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Dosimetric effects of a novel concept of adaptive radiotherapy for prostate cancer patients

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INTRODUCTION

Adaptive radiotherapy takes the constant changes in the anatomy and physiology of the patient during the course of treatment into account. Therefore, plan adaptation strategies are necessary.

AIM

This analysis was aimed at investigating dosimetric consequences of a novel concept for adaptive radiotherapy using an individualized plan-database.

METHOD

The data of ten patients with prostate carcinoma (salvage radiotherapy to the prostatic bed, 68Gy in 34 fx, step-and-shoot IMRT) were investigated. Prior to each fraction, a diagnostic in-room position-control-CT (fx-CT) was performed. Based on the daily fx-CT, the target volume and all OARs were contoured. Two additional plans were calculated based on the bladder filling observed using the first five fx-CTs, thereby creating a plan database that contained plans for low, intermediate and high bladder volume for each patient. Using a deformable registration algorithm for each daily fx-CT, applied doses were tracked and analyzed against the planned doses.

RESULTS

Interfractional variabilities resulted in an increase of D_{50} (0.40±0.38Gy) and a decrease of D_{95} (2.03±5.40Gy) to the PTV and effect a dose deviation to the bladder of at mean 7.76±6.05Gy of the D_{50}. By using a plan database, the applied dose of the bladder could be reduced by 4.55±5.81Gy. The D_{50} of the PTV was marginally lower (-0.23±0.31Gy) and the D_{95} of the PTV was marginally higher (1.0±0.9Gy) than without using plan database and thus closer to the planning value.

The use of a plan database did not result in significant benefits for all cases. In 9 of 10 cases, a better PTV coverage was reached. In 6 of these 9 cases, better sparing of the bladder and in 5 of these 6, better sparing of the rectum was achieved. A plan database was useful for 9, 6 or 5 cases of the cohort, depending on the maintained criteria. A plan database seemed particularly useful for patients with large or medium bladder volume (compared to the first 5fx) at treatment planning.

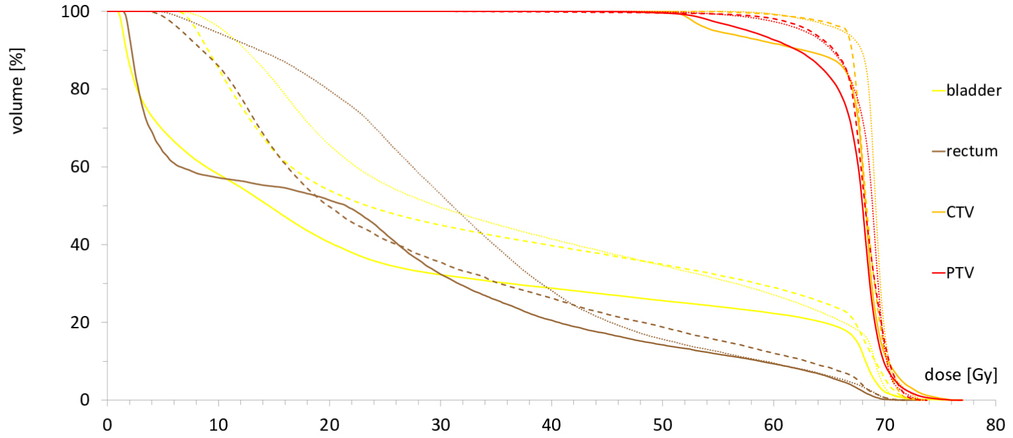

figure 1: DVH Comparison one patient: continuous line: DVH at planning, dotted line: DVH accumulated applied dose, dashed line: DVH accumulated applied Dose using the plan database (yellow: bladder, brown: rectum, orange: CTV, red: PTV)

CONCLUSIONS

The observed variability resulted in significant dose increases of the D_{50} to the bladder, whereas in the PTV, only small non-significant dose deviations could be detected. By using an individualized plan-database a significantly lower dose to the OAR was achieved, while the target volume coverage was virtually unchanged.

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