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Clinical Nutrition Experimental

journal homepage: [http://
www.clinicalnutritionexperimental.com](http://www.clinicalnutritionexperimental.com)

Lipids: An insight into the neurodegenerative disorders

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ARTICLE INFO

Article history:

Received 4 January 2018

Accepted 6 May 2018

Available online xxx

Keywords:

Glycerolipids

Glycolipids

Polyunsaturated fatty acids

Neurodegenerative disorders

Sphingolipids

SUMMARY

Brain development is a sequential anatomical process characterised by specific well-defined stages of growth and maturation. One of the fundamental and necessary events in the normal development of the central nervous system in vertebrates is the formation of a myelin sheath. This process is influenced by dietary lipids. A number of researches have indicated that the administration of a diet, deficient in essential fatty acids during development causes hypomyelination in the brain. Brain lipids determine the localization and function of proteins in the cell membrane and in doing so regulate synaptic signalling in neurons. Lipids may also function as transmitters and relay signals from the membrane to intracellular compartments or to other cells. Several experimental studies have suggested a crucial role of n-3 polyunsaturated fatty acids in membrane formation, as well as clinical role of glycerolipids, glycerophospholipids, and sphingolipids in the attenuation of depression- and anxiety-related behaviours. Hence it can be assumed that polyunsaturated fatty acids may also offer new treatment options (for example, targeted dietary supplementation or pharmacological interference with lipid-regulating enzymes). These lipids could be exploited for improved prevention and treatment. A very interesting and emerging approach in this direction is through 'Lipidomics' which is a relatively recent research field that has been driven by rapid advances in technologies such as mass spectrometry (MS), nuclear magnetic resonance (NMR) spectroscopy, fluorescence spectroscopy, dual polarisation interferometry and computational

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methods, coupled with the recognition of the role of lipids in many metabolic diseases such as obesity, atherosclerosis, stroke, hypertension and diabetes.

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1. Introduction

Lipids play a pivotal role in normal physiological function of the neurons and structural development of the brain. The lipid composition of the brain highly governs mood, perception and emotional behaviour of the subject. There are eight different classes of lipids that form the central nervous system [1]: Fatty acyls, glycerolipids, glycerophospholipids, sphingolipids, sterol lipids, prenol lipids, saccharolipids and polyketides.

The lipids have variety of functions like formation of lipid bilayers that form the structure and provide necessary channel for protein function, function as an energy reservoir (for example triglycerides) and serve as precursors for various secondary messengers such as arachidonic acid (ArAc), docosahexaenoic acid (DHA), ceramide, 1,2-diacylglycerol (DAG), phosphatidic acid and lysophosphatidic acid. The normal functions of these lipids govern the overall normal physiology of the brain. Any abnormal deviation from the normal function of brain, either due to any mechanical injury or due to pathological changes in neurons, leads to different types of neurodegenerative diseases, mental disorders, stroke and CNS traumas. Currently there exists no cure for these CNS injuries and disorders, resulting in a huge impact on quality of life. The crucial role of lipids in tissue physiology and cell signalling is demonstrated by the many neurological disorders. Both, neurological disorders and neurodegenerative diseases involve unregulated lipid metabolism. Altered lipid metabolism is also believed to be a key event which contributes to CNS injury [2].

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