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DELAY EFFECTS IN THE RESPONSE OF LOW GRADE GLIOMAS TO RADIOTHERAPY: A MATHEMATICAL MODEL AND ITS THERAPEUTICAL IMPLICATIONS

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ABSTRACT

Low grade gliomas (LGGs) are a group of primary brain tumors, which are highly infiltrative and generally incurable but have median survival time of more than 5 years because of low proliferation. Management of LGGs has historically been controversial because these patients are typically young, with few, if any, neurological symptoms. The clinical trial by García et al. [?Garcia] showed that radiotherapy implies the advantage in addition to surgery. However, the timing of radiotherapy after biopsy or debulking is debated. Radioteraphy is usually offered for patients with poor risk factors such as age, sub-total resection, or diffuse astrocytoma pathology. Recently Pallud et al. [?Pallud] studied patients with LGGs treated with first-line radiation therapy and found the counterintuitive result that tumors with a fast response to the therapy had a worse prognosis than those responding late.

In this paper we construct a mathematical model describing the basic facts of glioma progression. Radiation therapy included in our mathematical model captures the essentials of the dynamics and explains the relationship between proliferation, response to the therapy and prognosis. It can also provide an explanation to the observations of Pallud et al. [?Pallud] and it can be used to explore different radiation regimes. Using the model we propose radiation fractionation schemes that might be therapeutically useful by helping to evaluate the tumor malignancy. It could help the oncologists in making the best possible decisions on when and how act on the tumor.
We hope that our results will stimulate further collaborative studies directed to improve the quality of life of patients suffering this devastating disease.

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