AbstractID: 6376 Title: Surviving fraction (SF2) is the dominant predictor of tumor control probability (TCP) in prostate cancer patients treated with IMRT and dose escalation

Purpose: To quantify the effect of radiation dose escalation in prostate cancer patients treated with IMRT using TCP mathematical modeling.

Methods and Materials: CT treatment planning in the prone position was performed in ten patients at Houston VAMC using an endorectal balloon for prostate immobilization. The planning target volume included the prostate gland with a 5 mm circumferential expansion. TCP was calculated with the Niemierko method of Equivalent Uniform Dose (EUD) and Munro-Gilbert hypothesis as a function of increasing radiation doses (70-140 Gy), α/β (1.5-20), SF_2 (0.3-0.7) and clonogen cell density (CCD, 100-10 million cells per cc).

Results: At 70 Gy and CCD of 10 million/cc, TCP $\geq$ 99% for SF_2 of 0.3 or 0.4, 97.4%-98.6% for SF_2 of 0.5 and less than 2% for SF_2 of 0.6 or 0.7. With dose escalation, TCP values above 99% were seen at 80 Gy for SF_2 of 0.5 and 100 Gy for SF_2 of 0.6. For SF_2 of 0.7, 100 Gy resulted in TCP above 99% only with lower CCD $\leq$ 10000/cc while doses of 140 Gy were required for higher CCD $\geq$ 10 million cells/cc. With dose escalation, low α/β of 1.5 increased clonogen cell survival approximately by a factor of 1.5 to 2, when compared to α/β of 3, 5 and 10, therefore, increasing radioresistance but at a much smaller scale compared to SF_2.

Conclusions: TCP modeling predicts that SF_2 is the dominant predictor of radioresistance in prostate cancer. Radiation dose escalation of 100 Gy or higher may be required for tumors with SF_2 of 0.6 or above. Relating clinical tumor prognostic indicators such as Gleason score and pretreatment PSA to SF_2, α/β and CCD will allow us to identify subsets of patients in need of higher radiation doses and adjuvant therapy that will maximize treatment outcomes.