Organs associated with the digestive tract

These organs include the salivary gland, the pancreas, the liver and the gall bladder.

Salivary glands:

Saliva is a complex fluid which wet and lubricate the oral mucosa and the ingested food and participate also in the initiation of carbohydrate digestion by the action of amylase enzyme, the saliva also secrete germicidal substances such as IgA, lysozyme. There are three pairs of salivary glands: The parotid, the submaxillary and the sublingual gland, there are also scattered small salivary gland in the oral cavity.

The whole gland is surrounded by a capsule which sends trabeculae to divide the gland into lobules, the parenchyma of the gland consists of the secretary part and the ductal part.

In the secretary part, there are two types of secretary cells, mucous and serous cells as well as non secretary cells called the myoepithelial cells.

Serous cells:

Are pyramidal in shape, resting on the basal lamina, they have criteria of protein secreting cells, rounded nucleus, group of serous cells usually form spherical mass called the (acinus), with small narrow lumen, serous fluid is watery in consistency.

Mucous cells:

Are cuboidal or columnar in shape, resting on basal lamina, the nuclei are flattened, basally located, have criteria of mucous secreting cells, mucous cells are organized into tubules, consisting of cylindrical arrays of secretary cells surrounding a large lumen. Sometime the mucous cell acinus is capped by serous cells which constitute the serous demilunes.

Myoepithelial cells:

These cells are found between the basal lamina and the basal plasma membrane of secretary cells, myoepithelial cells surround each secretary portion usually 2-3 cells/secretary unit. Sometime is called Basket cells, myoepithelial cells have criteria similar to those in smooth muscles such as the contractility, so the contraction of these cells accelerate the secretion of saliva.

In the ductal system, secretary portion empty into the intercalated ducts, lined by cuboidal cells, several of these intercalated ducts join each other to form the striated ducts, characterized by radial striation extending between the nucleus and the bases of the cells. The striation is due to the enfolding of the basal plasma membrane with numerous elongated mitochondria that are aligned parallel to the enfolding membrane, this striation is

characteristic of ion –transporting cells. Intercalated ducts and striated ducts are also called Intralobular ducts because of their location within the lobules.

The striated ducts joined to form the Interlobular ducts (located between the lobules), they are lined initially by pseudostratified, then it is lined by stratified columnar epithelium, finally as it open into the oral cavity it lined by non–keratinized stratified squamous epithelium.

- Vessels and nerves enter the large glands at the hilum and gradually branched into rich vascular and nervous plexuses. The capillaries surround the secretary parts stimulated by the autonomic nervous system. The parasympathetic stimulation, usually through the smell and taste of food, promote vasodilatation and copious watery secretion content. Sympathetic stimulation produce small amount of viscous saliva, rich in organic material

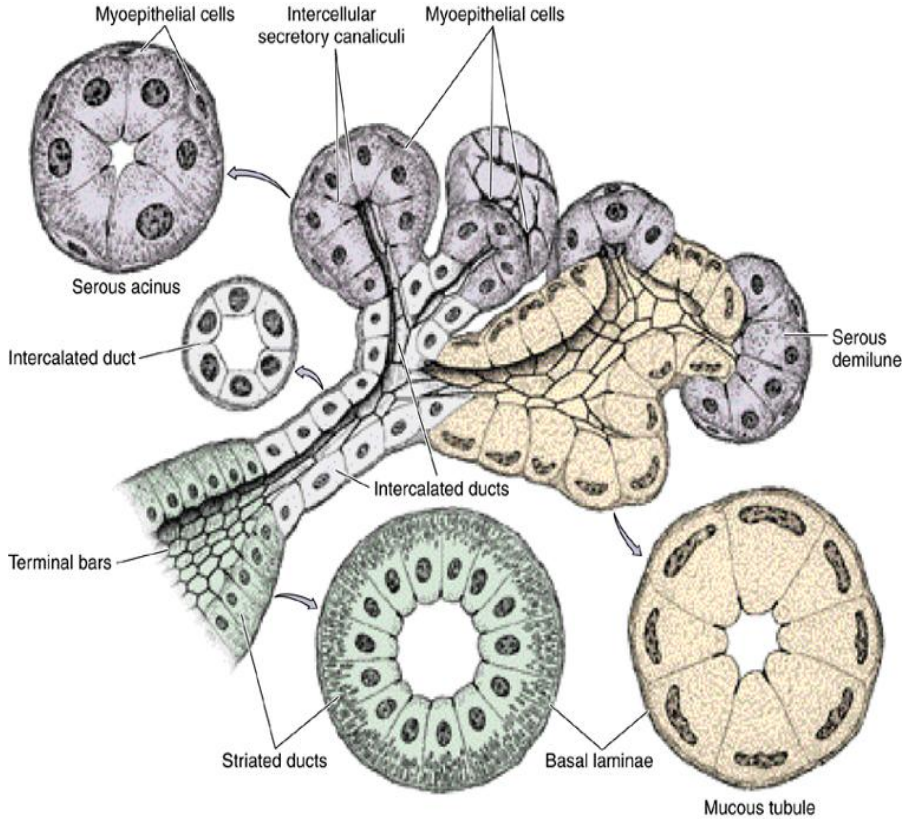

Figure 1. The structure of the submandibular (submaxillary) gland. The secretory portions are composed of pyramidal serous (light blue) and mucous (light yellow) cells. Serous cells are typical protein-secreting cells, with rounded nuclei, accumulation of rough endoplasmic reticulum in the basal third, and an apex filled with protein-rich secretory granules. The nuclei of mucous cells, flattened with condensed chromatin, are located near the bases of the cells. The short intercalated ducts are lined with cuboidal epithelium. The striated ducts are composed of columnar cells with characteristics of ion-transporting cells, such as basal membrane invaginations and mitochondrial accumulation. Myoepithelial cells are shown in the serous secretory endpieces.

Parotid gland:

Its secretary part composed exclusively of serous cells containing secretary granules which are rich in proteins and amylase enzyme.

Submandibular gland:

Its secretary part composed from serous acini and mucous tubules, 90% of secretary part is serous, 10% is mucous tubules with serous demilune.

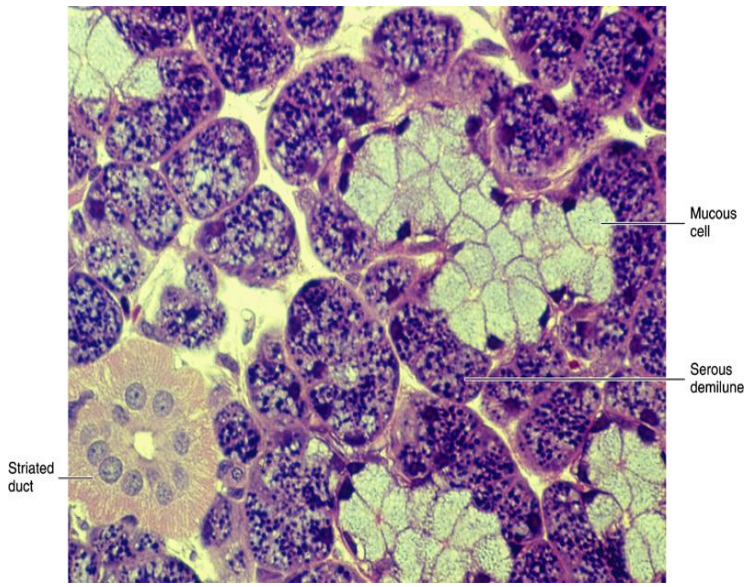

Figure 2 . Photomicrograph of a submandibular gland. Note the presence of dense serous cells forming demilunes and pale-staining mucous cells grouped along the tubular portion of this tubuloacinar gland. Medium magnification.

Sublingual glands:

Its secretary part composed from serous and mucous cells, but here the mucous tubules are predominant, serous cell appear as a demilune on mucous tubules.

Pancreas:

The pancreas is mixed exocrine and endocrine organ, the exocrine part arranged in acini, in which the enzymes are stored and released. The hormones are produced by endocrine cells known as Islet of Langerhans. The exocrine part of pancreas is similar to that of parotid gland, the distinction is based on the absence of intralobular ducts, presence of islet of Langerhans, absence of striated ducts.

The exocrine part is composed of serous acini, serous cells contain a number of zymogenic granules. The exocrine part secrete 1500-3000 ml of alkaline fluid /day contain H_2O, ions and

several proteases, amylase , lipase, phospholipase, nuclease, ribonuclease. The majority of enzymes are stored in an inactive form being activated in the lumen of intestine.

Pancreatic secretion under hormonal control (secretin and cholycystokinin) and neural control (parasympathetic), gastric acid in the intestine stimulate the release of secretin which stimulate the acinar cells to produce alkaline fluid rich in electrolytes and poor in enzymes, cholycystokinin promote the secretion of fluid rich in enzymes. The integrated action of these 2 hormones provides secretion of enzyme-rich pancreatic juice.

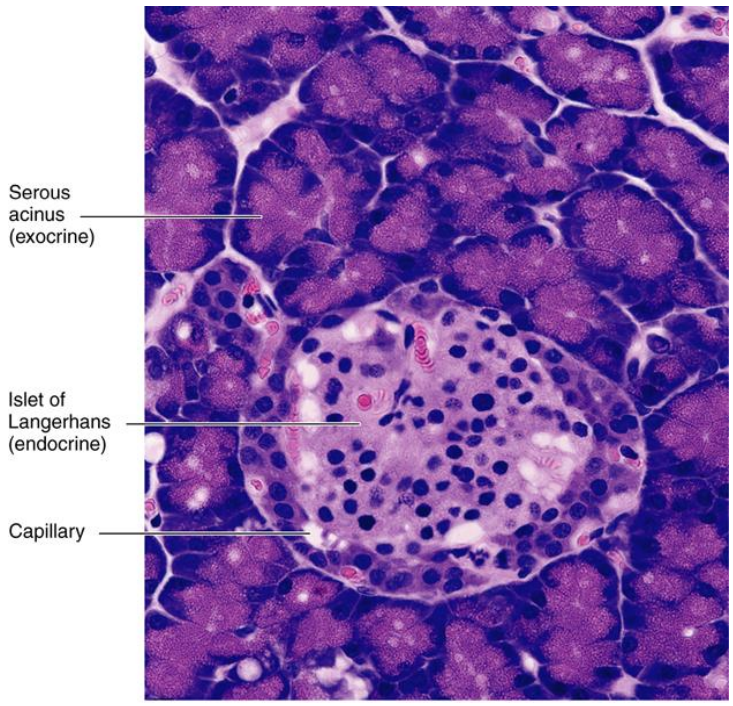

Figure 3 . Photomicrograph of a pancreas showing the exocrine portion (acini) and the endocrine portion (islet of Langerhans). The acini contain secretory cells with basophilic cytoplasm. Different types of endocrine cells are seen in the islet. PT stain. Medium magnification.

The liver:

Is the second heaviest organ of the body (second to skin) about 1-1.5 kg in weight. The liver metabolizes the nutrients that are absorbed from GIT to be stored and processed by other parts of the body. 70-80% of blood comes from the portal vein (from the GIT and spleen), 20-30% from the hepatic artery. The liver produce the bile which is the exocrine secretion, it also produce plasma proteins, coagulative proteins and growth factors.

The liver lobule:

The basic unit of the liver is liver cell or hepatocyte, these cells arrange in an interconnected plates. In L.M the structural unit called (liver lobule). This lobule is formed by polygonal

mass of tissue with portal space at the periphery and a vein n the center of the lobule called the central vein. Portal spaces, regions located at the periphery of the lobule (3-6 in no.) containing CT, bile duct, hepatic arteriole and portal venule (Triads). The duct is lined by simple cuboidal epithelium, hepatic arteriole carry oxygenated blood, portal venule come from GIT. In certain animals the lobule is surrounded by a CT which is not present in the human.

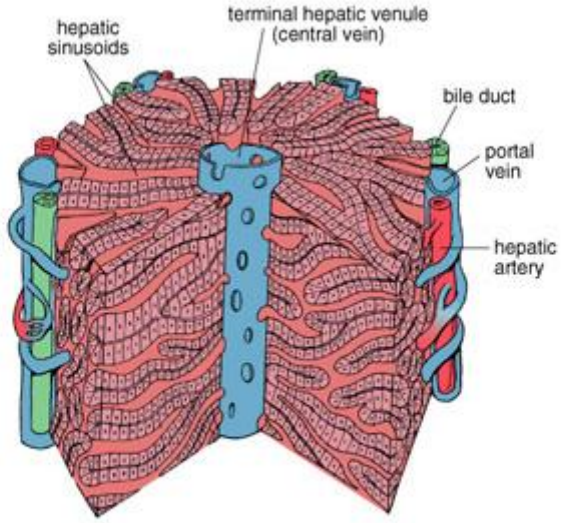

Figure 17.3. **Diagram of a "classic" liver lobule.**

The hepatocytes arranged in plates, anastamosing freely form labyrinthine and spongelike structure. The space between these plates contain liver sinusoids, which have irregular diameter and discontinuous layer of fenestrated endothelial cells with no diaphragm.

A subendothelial layer (space)called Space of Disse between the endothelial cells and hepatocytes, the basolateral side of the hepatocyte, which lines the space of Disse, contain many microvilli and show endocytosis.

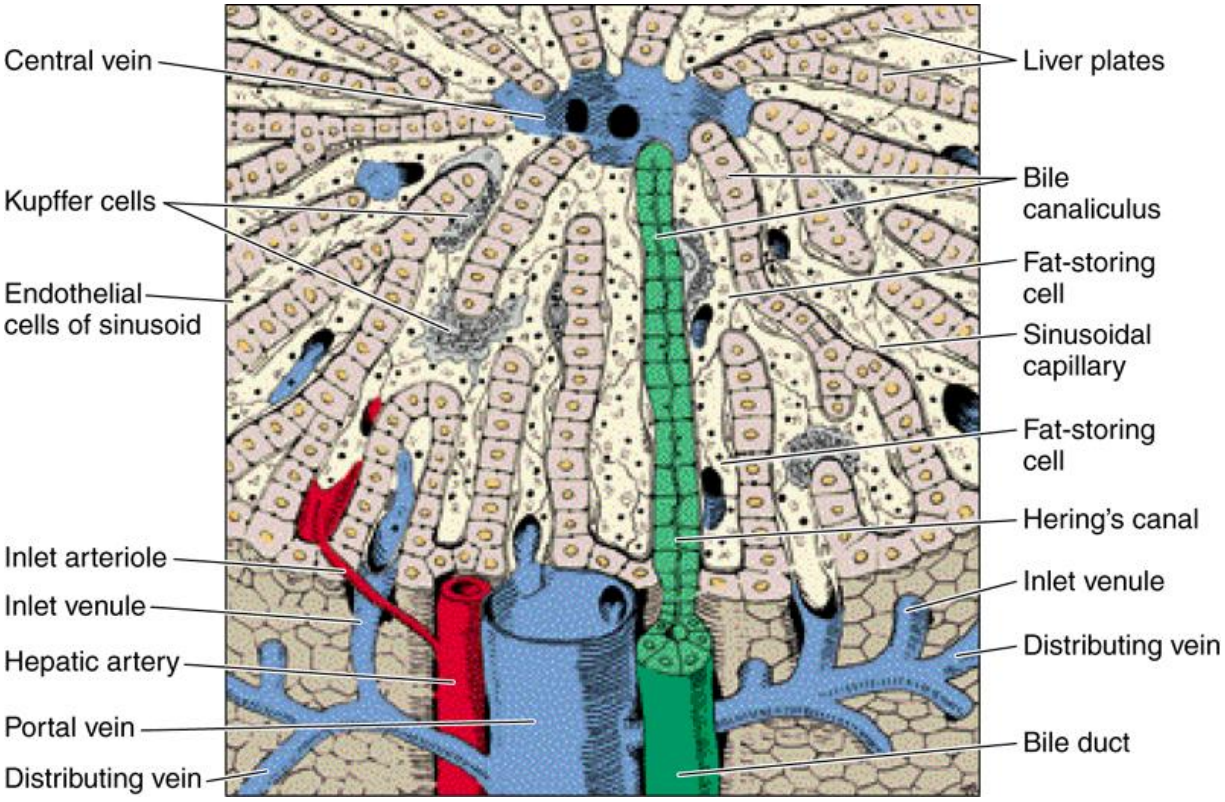

Figure 5. Three-dimensional aspect of the normal liver. In the upper center is the central vein; in the lower center, the portal vein. Note the bile canaliculus, liver plates, Hering's canal, Kupffer cells, sinusoid, fat-storing cell, and sinusoid endothelial cells. (Courtesy of M Muto.)

The sinusoids also contain macrophage called Kupffer cells, which are found in the luminal surface of the endothelial cells, their function is to metabolize the aged RBC's, secrete proteins related to immunological processes and destroy bacteria that enter through the portal circulation, they comprise about 15 % of the liver cells and they are active in phagocytosis.

Blood supply

Portal system: The portal vein divide repeatedly to give the portal venules, the portal venule branched into the distributing veins run around the periphery of the lobule, then it give the inlet venule which empty into the sinusoids, the sinusoid converge into the central vein which receive more and more sinusoids to increase in size and become the larger sublobular vein then it converge to form the hepatic vein.

Arterial system: Hepatic artery repeatedly to give the interlobular arteries in the portal spaces which then give the inlet arteriole which open into the sinusoids. The blood flows from the periphery to the center of liver lobule. So the O_2, nutrients, any substances that are absorbed from the intestine reach the peripheral cells first and then reach the central cells of the lobule.

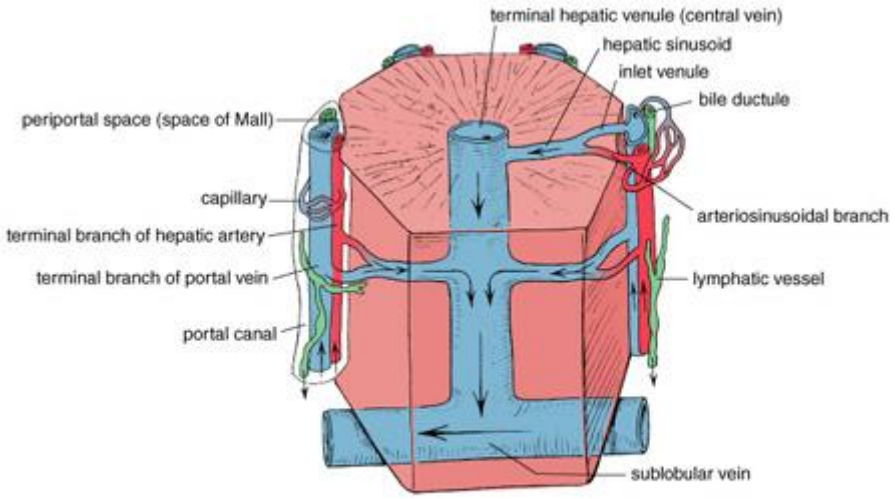

Figure 17.2. **Blood supply to the liver: the portal triad.**

Hepatocytes:

Hepatocytes are polyhedral, the cytoplasm is acidophilic due to the presence of large number of mitochondria and SER. The surface of hepatocyte is in contact with the wall of sinusoids and with the surface of other hepatocyte. Whenever two hepatocytes abut, they delimit a tubular space between them called the Bile canaliculus which is the first part of bile duct system, the cell membrane near these canaliculus are joined by tight junctions. Gap junctions also present between the hepatocyte, which are the site of intercellular communication to coordinate the physiological activity of hepatocyte. The bile canaliculus progress along the liver plates and terminate in the portal spaces, so the bile flow is opposite to that of blood (from the center to the periphery), at the periphery the bile enter the bile ductules OR Hering's canal then these ductules enter the bile ducts at the portal space, they are lined simple cuboidal cells, which gradually enlarge to become hepatic duct.

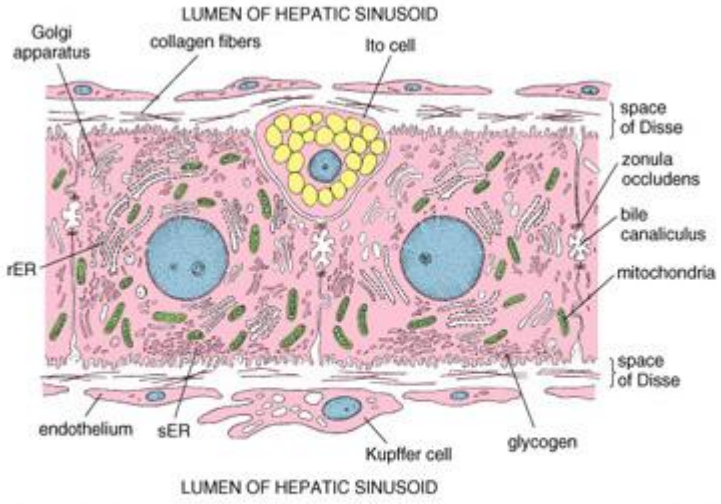

Figure 17.12. **Schematic diagram of a plate of hepatocytes interposed between hepatic sinusoids.**

The hepatocyte has one or two nuclei with one or two nucleoli, sometime the hepatocyte nucleis contain polyploidy (multiple of the haploid number of chromosomes). The hepatocytes have abundant endoplasmic reticulum (smooth and rough), the RER aggregate to form basophilic bodies which produce several proteins while the SER is responsible for detoxification of toxic substances.

The hepatocyte contain glycogen, this polysaccharide is a depot for glucose and is mobilize if the blood glucose falls.

Each hepatocyte has 2000 mitochondria, also has lipid droplets, lysosomes for cellular organelles turnover, peroxisomes which breakdown the H_2O_2 .Golgi complex is numerous (up to 50/cell) this organelle produce plasma proteins, glycoprotein, lipoprotein and lysosomes.

Bile secretion is an exocrine function of the liver, bile composed from H_2O, electrolyte, phospholipids, cholesterol and other substances. Bile acid is important for emulsifying the lipids and promotes their absorption by GIT.

The SER in the hepatocyte conjugate the bilirubin which is produce from the RBC degradation into water soluble bilirubin glucoronide, when it was hydrophobic. The liver is an important storage compartment of lipid, glycogen, vitamins (Vit A).

Liver regeneration:

The liver has an extraordinary capacity for regeneration, the loss of hepatic tissue by surgical removal triggers a mechanism by which hepatocytes begin to divide until the original mass of tissue is restored.

Biliary tract:

The daily secretion of bile is 500ml, the bile flows through bile canaliculi, bile ductuless, and bile ducts then these ducts converge to form large Lt and Rt hepatic ducts which join each other to form common hepatic duct which receive the cystic duct to form the common bile duct.

The hepatic, cystic and common bile ducts lined by simple columnar epithelium, the L.P is thin and has few smooth muscles.The muscle layer become thicker near the duodenum to form sphincter that regulate bile flow.

Gall bladder:

Is pear shaped organ, attached to the lower surface of the liver, the main function is to store bile, concentrate it by absorbing its water and release it when needed into the digestive tract. The wall consists of mucosa composed of simple columnar epithelium and L.P, a layer of smooth muscles, perimuscular CT and serous membrane.

The mucosa has abundant folds, the epithelium cells are capable of secretion of mucous, mucous glands near the cystic duct to produce mucous.

Figure 17.16. **Photomicrograph of the wall of the gallbladder.** x175.