

Cholesterol

1. The word cholesterol is derived from Greek words, **cho** = bile, **steros**= solid , **ol**= alcohol
2. All steroids have cyclopentanophenanthrene ring (A,B,C and D) called steroid nucleus. Cholesterol is called **sterols** because it has hydroxyl group, while **steroids** contain ketone groups (C=O) or carboxyl group (COOH).
3. In **70 kg** man a total of **140 gm** of cholesterol is available, which is distributed in brain, nerves ,muscles , adipose tissues, skin, blood, liver, spleen, bone marrow , alimentary tract , adrenal gland and present in all cell membranes .
4. It is a light yellow crystalline solid.
5. soluble in organic solvents.
6. it is present as free and ester cholesterol.

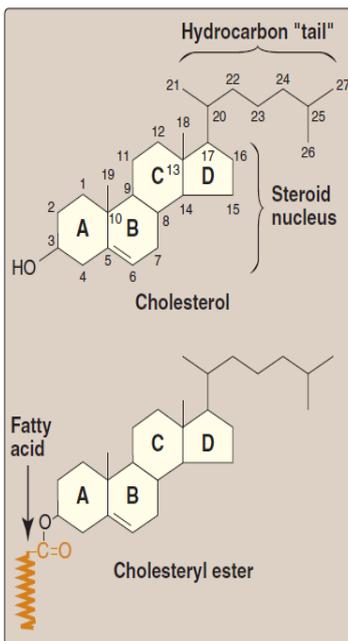
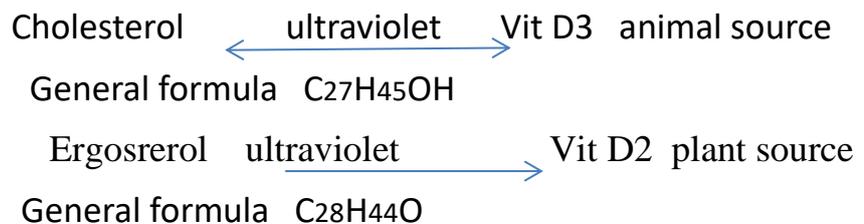


Figure 18.2
Structure of cholesterol and its ester.



Ergosterol is a sterol found in cell membranes of fungi and protozoa, serving many of the same functions that cholesterol serves in animal cells.

Sources of cholesterol:

1. **Exogenous:** dietary cholesterol about 0.3 gm /day. Butter, cream, milk, egg yolk and meat are rich in cholesterol.
2. **Endogenous:** cholesterol is synthesized by all tissues such as liver, intestine, adrenal cortex, ovaries, testes and placenta.

Cholesterol is synthesis from acetyl COA.

Functions of Cholesterol:

1. Regulated of body fluids

Cholesterol is esterified with essential fatty acids to form ester cholesterol, tend to lower the plasma bad cholesterol level.

2. Formation of Vit D3, bile acid and steroid hormones (testosterone, estradiol, progesterone).
3. Neutralize the hemolytic action of number of agents like snake venoms and bacterial toxins.

Elimination of cholesterol:

Cholesterol is eliminated from the liver by converted to: 1. **bile acid and bile salts**, secreted into the intestinal lumen(duodenum).

2. Serve as **a component of lipoproteins** sent to the peripheral tissues.

Plasma Lipoproteins:

Lipoproteins : spherical macromolecular complex lipids and specific proteins apoproteins or apolipoproteins transport cholesterol and triglycerides in the blood stream.

Types of lipoproteins:

1. Chylomicrons.
2. Very low density lipoproteins (VLDL).
3. Low density lipoproteins (LDL).
4. High density lipoproteins (HDL).

They are differ in lipid and protein in:

1. Composition
2. size
3. density
4. site of origin.

Composition of lipoproteins .2

Composed of **neutral fat(TG)** and **cholesterol** in the **core** surrounded by a shell of amphipathic **apoproteins, phospholipids** and **free cholesterol**.

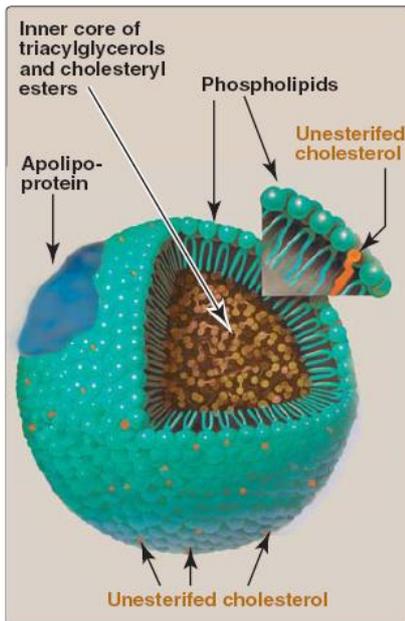


Figure 18.14
Structure of a typical lipoprotein particle.

1. Chylomicrons: lipoprotein particles, large size, low density, contain highest percentage of lipid (90%) and lowest percentage of protein.

Function: Transport of triglyceride (comes from diet) to adipose tissues for storage and to muscles or heart for energy needs.

2. Very low density lipoproteins (VLDL).

synthesis in liver, it contains about (60%) of (TG), convert into LDL in the capillaries.

Function: Transport of TG synthesis in liver as VLDL to the peripheral tissues.

3. Low density lipoprotein (LDL).

Particles contain:

much less of TG than VLDL

high concentration of **free and ester cholesterol**.

most of **LDL** derived from **VLDL**.

Function: Transport of cholesterol from liver to the peripheral tissues.

LDL concentration in the blood has positive correlation with incidence of cardiovascular disease, so it is highly atherogenic. Called (**bad cholesterol**).

4. High density lipoprotein (HDL).

Particles formed from 70% of apo protein (APO -A1) made by the liver and intestine.

Functions: transport **cholesterol** from **tissues** to the **liver for synthesis of bile acid** and **steroid hormones**. HDL designation as the (good cholesterol) It is anti atherogenic.

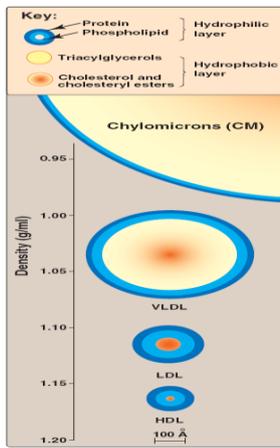


Figure 18.13
Approximate size and density of serum lipoproteins. Each family of lipoproteins exhibits a range of sizes and densities; this figure shows typical values. The width of the rings approximates the amount of each component. [Note: Although cholesterol and its esters are shown as one component in the center of each particle, physically cholesterol is a surface component whereas cholesteryl esters are located in the interior of the lipoproteins.]

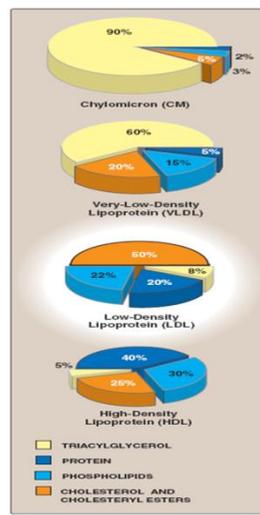


Figure 18.19
Composition of the plasma lipoproteins. Note the high concentration of cholesterol and cholesteryl esters in LDL.

Methods used for separation of lipoproteins

1. Ultracentrifugation.

The separation of lipoproteins **depend on their densities.**

lipoprotein contain high amount of fat, so it is less dense like **chylomicron.**

And contain less amount of protein, so has low mobility.

2. Electrophoresis

The mobility of lipids **depend on protein content.**

Particles with **higher protein content, has high density, so it move faster towards anode(+).**

to determine abnormal distribution and concentrations of lipoproteins in the serum, an important risk factor in the development of coronary artery disease (CAD).

The lipoprotein fractions, in order of increasing density, are **chylomicrons, VLDL, LDL, HDL.**

HDL move faster, than LDL, VLDL, Chylomicron.

Bile acid

Define: as watery mixture of organic and inorganic compounds. Lecithin and bile salts are the most important organic components of bile.

Bile synthesis in liver, then pass through bile duct to the duodenum for:

1. digestion and absorption of fat, **or**
2. stored in gallbladder when needed for digestion (not immediately).

Types of bile acids:

1. **Primary bile acid:** Synthesis in liver from cholesterol. **ex: cholic acid act as emulsifying agents.**

2. **Secondary bile acid:** produced in intestine from primary bile acids by the action of bacteria. **Ex : deoxycholic acid and lithocholic acid.**

bile acids in liver, conjugate with glycine or taurine producing bile salts (glycocholic acid and taurocholic acid).

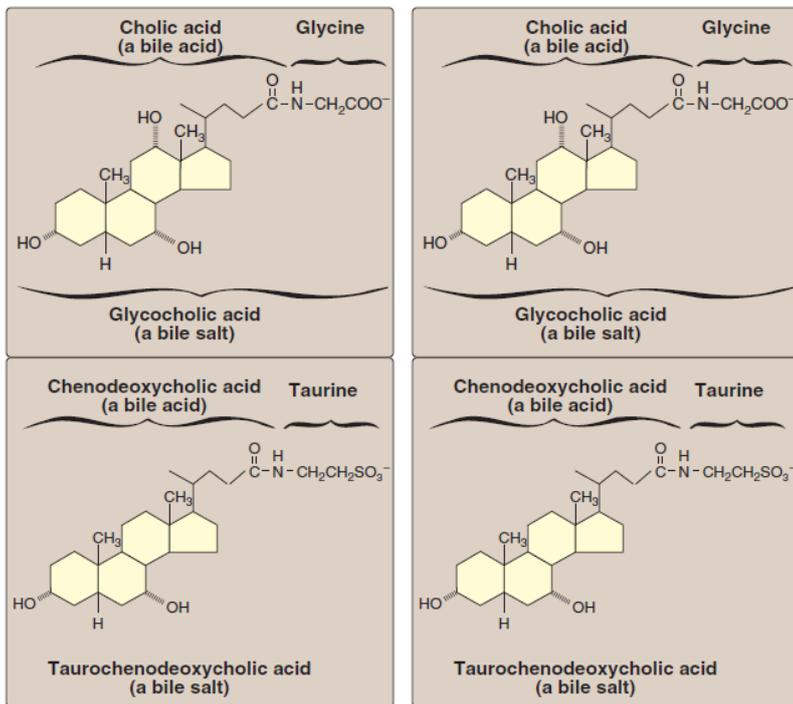


Figure 18.10
Bile salts. [Note “cholic” in the names.]

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Function of bile salt

- a.** Bile salts have ability to lower surface tension of water to emulsify fat.
- b.** The alkaline content of pancreatic biliary secretions shift the PH of food to make alkaline.
- c.** Bile salts facilitate the action of **lipase** to hydrolyze TG into their derivatives in intestine.
- d.** when the PH of food make alkaline the lipase enzyme become hydrolysis the fats **into:** diglyceride , monoglyceride and fatty acids + glycerol

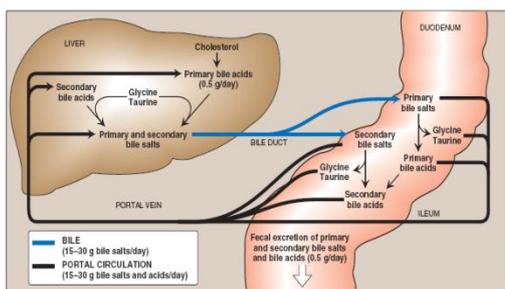


Figure 18.11
Enterohepatic circulation of bile salts and bile acids.