AbstractID: 2860 Title: An Estimation of Radiobiological Parameters from Clinical Outcomes for Radiation Treatment Planning of Brain Tumor

Purpose: Appropriate organ-specific radiobiological parameters are crucial for biologically-based treatment planning. The purpose of this work is to derive a plausible set of such radiobiological parameters for malignant gliomas (MG) based on clinical outcomes.

Methods and Materials: Several radiobiological models, including the linear quadratic formalism with consideration of repopulation and repair, tumor control probability and equivalent uniform dose, were used to analyze a series of published clinical data for MG involving different regimens of radiation therapy. The least chi-square χ^2 fitting technique was employed to estimate the LQ parameters.

Results: A plausible set of LQ parameters: $\alpha = 0.08 \pm 0.02$ Gy^{-1}, $\alpha/\beta = 11.4 \pm 8.6$ Gy, the tumor cell doubling time $T_d = 50 \pm 30$ days, with the repair halftime of 0.5 h was obtained for gliomas. The presently estimated biological parameters reasonably predict the effectiveness of the most of recently reported clinical results employing either single or combined RT modalities. In addiation, the radiosensitivity for grade III and VI astrocytoma was found to be: $\alpha = 0.18 \pm 0.03$ Gy^{-1}, $\alpha/\beta = 6.0 \pm 4.1$ Gy and $\alpha = 0.09 \pm 0.04$ Gy^{-1}, $\alpha/\beta = 9.0 \pm 9.8$ Gy respectively. For Grade III, our result agreed with the published *in vitro* data, while for Grade 4, the α and α/β values estimated presently based on clinical data are smaller than those from *in vitro* measurements, indicating lower radiosensitivity occurred *in vivo* as compared to *in vitro*. The derived α and α/β values demonstrated that GBM is quite radioresistant as known from clinical practice.

Conclusions: The radiobiological parameters derived presently for MG can reasonably predict the most of the recently reported clinical results employing either single or combined RT modalities. These parameters can be potentially useful in evaluating, optimizing, and designing biological/functional image guided IMRT strategies.