

AbstractID: 7513 Title: Biologically Guided Determination of Individualized Dose Distributions

Purpose

A biologically motivated scheme to guide the determination of individualized dose distributions is developed from the Poisson tumor control probability (TCP) and linear-quadratic (LQ) survival model. The method combines clinical experience, in the form of a reference treatment, with possibly patient-specific information to help circumvent well-known issues associated with outcome modeling. To illustrate the approach, isoeffect doses for populations of prostate cancer patients are compared.

Method and Materials

Monte Carlo methods are used to sample prostate cancer radiosensitivity parameters derived from clinical data in ways that mimic two treatment planning scenarios. In the first scenario, the dose distribution needed to achieve the same TCP in all patients is estimated. In the second scenario, the distribution of doses needed to achieve the same distribution of TCP values in the patient population as a reference treatment (37 daily fractions of 2 Gy) is determined.

Results

For 28 to 40 daily fractions, uncertainties associated with population-averaged radiosensitivity parameters correspond to about a 20% uncertainty in the fraction size needed to achieve the same TCP. However, the fraction size needed to achieve the same distribution of clinical outcomes as 37 daily fractions of 2 Gy can be estimated to within 3% for 5 to 50 daily fractions.

Conclusion

To achieve the same TCP in all prostate cancer patients requires very accurate (*a priori*) estimates of radiosensitivity parameters. However, the fraction size needed to achieve the same *distribution of TCP values* among a patient population with an alternate fractionation schedule can be accurately estimated without the need for patient-specific information. When combined with information from predictive assays or functional and biological imaging, the proposed method has the potential to determine patient-specific dose distributions for use in commercially available inverse planning software.