AbstractID: 8265 Title: Hypofractionation: What Does It Mean For Prostate Cancer Treatment?

Purpose:
Using current radiobiological models, we quantitatively examined the predicted clinical consequences of hypofractionation in prostate cancer radiotherapy while varying biological indices such as α/β, SF2, and total dose and dose per fraction.
Methods and Materials:
Four hypofractionated treatment regimens, 22×2.94Gy, 16×3.63Gy, 12×4.3Gy, and 5×6.7Gy, were compared with standard fractionation of 39×2Gy. All regimens produce similar EQD_2 to the tumor assuming α/β=2.4Gy for prostate carcinoma. Actual α/β values ranging from 1.5 to 8.5Gy for prostate carcinoma and fixed α/β values of 4Gy for both rectum and bladder were used to calculate biologically relevant parameters. The LQ model and gEUD formalism were used to transform the physical dose distribution into normalized equivalent uniform dose ($gEUD_2$), from which TCP and NTCP were calculated. Final ranking of the radiotherapy plans was based on "complication-free tumor control probability".
Results:
$gEUD_2$ to rectum and bladder decreased by 28% and 23%, respectively, in the 6.7Gy/fraction regimen compared with 2Gy/fraction using "a"=5 for the gEUD calculation. A corresponding 10% decrease in NTCP was predicted for the 6.7Gy/fraction regimen compared with 2Gy/fraction. Conversely, predicted TCP for hypofractionated regimens decreases significantly with increasing SF2 and α/β. We found that for relatively responsive tumor cells (SF2=0.4-0.5), complication-free tumor control probability was superior for nearly all hypofractionated regimens even for α/β values up to 8.5Gy. For less responsive tumor cells, (SF2=0.6), 6.7Gy/fx is predicted to be inferior to standard fractionation even when α/β=1.7Gy, and the other hypofractionation regimens remain superior to the standard fractionation for α/β values up to 3.5Gy.
Conclusion:
Existing radiobiological data and models predict better clinical results from hypofractionation than standard fractionation for prostate carcinoma when SF2<0.5 and $<5\times10^6$ clonogenic cells, implying that it is superior for early stage disease. This is true even when tumor α/β is high.

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