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Neuroimmunochemistry: A complex discipline

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Abstract

Neuroimmunochemistry is a complex discipline. Understanding the role of immune cells and manipulated to increase the neurodegenerative disease outcome will led the hallmark of epigenetic medicine. Immunologic approach to examine in depth neural immune interactions to counteract neurodegenerative disease like brain stroke, tumour, Alzheimer's, multiple sclerosis. The reward system and circadian rhythm are also immune related neurological phenomena. Exploring the link between immune cells and the CNS will led the development of most advance therapeutic treatment.

Keywords: Immune cells, Alzheimer's disease, Epigenetic medicine, Dendritic cells, Cytokines, MHC

Introduction

Signalling pathways between the brain and immune system could be the game changing discoveries. Scientist believe that the brain is directly connected to the immune system. University of Virginia School of Medicine have made dazzling discovery, published in Nature: Brain is directly connected to immune system by previously known vessel. The discoveries of the new vessel have enormous implications of every neurological disease with an immune component from Alzheimer's to multiple sclerosis. The production of cytokine are detected in the CNS. Jonathan Kipnis and colleague shows that IFN gamma acts on the inhibitory neurons in the brain to regulate neuronal connectivity and social behaviour. Macrophages, dendritic cells, T cells are continuously monitored in CNS to detect disease prone agent which would disrupts the homeostasis and optimal functioning of the vital organs. Certain immune cells patrols the CNS and perform immune surveillance in the CNS. Our aim is to understand the physiological and biochemical role of those immune armies that guard the CNS. The bio molecular marker that underlies the surveillance duties could be a novel approach towards the development of epigenetic medicine. Dendritic cells play role of antigen presentation in autoimmune diabetes mellitus (IDDM). The role of dendritic cells in immune mediated inflammatory disease in CNS is some of the current issues. Dendritic cells induce primary immune response. They also play crucial role in immune tolerance.

MHC 1 and the neural synaptic modification

Neurons also response to MHC 1 during synaptic modification. The synapse of CNS is also regulated by neuronal MHC1. The CNS is considered to be an "immune privileged" site with the restricted access and unique microenvironment that profoundly affect the capacity of T cell to exert their functions (Dorian B Mc Gavern, Dirk Homann, Michael B. A. Oldstone; J Infect Dis 2002, Dec 1). CD8+T cells also damaged the neural cells. CD8+T cells contribute inflammatory disease and CNS dysfunction. They target the neurons of CNS and show programmed CNS effect.

NK CELLS: Dual role of neurotoxicity and neuroprotection

NK cells are the potent immune cells. They are the component of innate immunity. They are cytotoxic in nature and cytoplasm contains killer proteins collectively called as granzymes. They are one the first effectors on the sites of inflammation. NK cells play huge role in neurotoxicity and neuroprotection following the CNS pathology. Understanding the interference between NK cells and brain resident immune cells are important aspects in nervous system disorder.

Neuro immune cross talks

The nature of neuroimmune interactions is controversial, with the various factors including the concept of immune privileged, the existence of blood brain barrier and the observation that excessive autoimmune CNS inflammation drives pathology in multiple sclerosis (Ousman. et. al. 2007; Steinman, 2014) contributing to the notion that the activity of the peripheral immune system is harmful to the CNS and does not support its functions. Abrasion to CNS evoke a distinct inflammatory torrent that begins with the cell end and progress through the multiple molecular and cellular phases.

Signalling pathways between brain and immune cells

From immune signalling brain pathway to different neurodegenerative disease is one vital motto need to be understood. Reciprocal interactions between immune system and the brain have attracted considerable attention regarding the role immune system in neuropsychiatric disease especially depression (Lucille

Capwon and Andrew H. Miller; Pharmacol Ther, 2011 May).

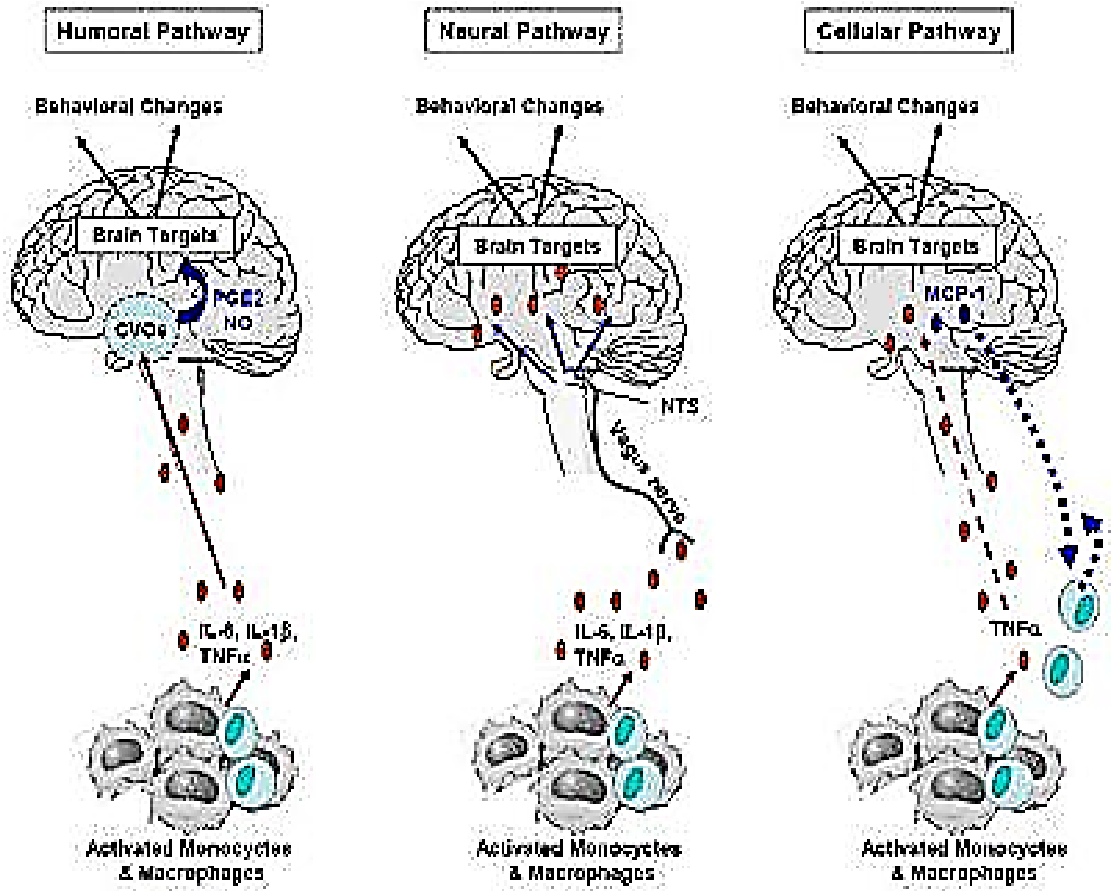
Cytokines: sickness behaviour

Cytokines are the number of cells including the growth factor, interferon which are secreted by certain immune cells of immune system and have effect on other cells. They exist in peptide, protein and glycoprotein. They are signalling molecule and triggers inflammatory response. Cytokines shows the sickness behaviour with CNS. Sickness behaviour is typically associated with the behavioural changes seen in human and laboratory animals suffering from microbial infections and include depressive like behaviour, anhedonia, fatigue, psychomotor slowing, decreased appetite, sleep alterations and increased sensitivity to pain (Hart 1988; Kent et al 1992). Proinflammatory cytokine or cytokine inducer like LPS or agents like Salmonella typhi and some endotoxin evoke the sickness behaviour.

Cytokine green light to brain

Cytokine are immune modulating agents. They alter the immune response. They do not easily cross the blood brain barrier. Cytokine signals reach the brain through humoral, neural and cellular pathways. There are some passage stream like leaky channel present in the blood brain barrier which comprises of choroid plexus and circum ventricular organ. They breach the CNS through the process of active transport and using some cytokine transporter molecule present in brain endothelium.

With the activation of endothelial cells certain secondary messenger like prostaglandins, Nitric Oxide are activated in the brain. The cytokine signals are transmitted trough afferent nerve fibres such as vegus nerve.



Immune cells: brain healing

Immune cells supports and shape the brain in health, ageing and diseases. Immune may be called as the master guardian of CNS. Inflammation by immune cells and local inflammation associated with Alzheimer's show common genetics. The physiology of disease and origin of immune cells determines the nature of the inflammatory response. Innate and adaptive defence system have protective and healing properties in CNS. They play major role in maintaining the brain pliability in health, ageing and neurodegenerative disorder. The discovery led to the CNS repair process, brain ageing and certain disorder like Alzheimer's and multiple sclerosis.

Future prospects of neuroimmunology

Some of the neurodegenerative disease like Guillain bare syndrome, multiple sclerosis, cerebeller degeneration, inflammatory myopathies is associated with the autoimmune condition. Neuroimmunology could be the sole motives towards immune therapeutic target in future. The system between neuro and immune function will provide broad overview of designing novel vaccines. Epigenetic medicine is a new brand of neuroimmunology. This will underlie the brain development, neuronal network, homeostasis and diverse function of neurological disorder. Understanding the epigenetic medicine will help in future pharmacological treatment. CNS and immune system need appropriate aspects of cellular connectivity (neural connectivity). Therapies based on DNA methylation inhibitors, RNA approach were already in the market. Understanding the epigenome concept will led to the understanding of global genome wide cellular process. Combine imaging technologies and advanced nanotechnology application foster the scientific link between the immune system and nervous system.

Conclusion

Neuroimmunochemistry is spirited young area of research. The vast research in this area has increased by an order of magnitude of understanding the link between the immune system and the brain. The research may led to new discoveries, to well established perspective. The basic understanding that cross bridged the immune cell with brain will be a major contributor of epigenetic medicine and will be the end of neurodegenerative disease. Hopefully, the identification of those signalling pathways that link brain with immune cells contribute to the new theories and mapping of those pathways will led to the future therapeutics. Neuroimmunology could be both science of new techniques, theories and science of new ideas.

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