Medical School Histology Basics
Liver, gallbladder, salivary glands, and pancreas

VIBS 243 lab

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Female Torso, 1999

This opened torso shows the internal organs of the chest and abdominal cavities in their proper positions. The stomach as well as the large and small intestines have been almost completely removed to permit a view of the organs located between the abdominal cavity and the wall of the back, known as the retroperitoneum. These include the ureters, the aorta and the lower vena cava as well as the pancreas and the duodenum. In the small pelvic cavity, the bladder can be seen, and behind it, the uterus, which is inclined forward with the fallopian tubes emerging from the sides. The large intestine extends downward behind the uterus.

Male Torso with Situs Inversus, 1999

This torso displays a rare anatomical variation, known as situs inversus. Here the organs of the chest and abdominal cavities are transposed through the sagittal plane, showing a reversed mirror-image: the apex of the heart points to the right instead of the left; the liver is on the left side of the body while the spleen is on the right; and the pancreas extends from left to right across the spinal column instead of vice versa. This anatomical variation does not cause any disorders. The incidence of this phenomenon is approximately 1 in 25,000. The bladder can be seen in front of the rectum in the small pelvic cavity.
Objectives

To understand the general organization of the accessory organs of the digestive system and how they contribute to obtaining metabolites necessary for growth and energy for the body.

To learn the origin of these glands and how structural features of these glands contribute to their function in digestion and absorption of food stuffs.
Function of the Digestive System
Role of liver, gall bladder, salivary glands, and pancreas

Movement of food
Salivary glands lubricates

Secretion of digestive juices
Salivary glands and pancreas secretes digestive juices and liver secretes bile

Absorption of digested foods, water, and electrolytes
Liver stores nutrients and cleans the blood. Also, the accessory digestive organs contribute antibodies and antibacterial/viral growth substances.
ORIGIN AND DISTRIBUTION OF EPITHELIUM

**ECTODERM** - EPIDERMIS OF SKIN AND EPITHELIUM OF CORNEA TOGETHER COVERS THE ENTIRE SURFACE OF THE BODY; SEBACEOUS AND MAMMARY GLANDS

**ENDODERM** - ALIMENTARY TRACT, LIVER, PANCREAS, GASTRIC GLANDS, INTESTINAL GLANDS
  - ENDOCRINE GLANDS - LOSE CONNECTION WITH SURFACE

**MESODERM**
  - ENDOTHELIUM - LINING OF BLOOD VESSELS
  - MESOTHELIUM - LINING SEROUS CAVITIES
ORIGIN AND DISTRIBUTION OF EPITHELIUM con’d

Liver

Gallbladder

Salivary gland

Pancreas

Ref code # 14, 16
LIVER FUNCTIONS

- Blood filtration - 1.2 x 10^7 Kupffer cells/g
- Blood storage - liver size and sinusoids expand
- Maintain normal blood glucose concentrations
- Metabolism and transport of lipids
- Secrete plasma proteins - blood clotting
- Nutritional metabolism and bile secretion
- Drug metabolism - drug tolerance
- Excretion of bilirubin - jaundice
- Secrete bile - emulsifying fats
Fig. 13-1 Pig’s Liver (panoramic view, transverse section). Stain: Mallory’s azan. Low magnification.
Figure 16-16. Schematic drawing illustrating the territories of the classic liver lobules, hepatic acini, and portal lobules. The classic lobule has a central vein (CV) and is separated and surrounded with connective tissue in the pig.

Classical liver lobules

Connective tissue capsule

Mesothelium

Monkey liver

Human liver

Pig liver

Ref code # 12
Liver

The hepatocyte functions as an endocrine-like cell (e.g., secretion of glucose and plasma proteins directly into the blood vascular system) and as an exocrine cell (e.g., secretion of bile into the bile canaliculi). This dual export of secretory products by a single cell requires a unique cellular arrangement in the liver in order to separate and compartmentalize the exocrine and endocrine-like products. Hepatocytes are arranged in fenestrated, anastomosing plates of one cell thick. Also each hepatocyte may have as many as four areas of access to the lumen.
Landscape of the Hepatocyte – Four Luminal Regions (two blood and two bile)
LIVER FUNCTION - LARGEST GLAND

EXOCRINE - BILE ACIDS, BILIRUBIN

ENDOCRINE - ALBUMIN, FIBRINOGEN, ETC.
Portal radicles containing:
- A bile duct
- Branch of portal vein
- Branch of hepatic artery
- Lymphatic vessel (usually)

Liver

Cords of hepatocytes

or portal canals
Liver

Portal radicles containing:
- A bile duct
- Branch of portal vein
- Branch of hepatic artery
- Lymphatic vessel (usually)

Central vein

Cords of hepatocytes
CELLS OF THE LIVER

HEPATOCYTES
KUPFFER CELLS
ENDOTHELIAL CELLS
CELLS OF THE LIVER

- HEPATOCYTES
- KUPFFER CELLS
- ENDOTHELIAL CELLS
CELLS OF THE LIVER

HEPATOCYTES
KUPFFER CELLS
ENDOTHELIAL CELLS
Liver hepatocyte

1. Glycogen
2. Autophagosome
3. Mitochondria
1. Hepatic sinusoid
2. Bile canaliculi
3. Space of Disse
Liver cells

- Hepatic sinusoid
- Hepatic parenchymal cells with microvilli
- Endothelial cell projecting into sinusoid
- Bile canaliculi with lysosomes close by the canaliculi
- Space of Disse containing reticular fibers
- Platelet
Glycogen in Hepatocytes

Dietary Differences In Amount Of Glycogen In Hepatocytes
2-hour Fast (8.2% Glycogen)            24-hour Fast (0.9% Glycogen)

Liver plays a role in blood sugar concentrations on a daily basis.
Sugar and protein
ZONATION OF THE LIVER

1. Classical lobule
2. Portal lobule with triad in center
3. Acinus layers between two central veins
If liver damage is due to a toxicant, it kills hepatocytes in Zone I first.
If liver damage is due to a oxygen deprivation, it will kill the hepatocytes in Zone III first.
Triad with bile duct and central vein
Liver with colloidal carbon, rat
Portal radicles:
- A bile duct
- Branch of portal vein
- Branch of hepatic artery

HEPATOCYTES
KUPFFER CELLS
ENDOTHELIAL CELLS
Bile Canaliculi

Bile duct

Blood luminal surface

Bile luminal surfaces

155

Ref code
# 6
BILE CANALICULI

Stained to see the bile canaliculi as embedded in hepatocytes
Bile canaliculus

Four + compounds that are deposited/secreted into this space.

a. Cholesterol
b. EGF
c. insulin
d. IgA

also bile salts and BILIRUBIN
The wall of the cystic duct is convoluted and contains abundant smooth muscle fibers which represent the spiral valve preventing distention or collapse of the cystic duct when the latter is subject to sudden changes of pressure.
Fig. 10.2. Gill arch (panoramic view). Stain: hematoxylin-eosin. Medium magnification.
The gallbladder stores and concentrates the bile elaborated by the liver.
The mucosa is thrown into folds which project into the lumen of the gallbladder.

- Simple columnar epithelium
- Lamina propria
- Smooth muscle layer or branching layers
- A thick perimuscular layer of connective tissue
- Peritoneal serosal layer
Distinguishing characteristics between the mucosa of the various parts of the stomach, intestines, and gallbladder.

Mucosa = surface epithelium, lamina propensa, and muscularis mucosa
SALIVARY GLANDS
ACINUS = FUNCTIONAL UNIT
SEROUS
MUCOUS
MIXED
Origin of Salivary Glands?

- Ectoderm - oral ectoderm epithelial sheet
- Endoderm - alimentary tract
Saliva Helps Prevents Infections

Contains secreted IgA
Contains Lactoferin - bind up iron needed for bacteria division
Contains lysosome that kills bacteria
Constantly washes mouth to dislodge and sweep bacteria down GI tract
Salivary Glands
Salivary Glands
Ducts of Salivary Glands

Intercalated
Striated
Figure 23-21. Electron micrograph of basal region of striated duct cells from cat submandibular gland. Notice the desmosomes joining the interdigitating processes of the cells.
Submandibular gland - intercalated duct runs into Striated duct of salivary gland

The salivary gland is a compound, tubuloacinar gland.

- Striated Ducts
- These striations reflect vertically arranged mitochondria associated with deep infoldings of the basal plasma membrane
- Secretory acini
- Intercalated ducts
Salivary gland

Secretory acini are drained by intercalated ducts and join striated ducts.

Serous and mucous acini

Myoepithelial cells
Individual secretory acini are drained by intercalated ducts and join striated ducts.
Pancreas
PANCREAS

FUNCTION
1. EXOCRINE
2. ENDOCRINE

HISTOLOGICAL ORGANIZATION,
EXOCRINE PORTION
1. ACINI
2. DUCTS

ENDOCRINE PORTION
• ISLETS OF LANGERHANS

HISTOPHYSIOLOGY
Fig. 13-10  Pancreas (sectional view). Stain: hematoxylin-eosin. Low magnification.
All acini are of the serous type and many contain centroacinar cells initiate the duct inside the acinus.
The pancreas is a compound tubuloalveolar (tubuloacinar) gland which functions in the digestion of food.

Insulin is secreted by the B cells which are most numerous and centrally located in the islets.
Pancreatic acinar cell (EM 1)

1. Lumen
2. Zymogen granule
3. Vesicles
4. Central acinar cell
Beginning of intercalated ducts

Islets of Langerhans

Interlobular duct

Intercalated duct
In summary

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secrtes digestive juices and liver
secrtes bile

Absorption of digested foods, water, and electrolytes
Liver stores nutrients and cleans the blood.
Also, the accessory digestive organs
contribute antibodies and antibacterial/viral
growth substances.
Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

Questions on the Liver, pancreas, and salivary glands

The humoral activity of the immune system is illustrated by the transfer of IgA immunoglobin by epithelial cells into which of the following body fluids?
- a. saliva
- b. milk
- c. bile
- d. a and b
- e. a, b, and c

Which function(s) do the gallbladder and urinary bladder have in common?
- a. temporary storage of waste products
- b. concentration of their respective luminal contents
- c. similar type of luminal epithelium
- d. a and b
- e. a, b, and c

Characteristics of the pancreas include:
- a. a portal blood vascular system
- b. endocrine cells of the islets of Langerhans
- c. acinar cells and striated ducts
- d. a and b
- e. a, b, and c
The end of

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