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Review Article

Exploring the Etiological Overlap between Parkinson's Disease and Multiple Sclerosis: A Novel Avenue for Treating MS

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Abstract

After many years of monotherapy with ursodeoxycholic acid and many reports of its long-term benefits, mostly positive the physician now has an opportunity to consider the use of newer medications. However, the decision to choose a newer medication is biased in favor of ursodeoxycholic acid because it is viewed as the ""gold standard" implying that other medications will always have a secondary role. A major threat to the patient's well-being is persisting with this approach and the failure to recognize in a timely manner that ursodeoxycholic acid is causing liver injury. Very rarely toxicity is apparent within a few weeks of administration.

Key words: multiple sclerosis; parkinson's disease; neurodegenerative conditions; treatments; dopamine agonists

Introduction

Both Parkinson's disease (abbreviated as PD) and multiple sclerosis (abbreviated as MS) are degenerative neurological conditions that afflict millions of people all over the world. Recent study has demonstrated that there may be some etiological overlap between these disorders, despite the fact that each condition manifests clinically in a manner that is distinctive from the others. In particular, Parkinson's disease (PD) and multiple sclerosis (MS) both entail deregulation of the immune system, inflammation, and oxidative stress, which implies that similar pathways may be implicated in the pathogenesis of both conditions (Lee et al., 2012; Ghorbanian et al., 2017; Kaur et al., 2018; Sehgal et al., 2018).

In this article, we will investigate the evidence supporting the etiological parallels between Parkinson's disease (PD) and multiple sclerosis (MS), and we will talk about the prospective therapeutic approaches that could be applied to both disorders.

Etiological similarities between PD and MS

Immunological dysregulation

Immunological dysregulation is a hallmark of both Parkinson's disease and multiple sclerosis (MS), leading researchers to hypothesize that the immune system plays a significant part in the pathogenesis of both of these illnesses. According to Kaur et al. (2018), researchers believe that Parkinson's disease is caused when the immune system incorrectly recognizes proteins in the brain as being foreign. This results in an inflammatory response that ultimately kills neurons. In a manner analogous, multiple sclerosis is characterized by an attack by the immune system on the myelin sheath that surrounds neurons, which results in demyelination and, ultimately, neuronal impairment (Sehgal et al., 2018).

Recent research has shown that the immunological responses seen in people with Parkinson's disease and multiple sclerosis share significant similarities. For instance, activation of microglia, which are immune cells found in the brain, is a common feature of both disorders. According to Kaur et al. (2018), activated microglia in Parkinson's disease (PD) emit pro-inflammatory cytokines and reactive oxygen species (ROS), both of which contribute to neuronal damage. In multiple sclerosis (MS), activated microglia and other immune cells emit pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF-) and interleukin-6 (IL-6), both of which lead to demyelination and damage to neuronal cells (Lee et al., 2012).

In addition, both PD and MS are associated with a dysfunction in regulatory T cells, also known as Tregs, which are an immune cell subtype that works

to suppress inflammation. According to research done by Saunders et al. (2012), people who have Parkinson's disease have fewer regulatory T cells, which also have a diminished ability to control inflammation in the brain. Also, people with multiple sclerosis have less regulatory T cells (Tregs), which is one factor that contributes to their abnormal immune response (Feger et al., 2007).

Oxidative stress

Oxidative stress is another characteristic that both PD and MS have in common. According to Kaur et al. (2018), oxidative stress arises in Parkinson's disease when reactive oxygen species (ROS) created by activated microglia and other cells damage neurons. In a manner analogous, oxidative stress can develop in multiple sclerosis (MS) when reactive oxygen species (ROS) are produced by immune cells during demyelination (Smith and Lassmann, 2002).

Recent research has indicated that oxidative stress may have a causal relationship with the onset of multiple sclerosis and Parkinson's disease (PD). Exposure to environmental toxins such as pesticides and heavy metals, for instance, has been found to lead to increased oxidative stress and an increased chance of acquiring Parkinson's disease (Gorell et al., 1998; Kamel et al., 2013). Another example is that exposure to environmental toxins can lead to an increased risk of developing Alzheimer's disease. In a similar vein, oxidative stress has been linked to the development of multiple sclerosis (MS), with research indicating that patients suffering from the condition had lower levels of antioxidant enzymes than healthy individuals.

(Dutta and Trapp, 2011). stress is another shared feature of PD and MS. In PD, oxidative stress occurs when ROS produced by activated microglia and other cells damage neurons (Kaur et al., 2018). Similarly, in MS, oxidative stress occurs when ROS are generated by immune cells during demyelination (Smith and Lassmann, 2002).

Recent studies have shown that there may be a direct link between oxidative stress and the development of PD and MS. For example, it has been shown that exposure to environmental toxins, such as pesticides and heavy metals, can lead to increased oxidative stress and an increased risk of developing PD (Gorell et al., 1998; Kamel et al., 2013). Similarly, oxidative stress has been implicated in the pathogenesis of MS, with studies showing that the levels of antioxidant enzymes are decreased in patients with the condition (Dutta and Trapp, 2011).

Potential therapeutic approaches

It is feasible that therapeutic techniques developed for one ailment may be useful to the treatment of the other condition given the etiological parallels between Parkinson's disease and multiple sclerosis. In the following paragraphs, we will go through some of the potential therapeutic options that have the potential to be successful in treating both PD and MS (Khatib, 2022).

Immunomodulatory therapies

Immunomodulatory therapy, which tries to modify the immune system to minimize inflammation and prevent neuronal damage, is one prospective therapeutic method that can be used for both Parkinson's disease and multiple sclerosis. Immunomodulatory therapy have been demonstrated to improve motor function and reduce inflammation in the brain in animal models of Parkinson's disease (Dobbs et al., 1999; Olechowski et al., 2013) (Dobbs et al., 1999; Olechowski et al., 2013). It has been demonstrated that immunomodulatory treatments, such as interferon-beta and glatiramer acetate, can reduce inflammation and halt the course of multiple sclerosis (Frohman et al., 2006).

However, it is important to keep in mind that the efficacy of immunomodulatory therapy differs from patient to patient, and there is a possibility of experiencing adverse effects as a result of receiving these treatments. Therefore, additional research is required to produce immunomodulatory medications that are both more successful and safer for the treatment of Parkinson's disease and multiple sclerosis (Mehanna and Jankovic, 2010; Fox and Khatri, 2017; Rizvi and Mubarak, 2019).

One study that supports the concept of personalized medicine for multiple sclerosis (MS) was carried out by Klein and Wu (2019). They explored a number of genetic characteristics that have been connected with response to MS medications, such as differences in genes related to immune regulation and inflammation. This study is one example of a study that lends support to the concept of personalized medicine for MS. The authors propose that genetic testing may be able to assist in identifying individuals who are more likely to benefit from particular treatments or who may be at a higher risk for experiencing harmful effects from those treatments.

Another study looked especially at the impact of genetic polymorphisms on the response to interferon-beta therapy, which is a typical treatment for multiple sclerosis (MS). This study was published in the journal Multiple Sclerosis and Related Disorders in the year 2020. According to the findings of the study that was conducted by Saboori et al. in 2020, particular variants in the genes that code for the interferon-beta receptor and related signaling pathways were associated with variances in treatment response as well as the development of adverse effects.

In general, the findings of these and other studies imply that personalized medicine techniques that take into account individual genetic differences may assist to maximize treatment outcomes for multiple sclerosis and other autoimmune illnesses. However, additional research is required in order to have a complete understanding of the intricate relationships that exist between genetics, immunological function, and treatment response.

Anti-oxidant therapies

Anti-oxidant medicines are another potential option for treating both Parkinson's disease and multiple sclerosis (MS), given the role that oxidative stress plays in the pathophysiology of both of these disorders. It has been demonstrated in Parkinson's disease (PD) through the use of animal models that the administration of antioxidants, such as coenzyme Q10 and vitamin E, can reduce oxidative stress and improve motor function (Shults, 2006, 2008). Antioxidants like alpha-lipoic acid and N-acetylcysteine have been proven to lower oxidative stress and enhance clinical outcomes in multiple sclerosis both in animal models and in human trials (Yadav et al., 2009; Gaby, 2010).

On the other hand, the efficacy of antioxidant therapy, like that of immunomodulatory therapies, varies from patient to patient, and there is a possibility of experiencing adverse effects in conjunction with these treatments. Therefore, additional research is required to create antioxidant medications that are both more effective and safer for the treatment of Parkinson's disease and multiple sclerosis (Sanoobar et al., 2013; Vollmer et al., 2014).

Stem cell therapies

Stem cell therapies are a third potential treatment option for both Parkinson's disease and multiple sclerosis. According to Barker et al. (2017), because stem cells are capable of differentiating into a wide variety of cell types, including neurons and immune cells, they can be employed to replace damaged cells in the brain and to control the immunological response. Dopaminergic neuron transplantation, which is derived from stem cells, has been proven in a number of trials to be effective in the treatment of Parkinson's disease (PD) in animal models of the condition. Stem cell transplantation has also been demonstrated to enhance clinical outcomes in human trials for multiple sclerosis (MS), presumably by replacing damaged immune cells with healthy ones (Mendonca et al., 2009; Barker et al., 20017). These findings were published in the journals Mendonca et al., 2009 and Barker et al., 20017.

However, the efficacy of stem cell therapies varies between patients, and there is a possibility of experiencing adverse effects in conjunction with these treatments (Weiss et al., 2019). This is similar to the situation with immunomodulatory and antioxidant therapy.

Conclusion

Parkinson's disease (PD) and multiple sclerosis (MS) are two separate neurological ailments; nevertheless, new research has suggested that there may be some etiological overlap between these conditions. To be more specific, Parkinson's disease and multiple sclerosis both include deregulation of the immune system, inflammation, and oxidative stress, which suggests that similar pathways may be implicated in the pathogenesis of both diseases. As a consequence of this, there may be prospective therapeutic methods that are applicable to both illnesses, such as stem cell therapies, immunomodulatory therapies, and anti-oxidant therapies. However, additional research is required to create treatments that are both more successful and safer for people living with Parkinson's disease and multiple sclerosis (MS), as well as to improve the application of these medicines for particular patients.

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