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Bilobalide's Promising Role in Autoimmune Encephalomyelitis and Peripheral Neuropathy: Modulating the Immune System and Protecting the Myelin Sheath

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Abstract

Bilobalide (BB), a sesquiterpene isolated from Ginkgo biloba extract, has attracted great interest as a potential therapeutic agent for several neurological diseases. Multiple Sclerosis (MS) is a chronic immune-mediated inflammatory and neurodegenerative disease of the Central Nervous System (CNS), which results in demyelination and axonal degeneration. Experimental Autoimmune Encephalomyelitis (EAE), characterized by infiltration of T cells and macrophages, neuroinflammation and severe demyelination, is the best imitation and extensively used to study MS. The recent paper, "The therapeutic potential of bilobalide on Experimental Autoimmune Encephalomyelitis (EAE) mice", provides evidence that BB protected myelin sheath by immunomodulatory, anti-inflammation and antiapoptosis. In this review, we discussed the findings of BB treatment on EAE.

Multiple Sclerosis (MS) is a chronic immune-mediated inflammatory demyelinating disease of the Central Nervous System (CNS). T cells appear early in lesion formation, and the disease is initiated by aberrant responses against CNS autoantigens, the precise pathogenesis, however, remains enigmatic. Autoreactive lymphocytes penetrate the Blood-Brain Barrier (BBB) and infiltrate into CNS to initiate inflammation, followed by gliosis, apoptosis of oligodendrocytes and demyelination [1]. Experimental Autoimmune Encephalomyelitis (EAE) is the most commonly used experimental model for MS, characterized by infiltration of T cells and macrophages, neuroinflammation and severe demyelination, is the best imitation and extensively used to study MS.

Introduction

Autoimmune diseases, characterized by the body's immune system attacking its own tissues, are a significant challenge in modern medicine. Among these, Experimental Autoimmune Encephalomyelitis (EAE) and Peripheral Neuropathy represent disorders affecting the central and peripheral nervous systems, respectively. These conditions can have devastating consequences for patients, leading to disability and a significant reduction in their quality of life. peripheral neuropathy Peripheral neuropathy refers to the many conditions that involve damage to the peripheral nervous system, which is a vast communications network that sends signals between the central nervous system (the brain and spinal cord) and all other parts of the body. Peripheral nerves send many types of sensory information to the central nervous system (CNS), such as the message that your feet are cold. They also carry signals from the CNS to the rest of the body. Best known are the signals to the muscles that tell them to contract, which is how we move, but there are different types of signals that help control everything from our heart and blood vessels, digestion, urination and sexual function to our bones and immune system [2].

In recent years, a growing body of research has focused on natural compounds as potential remedies for autoimmune diseases. One such compound, bilobalide, found in Ginkgo biloba, has shown promising immunomodulatory and neuroprotective properties. This article explores the potential of bilobalide in the context of EAE and peripheral neuropathy and how it could offer new hope for those suffering from these debilitating conditions.

Understanding EAE and peripheral neuropathy

Experimental Autoimmune Encephalomyelitis (EAE): EAE serves as an animal model for multiple sclerosis (MS), a chronic autoimmune disease that affects the central nervous system. In EAE, the immune system targets the myelin sheath surrounding nerve fibers, leading to inflammation, demyelination, and neurological dysfunction. The quest for effective treatments for EAE and MS has been ongoing for decades. Peripheral Neuropathy: Peripheral neuropathy is a disorder affecting the peripheral nerves that transmit information between the central nervous system and the rest of the body. It can manifest as numbness, tingling, muscle weakness, and even pain. The underlying causes of peripheral neuropathy are varied, including autoimmune conditions .

Nerve signal interruption

The peripheral nerves are like cables that connect different parts of a computer or connect to the Internet. When they malfunction, complex functions can grind to a halt.

Nerve signaling in neuropathy is disrupted in three ways:

- Loss of signals normally sent
- Inappropriate signaling when there shouldn't be any
- Errors that distort the messages being sent.

Some forms of neuropathy involve damage to only one nerve (mononeuropathy). Neuropathy affecting two or more nerves in different areas is called multiple mononeuropathy or mononeuropathy

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multiplex. More often, many or most of the nerves are affected (polyneuropathy) [3].

Bilobalide: A glimpse of hope

Bilobalide is a terpenoid compound found in the leaves of the Ginkgo biloba tree. It has gained attention for its potential therapeutic properties in the context of autoimmune diseases, including EAE and peripheral neuropathy.

Immunomodulatory effects

Bilobalide has been observed to have immunomodulatory properties, which means it can regulate the immune system's response. In the context of EAE, this is particularly significant, as the disease results from an overactive immune response targeting the myelin sheath. Bilobalide can potentially reduce inflammation and curb the autoimmune response.

Neuroprotective properties

Bilobalide's neuroprotective effects are also noteworthy. Studies have shown that it may help protect the myelin sheath and nerve cells from damage, potentially preventing or slowing the progression of conditions like EAE and peripheral neuropathy.

Anti-inflammatory action

Inflammation is a common feature of autoimmune diseases, and bilobalide has demonstrated anti-inflammatory properties. By reducing inflammation, it can potentially alleviate some of the symptoms associated with EAE and peripheral neuropathy [4-10].

Research and Implications

Several studies have explored the potential of bilobalide in the context of EAE and peripheral neuropathy. While most research has been conducted in animal models, the results are promising. Bilobalide's ability to modulate the immune system and protect the myelin sheath offers a new avenue for therapeutic interventions in these conditions. However, it is important to note that further research is needed to establish the safety and efficacy of bilobalide in humans. Clinical trials and extensive studies are necessary to confirm its potential as a treatment for EAE, multiple sclerosis, and peripheral neuropathy.

Conclusion

Experimental Autoimmune Encephalomyelitis and Peripheral Neuropathy are debilitating conditions that affect the nervous system and quality of life of those afflicted. As conventional treatments may have limitations, exploring natural compounds like bilobalide could be a promising alternative. However, the causes of oligodendrocyte apoptosis remain unclear. Our study described that BB contributed to the re-balance of pro-and anti-apoptotic proteins including the down regulation of apoptosis proteins (i.e., Cleave- Caspase-3 and Bax) and up-regulation of the Bcl-2 protein. More importantly, the administration of BB resulted in a fall of apoptotic cleaved Caspase-3-positive oligodendrocytes, explaining that BB protects oligodendrocytes from apoptosis. Besides, BB did not enhance the expression of NG2, a marker of oligodendrocyte precursor cells. Moreover, anti-apoptosis of BB was linked with the decline of inflammatory cytokines. Bilobalide, derived from the Ginkgo biloba tree, offers a glimmer of hope for patients suffering from these conditions. Its immunomodulatory, neuroprotective, and anti-inflammatory properties make it a fascinating subject for future research. While it is not a cure, the potential of bilobalide in modulating the immune system and protecting the myelin sheath opens up new possibilities for the development of therapies that may alleviate the suffering of those with EAE and peripheral neuropathy.

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