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Abstract

MR-Only Planning for Simultaneous Integrated Boost of MRI-defined Dominant Intraprostatic Lesions

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Objectives: To assess the feasibility of using synthetic CT images for treatment planning of dominant intraprostatic lesions (DILs), a known high risk region of interest that may offer potential for increased local control.

Methods: A retrospective study was performed on six patients with biopsy-proven prostate cancer who underwent T2-weighted, mDixon, and diffusion-weighted imaging (DWI) 3T MRI. A radiologist interpreted MR examinations and the suspicious DIL was contoured based on the T2 and DWI MR images. Air, bone, fat, and soft tissue were segmented (assigned -1000, 285, -50, 40 HU respectively) to create a synthetic CT from the water and fat mDixon sequences. A 5mm margin was added to the prostate and the DIL to compensate for setup uncertainty. VMAT treatment plans were created with the total dose being 79.2Gy and a boost of 100Gy to the DIL. All plans were evaluated using the dose volume histogram curves.

Results: The maximum dose and mean dose to the PTV were 87.6+/-1.1Gy and 81.0+/-0.3Gy. For the DIL, the maximum dose and mean dose were 106.8+/-2.3Gy and 103.8+/-1.3Gy. The doses to 95% of the treatment volume (D95) were 78.7+/-0.1Gy and 101.5+/-0.2Gy for the PTV and DIL. The total MU ranged from 589 to 910. For each patient, the hotspot was located within the DIL. The femoral heads, rectum, and penile bulb all received a mean dose of 50Gy or less with the highest mean dose being 50.4Gy for the bladder of patient 1. The bladder and rectum received the highest doses for the organs at risk (OARs) with maximum doses of 84.5+/-1.5Gy and 84.8+/-1.0Gy respectively, but both were within the established clinical NRG guidelines. For the rectum, the volume receiving 70Gy (V70) and the volume receiving 75Gy (V75) are 11.0+/-4.5% and 8.3+/-3.4%. For the bladder, V70 and V75 are 11.4+/-3.6% and 8.1+/-2.6% respectively.

Conclusions: We demonstrated the feasibility of implementing MR-only treatment planning for prostate cancer with a simultaneous integrated boost for DILs. The dose to the DIL can be escalated to 100Gy on the synthetic CTs while maintaining the original prescription of 79.2Gy and remaining in clinical criteria for the OARs. Future work involves including more patients, all with biopsy-proven prostate cancer. With a successful study, a prospective study could potentially be performed.

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