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Commentary

Various Functions of Cholesterol in Human Body

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DESCRIPTION

Membranes

About 30% of the animal cell membranes are made of cholesterol. It is necessary for the maintenance of membranes and also controls the fluidity of membranes over the spectrum of physiological temperatures. The bulky steroid and the hydrocarbon chain are embedded in the membrane, along with the nonpolar fatty-acid chain of the other lipids. Each cholesterol molecule's hydroxyl group, together with the polar heads of the membrane's phospholipids and sphingolipids, interacts with the water molecules around the membrane. Cholesterol promotes membrane packing by the interaction with phospholipid fatty-acid chains, altering membrane fluidity and maintaining membrane integrity such that animal cells do not require the construction of cell walls (like plants and most bacteria). Animals are able to move because the membrane is strong and solid without being rigid.

The structure of the tetracyclic ring of cholesterol contributes to the fluidity of the cell membrane. In this structural function, cholesterol also lessens the plasma membrane's permeability to neutral solutes, hydrogen ions, and sodium ions.

Substrate presentation

The biological process of substrate presentation and the enzymes that utilize it as a mechanism for activation are regulated by cholesterol. An enzyme that is activated by substrate presentation is known as Phospholipase D2 (PLD2). This enzyme is palmitoylated, which causes it to move to lipid regions that depend on cholesterol and are frequently referred to as lipid rafts. Phospholipase D uses the unsaturated, seldom present Phosphatidylcholine (PC) as its substrate. Together with the polyunsaturated lipid phosphatidylinositol 4,5-bisphosphate (PIP2), PC localizes to the disorderly area of the cell. A PIP2 binding domain exists in PLD2. PLD2 leaves the cholesterol-dependent domains and attaches to PIP2, gaining access to its substrate PC and start catalysis based on substrate presentation when the concentration of PIP2 in the membrane rises.

Signaling

The creation of lipid rafts in the plasma membrane brings receptor proteins in close contact with abundant second messenger molecules. It is a way that cholesterol is connected to cell signaling pathways. Electrical insulators like cholesterol and phospholipids, which are present in several layers, can speed up the passage of electrical impulses along nerve tissue. Since it is made of compressed layers of Schwann cell membrane and myelin sheaths, which are abundant in cholesterol, provide insulation for more effective impulse conduction for numerous neuron fibers. It is thought that demyelination, or the loss of some of these Schwann cells, contributes to the development of multiple sclerosis.

Numerous ion channels, including the nicotinic acetylcholine receptor, the GABA receptor, and the inward-rectifier potassium channel are affected by the binding of cholesterol. Cholesterol may be the endogenous ligand for the Estrogen-related Receptor alpha (ERR). A significant mediator of the effects of statins and bisphosphonates on bone, muscle, and macrophages has been identified as the inhibition of ERR signaling *via* reduction of cholesterol synthesis. These results have led to suggestions that the ERR be deorphanized and categorized as a receptor for cholesterol.

Chemical precursor

Cholesterol functions as a precursor molecule in various metabolic pathways inside of cells. For instance, it is the building block for the synthesis of all steroid hormones, including the adrenal gland hormones such as cortisol and aldosterone, as well as the sex hormones progesterone, estrogen, and testosterone and their derivatives. It is also the precursor molecule for the synthesis of vitamin D in the calcium metabolism.

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