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Implications of Cervix-Influencing Organs Variation During Online Adapted Radiation Treatment

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INTRODUCTION

Adaptive radiation therapy (ART) is an evolving paradigm that considers the daily changes in the patient's anatomy. Due to the daily anatomical variations, the initial treatment plan may be inadequate and tumor coverage may be impacted. ART promises improvements in the accuracy of delivery and improvement of patient outcomes and efficiency in workflows in radiation clinics.

AIM

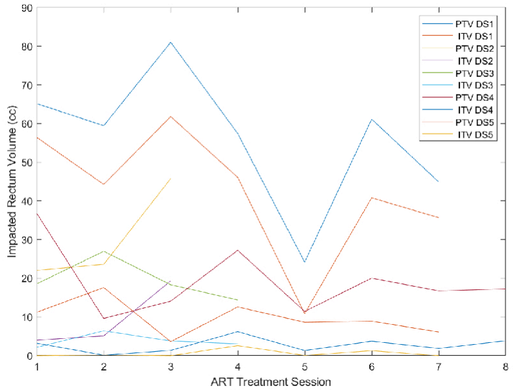
To study the effect of daily variation of normal tissue influencer structures on the volume and dose of a tumor target for patients undergoing adaptive radiation therapy treatments

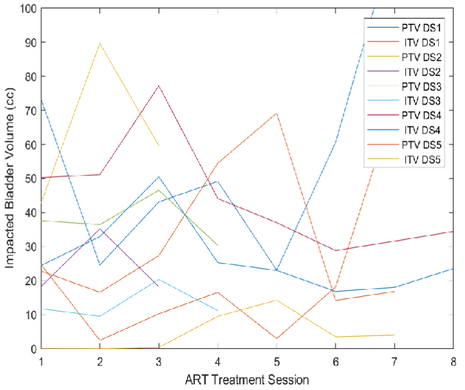
METHOD

Five patients with cervical cancer (36 simulated sessions) underwent virtual adaptive radiotherapy using a commercial, CT-based, adaptive radiation therapy solution. The ITV structure was delineated, while the PTV was calculated by expanding the ITV 0.5 cm laterally and 1.0 cm otherwise. The influencing structures considered here were rectum and bladder. These influencer ROIs are AI-segmented and pre-introduced to the models of the planning system. To evaluate daily variations in these ROIs, geometrical and morphological properties were studied via in-house developed algorithms. Daily baseline changes for volumes, centroids, orientation, and air pocket percent volumes were calculated across all patients for relevant structures. The impact on the original PTV/ITV by daily shape variations in the influencers were studied and estimated by convolution methods

RESULTS

For all patients, the mean bladder volume was 94.9 ± 33 cc and experienced a change of up to 135%. The mean rectal volume was 47.9 ± 14.8 cc and experienced a change up 82%. Changes in the bladder centroids were on average 4.1 ± 1.4 mm in the lateral direction and < 2 mm otherwise. For the rectum, the centroids retained the position laterally within 0.5 mm and < 2mm otherwise. For the ITV and PTV, the mean bladder-ITV / rectum-ITV volume impact was 17.4 ± 8 cc / 12.6 ± 15 cc, respectively. Whereas for PTV, the mean bladder/rectum volume impact was 45.3 ± 11.8 cc / 27 ± 16 cc, respectively. Dosimetric impact, on the clinical goals (V95% > 98% and 95% for ITV and PTV, respectively), were 4.3 ± 7.4% and 9.4 ± 6.5% for ITV and PTV, respectively, due to the daily variations in the rectum and the bladder. The plots on the right show the impacted volume of the rectum and the bladder, for five datasets (DS), as a function of the ART treatment session.





CONCLUSIONS

These preliminary results are the first step in the development of IGRT vs ART patient-gained risk/benefit comparisons. Further simulations are essential to build predictive models for efficient decision making.

REFERENCES

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