Al-Rasheed University College
Department of Dentistry

practical Biochemistry

## For the second class

lab 4

Cholesterol

Edited By:

Asst. Lab. Roaa hatem algburi

lab 4

Cholesterol

Cholesterol is an unsaturated steroid alcohol(chole ; yellow;sterol,solid alcohol) about one third of serum cholesterol is present in the free in blood plasma in the form of lipoproteins. Low density lipoprotein(LDL)is the richest in cholesterol among other lipoproteins.

Serum cholesterol is a vehicle of unsaturated fatty acids because it is easily esterified with these acids. Cholesterol is a precursor of sex steroid hormones and of vitamin D but about 80% of utilized cholesterol is converted into bile acids and an important proportion is excreted free in the bile.
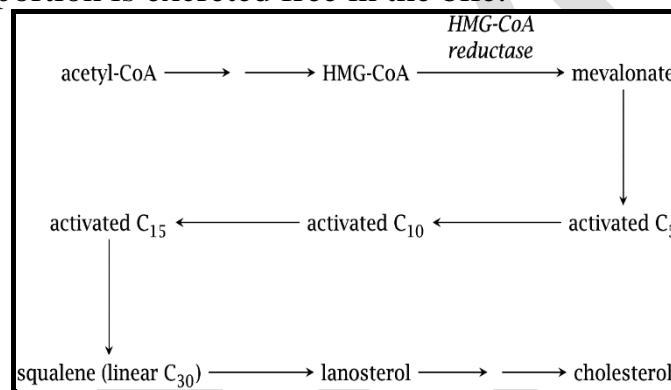
Normal range: 150-250 mg/dl(3.9-6.5 mmol/l)

Most ingested cholesterol is esterified, and the esterified cholesterol is poorly absorbed. The body also compensates for any absorption of additional cholesterol by reducing cholesterol synthesis. For these reasons, seven to ten hours after ingestion of cholesterol, blood levels will show little if any effect on total body cholesterol content or concentrations of cholesterol in the blood. However, during the first seven hours after ingestion of cholesterol, the levels significantly increase.

Cholesterol is recycled. The liver excretes it in a non-esterified form (via bile) into the digestive tract. The body needs some cholesterol to make hormones, vitamin D, and substances that help digesting foods, the body makes all the cholesterol it needs. However, cholesterol also is found in some of the foods we eat.

Cholesterol provides both structure and function to our body:
1-Cholesterol is required to build and maintain membranes; it modulates membrane permeability and fluidity.

2-Compact layers of cholesterol-rich cell membranes (of Schwann cells) form myelin sheath which surround nerve fibers and provide insulation for efficient conduction of nerve impulses.

3-Cholesterol is converted in the liver to bile which is then stored in the gallbladder. Bile contains bile salts, which solubilize/emulsify the water-insoluble fats in the digestive tract and aid in the absorption of fat molecules, as well as the fat-soluble vitamins A, D, E, and K.

4-Cholesterol is involved in the synthesis of vitamin D and the steroid hormones, including the adrenal gland hormones (adrenocortisol and aldosterone), as well as the sex hormones progesterone, estrogens, and testosterone.

Major sources of liver cholesterol and its utilizations.
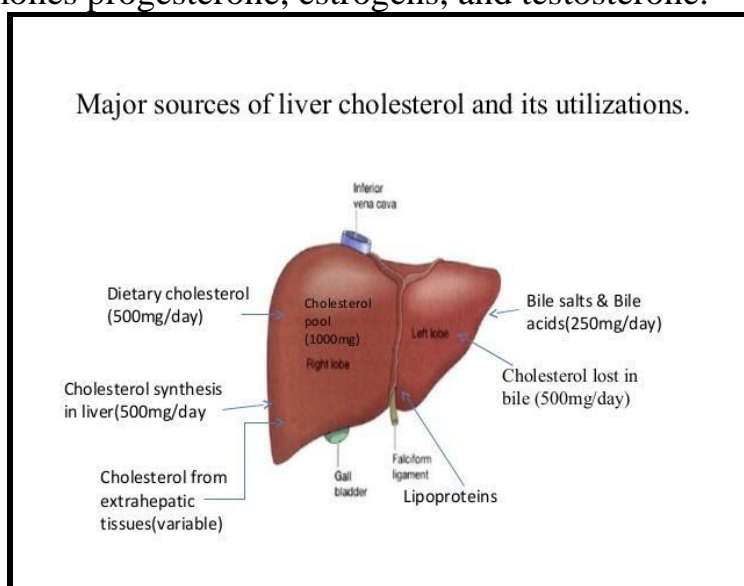
**Types of cholesterol that circulate in our blood**

Cholesterol is only slightly soluble in water so it is insoluble in blood. Therefore it is transported by lipoproteins – (chemicals made up of lipids and proteins).

A **Lipoprotein** is a biochemical assembly whose purpose is to **transport hydrophobic lipids** through water, as in blood or ECF. They have a single layer phospholipid membrane, with their hydrophilic portions out to the water and lipophilic parts in to the lipids within.

Lipoproteins are classified according to their densities,the more lipid and less protein a lipoprotein has, the less dense it is.
Types of lipoproteins present in blood are:

1. Very-low-density lipoprotein (VLDL).
2. Intermediate-density lipoprotein (IDL).
3. Low-density lipoprotein (LDL).
4. High-density lipoprotein (HDL).
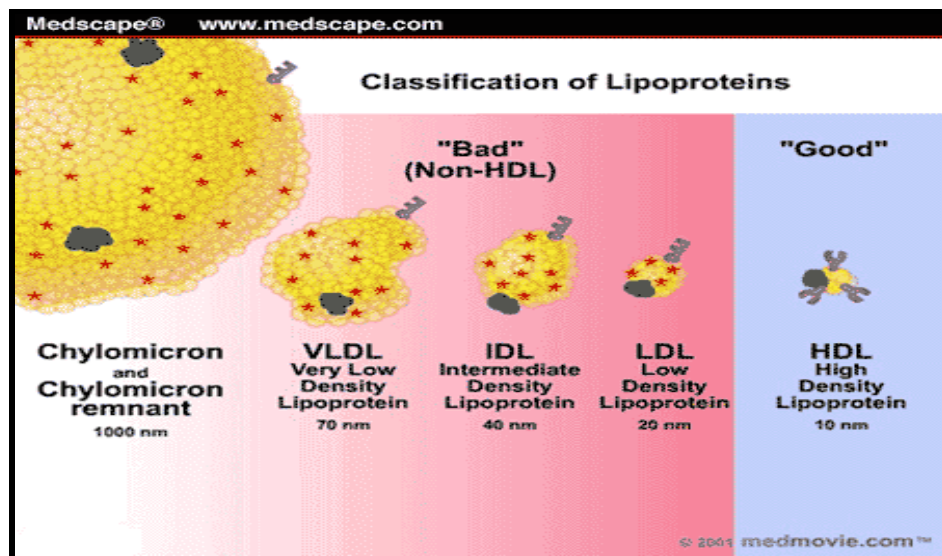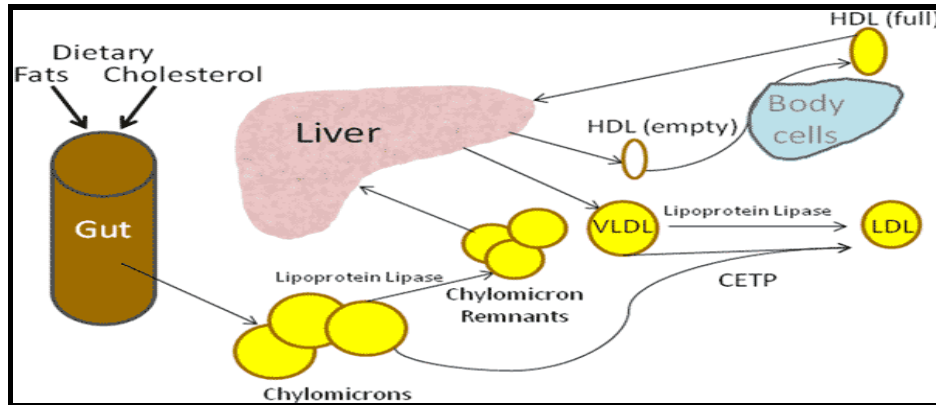
Cholesterol travels through the bloodstream in small packages called **lipoproteins**. These packages are made of fat (lipid) on the inside and proteins on the outside. The **two main types of cholesterol** are **LDL** (low-density lipoprotein), and **HDL** (high-density lipoprotein).
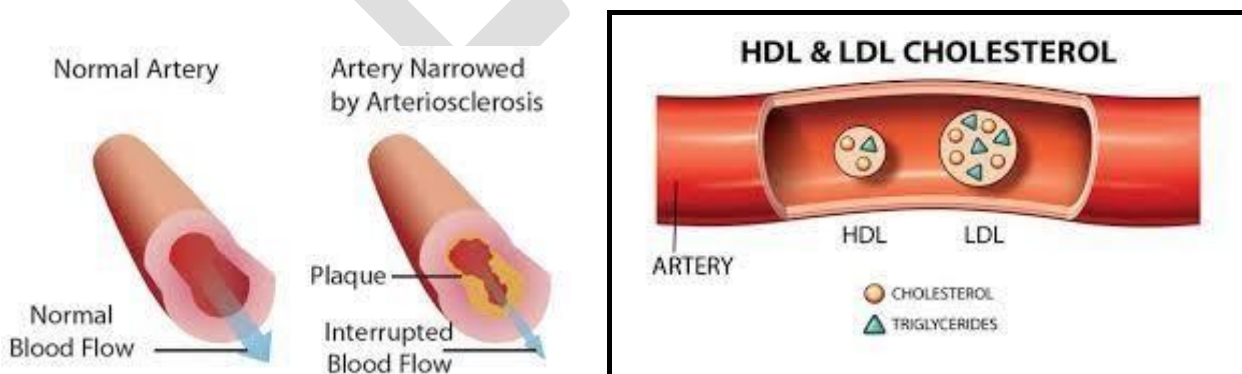
LDL cholesterol sometimes is called **"bad" cholesterol**. A high LDL level leads to a buildup of cholesterol in the arteries.

1. Most of the cholesterol in the blood is carried by low density lipoproteins or LDL.
2. LDL cholesterol is carried to the body's cells, where the cells take as much cholesterol as they need, leaving the excess in the blood. If there's constantly too much bad cholesterol left in the blood it can aid formation of plaque and thrombus in the arteries, which eventually cause blockages or break away to form clots and block other blood vessels. This is why it's often referred to as 'bad' cholesterol.
3. For most people an LDL score below 100 is healthy, but people with heart disease need to aim for even lower LDL score.


HDL cholesterol sometimes is called **"good" cholesterol.** This is because it carries cholesterol from other parts of the body back to the liver.

1. Up to one third of blood cholesterol is carried by high-density lipoproteins or HDL.
2. HDL cholesterol is extra cholesterol from the tissues that gets carried away from the arteries to the liver, where the body gets rid of it. This type is important for a healthy heart as it's the cholesterol that's eliminated from the body – hence the reason it's sometimes referred to as 'good' cholesterol. HDL removes cholesterol and prevents it from building up inside the arteries.
3. Thus **higher levels of HDL cholesterol are better**. People with lower HDL scores are more likely to develop heart disease. Coronary heart disease is a condition in which plaque (plak) builds up inside the coronary (heart) arteries. Plaque is made up of cholesterol, fat, calcium, and other substances found in the blood. When plaque builds up in the arteries, the condition is called **atherosclerosis.**

Atherosclerosis is a condition in which cholesterol is deposited in the arteries. Arteries become narrowed and hardened due to an excessive build up of plaque
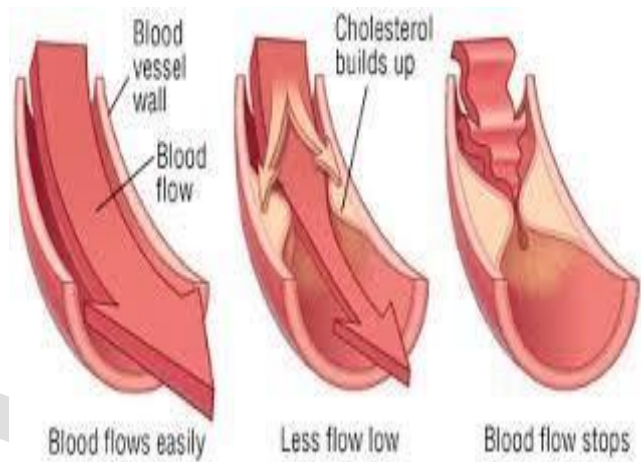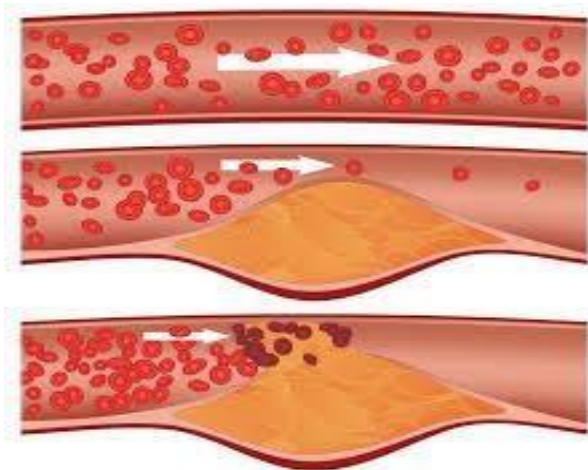
 Factors affecting serum cholesterol level:

Physiological factors:
Age: low values are found in children and increase with age until the sixth decade after which starts to decline.
Sex: it is higher in males than females before menopause then tends to equalize.
Season: lower values are found in summer.
Individual Variation: the variation is wide between individuals(interindividual variation) but the level is relatively constant in any one individual(intraindividual variation).
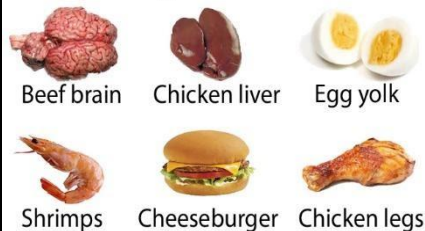
Pathological increase:

1-atherosclerosis: hypercholesterolemia predisposes to atherosclerotic cardiovascular disease although the association may be directly causal in the normal or slightly high levels.

2-Renal disease: hypercholesterolemia in addition to proteinuria and generalized oedema are the main characteristics of nephrotic syndrome.

3-Endocrine and metabolic disorders:diabetes mellitus may be associated with lipid disorders including elevated serum cholesterol in which case hypercholesrolemia will be highly atherosclerotic. In hypothyroidism or myxoedema the increase is due to decreased cholesterol utilization

4-Liver disease: in post hepatic jaundice or cholestasis , serum cholesterol is highly elevated because of obstruction of the main pathway of excretion of cholesterol.

Diagnosis

Hypercholesterolemia is diagnosed by using a blood test. A blood specimen is o btained after the patient does not eat ordrink anything (except water) for 12 hour s. The **fasting** is done to measure the LDL and HDL cholesterol, which can only be determined accurately in a fasting state.
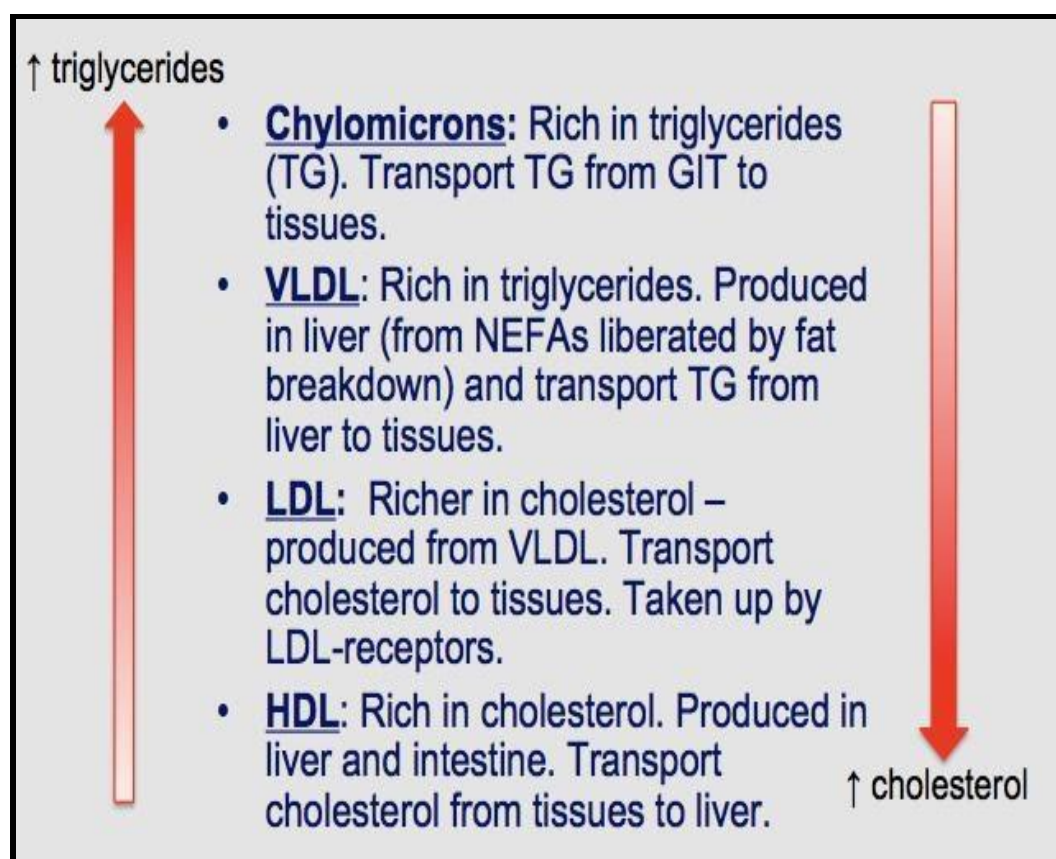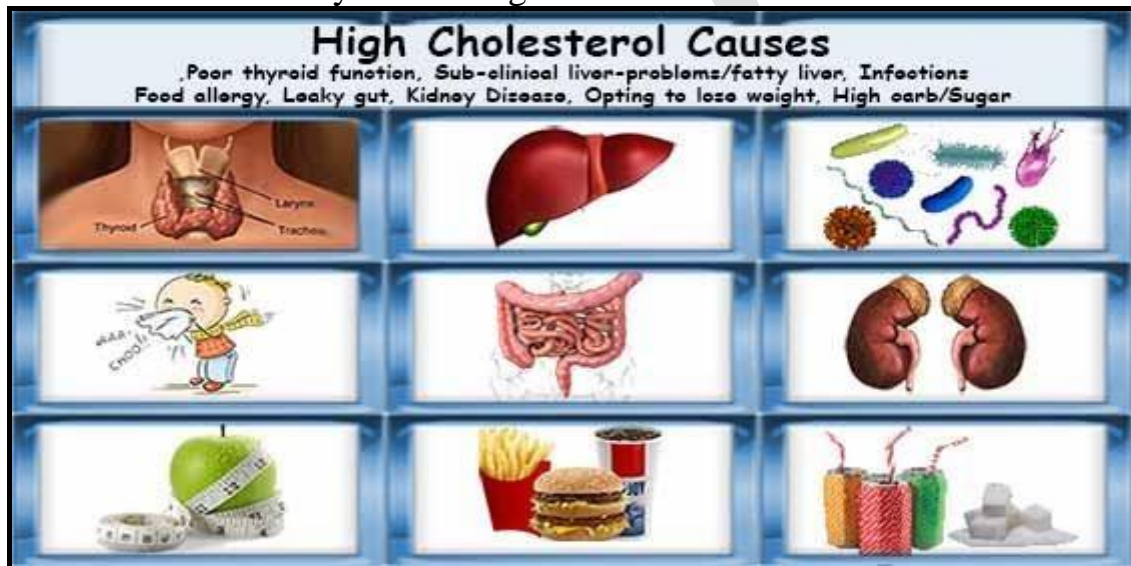

- There are five primary reasons for the rise in LDL cholesterol, they are:
1)Poor thyroid function – hypothyroidism. **2)**Sub-clinical liver problems or fatty liver. **3)**Infections. **4)**Food allergy or food toxins. **5)** Leaky gut. **6)** Kidney Disease.
7) Opting to lose weight. **8)** Adopting to low-carbohydrate diet.

↑ triglycerides

- **Chylomicrons:** Rich in triglycerides (TG). Transport TG from GIT to tissues.
- **VLDL:** Rich in triglycerides. Produced in liver (from NEFAs liberated by fat breakdown) and transport TG from liver to tissues.
- **LDL:** Richer in cholesterol – produced from VLDL. Transport cholesterol to tissues. Taken up by LDL-receptors.
- **HDL:** Rich in cholesterol. Produced in liver and intestine. Transport cholesterol from tissues to liver.

↑ cholesterol

$$VLDL_{-c} \ (mg/dl) = \frac{Triglyceride \ (TG)}{5}$$

$$VLDL_{-c} \ (mmol/l) = \frac{Triglyceride \ (TG)}{2.2}$$

$$LDL_{-c} = Total \ Cholesterol \ (TC) - (VLDL + HDL)$$

$$Cardiac \ Risk \ Ratio \ (CRR) = \frac{TC}{HDL}$$

$$Atherogenic \ Coefficient \ (AC) = \frac{TC - HDL}{HDL}$$

$$Atherogenic \ Index \ of \ Plasma \ (AIP) = \frac{Log \ TG}{HDL}$$