Iron as a Biomarker for Alzheimer's Disease

Sam Barlow – Email: samuel.h.barlow@gmail.com - Net ID: sbarlow2
Dr. Jonathan Wisco - Physiology and Developmental Biology

Project Purpose

The purpose of this project is to analyze the locations of amyloid beta, tau, and iron in postmortem brains (specifically the entorhinal cortex) of Alzheimer's Disease patients to better understand the progression Alzheimer's Disease and establish iron as a biomarker for Alzheimer's Disease.

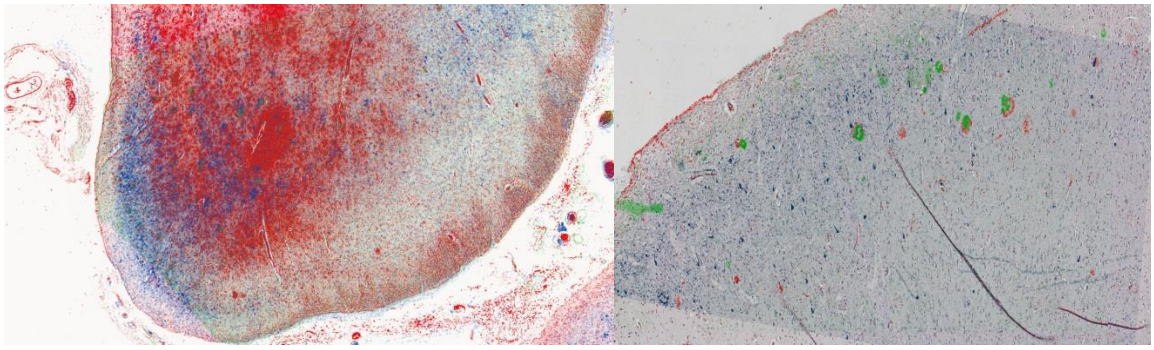
Project Importance

Alzheimer's disease is the the sixth highest cause of death in the United States. After the age of 65, the risk of developing Alzheimer's Disease doubles every five years and after the age of 85, the risk is almost 50 percent. Alzheimer's is also the most common form of dementia, a plague which is afflicting a generation with a much greater average life span than in the past. More effective ways to diagnose Alzheimer's Disease earlier would greatly help in the treatment of these patients. Iron may be used as a biomarker if iron is co-localizing to amyloid beta or tau in postmortem Alzheimer's brains. This means that magnetic resonance imaging (MRI) could be a potential method to check for the presence of dementia-causing proteins in living patients as iron causes a signal dropout in MRI. This project could ultimately result in the improvement of our ability to diagnose Alzheimer's earlier and will help in developing more effective treatments because other scientists will be able to use images and discoveries from this project to further the research in this area.

Project Profile Body

Since the discovery of Alzheimer's disease in 1906, scientists have discovered much about the disease, but many basic questions remain unanswered concerning the progression of the disease. There is a definite connection between the buildup of tau and amyloid beta proteins in the brain, but it is uncertain if these proteins are causing Alzheimer's Disease or if they are just side by-products of the disease. Deposits of iron in the brain have been shown to have spatial correlation with buildup of amyloid beta and tau protein. As iron causes signal dropout in magnetic resonance imaging, iron could potentially be a great biomarker for Alzheimer's Disease. This would help tremendously in the diagnosis and early prevention needed to combat Alzheimer's Disease. **The main goal in this project is to determine if there is a correlation between the location of tau and amyloid beta and iron in the entorhinal cortex of the brain or not. These proteins may correlate spatially because of previous research in Dr. Wisco's lab.**

A trademark sign for the diagnosis of Alzheimer's disease is the buildup of amyloid beta and tau protein. This buildup starts in the hippocampus and continues to the temporal lobes of the brain. One of the first areas to be affected is the entorhinal cortex, which is located in the medial temporal lobe and is the main interface between the hippocampus and the neocortex. Dr. Jonathan Wisco and other students at UCLA began a research project to understand the correlation of iron with the buildup of amyloid beta and tau protein, which is being continued at BYU. We removed the hippocampus and connected regions such as the entorhinal cortex in post-mortem brains affected by Alzheimer's, sliced three samples each seven microns thick, and stained the slices for beta, tau, and iron. We put these samples and slides and took high resolution photos of each slide.



Figures 1 and 2 show the histological staining in the entorhinal cortex of a brain affected by Alzheimer's disease. The red staining represents the iron, the blue represents the tau, and the green represents the amyloid beta.

Our present focus for this project is to combine these sets of three images to create one image clearly showing the spatial relationship between amyloid beta, tau, and iron. We are using OlyVia (an image viewing software) and Adobe Photoshop to do this. In OlyVia, we can alter the images to be the same dimensions and orientations so as to lay them right on top of each other. We use Photoshop to color the spots of amyloid beta, tau, and iron. We then put these three images on top of each other and make one final image showing the spatial relationship between the three proteins. We have hundreds of images that we need to alter and put together in the method just described. By using this method, we will be able to see if iron is a reliable biomarker for Alzheimer's Disease. We need to go through many images to get enough data to have reliable results.

Anticipated Academic Outcome

Dr. Wisco and I will present the outcome of this research at the annual American Association of Clinical Anatomists which will take place July 8th, 2014. We also plan on publishing the completed images and findings of this research.

Qualifications

I am qualified for this project because of my educational background and training and my interest in understanding Alzheimer's Disease so we can eventually cure it. I have been able to learn much of the anatomy of the brain from my anatomy and neuroanatomy classes. I have also been able to learn much about Alzheimer's Disease from my physiology and neuroscience classes. I have learned proper lab techniques by taking an organic chemistry lab, molecular biology lab, and doing cancer research for a year before joining this lab. I was able to present the results of my research at the AACR (American Association for Cancer Research) last April. The fight against Alzheimer's Disease also holds special importance for me because several members of my family have had to go through this disease or dementia. Dr. Wisco has helped me become trained to work on the immunohistochemistry and photoshopping that we will need to use to successfully complete this project. Dr. Wisco has been working on this project for many years at BYU as well as UCLA. He is qualified to guide me on this project because of his multiple degrees and his experiences as an Assistant Professor position at the David Geffen School of Medicine at UCLA. Dr. Wisco is more than qualified to guide this project with his years of experience in not just anatomy and neurobiology, but his specific research in this subject area that he started in UCLA. Dr. Wisco can also meet with us one to two times a week to regularly guide us in the right direction.

Project Timetable

This project will be completed before July 8th, 2014, because we will present the findings of our research at the American Association of Clinical Anatomists, beginning that day. We will also submit our abstract to participate in that conference by March 12, 2014. Since the beginning of the semester we have been processing a set of images a week. We will continue this every week until April and the publication of this research.

Scholarly Sources

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