

The study of the function of AQP4 in cerebral ischaemia–reperfusion injury using poroelastic theory

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Brain oedema is thought to form and to clear through the use of water-protein channels, aquaporin-4 (AQP4), which are found in the astrocyte endfeet. The model developed here is used to study the function of AQP4 in the formation and elimination of oedema fluid in ischaemia–reperfusion injury. The cerebral space is assumed to be made of four fluid compartments: astrocyte, neuron, ECS and blood microvessels, and a solid matrix for the tissue, and this is modelled using multiple-network poroelastic theory. AQP4 allows the movement of water between astrocyte and the ECS and the microvessels. It is found that the presence of AQP4 may help in reducing vasogenic oedema shown by a decrease in brain tissue extracellular pressure. However, the astrocyte pressure will increase to compensate for this decrease, which may lead to cytotoxic oedema. In addition, the swelling will also depend on the ionic concentrations in the astrocyte and extracellular space, which may change after ischaemic stroke. Understanding the role of AQP4 in oedema may thus help the development of a treatment plan in reducing brain swelling after ischaemia–reperfusion Copyright © 2016 John Wiley & Sons, Ltd.

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