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abstract

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abstract

Evaluating Organ-at-Risk Sparing Through Online Adaptive Radiotherapy in Prostate Cancer

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Introduction: Adaptive radiotherapy (ART) aims to compensate for daily anatomical variations to improve target coverage while minimizing dose to organs at risk (OARs). The Varian Ethos system enables online ART through daily plan re-optimization. The Ethos workflow generates three plans for evaluation: the adaptive plan (online re-optimized), the scheduled plan (reference plan recalculated on the synthetic CT), and the reference plan (optimized on the simulation CT). This study quantitatively evaluated the dosimetric benefits of ART for rectum and bladder sparing compared with non-adaptive plans.

Methodology: At Cleveland Clinic Abu Dhabi, online ART is delivered using the Varian Ethos system. We performed a retrospective review of 54 prostate cancer patients treated over the past three years. A total of 1424 fractions were analyzed. For each fraction, we extracted the following dosimetric metrics for bladder and rectum: $\Delta V50Gy(\%)$ for the adaptive, scheduled, and reference plans. Differences were evaluated as:

- Adaptive vs. Scheduled: $\Delta V50Gy(\%)_{\text{Adaptive}} - \text{Scheduled}$
- Scheduled vs. Reference: $\Delta V50Gy(\%)_{\text{Scheduled}} - \text{Reference}$

Results: Across all 1424 fractions, ART reduced bladder V50Gy by an average of 0.12%, while non-adaptive plans resulted in an average 0.26% increase relative to the reference. One patient demonstrated the greatest benefit from ART, with an 8.9% bladder dose reduction, whereas non-adaptive treatment would have increased bladder dose by 16.7%. Similarly, ART reduced rectum V50Gy by an average of 3.9%, compared with a 4.7% increase on non-adaptive plans. The most benefited patient had a 7.5% rectal dose reduction; without ART, rectal dose would have increased by 6.8%.

Conclusion: ART consistently reduced OAR doses compared with non-adaptive treatment across the patient cohort, although the magnitude of benefit varied among individuals. Further investigation is warranted to refine the Ethos workflow and identify factors that predict which patients gain the greatest advantage from ART.

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