CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
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Project Number
S0520

Project Title
A Model for Water Transport Mediated by Aquaporins in the Inner Ear

Abstract

Objectives/Goals
This project is a study to determine if aquaporins play any role in the movement of water in the inner ear. First I will localize the aquaporins in the inner ear, and then construct a model depicting the flow of water and ions in the inner ear.

Methods/Materials
Using immunohistochemical staining and fluorescence microscopy in mice chochlear tissue samples, I was able to determine the locations of aquaporin 1, 4, and 5 in the inner ear.

Results
Aquaporin 1 (AQP1) was found to be located in the fibrocytes near the temporal bone and the stria vascularis, AQP4 was localized to the supporting cells and inner sulcus cells, and AQP5 was localized to the external sulcus cells.

Conclusions/Discussion
From my research, I can conclude that there are four essential stages in the flow of water in the inner ear. In stage one, potassium is secreted by the stria vascularis into the cochlear duct via the potassium channel Kir4.1, maintaining the high potassium ion concentration. In stage 2, a passive ion-exchange gradient is established, where the potassium flows from high concentration to low concentration (cochlear duct to the scala vestibuli) and sodium ions flow from the scala vestibuli to the cochlear duct. In step three, the concentrations need to be reestablished, so a sodium-potassium exchange pump brings the potassium back into the cochlear duct and the sodium to the scala vestibuli. The endolymph moves into AQP4 channels and exits through the AQP5 channels, returning the fluids to homeostasis.
Thus, it is evident that aquaporins play a vital role in maintaining fluid and ion homeostasis in the inner ear. The dysfunction of aquaporins leads to endolymphatic hydrops, which are a key indicator of Meniere#s disease.

Summary Statement
This project creates a model for water transport in the inner ear, and links the dysfunction of aquaporins to Meniere's disease.

Help Received
Used lab equipment at UCLA under the supervision of Dr. Ivan Lopez