BRAIN TISSUE SWELLING DURING ISCHAEMIA-REPERFUSION: 2D FINITE ELEMENT ANALYSIS USING POROELASTICITY

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ABSTRACT

Brain vasogenic oedema is an injury that occurs after reperfusion treatment of ischaemic stroke patient. It can lead to brain tissue swelling consequently causing brain herniation that may affect brain functionality. In this paper, a mathematical model describing this injury are developed using capillary filtration and poroelastic theory to represent oedema formation and brain tissue swelling, respectively. An ideal 2D representation of human brain is developed and the mathematical model of ischaemia-reperfusion injury is solved using finite element method. The size and location of the ischaemic stroke infarct are varied and the movement of the midline that divides the cerebrals is observed. The midline movement represents the level of herniation. Results show that herniation level increases especially for large infarct size and for infarct located nearer to the brain ventricle. Further validation of the model using MRI data and patient-specific representation is needed to estimate brain tissue swelling subsequently predict the effectiveness of ischaemic stroke treatment.

Keywords: Poroelasticity, Finite Element Analysis, Cerebral Tissue Swelling, Ischaemia-Reperfusion Injury, Vasogenic Oedema