The Minimum Acceptable Bladder Volume in Prostate Cancer Radiation Therapy with VMAT Delivery Technique

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Abstract

Purpose

It is often difficult to maintain the consistency of bladder filling in prostate cancer radiation therapy. This work is to retrospectively study the dosimetric effect of the bladder volume variation between simulation and treatment and therefore to optimize the bladder preparation protocol.

Materials and Methods

The bladders of 37 patients treated for prostate cancer with the 36.25Gy/5fx VMAT SBRT technique were contoured on the simulation CT, MRI and CBCT images. The bladder volumes are in range of 55-800cc with differences of -82%-295% between simulation and treatment. The dose assessment metrics of V18.1Gy, V28Gy, V38Gy, V39.5Gy (bladder) and Dmax, V18.3Gy, V36.25Gy, V32.62Gy, V18.12Gy (bladder wall) were assessed against the bladder volumes in simulation and treatment.

Results

The absolute volume metrics and Dmax of bladder and bladder wall are not correlated to the bladder volume although the relative volume metrics do decrease with the bladder volume increase. If the bladder volume is >200cc, all the relative volume metrics are within the constraints. The absolute volume metrics of V38Gy of 7% and V39.5Gy of 14% of the patients exceed constraints when bladder filling is different from that in simulation while V38Gy of only one patient and V39.5Gy of only two patients exceed constraint if bladder volume >200cc.

Conclusions

The absolute volume dose assessment metrics of bladder and bladder wall are not correlated to the bladder volume. If bladder volume is >200cc, all the relative volume metrics of the patients in this study are within constraints. If the bladder dose of the initial plan is within constraints or deemed acceptable by a radiation oncologist and the bladder is >200cc on the treatment day, no further bladder preparation is needed for the treatment. A simple method is proposed to estimate the bladder volume based on CBCT image. The bladder preparation procedure can be potentially simplified and therefore reduce patient waiting time due to bladder filling variation.
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Introduction

It is often difficult to maintain bladder filling in prostate cancer radiation therapy. This work is to retrospectively study the relationship between bladder volume and treatment plan quality in prostate cancer patients who were treated with VMAT radiation therapy. The minimum acceptable bladder volume is determined using the bladder volume response in the prostate cancer patients. The dose-volume response is also obtained from the bladder volume response in the prostate cancer patients.

Methods and Materials

- 27 patients treated with VMAT and fiducial marking
- Auto Beam's heel correction matrix management
- CT: 25-30 mg/kg FFY, 45-50 Gy in 25-30 fractions
- RT: CT, CTV, a cist
- Bladder structure contoured on an MRI and in treatment CTV images
- The CTV volume was calculated by subtracting CTV from the body
- The volume of the bladder was calculated by subtracting the bladder volume from the body volume
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Results

The absolute volume metrics and the relative volume metrics of the bladder were consistent in the bladder volume (Fig.4A, B, C, 1, and Fig.2) although the relative volume metrics do not change significantly as the bladder volume increases (Fig.4A, B, C, 1, and Fig.2). If the bladder volume is >100 cc, the relative volume metrics are not consistent (Fig.4A, B, C, 1, and Fig.2). The absolute volume metrics and the relative volume metrics of the bladder were consistent in the bladder volume (Fig.4A, B, C, 1, and Fig.2). If the bladder volume is >100 cc, the relative volume metrics are not consistent (Fig.4A, B, C, 1, and Fig.2). The absolute volume metrics and the relative volume metrics of the bladder were consistent in the bladder volume (Fig.4A, B, C, 1, and Fig.2). If the bladder volume is >100 cc, the relative volume metrics are not consistent (Fig.4A, B, C, 1, and Fig.2).

Discussion

If the doses of a plan are acceptable, it is reasonable to consider that the bladder volume is a potential target for dose optimization. If the bladder volume is small, the bladder volume is small. The bladder volume is small. The bladder volume is small. The bladder volume is small.

Table

The absolute difference between the bladder volume and the bladder volume is the absolute difference between the bladder volume and the bladder volume. If the bladder volume is >100 cc, all the relative volume metrics of the patients in this study are within the acceptable range. If the bladder volume is >100 cc, all the relative volume metrics of the patients in this study are within the acceptable range. If the bladder volume is >100 cc, all the relative volume metrics of the patients in this study are within the acceptable range. If the bladder volume is >100 cc, all the relative volume metrics of the patients in this study are within the acceptable range.

References


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