AbstractID: 6629 Title: Optimal Dose Fractionation Schedules Computed with Different Tumor Reoxygenation Rates

Purpose: We investigate optimal fractionation schedules for radiotherapy of cancer which maximize surviving fraction of normal tissue and tumor control probability (TCP). Optimal fractionation schedules are computed upon assumption of tumor reoxygenation at different rates.

Method and Materials: We consider an optimization problem for fractionated radiotherapy where the dose fractions should be optimized to maximize TCP and survival fraction of normal cells surrounding the tumor. We assume that a tumor consists of aerobic cells with normal concentration of oxygen and hypoxic cells with low concentration of oxygen which are resistant to radiotherapy. We utilize a two level population model where only live oxygenated and hypoxic cells are present. Cells disappear from the system when they are killed. It is also assumed that the hypoxic fraction of tumor is oxygenated during the course of treatment. We use a reoxygenation model where a portion of surviving hypoxic cells becomes oxygenated after irradiation with each dose fraction. The cell survival is simulated using the linear-quadratic (LQ) model. A minimum of the objective function is found using a version of quasi-Newton algorithm.

Results: We have obtained optimized dose schedules which are non-uniform and reoxygenation rate dependent. Dose fractions are increasing with fraction number if the hypoxic tumor portion becomes reoxygenated. Survival fraction of normal tissue for optimized fractionation schedules is greater by a factor of 2÷3 than the surviving fraction of normal tissue calculated using uniform dose schedules.

Conclusions: Numerical results indicate that optimized dose fractionation schedules with variable dose fraction sizes can improve therapeutic ratio of radiotherapy for the tumors which undergo the process of reoxygenation.