

الكيمياء الحياتيه

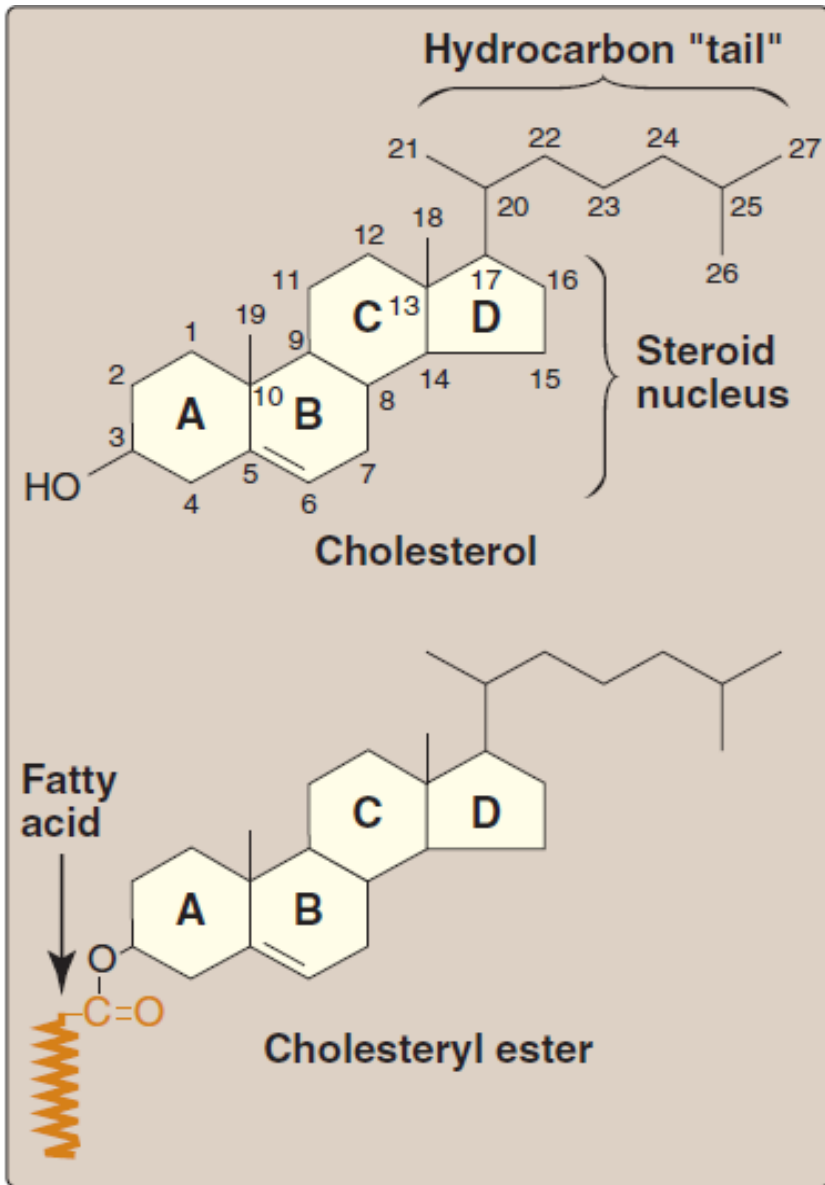
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المرحلة الاولى

محاضرة رقم (٣)

Cholesterol

1. The word chol 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.



Cholesterol $\xrightarrow{\text{ultraviolet}}$ Vit D₃
 animal source

Ergosterol $\xrightarrow{\text{ultraviolet}}$ Vit D₂
 plant source

Figure 18.2
 Structure of cholesterol and its ester.

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, tests and placenta. Cholesterol 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** that are secreted into the intestinal lumen(duodenum).

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

Plasma Lipoproteins:

- Lipoproteins are spherical macromolecular complexes of lipids and specific proteins (apo proteins) or (apo lipoproteins).
- **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:

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

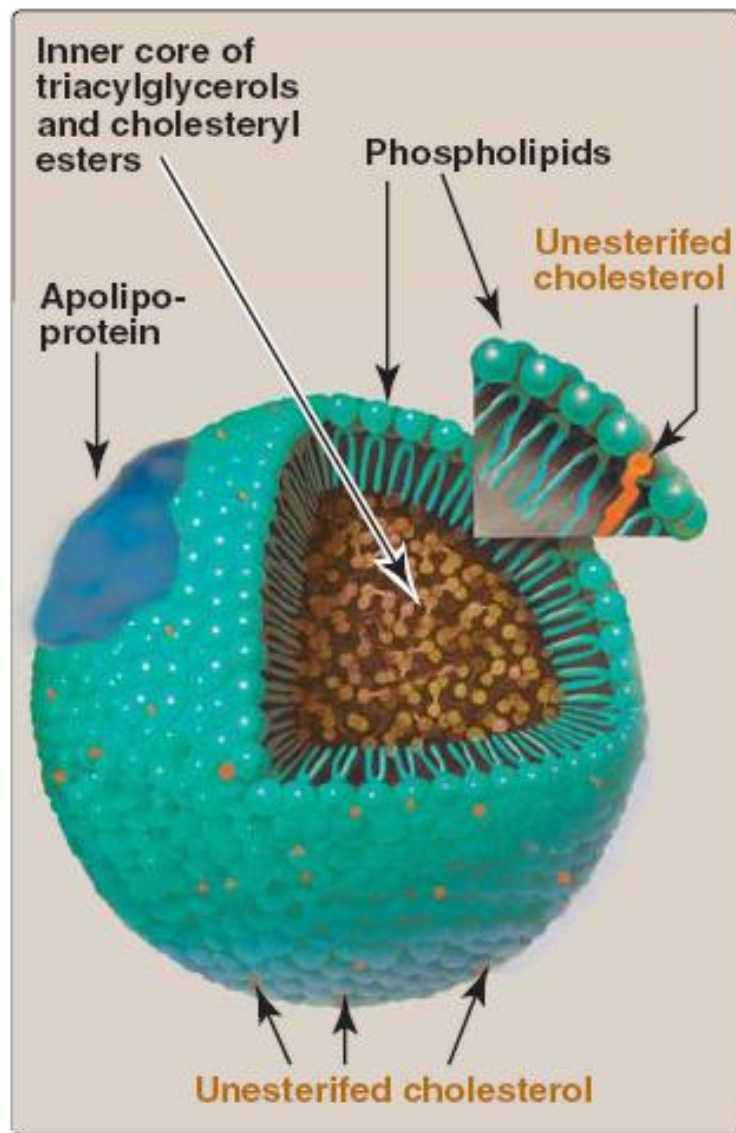


Figure 18.14

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 contain about 60% of (TG), convert in to LDL in the capillaries.

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

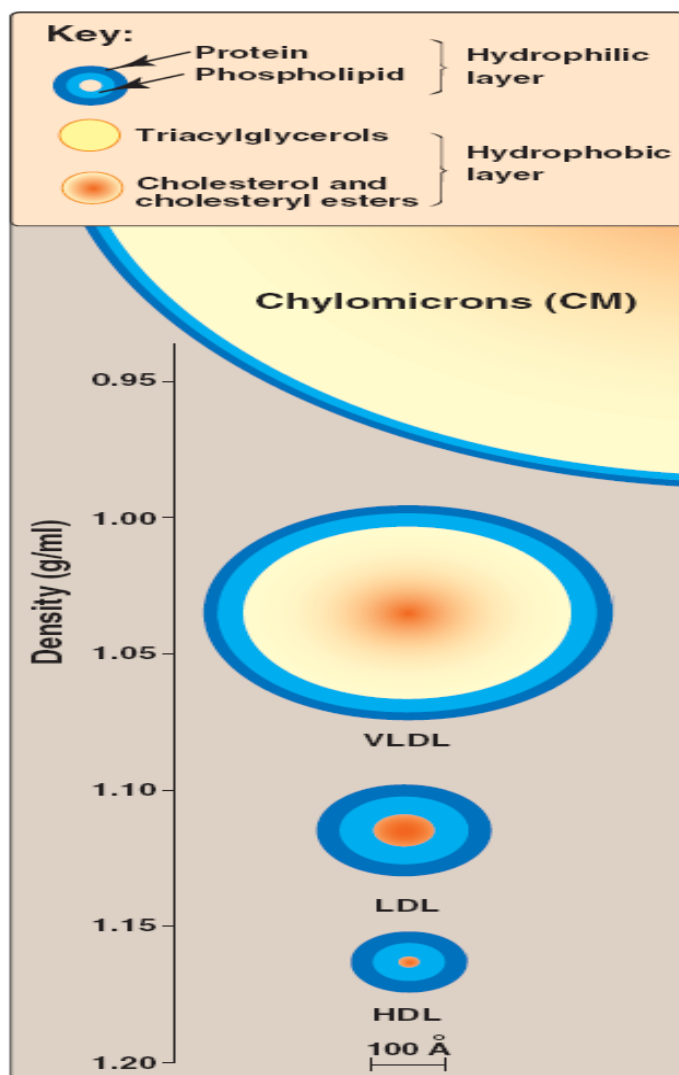


Figure 18.13

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.]

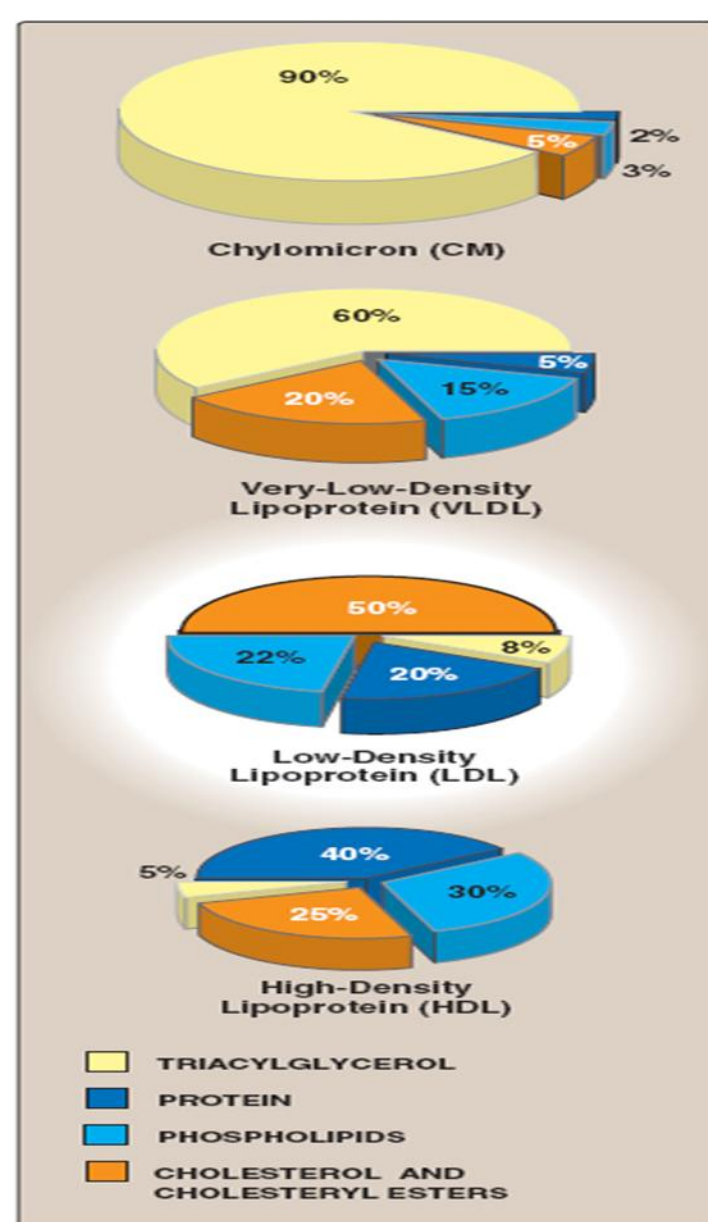


Figure 18.19

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

3. Low density lipoprotein (LDL).

Particales contain much less of **TG** than **VLDL** and have 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 and called (**bad cholesterol**).

4. High density lipoprotein (HDL).

Particales 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 and steroid hormones.

HDL designation as the (good cholesterol) It is anti atherogenic.

Methods used for separation of lipoproteins:

1. Ultracentrifugation.

- The separation of lipoproteins depend on their **densities**, lipoprotein which contain high amount of fat is less dense like **chylomicron**.
- Contain high amount of TG and less amount of protein, so it has slow mobility.

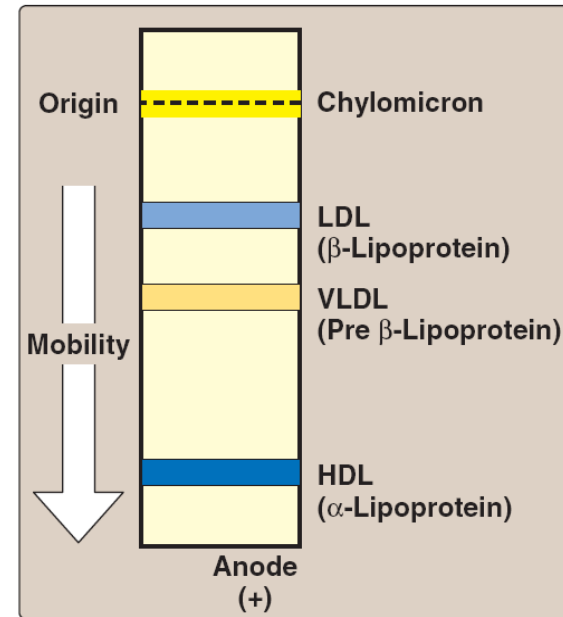


Figure 18.15

Electrophoretic mobility of plasma lipoproteins. The order of LDL and VLDL is reversed if ultra-centrifugation is used as the separation technique.

2. Electrophoresis

- The mobility of lipids depend on **protein** content.
- Particles with higher content of protein move faster towards anode(+).
- HDL is faster, then VLDL, LDL , chylomicron.