CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

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S1307

Project Title
Salivary Occludin: A Novel Biomarker for Concussion

Abstract

Objectives/Goals

Traumatic brain injury (TBI) damages cerebral cells leading to debilitating neurological symptoms. A concussion is mild TBI affecting over 2.5 million people/year. The annual cost of TBI is $76.5 billion as per CDC. Yet, concussion remains a subjective diagnosis, as CT scans are mostly normal. Current research supports blood-based biomarkers as early prognostic indicators of TBI. Saliva is a new, noninvasive diagnostic medium; however, TBI biomarkers in saliva remain unexplored.

We identified Occludin (OCLN), a tight junction protein that maintains the endothelial blood brain barrier (BBB), as an optimal biomarker with high serum concentration and a broad temporal profile. We sought to determine if OCLN levels in saliva correlated with severity of TBI.

Methods/Materials

Saliva was collected within 24 hours of head injury from 10 adult ER patients receiving CT scans and 10 non-injured controls. ER doctors categorized TBI severity. Samples were processed using Aviva ELISA protocol. Spectral analysis was used to measure absorbance.

Results

Median OCLN concentration in saliva of the control group, mild TBI group, and moderate/severe TBI group was 121 pg/mL, 113 pg/mL, and 474 pg/mL respectively. Correspondingly, mean OCLN concentrations were 120 pg/mL ±11%, 115 pg/mL ±8%, and 370 pg/mL ±37%. The moderate/severe TBI group showed a 4-fold increase in the median and a 3-fold increase in the mean OCLN concentration as compared to the mild TBI group.

Conclusions/Discussion

TBI results in disruption of tight junctions of the BBB, and OCLN levels reflect its functional integrity. Measuring OCLN may provide an early indication of the physiological alteration in the brain before changes are visible on CT scan, and can offer an opportunity for earlier intervention. Saliva is easier to obtain than blood or CSF, and tests for OCLN can be repeated more often and at the site of trauma.

This is the first study to show an increase of OCLN in saliva taken from TBI patients. In our limited data set, OCLN clearly separates mild TBI from moderate/severe TBI. While low OCLN level may help avoid overuse of CT scan, elevated OCLN in patients with negative CT scans may indicate the need for close observation. Repeating the study with a bigger cohort will be necessary to help determine statistical significance. Thus, salivary OCLN may serve as an objective decision-making tool for ER physicians to

Summary Statement

This is the first study to use saliva to show that increased occludin can differentiate moderate/severe traumatic brain injury from concussion and has the potential to become the first noninvasive biomarker test of disrupted brain function.

Help Received

We met with ER doctors to understand how concussion patients are evaluated, performed a literature search of biomarkers, curated potential biomarkers, and analyzed our data. We worked with Dr. Podoly (SJ BioCube) to do the experiments and with Dr. Feldman (Good Samaritan ER) to interpret our results.