World Academy of Science, Engineering and Technology
International Journal of Physical and Mathematical Sciences
Vol:11, No:01, 2017

Cerebrovascular Modeling: A Vessel Network Approach for Fluid Distribution

Authors : Karla E. Sanchez-Cazares, Kim H. Parker, Jennifer H. Tweedy

Abstract : The purpose of this work is to develop a simple compartmental model of cerebral fluid balance including blood and cerebrospinal-fluid (CSF). At the first level the cerebral arteries and veins are modelled as bifurcating trees with constant scaling factors between generations which are connected through a homogeneous microcirculation. The arteries and veins are assumed to be non-rigid and the cross-sectional area, resistance and mean pressure in each generation are determined as a function of blood volume flow rate. From the mean pressure and further assumptions about the variation of wall permeability, the transmural fluid flux can be calculated. The results suggest the next level of modelling where the cerebral vasculature is divided into three compartments; the large arteries, the small arteries, the capillaries and the veins with effective compliances and permeabilities derived from the detailed vascular model. These vascular compartments are then linked to other compartments describing the different CSF spaces, the cerebral ventricles and the subarachnoid space. This compartmental model is used to calculate the distribution of fluid in the cranium. Known volumes and flows for normal conditions are used to determine reasonable parameters for the model, which can then be used to help understand pathological behaviour and suggest clinical interventions.

Keywords : cerebrovascular, compartmental model, CSF model, vascular network
Conference Title : ICCMAS 2017 : International Conference on Computational Modeling, Analysis and Simulation
Conference Location : Zurich, Switzerland
Conference Dates : January 13-14, 2017