AbstractID: 1146 Title: Dose Escalation to Combat Hypoxia in Prostate Cancer: A Radiobiological Study on Clinical Data

Earlier studies have demonstrated that hypoxic regions exist in human prostate cancer and the degree of hypoxia correlates with the treatment outcome of radiotherapy. The purpose of this study is to explore the potentials of dose escalation to compensate for the hypoxia effect in prostate cancer, based on radiobiological analysis of reported clinical data. The generalized linear-quadratic (LQ) model extended to account for the effect of tumor hypoxia was used in this study. A new parameter, the clinical oxygen enhancement ratio (COER), was introduced to describe the degree of hypoxia effect found in clinical studies. The clinical data collected at the Fox Chase Cancer Center for prostate cancer were analyzed using the LQ model and the standard Poisson tumor control probability (TCP) model with updated parameters ($\alpha = 0.15$ Gy^{-1}, $\alpha/\beta = 3.1$ Gy and the number of clonogens $K = 10^6$~10^7 cells). The impact of LQ parameters on the calculations of COER and dose escalation was also discussed. The clinical OER for prostate cancer obtained from the current analysis of the Fox Chase clinical data is 1.36 ± 0.06. The prescription dose required to combat tumor hypoxia and to achieve a TCP of 81% for low-risk prostate patients should be 169 ± 6 Gy for permanent ^{125}I implants and 88 ± 4 Gy in 2 Gy fractions for external-beam radiotherapy. This study provides a preliminary estimate of the dose escalation to offset hypoxia based on clinical data. The proposed dose prescriptions are technically feasible for clinical trials.