Lipoproteins

By Dr. Yasmine Sami

Medical biochemistry 2022-2023

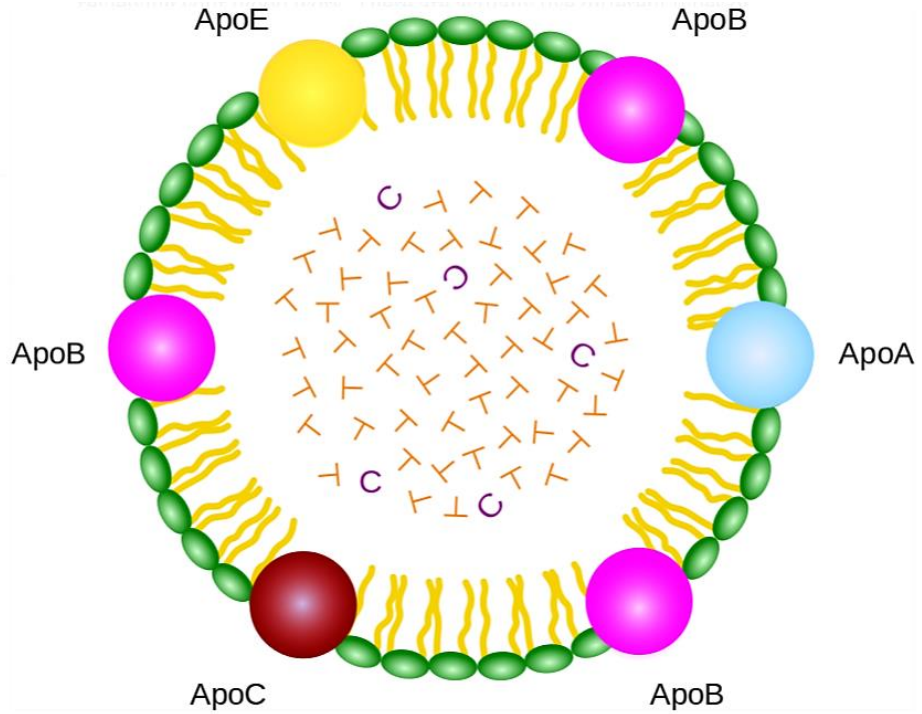
Intended learning outcomes

- Identify the lipoproteins
- Estimate the concentration of HDL and LDL in the unknown sample

Lipoproteins

Lipoproteins are spherical macromolecular complex of lipid and specific proteins (apolipoproteins and Apoproteins)

- The four main types of lipoproteins are **chylomicrons**, **VLDL**, **low-density lipoprotein (LDL)**, and high density lipoprotein (HDL)



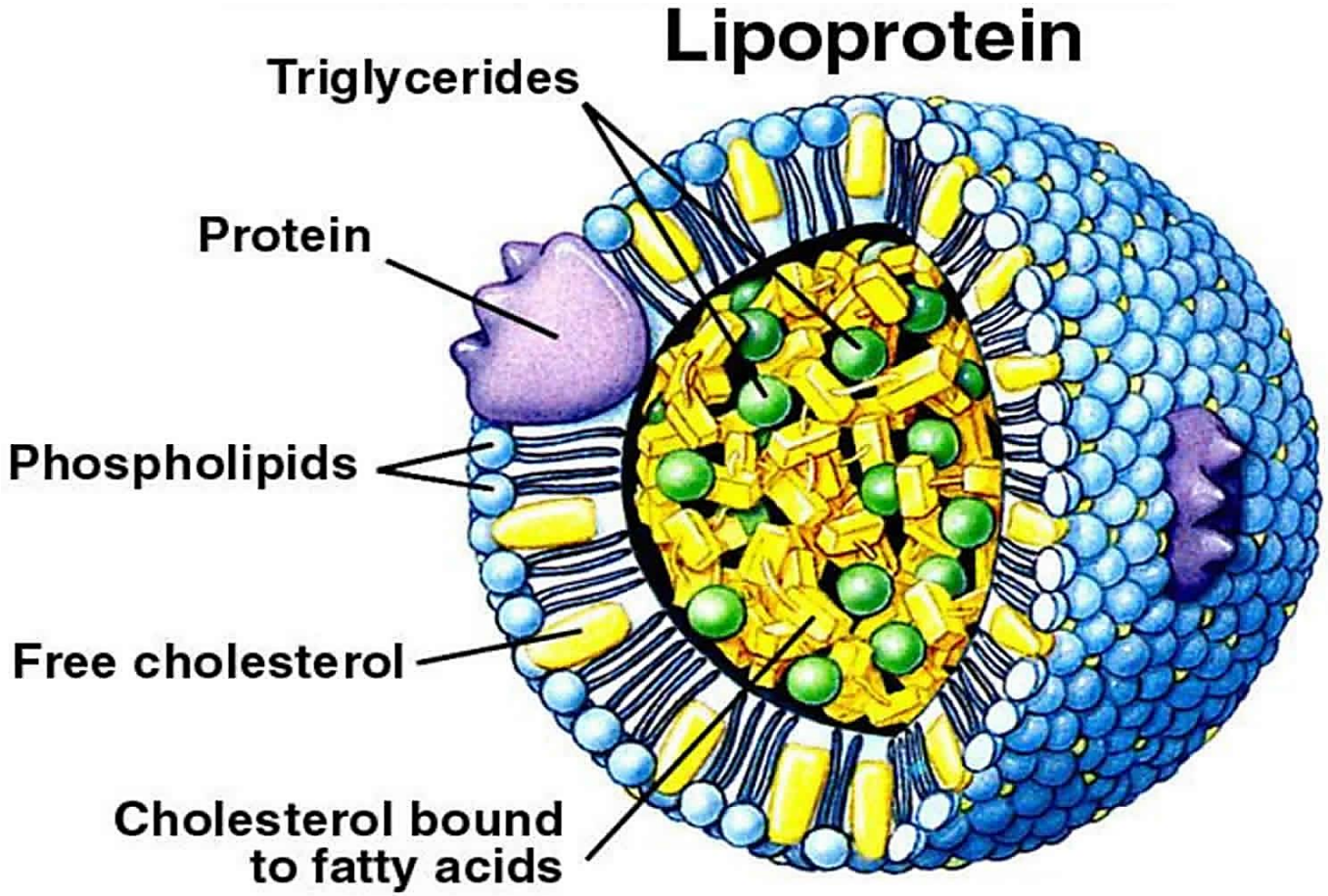
Lipoproteins

- Lipids absorbed from the diet and synthesized by the liver and adipose tissue must be transported between various cells and organs for utilization and storage
- Lipids are insoluble in water, the problem of transportation in the aqueous plasma is solved by associating nonpolar lipids (triacylglycerols and cholesteryl esters) with amphipathic lipids (phospholipids and cholesterol) and proteins to make water-miscible lipoproteins

General Structure of Lipoproteins

- Lipoproteins consist of a **nonpolar core** and a single surface layer of **amphipathic lipids**
- The nonpolar lipid core consists of mainly **triacylglycerol** and **cholesteryl ester** and is surrounded by a single surface layer of amphipathic **phospholipid** and **cholesterol** molecules
- These are oriented so that their polar groups face outward to the aqueous medium
- The protein moiety of a lipoprotein is known as an apolipoprotein or apoprotein

General Structure of Lipoproteins



Classification of Lipoproteins

- Lipoproteins are differing in **lipid and protein**, **density**, **size** and **site of origin**
- **Lipoproteins** may be classified as follows, listed from larger and less denes to smaller and denser. Lipoproteins are larger and less dense when the fat to protein ratio is increased

1. **Chylomicrons** are the largest in size and have low density (large amount of lipid), they carry **triglycerides** (dietary fat) from the **intestine** to the **liver** and **adipose tissue**

Classification of Lipoproteins

2. **Very low density lipoproteins** (VLDL) carry (newly synthesized) **triglycerides** from the **liver** to the **adipose tissue**

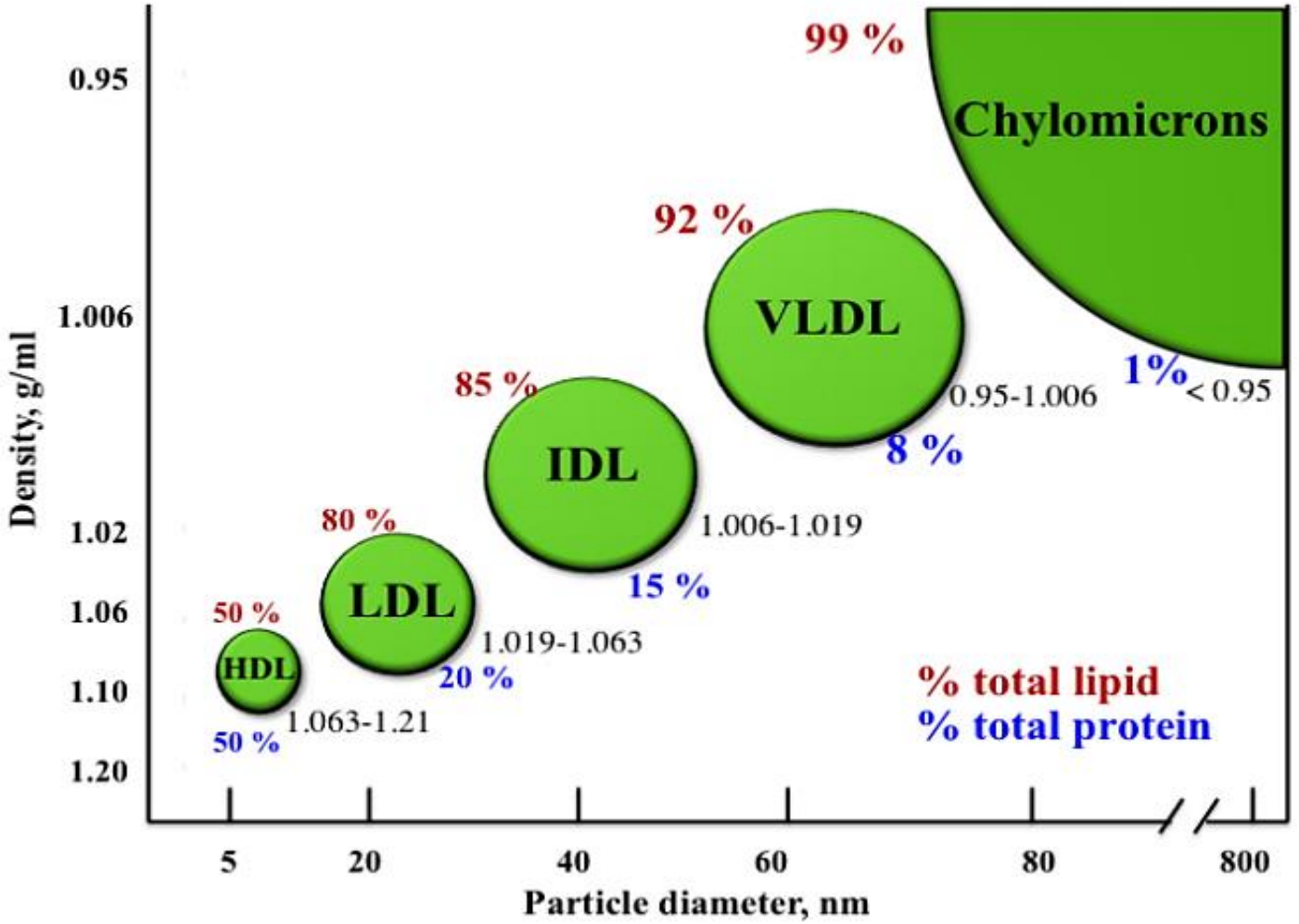
3. **Intermediate- density lipoproteins** (IDL) are derived from the catabolism of VLDL, with a density ranging intermediate between Very low density and Low density lipoproteins. They are not usually detectable in the blood

Classification of Lipoproteins

4. **Low density lipoproteins** (LDL) carry **cholesterol** from the **liver** to **cells** of the body. LDL is sometimes referred as the ***bad cholesterol*** lipoprotein

5. **High density lipoproteins** (HDL) are the smallest in size and has high density (large amount of protein). They collect **cholesterol** from the body's **tissues**, and bring it back to the **liver**. HDL is sometimes referred to as the ***good cholesterol*** lipoprotein

Classification of Lipoproteins



Lipid profile

- **Cholesterol** and **triglycerides**, like many other essential components of the body, attract clinical attention when present in abnormal concentrations.
- **Increased** or **decreased** levels usually occur because of abnormalities in the **synthesis**, **degradation**, and **transport** of their associated lipoprotein particles.
- Increased or decreased plasma lipoproteins are named hyperlipoproteinemia & hypolipoproteinemia respectively.

Lipid profile

The lipoprotein profile measures:

- **The total amount of cholesterol in blood**
- **The levels of HDL- cholesterol (the good cholesterol)**
- **The levels of LDL- cholesterol (the bad cholesterol)**
- **The amount of triglyceride or fat present in plasma**

HDL (high density lipoprotein)

- HDL is one of the four major groups of **lipoproteins**
- HDL is composed of 50% protein, 25% phospholipid, 20% cholesterol, and 5% triglycerides
- HDL: good cholesterol, carry cholesterol from body cells to the liver where it catabolizes or excreted in the bile
- It removes excess cholesterol from tissues (it cleans blood)
- High level of HDL-C is the better because it reduces the risk of heart and blood vessel disease.

Sample collection

- Lipid profile involves the measurement of **total cholesterol**, **triglycerides**, **HDL** and **LDL** after **12 hours** fast

HDL-C estimation

There are several techniques for separation of lipoprotein types depending on size or density of the content, such as **Ultracentrifugation**, **Electrophoresis**, or **chemical precipitation**

Precipitation Method for HDL-C estimation

- HDL lipoproteins are assayed, after precipitation of chylomicrons, LDL and VLDL lipoproteins by **phosphotungstic acid** (PTA) and **magnesium chloride**.
- HDL is left in the supernatant solution for cholesterol quantitation.

LDL (low density lipoprotein)

- LDL: bad cholesterol, carry cholesterol from liver to blood then to organs.
- It has less protein content and contains more cholesterol.
- LDL cholesterol is easy to stick to the walls of blood vessels.
- Reducing LDL levels is a major treatment target for cholesterol-lowering medications.
- Because high LDL in blood will deposited in blood artery and trigger clot formation

Normal range

HDL (mg/dl)	Desirable HDL	> 60
	Low HDL	< 40
LDL (mg/dl)	Desirable LDL	< 110
	High LDL	> 130

Concentration of LDL

The routine method used in biochemical laboratory is calculation by Friedwald formula, as follows:

$$LDL = TG – (HDL + VLDL)$$

VLDL is estimated as TG level divided by 5, so the final equation will be:

$$LDL = TG – (HDL + TG/5)$$

THANK YOU !

ANY QUESTIONS ??

PLEASE ASK