Bile

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Synthesis and Circulation

Synthesized Continuously By Hepatocytes

Liver with hammer

The hepatocytes of the liver continuously synthesis and secrete the consituents of bile, which includes bile salts, cholesterol, phospholipids, bilirubin, ions, and water.

Cholesterol 7 Alpha-Hydroxylase Rate Limiting Step

Cholesterol burgers-7-afro-hydras

The rate limiting step in bile synthesis is catalyzed by the enzyme 7 alpha-hydroxylase, which adds a hydroxyl group onto cholesterol. This permits cholesterol to be conjugated with an amino acid in a later step of synthesis, which confers the cholesterol (now a bile salt once conjugated) with its amphipathic property, allowing it to emulsify lipids.

Stored In Gallbladder

Arrow to gold-bladder

Bile synthesized in the liver is subsequently sent to the gallbladder, where it then stored until a meal is ingested and CCK initiates its release into the intestines to aid in digesetion. The gallbladder is not an essential step in this process, hence its removal as in the case of cholecystectomy will not significantly hinder the patient's health, as the liver will still continue to produce bile which will still enter the gastrointestinal tract.

Secreted Into Duodenum

duo-denim

When a meal is ingested, CCK is released by I-cells in the duodenum and jejunum which then causes contraction of the gallbladder and opening of the sphincter of Oddi, thereby facilitating the release of bile into the duodenum.

Bile Salts Reabsorbed In Terminal Ileum

Salt-arrow-eels

The bile salt component of bile is reabsorbed in the terminal ileum, which allows for bile salts to be sent back to the liver and recycled. Importantly, patients who have had this portion of their ileum removed are unable to reabsorb bile salts and will typically have some degree of fat malabsorption and steatorrhea, as bile salt production in the liver is unable to keep up with loss in feces.

Returned To Liver Via Portal Circulation

Arrow-portal

Bile salts which are reabsorbed in the terminal ileum are subsequently returned to the liver via the hepatic portal system, which bypasses systemic circulation and brings the absorbed nutrients through the blood directly to the liver. This allows bile salts to be re-used.

Composition

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Bilirubin

Belly-dancer-ribbon

Bilirubin, a yellow-green colored byproduct of hemoglobin breakdown, is the major component that gives bile its green pigment. Recall that the reticuloendothelial system degrades hemoglobin to produce unconjugated bilirubin which is then bound to albumin and transported to the liver, which conjugates the bilirubin and secretes it with bile.

Bile Salts

salt shakers

Bile salts constitute 50% of the organic component of bile. They consist of cholesterol which has subsequently been conjugated with an amino acid. This makes them amphipathic, meaning they have a hydrophobic end and a hydrophilic end. This allows them to form micelles around lipids, which are then water soluble and able to be absorbed by the gastrointestinal tract. The hydrophobic portions of the bile salts point toward the interior of the micelle, and the hydrophilic portions dissolve in the aqueous intestinal solution.

Cholesterol And Phospholipids

Cholesterol-burger and P-lips

Phospholipids and cholesterol are also secreted into bile by hepatocytes and help form micelles which aid in the emulsification and digestion of dietary fats.

Ions And Water

Ions bubbling out of water

The epithelial cells lining the bile ducts secrete various anions in addition to water, which is stimulated by secretin.

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