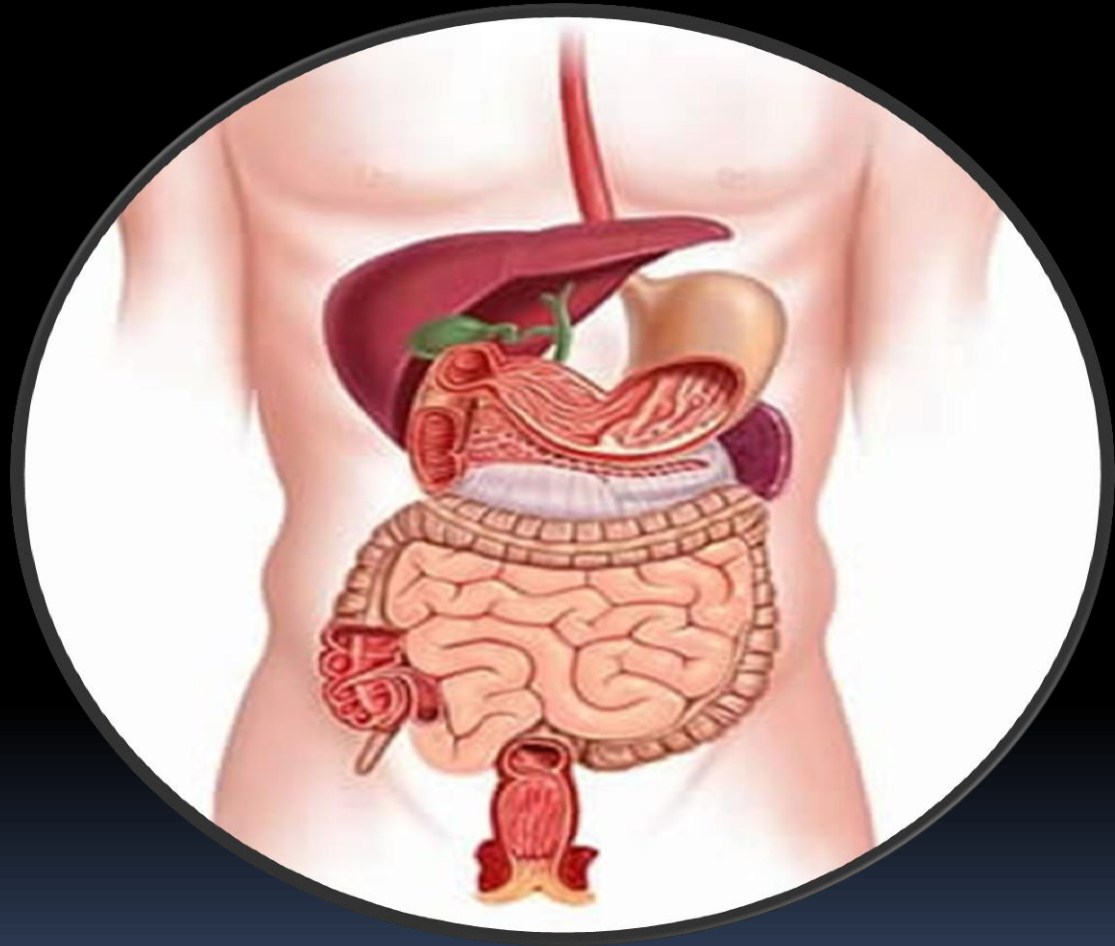




Physiology of Digestive System

4th Lecture

2nd Term



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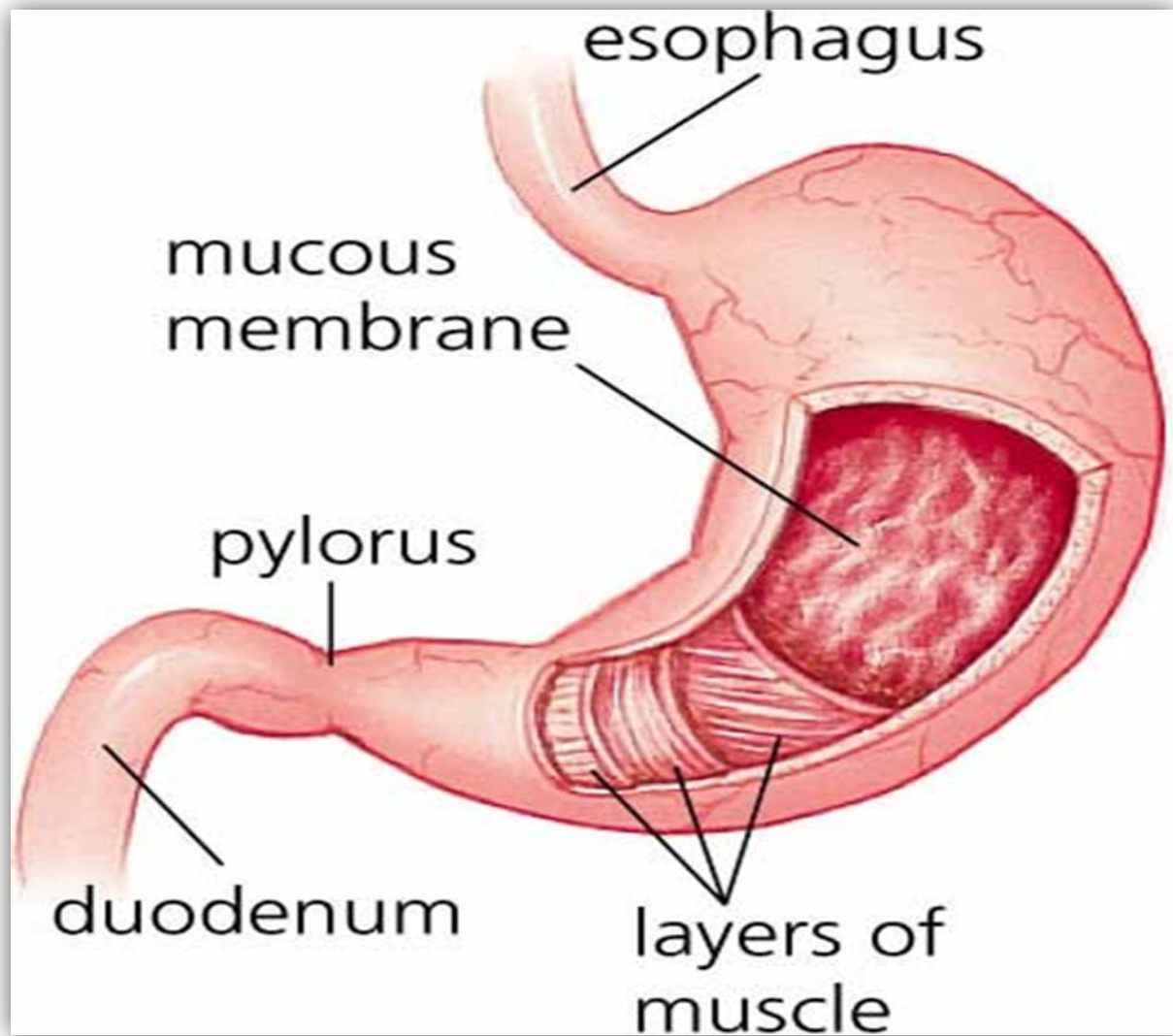
**Teaching of Physiology
College of Technology & Health Sciences
Radiological Techniques Department**

Stomach

The stomach has thick muscles in its wall. These contract to mash the food into a water soup called chyme.

The stomach lining produces strong digestive juices.

- Acid digestion occurs in the stomach.**
- Gastrin, a hormone, stimulates acid release.**
- Pepsin, an enzyme that breaks up proteins, requires an acidic environment to become active.**



Secretions of Stomach

The entire surface of the stomach mucosa has a continuous layer of a special type of mucous cells called surface mucous cells that secrete large quantities of a very viscid and alkaline mucus to coat the mucosa with a gel layer (>1 mm thickness) in order to protect stomach wall from digestion by highly acidic and proteolytic enzymes, as well as contributing to lubrication of food transport.

In addition to these cells, the stomach mucosa has two important types of tubular glands:

Oxyntic glands found in the body and fundus of the stomach,

Pyloric glands which located in the antrum.

These glands open into a common outlet on the surface of the mucosa called gastric pits, and composed of different cell types, each secreting a unique substance

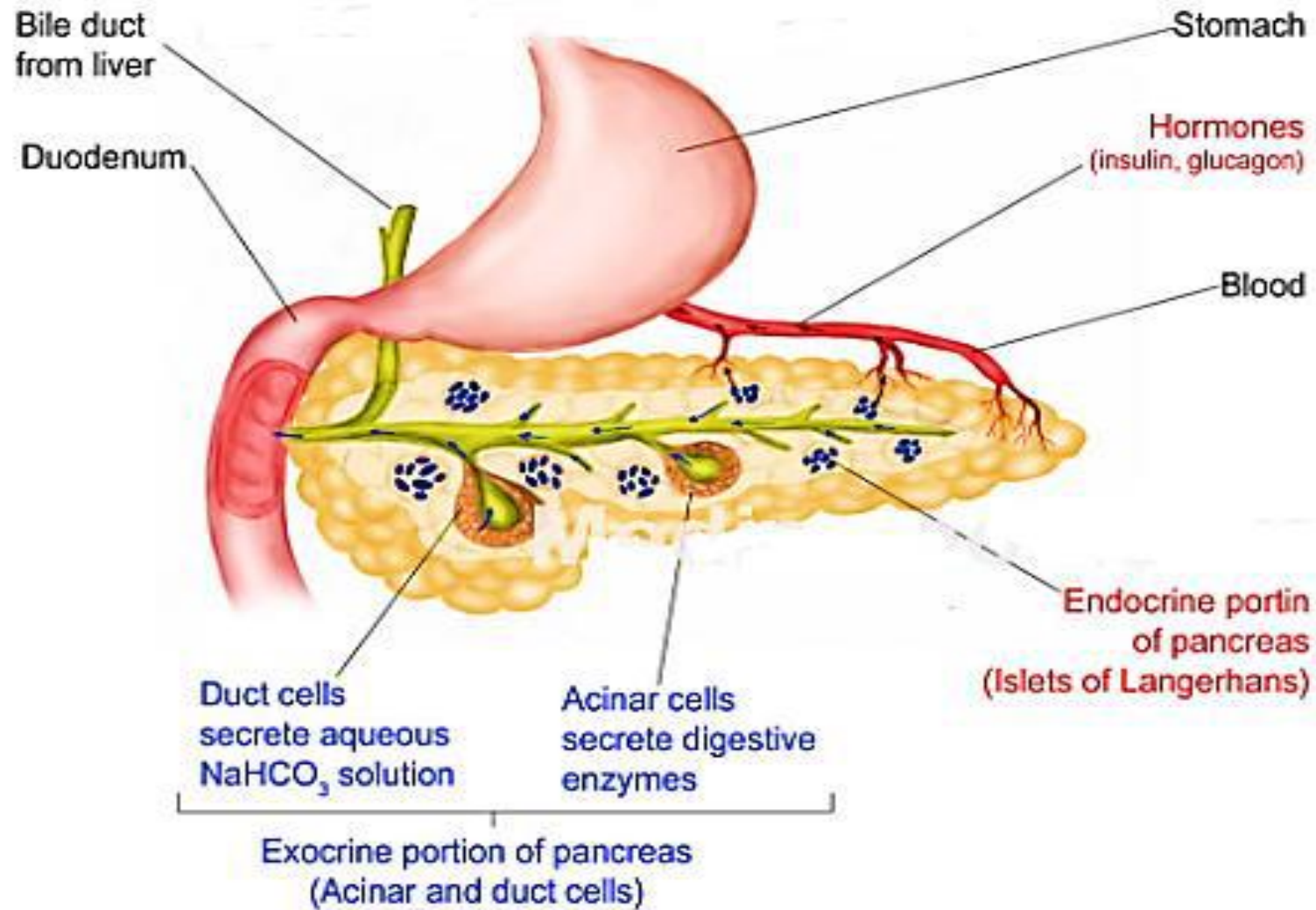
Secretions of Pancreas

The pancreas is a large gland lies beneath the stomach, which is a mixed exocrine-endocrine gland that produces digestive enzymes and hormones.

The hormones are synthesized in clusters of endocrine epithelial cells known as islets of Langerhans and secreted directly into the blood, while the exocrine portion of the pancreas is a compound acinar gland, similar in structure to the parotid gland.

The pancreatic digestive enzymes are secreted by *acini*, and large volumes of sodium bicarbonate solution are secreted by the *ducts* leading from the acini.

The combined product of enzymes and sodium bicarbonate then flows through a long *pancreatic duct* that normally joins the hepatic duct immediately before it empties into the duodenum through opening surrounded by the sphincter of Oddi.



Pancreatic Digestive Enzymes

Pancreatic secretion contains multiple enzymes for digesting all of the three major types of food: proteins, carbohydrates, and fats. It also contains large quantities of bicarbonate ions, which play an important role in neutralizing the acidity of the chyme emptied from the stomach into the duodenum.

1. Enzymes for digesting proteins:

a) Trypsin: It is the most abundant enzyme that is synthesized in the pancreatic cells as inactive enzyme known as *Trypsinogen* and then activated by an enzyme called *enterokinase*, which is secreted by the intestinal mucosa when chyme comes in contact with the mucosa. Also, trypsinogen can be autocatalytically activated by trypsin itself that has already been formed from previously secreted trypsinogen. Trypsin splits whole and partially digested proteins into peptides of various sizes but does not cause release of individual amino acids.

b) Chymotrypsin: It is synthesized in the pancreatic cells as inactive enzyme known as *chymotrypsinogen* and then activated by trypsin when becomes in contact with chyme in small intestine. Chymotrypsin also split proteins into peptides of various sizes but do not cause release of individual amino acids.

c) Carboxypolypeptidase: It is synthesized in the pancreatic cells as inactive enzyme known as *procarboxypolypeptidase*, and also become activated by trypsin only after they are secreted into the intestinal tract. Carboxypolypeptidase does split some peptides into individual amino acids, thus completing digestion of some proteins all the way to the amino acid state.

Because trypsin is the most abundant one and it activates the other pancreatic proteolytic enzymes, thus the same cells that secrete proteolytic enzymes into the acini of the pancreas secrete simultaneously another substance called *trypsin inhibitor* to prevent activation of trypsin and other proteolytic enzymes both inside the secretory cells and in the acini and ducts of the pancreas.

When the trypsin inhibitor is often overwhelmed, the pancreatic secretions rapidly become activated and can digest the entire pancreas within a few hours, giving rise to the condition called *acute pancreatitis*, which usually leads to a subsequent lifetime of pancreatic insufficiency, or sometimes is lethal due to circulatory shock.

2. Enzyme for digesting carbohydrates:

The acini of pancreas s secret one enzyme known as *pancreatic amylase*, which hydrolyzes starches, glycogen, and most other carbohydrates (except cellulose) to form mostly disaccharides and a few trisaccharides.

3. Enzymes for digesting fat:

They are three enzymes; (1) *pancreatic lipase*, which is capable of hydrolyzing neutral fat into fatty acids and monoglycerides; (2) *cholesterol esterase*, which causes hydrolysis of cholesterol esters; and (3) *phospholipase*, which splits fatty acids from phospholipids.

Acid from stomach releases secretin from wall of duodenum; fats and amino acids cause release of cholecystokinin

Common bile duct

Vagal stimulation releases enzymes into acini

Secretin and cholecystokinin absorbed into blood stream

Secretin causes copious secretion of pancreatic fluid and bicarbonate; cholecystokinin causes secretion of enzymes

