

AbstractID: 2688 Title: Optimization of Radiotherapy Dose-Time-Fractionation Scheme with Consideration of Tumor Specific Biology

Purpose: To explore the influence of the “four Rs” of radiobiology on external beam radiotherapeutic strategies for fast and slowly proliferating tumors and develop an optimization framework for tumor-biology specific dose-time-fractionation scheme.

Methods: The LQR model proposed by Brenner et al (IJROBP, 32(2), 1995) is used to describe radiation response of tumor, in which the time dependence of sublethal damage repair and redistribution and reoxygenation effects are included. The optimum radiotherapeutic strategy is defined as the treatment scheme that maximizes tumor biologically effective dose (BED) while keeping normal tissue BED constant. Simulated annealing optimization technique is used to search for the optimal radiotherapeutic strategies and the influences of different model parameters are studied.

Results: For fast proliferating tumors the optimum overall time is similar to the kick-off time T_k and almost independent of the interval patterns. Significant increases in tumor control can be obtained using accelerated schemes for the tumors with doubling time shorter than 3 days but little gain for those with doubling time longer than 5 days. Although the incomplete repair of normal tissues has little influence on fractionation doses, when the resensitization effect included, it becomes obvious that the optimum scheme require higher fraction doses at the beginning and end of each treatment week and hyperfractionation schemes have little advantageous. For slowly proliferating tumors, hypofractionation schemes are the optimum schemes and overall time should be larger than a minimum one mainly influenced by the resensitization time.

Conclusion: The proposed approach provided a useful tool to systematically optimize radiotherapeutic schemes for different tumors based on the differences in the “four Rs” of radiobiology between tumor and normal tissue. The results suggest that tumor site-specific optimization has great potential to improve therapeutic outcome for both fast and slowly proliferating tumors and provide useful information for designing radiotherapeutic clinical trials.