Spatiotemporal Mapping of CNS Lymphatics in Xenopus tropicalis Using Time-Lapse Imaging

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Affecting approximately one in every 1000 babies born in the U.S., congenital hydrocephalus (CH) is the abnormal build-up of cerebrospinal fluid (CSF) in the ventricles of the brain. CH results in a large-sized head, seizures, drowsiness, and vomiting. If untreated, 50% of patients will die in the first three years of life. Understanding the microscopic pathways that facilitate the flow of CSF in the brain, known as the glymphatic system, may hold a key to unraveling the progression of CH. To understand the dynamics of CNS lymphatics in Xenopus tropicalis, ventricle injections of different-sized dye molecules were utilized; 10kDa Dextran, 40kDa Dextran or Ovalbumin, and 2000kDa Dextran. X. tropicalis tadpoles were used as a model organism due to their transparency and rapid reproduction. We investigated how molecule size related to the change of fluorescent intensity levels in the ventricles and kidneys of the tadpoles, to elucidate how fluorescent molecules moved through tadpoles. We planned to understand the selective mechanisms of CNS lymphatics in X. tropicalis. Tadpoles were injected and imaged at time zero, one, three, and 24 hours. Results showed that 40kDa Ovalbumin showed clear tracts within the tadpole as well as a significant decrease in ventricle fluorescence and an increase in kidney fluorescence indicating movement of fluorescent molecules between the ventricles and kidneys. This is important because a transfer of fluorescence demonstrates the selectivity of X. tropicalis CNS lymphatic pathways. Future research should utilize X. tropicalis tadpoles with CH mutations to compare normal CNS tracts to mutated tracts. This will allow for an understanding of the effect that CH has on CNS lymphatics and for more effective treatment methods to be developed.

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