ABSTRACT

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Simulating the behaviour of glioblastoma multiforme based on patient MRI during treatments.

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Glioblastoma multiforme is a brain cancer that still shows poor prognosis for patients despite the active research for new treatments. In this work, the goal is to model and simulate the evolution of tumour associated angiogenesis and the therapeutic response to glioblastoma multiforme. Multiple phenomena are modelled in order to fit different biological pathways, such as the cellular cycle, apoptosis, hypoxia or angiogenesis. This leads to a nonlinear system with 4 equations and 4 unknowns: the density of tumour cells, the [Formula: see text] concentration, the density of endothelial cells and the vascular endothelial growth factor concentration. This system is solved numerically on a mesh fitting the geometry of the brain and the tumour of a patient based on a 2D slice of MRI. We show that our numerical scheme is positive, and we give the energy estimates on the discrete solution to ensure its existence. The numerical scheme uses nonlinear control volume finite elements in space and is implicit in time. Numerical simulations have been done using the different standard treatments: surgery, chemotherapy and radiotherapy, in order to conform to the behaviour of a tumour in response to treatments according to empirical clinical knowledge. We find that our theoretical model exhibits realistic behaviours.

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