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COMPUTATIONAL MODEL OF PASSIVE WATER TRANSPORT THROUGH THE CHOROID PLEXUS

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ABSTRACT

The human brain produces roughly 500 ml of cerebrospinal fluid (CSF) per day, mostly through the choroid plexus. An imbalance between CSF production and absorption may lead to accumulation of CSF, increase in intracranial pressure (ICP), and occurrence of conditions such as hydrocephalus. To control ICP, ventricular shunting, a potentially complication-prone procedure, can be performed to drain CSF into the peritoneal cavity. No effective pharmaceutical approach exists so far to control ICP, which is in part due to a lack of fundamental understanding of the physical mechanisms governing water production in the choroid plexus.

Animal experiments have shown that the transport of water through renal proximal tubule, intestine, and gall bladder epithelia is a passive process [1]. It is thought that solutes accumulating between the cells create a standing osmotic gradient that can draw intracellular water. However, it is disputed whether this passive mechanism is also responsible for CSF production in the choroid plexus, or whether active water transport must be considered [2]. In this study, we implemented a standing osmotic gradient model numerically, focusing on the inter-microvillar space of the choroid plexus epithelial luminal membrane. We set model parameters based on experimental data obtained in rats to assess the contribution of passive water transport to the total CSF production rate by comparison with measurements. Our results suggest that the standing gradient mechanism by itself is not sufficient to account for the entire CSF production through the choroid plexus.

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