

AbstractID: 7523 Title: The impact of procedure-induced edema on cell survival and tumor control probability in permanent prostate brachytherapy using ^{131}Cs radioactive source

Purpose: Procedure-induced prostate edema can cause significant changes to the dose delivered by a permanent prostate brachytherapy. The aim of this work was to examine systematically the impact of procedure-induced edema on the effectiveness of cell kill in permanent prostate brachytherapy using ^{131}Cs radioactive sources.

Method and Materials: The concept of biologically effective dose (BED) was used to quantify the impact of prostate edema on the radiation-induced cell kill in ^{131}Cs permanent prostate brachytherapy. The repopulation of surviving cells and the repair of sub-lethally damaged cells during the protracted dose delivery was modeled by the cell potential doubling time and a repair half-time, respectively. The procedure-induced prostate edema and its resolution dynamics was described by a quantitative model reported by Waterman et. al. (*Int. J. Radiat. Oncol. Biol. Phys.* 41, 1069-1077, 1998). The surviving fraction of cancer cells and the potential tumor control probability was examined over a range of edema magnitudes and resolution half-lives observed in real patients.

Results: When edema was neglected in pre-implant treatment planning, the BED of an actual implant was found to depend strongly on the edema magnitude, its resolution half-life, and tumor potential doubling time. For a typical edema with magnitude of 50% and half-life of 10 days, the edema-induced reduction in BED was greater than 15% resulting in an increase of cell-survival by more than one order of magnitude. For larger edemas with magnitude of 90% and half-life of 20 days, the edema-induced increase in cell survival was more than two orders of magnitude.

Conclusions: Procedure-induced edema can cause significant reduction in BED and increase in cell survival in ^{131}Cs permanent prostate brachytherapy. Depending on the initial tumor burden, the increase in cell survival could lead to significant reduction in tumor control probability for patients having moderate and large edemas.