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Influence of Discrete Cerebral Vasculature on 3D Perfusion and Temperature Maps Using a Vascular-Porous Model Following Ischaemic Stroke[1] LUKE FULFORD, Institute for Multiscale Thermofluids, School of Engineering, University of Edinburgh, IAN MARSHALL, JOANNA WARDLAW, Centre for Clinical Brain Sciences, University of Edinburgh, PRASHANT VALLURI, Institute for Multiscale Thermofluids, School of Engineering, University of Edinburgh — Modelling the brain volume with an arterial blockage requires detailed vasculature of a resolution not readily available from cerebral-vessel imaging. We have developed a Vascular-Porous (VaPor) model to fully simulate the cerebral geometry, including the ischaemic region. Here we embed a 1D hybrid vasculature, representing the larger vessels, in a 3D porous tissue. Our hybrid vasculature is created by taking vessel centrelines extracted from cerebral-vascular imaging and expanding them using an algorithm weighted by the tissue type and constrained by the perfusion territory. An ischaemic stroke is then simulated by obstructing a selected vessel in the arterial tree, allowing varying stroke severities. The resulting occlusion geometry and thermal effects can then be calculated by solving the mass, momentum and energy equations. We show that discrete vessels are important in modelling thermal and perfusion effects of stroke. Good agreement can be seen between 3D perfusion maps obtained from VaPor and those from in-vivo cerebral imaging of stroke, including the presence of potentially salvageable penumbral tissue. We further show a temperature increase in the ischaemic region of around 0.5°C following stroke.

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