6.5: Sphingolipids

Learning Objectives

- Define and understand the structure of sphingolipids, their subclasses, and their role in the nervous system.
- Understand the role of sphingolipids in multiple sclerosis.

Sphingolipids and their subclasses

Sphingolipids are a class of lipids having a sphingoid base that is a set of aliphatic amino alcohols, including **sphingosine,** shown in Figure 6.5.1. When the amino ($-NH_2$ group is attached to a fatty acid by an amide bond, it is called **ceramide**. When the primary alcohol of ceramide is linked to a phosphorylcholine or phosphorylethanolamine group, it is called **sphingomyelin**. When the primary alcohol of ceramide is bound to glucose or galactose by a glycosidic bond, it is called **cerebroside**. When a glycosidic bond connects the primary alcohol of ceramide to an oligosaccharide with one or more sialic acids, it is called **ganglioside**.

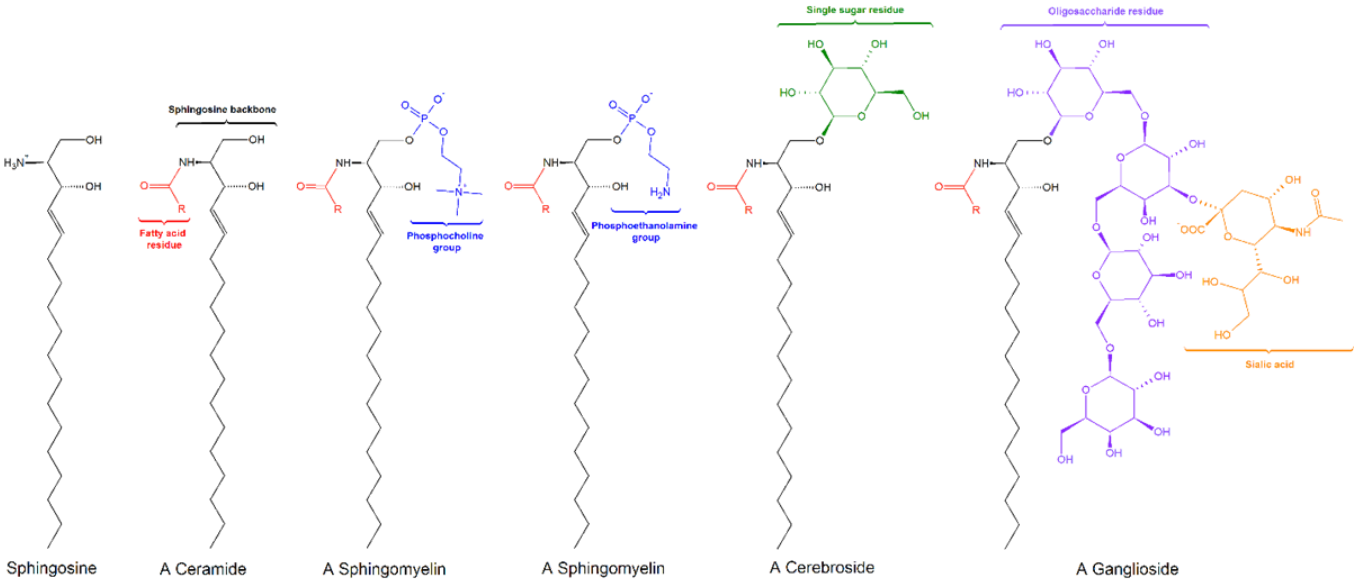

Figure 6.5.1: General structures of sphingolipids. (Copyright; LHcheM, CC BY-SA 3.0, via Wikimedia Commons)

Figure 6.5.2 illustrates two examples of sphingomyelin. Like glycerophospholipids, these sphingolipids are an essential component of the lipid bilayer. Mainly, they are abundant in the brain and nerves. They are abundant in the white matter of myelin sheath, i.e., a coating surrounding the nerve cells. Myelin sheath increases the speed of nerve impulses and is essential in protecting nerve cells, signal transduction, and cell recognition.

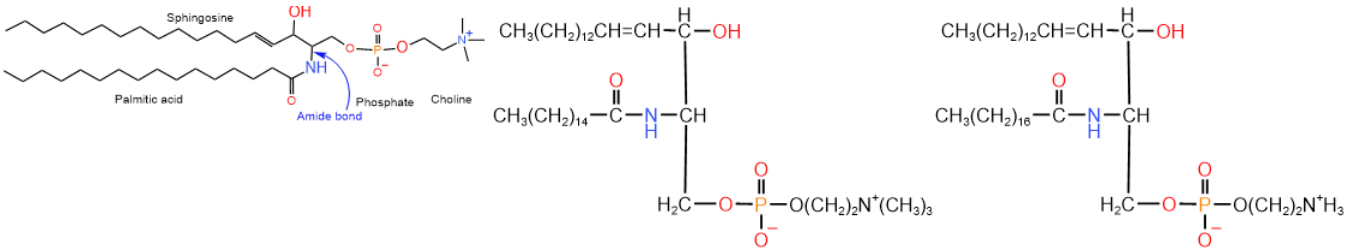

Figure 6.5.2: Two examples of sphingomyelin: one containing palmitic acid and choline (right -a skeletal formula, and middle -a condensed formula) and the other containing stearic acid and ethanolamine (right). (Copyright: Public domain).

Multiple sclerosis

Multiple sclerosis is a nervous system disease in which the myelin sheaths wrapped around axons of nerve cells are damaged, as illustrated in Figure 6.5.3. Symptoms are related to the retardation of signal conduction by the nerves that, in turn, reduces sensation, coordination, movement, cognition, muscle weakness, blindness, and other functions involving nerves. The severity

of the effects depends on the amount of damage. Studies indicate that vitamin D may lessen the severity of the disease. Nearly 1 million people in the US and about 2.8 million worldwide have multiple sclerosis.

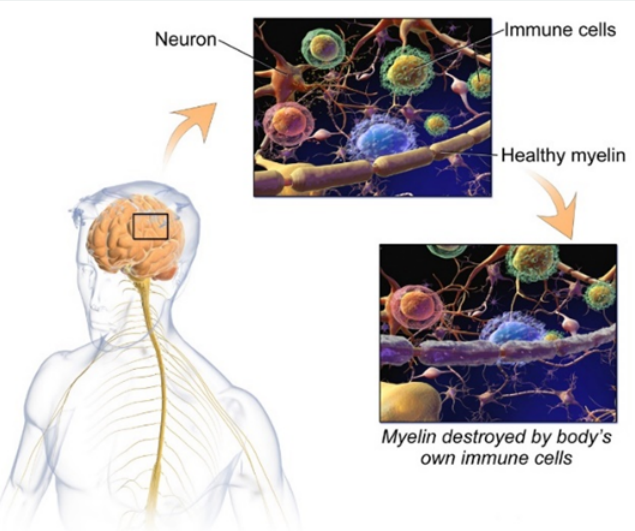

Figure 6.5.3: Multiple sclerosis is currently thought to be a disease in which autoimmune cells attack the nervous system, destroying myelin. (Copyright; BruceBlaus, CC BY-SA 4.0, via Wikimedia Commons)