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Proteins are one the most versatile molecules that exist within the human body and take on many important roles in order to keep us functioning at our best. They are responsible for everything from transporting smaller molecules in and out of the cell, maintaining the structure of a variety of bodily tissues, all the way to composition of our DNA. It goes without saying that proteins are vital to what makes us who we are and throughout this semester we have explored the specific ways in which they do so. However, just like every coin has two sides, so too do the many benefits of proteins also come with a number of less discussed disadvantages. An example of this dark side is the protein Beta-amyloid, and Tau and the role they play in Alzheimer’s disease. This “role” is the subject of an extensively researched process and will hopefully lead to a cure. By examining Alzheimer’s disease and its effect on the nervous system, I hope to illuminate the various components and key structures of the nervous system and illuminate how important they are to our daily life.

Alzheimer’s disease is a form of dementia in which the patient suffers from a degenerative neurological condition that causes a progressive decline in memory and cognitive function. According to the Alzheimer’s association this disease is currently the 6th leading cause of death in the United States, killing more than breast and prostate cancer combined. It affects over 5 million Americans, and by 2050 that number will rise to nearly 14 million. (“Alzheimer’ s Disease Facts and Figures ,” 2020). This disease is a looming crisis within the US and so it is important to arm the country with as much knowledge as possible to help combat this threat in the coming days.

Alzheimer’s is a very complex disease with many contributing factors that we do not yet fully understand. However, what we do know is that inside the brain of a person who has contracted Alzheimer’s disease there is a far greater number of dead nerve cells compared to a person who does not have the disease. The lack of nerve cells causes the brain to shrink dramatically and prevents the brain from being able to effectively communicate with itself. One reason believed to be behind this die off is the presence of a large quantity of twisted Tau proteins called tangles.

Inside of every nerve cell located in our brain there are Tau proteins that perform an important function in keeping the nerve cell healthy. Normally Tau is located in the axion and dendrite regions of the nerve and supports microtubules in running straight and parallel throughout the cell. These microtubules act as miniature highways, moving nutrients and waste into and out of the cell and keeping the cell healthy. However, in Alzheimer’s patients, researchers have found an increase in the overall number of Tau proteins which seem to have interacted with one another and become knocked down. These abnormal Tau become twisted together bunching into small groups known as tangles. Because of this phenomenon the proteins can no long support the microtubules that were transporting nutrients into cell and those tubules become pinched. This interrupts the flow of nutrients into the nerve and eventual results in the cell starving and dying off (Naseri & Wang & Guo & Sharma & Luo, 2019, pg. 183-194). Because of the significance of this process scientists are becoming increasingly focused on discovering the reasons behind this concentration of abnormal Tau cells. It is now believed that the presence of abnormal Tau within the cells can be linked to the increase in the amount of plaque surrounding the neurons though more research is needed to confirm this.

A second major cause that scientists believe contributes to Alzheimer’s disease is the aggregation of plaque around the dendrites of a nerve cell. This plaque is made from oligomers of aggregated beta-amyloid protein fragments located in the fatty membrane surrounding nerve cells (Caria & Nonaka & Cavalcante & De Sousa & Aras & Souza, 2020). Monomers of Amyloid beta aggregate into oligomers of Amyloid beta which aggregate into insoluble fibrils of protein that eventual forms plaque. The plaque forms in the synaptic gap of communicating neurons and blocks the passage of the neurotransmitters that the nerves use to communicate. This isolates the cell and makes it more vulnerable to abnormal mutations and processes that eventually lead to its death.

Proteins are neither good nor bad and are used in variety of situations to help the keep the body healthy and efficient. Yet when things go wrong, sometimes the very thing that is so vital to keep us functioning properly can also be used to harm us. This is the case with Tau and Amyloid Beta proteins and one of the reasons why educating ourselves on our body is so important. Alzheimer’s is a horrible disease that can tear a family apart but through education and research we move a step closer to one day finding a cure. Yet by examining this disease we can see how important the nervous system is to our daily life and see what happens when one of its key structures has been damaged.

References

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