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M1 - GI Sequence

Liver, Pancreas, and Gallbladder

January 12, 2009

Winter 2009
Pancreas

Endocrine Function
Islets of Langerhans cells:
- insulin
- glucagon
- somatostatin

Exocrine Function:
- Acinar cells: digestive enzymes
- Centroacinar cells: bicarbonate-rich alkaline fluid
- Ducts: main and accessory ducts

Liver

(Glands outside the GI tract)

Endocrine-like Secretion
Hepatocytes:
- albumin
- fibrinogen
- thrombin

Endocrine Function
Hepatocytes:
- [Secretory IgA]
- [Bilirubin glucuronic acid]

Exocrine Function (digestive):
- Hepatocytes: bile
- Ducts: bile canaliculi, bile ducts, hepatic ducts, cystic duct and common bile duct
The Pancreas

Islets

Duct
Islets of Langerhans

Source Undetermined
Pancreatic Islet

Stained with Chrome-Alum Hematoxylin and Phloxine

Source Undetermined
Secretory Granules of the Islet cells
Exocrine Pancreas
Centroacinar Cells and Bicarbonate Secretion

[Image: Diagram showing the process of bicarbonate secretion involving centroacinar cells, duct cells, and the steps of CO₂ hydration to HCO₃⁻ and the effects of secretin and cAMP.]
Pancreatic Acinar Cells
Secretory Proteins Produced by Pancreatic Acinar Cells

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<td>(Pro)elastase</td>
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<td>(Pro)phospholipase</td>
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<td>Ribonuclease</td>
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<td>?</td>
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<tr>
<td>Deoxyribonuclease</td>
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</table>

Hormones Regulating Exocrine Pancreatic Function

- **Cholecystokinin (CCK)**: Exocytosis stimulation in acinar cell.
- **Secretin**: Secretion of H₂O and electrolytes.
- **Pancreatic polypeptide (PP)**: Opposes action of CCK.
- **Vasoactive intestinal polypeptide (VIP)**: Stimulates H₂O and electrolyte secretion.
- **Gastric inhibitory polypeptide (GIP)**: Postprandial stimulation of insulin release.
Regulation of Pancreatic Secretion
Ducts of the Pancreas

Intercalated duct (intralobular duct)

Interlobular ducts

Source Undetermined
Major Functions of the Liver

Synthesis and secretion of Bile (SER)
- bile acids from cholesterol
- elimination of bilirubin
- secretion of secretory IgA

Synthesis and secretion of plasma proteins (RER)
- albumin, fibrinogen, thrombin, etc.

Metabolism of carbohydrates (SER, cytosol)
- maintenance of normal level of blood glucose

Metabolism of lipid (RER)
- maintenance of normal level of blood lipid - VLDL

Metabolism of lipid soluble drugs and detoxification (SER)

Filtration and storage of blood

Liver regeneration
EM of Hepatocyte
Hepatic Portal Vein Tributaries

- Portal Vein
- Splenic v.
- Superior mesenteric v.
- Inferior mesenteric v.

See Netter image

Gray’s Anatomy, Wikimedia Commons
Hepatic Venous Drainage

Inferior Vena Cava

Hepatic Veins

Collecting Vein

Sublobular Vein

Central Vein

(Terminal Hepatic Venule)
Basic Structure of Liver Lobule

Hepatocytes

Hepatic Portal Vein

Hepatic Artery

Central Vein

Bile Canaliculi

Bile Ducts

Venous Sinuses

[Image credit: Frank Boumphrey, M.D., Wikimedia Commons]
Liver Lobules

Portal triad

Central vein

Source Undetermined
Portal triad and central vein

Central vein (t.h.v)

Portal triad
Central Vein (Terminal Hepatic Venule)

Source Undetermined
Liver Sinusoid
Liver sinusoids, space of Disse, and Kupffer cells
Kupffer cell

Scanning EM
Fat Storing Cells of Ito
Distribution of Reticular Fibers in the Liver
Type I Collagen in Space of Disse

Cirrhosis of the liver
Cirrhosis of the Liver
Caval System:
arteries - capillaries - veins - vena cava - heart

Portal System:
arteries - capillaries - veins - portal vein - capillaries (sinusoids) - veins - vena cava - heart
Caput Medusae

Dilated Paraumbilical Veins

Source Undetermined
Bile Calaniciuli and Ducts
Drawing of a 3D cross-section of liver lobule highlighting the spatial relationship of bile canaliculi, hepatocytes, and sinusoids was removed.
Bile Canaliculus

Bile Duct

Cormack, D.H. 9th ed. P. 522

Weiss, L. 6th ed. P. 709
Secretion of Bilirubin

- Bilirubin glucuronide
- Water-soluble bilirubin glucuronide
- Water-insoluble bilirubin
- Kupffer cell
- Hemoglobin
- Bilirubin formed in other parts of the mononuclear phagocyte system
- Crigler-Najjar syndrome and neonatal hyperbilirubinemia
- Dubin Johnson and Rotor’s syndromes
- Glucuronyltransferase

Basic Histology, Junqueira and Carneiro, p. 347
Secretory IgA

IgA is synthesized and secreted by plasma cells in the lamina propria of the gut.

Some IgA is transported across the intestinal epithelial cells as secretory-IgA and released into the lumen.

The remainder is carried in the lymph to the thoracic duct, to the general circulation, to the liver.

IgA is taken up by the hepatocytes as secretory-IgA and is secreted into the bile canaliculi.

The secretory component is cleaved and the antibody is released into bile for transport to the intestinal lumen.
Liver Lobules

Portal triad

Central vein

Source Undetermined
Liver Lobule and Acinus
Gallbladder and Extrahepatic Bile Ducts
Mucosal Lining of the Gallbladder

Weiss, L. 6th ed. P. 711
Gallbladder and its Wall
Epithelial Cells of the Gallbladder

Michigan Medical School Histology Slide Collection

Bloom and Fawcett p.685
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Slide 8: Source Undetermined
Slide 9: Source Undetermined; Michigan Medical School Histology Slide Collection
Slide 10: Bloom and Fawcett p. 700-701
Slide 11: Source Undetermined
Slide 12: Michigan Medical School Histology Slide Collection
Slide 13: Michigan Medical School Histology Slide Collection
Slide 14: Bloom and Fawcett p. 696; J. Williams
Slide 15: Sun-Kee Kim
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Slide 17: J. Williams
Slide 18: Source Undetermined
Slide 20: Source Undetermined
Slide 21: Bloom and Fawcett p. 668
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Slide 31: Source Undetermined
Slide 32: Bloom and Fawcett p. 662
Slide 33: Source Undetermined
Slide 34: Michigan Medical School Histology Slide Collection
Slide 35: Source Undetermined; Cormack, D.H. 9th Ed. P. 530
Slide 36: Ross/Romrell p. 474
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