

Comparison of radiobiological models for radiation therapy plans of prostate cancer: three dimensional conformal versus intensity modulated radiation therapy

Abstract

Purpose: In the current study, using different radiobiological models, tumor control probability (TCP) and normal tissue complication probability (NTCP) of radiotherapy plans were calculated for three dimensional conformal radiation therapy (3D-CRT) and intensity modulated radiation therapy (IMRT) of prostate cancer.

Methods and materials: 10 prostate plans were randomly selected among the patients undergoing radiation therapy of prostate cancer. For each patient, 3D-CRT and IMRT plans were designed to deliver on average 76 Gy and 82 Gy to planning target volume respectively. Using different radiobiological models including Poisson, equivalent uniform dose (EUD) and Lyman-Kutcher-Burman (LKB), TCP and NTCP were calculated for prostate and critical organs including bladder, rectum and femoral heads.

Results: IMRT plans provided significantly lower NTCP for bladder, rectum and femoral heads using LKB and EUD models (p-value <0.05). The EUD-calculated TCP for prostate cancer showed no considerable improvement for IMRT plans relative to 3D-CRT plans. However, the TCPs calculated by Poisson model were dependent on α/β , and higher TCP for IMRT relative to 3D-CRT was seen for α/β higher than 5.

Conclusions: It can be concluded that IMRT plans was superior to 3D-CRT plans in terms of estimated NTCP for studied critical organs. On the other hand, different mathematical models provided different quantitative outcomes for TCP of prostate cancer plans. More clinical studies were suggested to confirm the accuracy of studied radiobiological models.

Keywords: Tumor control probability, Normal tissue complication probability, Radiobiological modeling, IMRT, 3D-CRT, Radiation therapy, Prostate cancer.