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Characterizing the temporal response of glioma cells to single-dose radiation therapy: confrontation of a mathematical model to experiments

Gliomas are a type of brain tumor characterized by highly invasive cells, capable of migrating significant distances while remaining under the MRI detection threshold. This invasive behavior often leads to inevitable tumor recurrence following treatment. Radiotherapy is a key component in this treatment, involving the administration of fractionated doses according to a precise schedule.

While fundamental aspects of radiotherapy treatment have been extensively studied, the current clinical model only predicts the survival fraction of cells after a given radiation dose without considering the timing of the response. We believe that by characterizing the temporal response of the tumor to irradiation, treatment schedules could be better tailored, resulting in improved outcomes of the disease.

To investigate this, we employed time-resolved fluorescence microscopy to track glioma cells receiving different single radiation doses. Cells were additionally seeded at various concentrations to explore potential collective effects. Subsequently, we developed a mathematical model describing the evolution of cell density over time taking into account various biological process and we compared it to the experimental results. The latter seem to indicate that the seeding density does have an impact on the growth following irradiation.

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