Intracellular and immune-response delays effects on the interaction between tumor cells, oncolytic viruses and the immune system

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Background: Oncolytic viruses are used as a form of cancer treatment since they lyse the tumor cells whilst leaving normal cells largely unharmed. The oncolytic effect depends on both the viral replication ability as well as the type of immune response induced by the said replication. One major challenge to this therapy is the delays that can occur during viral replication combined with a fast immune response.

Aim: We therefore aim at investigating the possible trade-offs between the tumor cells, oncolytic viruses and the immune systems with particular focus will be on the simultaneous effects of these two delays.

Methods: We extend recently published mathematical models on viro therapy by taking into account the simultaneous effects of the two delays and considering various forms of virus cell infections; namely mass-action, frequency- dependent and Holing-type. We investigate the models' stability and bifurcation behaviour and then fit them to data. Consequently, carry out numerical simulations to explore various scenarios of model treatment Results: We derived an explicit formula for the trade off between the two delays that leads to tumor eradication. One of the main findings is the occurrence of delay-induced Hopf bifurcation, indicative of tumor relapse.