Brain tissue structures and their influence on glioma migration and invasion: a multiscale approach

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Abstract

The invasion of tumor cells into healthy tissue is a highly complex process involving several scales, from the microscopic to the macroscopic level. Furthermore, most of the events taking place on the various scales are still not completely understood.
In this work we focus on glioma, a particularly invasive brain tumor, whose evolution, owing to the peculiarities of the nervous tissue structures, is characterized by highly anisotropic diffusion and heterogeneous patterns.
A multiscale mathematical model for glioma cell migration and proliferation is proposed, taking into account a possible therapeutic approach. Starting with the description of processes taking place on the subcellular level, we formulate the equation for the mesoscopic level, in the line of well-established approaches in this field [1, 2], and, thus, we derive the macroscopic model, using a parabolic limit and the Hilbert expansions in the moment system.
We perfom an extensive study about the role of the nervous fibers in tumor dynamics [3]. In particular, focusing on the fiber density function, we compare different possible choices present in literature with the aim of understanding which approach could better describe the actual fiber density and orientation. Finally some numerical simulations, based on real data of brain geometry and cell diffusivity, show the role of each modelled process in the evolution of the solution.
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References

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