Correlation between Pancreatic Lipase Levels and Alzheimer’s Disease Progression

Tyler Meeks1,2, Christina Wooden2, Riju Datta2, Karthik Dharmarajan2, Aishwarya Rallabhandy2, Dr. Jonathan Wisco3

Glenbard South High School, 23W200 Butterfield Rd., Glen Ellyn, IL 60137
Boston University School of Medicine, 72 E. Concord St., Boston, MA 02118

INTRODUCTION

- Alzheimer’s Disease is a neurodegenerative disease prevalent in the elderly population (32% of people over the age of 85), likely caused by the buildup of Amyloid-Beta (Aβ) plaques (formed by the breakdown of amyloid precursor protein) between neurons, disrupting cell function. It is also attributed to neurofibrillary tangles, which are abnormal accumulations of the protein Tau, which detach from microtubules and stick to other Tau molecules, creating long thread-like structures known as “tangles,” inhibiting synaptic communication.

- It has long been posited that diet plays a role in development and progression of Alzheimer’s Disease. Specifically, it is thought that Alzheimer’s could be correlated with nutritional deficiencies from mal-absorption of essential nutrients, stemming from diseases such as Exocrine Pancreatic Insufficiency (EPI), a condition which hinders the secretion of the pancreatic exocrine enzymes (pancreatic lipase, protease, and amylase). Notably, around 20% of the elderly population suffers from some form of EPI, which could suggest a correlation between EPI and AD.

- In this study, we hope to determine the correlation between the amount of pancreatic lipase produced in various cohorts of mice, and the diagnosis of Alzheimer’s Disease. Additionally, we hope to obtain more information on whether or not diet plays a role in Alzheimer’s Disease progression, and if so, to what extent it affects development.

METHODS

- 23 pancreases were harvested from three different cohorts of mice (Aβ, Tau, WT). The Amyloid-Beta cohort was diagnosed with Alzheimer’s, and had an abnormal amount of Aβ protein present in each brain. The Tau cohort was also diagnosed with Alzheimer’s, and had an abnormal amount of Tau protein present. Meanwhile, the Wild Type cohort was not diagnosed with Alzheimer’s, and was used as a control group.

- Each pancreas was sliced at six microns, and then stained with anti-lipase polyclonal rabbit antibodies, and counter-stained with hematoxylin, to aid in visibility.

- The pancreatic tissue slides were scanned digitally using a Keyence bright-field slide scanner, with a 20x objective lens. The scan was then run through an image-analyzing algorithm, used to quantify the results. The number of positive pixels detected (ones that had been stained) was divided by the total pancreas pixel count (omitting the background). This algorithm yielded a final percentage for each subject, and was recorded.

RESULTS

- While many samples from each cohort had significantly variable percentages of stained pixels, each cohort’s mean value of stained pixel percentage was very close to 0.35 (or 35% stain coverage).

- This data shows that lipase production across each sample was both variable, and relatively even, signifying that both the mice diagnosed with Alzheimer’s, and the mice without Alzheimer’s did not produce varying levels of lipase. This suggests that lipase production has little to no correlation with Alzheimer’s Disease diagnosis or progression.

- From this study, we can deduce that diseases such as Exocrine Pancreatic Insufficiency, which hinder production of lipase, amylase, and protease in the pancreas, likely do not have any effect on Alzheimer’s Disease progression, and instead, only have similar numbers of cases in elderly population due to chance.

- Future studies could potentially look into:
  - Protease and amylase levels in cohorts of mice both with and without Alzheimer’s Disease.
  - Lipid intake through one’s diet, and progression of neurodegenerative diseases, specifically Alzheimer’s Disease.

DISCUSSION & CONCLUSIONS

REFERENCES


ACKNOWLEDGEMENTS

A huge thank you to Dr. Jonathan Wisco for his mentorship and words of encouragement, to Dr. Benjamin Wolozin for allowing us to use his Keyence slide scanner, and to Dr. Amanda Kautzman and the R.I.S.E. Program at Boston University for this wonderful research opportunity.