AbstractID: 10947 Title: Replacement for Generalized Equivalent Dose in Phenomenological NTCP Models

Purpose: phenomenological normal tissue complications probability (NTCP) models use generalized equivalent uniform dose (gEUD) as a summary measure which converts an inhomogeneous dose distribution into an "equivalent" uniform dose. We have investigated adapting gEUD models to brachytherapy dose distributions which are characterized by small focal hotspots. We have found that small hotspots dominate the behavior of gEUD measure. As it is unlikely that clinical NTCP values are determined to this extent by small focal hotspots, we have developed an alternative to gEUD-based dose-volume histogram reduction for adapting the phenomenological NTCP models to combined external-beam and brachytherapy treatments. Our revised metric allows for local saturation in biological effectiveness in volume-limited high-dose regions.

Materials & Methods: Three summary measures were computed on rectal DVHs. The gBEUD is an equivalent of gEUD, but with the physical dose replaced by biologically equivalent dose (BED). The tESD and vESD measures compute ESD index (equivalent uniform dose leading to the same cell survival fraction as the inhomogeneous dose distribution) on high BED portions of rectal DVHs. The tESD measure uses common BED threshold for all DVHs, which becomes an adjustable parameter of the measure. The vESD measure uses common fraction of the rectal volume as an adjustable parameter, and thus computes a BED threshold for each DVH. Properties of the three measures are compared. A database of 9 prostate patients with 7-field IMRT boost plans and HDR brachytherapy boost plans delivering biologically equivalent D98 doses were used for the study.

Results: For 6 of the 9 patients the gBEUD increased by approximately 100% due to doses confined to volumes <1% of the organ volume. The gEUD/gBEUD measures could be replaced by ESD based metrics, which explicitly incorporate saturation of biological effectiveness of high doses.

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