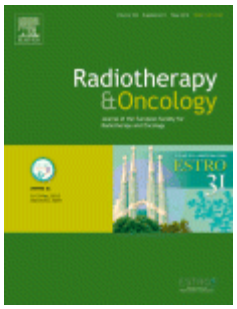

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ALTERNATIVE REGIMENS FOR PROSTATE CANCER TREATMENT USING RADIATION THERAPY

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Purpose/Objective: The purpose of this work was to determine biologically equivalent alternative regimens for the treatment of prostate cancer using External Beam Radiotherapy (EBRT) and Low Dose-Rate Brachytherapy (LDRBT) with 125I implants and to evaluate the sensitivity of these regimens to different sets of radiobiological parameters of the Linear-Quadratic (LQ) model.

Materials and Methods: The biological effective dose (BED) was used to determinate equivalences of the two modalities assuming that BED values are additive for different treatment techniques. Two sets of parameters were employed considering whether accelerated repopulation of the clonogens during the treatment time occurs: LQ1) α/β=3.1 Gy, α=0.15 Gy-1,μ=2.6 h-1, Tpot=42 days, N=3x106 clonogens, or not, LQ2) α/β=1.5 Gy, α=0.03 Gy-

1, μ=0.4 h-1, Tpot=∞, N=95.3 clonogens. Three different approaches were used: 1) BED for late rectal complications was determined for a set of conventional fractionated EBRT regimens and the necessary dose per fraction of hypofractionated schedules calculated in order to obtain the same level of late effects. Tumor control probabilities (TCP) were assessed for the different regimens and related to the number of fractions employed in each case. 2) EBRT BED was calculated for several total doses of LDRBT (TDLDRBT) in order to obtain the same total BEDt as 110 Gy of TDLDRBT plus 46 Gy of EBRT (normalized total dose - NTD). Iso-BEDt curves were plotted to access TDLDRBT in function of EBRT BED. 3) Gain in TCP was assessed for the addition of certain amounts of TDLDRB to varying EBRT NTD.

Results: 1) The use of hypofractionated schedules increased TCP. If using 10 fractions, an increment of 32% (LQ1) and 18% (LQ2) in tumor BED was predicted for an equivalent rectal BED calculated from a NTD of 70 Gy and of 37% (LQ1) and 20% (LQ2) from a NTD of 86 Gy. 2) The relations of TDLDRBT and EBRT BED were found as follows: where TDLDRBT is predicted with less than ±1% deviation for doses higher than 40 Gy with LQ1 and higher than 24 Gy with LQ2. Calculated BED with LQ1 predicted, as expected, lower BED values than LQ2. 3) For the lower quantities of TDLDRBT, LQ1 yielded steeper dose response curves. Curves intersected at NTD of 63 Gy, 54 Gy, 37 Gy, 20 Gy and 1 Gy for TDLDRBT of 0 Gy, 20 Gy, 40 Gy, 60 Gy and 80 Gy, respectively. When TDLDRBT of 100 Gy and 120 Gy were applied, LQ1 predicted always higher TCP values than LQ2. The EBRT NTD combined with TDLDBRT which results in TCP ≥ 98% are presented in the following table: TDLDRBT (Gy) 0 20 40 60 80 100 120 EBRT NTD (Gy) LQ1 80 70 54 38 22 4 - LQ2 - - 94 80 66 54 40.

Conclusions: The results of this study show that alternative schemes of radiotherapy treatment for prostate cancer can be as effective as the current approaches or even present a therapeutic gain with the same levels of rectal late complications. New therapeutic schemes will allow physicians to prescribe the best treatment to each patient taking into account patient conditions and institutional limitations. Nonetheless, caution should be taken when choosing the model parameters, as they can lead to considerable different results.