Detection of Early Onset Alzheimer's Disease

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Introduction

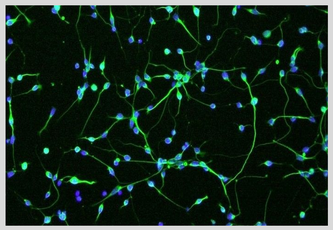
Alzheimer's is a neurodegenerative disorder that is estimated to have 500,000 new diagnoses every year. People with Alzheimer's disease (AD) live an average of 4-8 years after the diagnosis and 1 in 3 seniors die from alzheimer's or dementia; causing it to be the 6th leading cause of death in the United States. We chose this topic as it applies to our educational interests and is a critical topic that affects the lives of millions. There are many factors leading to the early diagnosis of the disease, however research currently points to 3 promising possible avenues within the brain for further exploration. The most promising three predictors of early onset of Alzheimer's are oligodendrocytes, astrocytes, and various proteins produced by glial cells.

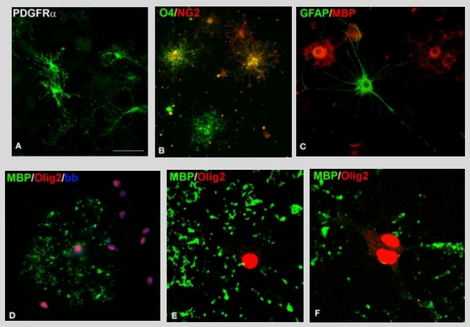
Oligodendrocytes

The myelin sheath is an insulating layer that forms around nerves, including those in the brain and spinal cord. It is made up of protein and fatty substances. This myelin sheath allows electrical impulses to transmit quickly and efficiently along the nerve cells. Oligodendrocytes play an important role in myelin formation and if myelin is damaged, impulses slow down. The damage to the myelin sheaths detected in AD raises the possibility that oligodendrocytes experience a pathophysiological assault by various proteins and mechanisms over time (Desai et al., 2010). A postmortem study reported that oligodendrocyte loss, together with reduced myelin density, axonal loss and astrogliosis, are the main structural white matter changes in a patient with AD (Zhan et al., 2014). Research shows that the cause of several mechanisms that cause the reduction of myelination such as, ischemia, oxidative stress, excitotoxicity, iron overload, Aβ toxicity and tauopathy.

Why this is promising

- It has been demonstrated that a requirement for the cell shape change in myelination and cell shape formation is the complex protein, known as Scribble, the central nervous system (CNS) myelination and remyelination.
- White matter abnormalities, and in particular myelin and oligodendrocytes, could be mechanistically important in AD pathology and could be potential treatment targets.



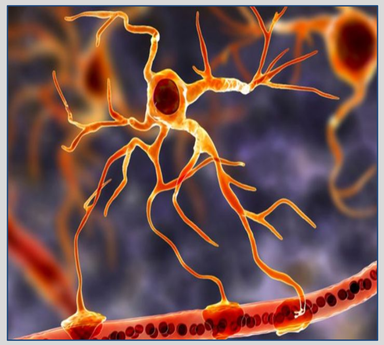


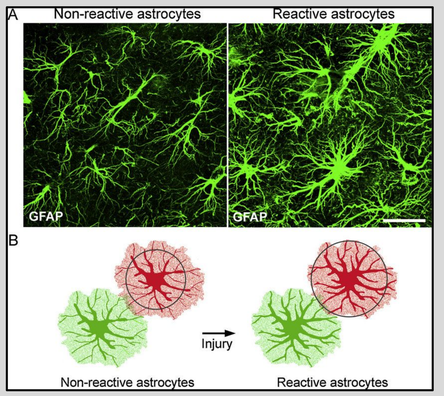
Astrocytes

Astrocytes are the most common type of glial cell, which can be thought of as nourishing regulators for the neurons of the CNS. They are known to surround neurons and provide support and insulation between them. Astrocytes are a promising component of AD to research due to their involvement in cognitive functions such as learning and memory. Findings suggest that astrocytes may play a protective role through signaling pathways in some neurodegenerative lesions, studies have reported that neural inflammation and ischemia can induce two types of reactive astrocytes, termed "A1" and "A2".Gene analysis of reactive astrocytes shows that A1 astrocytes can promote complement genes that can secret various neurotoxins that to the synapses of the brain. In contrast, A2 astrocytes can nullify neurotoxins from A1 astrocytes promoting both the survival and growth synapses in the brain. Thus, A1 astrocytes may promote AD, while A2 astrocytes have the ability to stem off the negative effects from A1 astrocytes reducing the likelihood of onset for AD.

Why this is promising

- If it can be noticed that a patient is suffering from large amounts of neuroinflammation, their astrocytes may be activated and release damaging amounts of Amyloid beta which add neurological damage and speed up the progression of AD.





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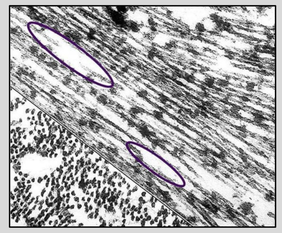
Tau Proteins

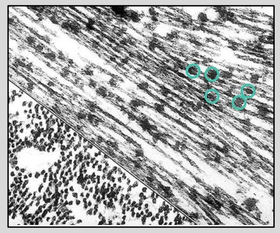
Another protein that is associated with the diagnosis of Alzhimer's is the Amyloid beta protein. In AD patients, it is hypothesized that secreted Ab gradually increases in the extracellular space until it starts to form aggregates of insoluble b-pleated amyloid fibrils.It has been hypothesized that these extracellular Ab proteins exert their toxic effects on the surrounding neurons and their processes. Previous research from Stanford Medical states that, Beta-amyloid begins life as a solitary molecule but tends to bunch up — initially into small clusters that are still soluble and can travel freely in the brain, and finally into the plaques that are hallmarks of Alzheimer's.

Why this is promising

- Research has shown that the accumulation of tau and amyloid beta proteins have toxic effects that are responsible for the impairment in neurological function and alteration of the shape of the neurons which has been linked to causing early onset Alzheimer's Disease.



Tau proteins collapsed into tangles



Tau Proteins keeping the strands straight

Conclusion

The research provided above points to the three most promising areas that allow for the early detection of Alzheimer's Disease. Out of these, we are optimistic that the research within the tau and amyloid beta proteins will yield the most critical results in the future. Alzheimer's disease is still in the begging processes of being understood. These avenues within the brain do not have answers currency however research is being done around the clock and hopefully offer some promising results.