Can rectal dose be reduced by removal of ultrasound probe before delivery of HDR brachytherapy in prostate cancer?

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Purpose/Objective: Transrectal Ultrasound (US) is the standard imaging modality for High-Dose-Rate brachytherapy (HDR-BT) in prostate cancer. The treatment is most often delivered with the US probe positioned in the rectum, in order to maintain the same patient set-up as during the US treatment planning. However, it is an open question whether removal of the probe before HDR-BT delivery may be an advantage in terms of rectal dose. The objective of this study was to compare rectum dose with and without the US probe in place.

Materials and Methods: T2-weighted (T2W)-MRI based HDR-BT treatment planning was performed after transrectal US guided needle implantation for 6 fractions of HDR-BT in 3 prostate cancer patients. HDR-BT was delivered in 2 fractions of each 8.5 Gy preceded by 46 Gy given in 23 fractions of external beam radiotherapy (EBRT). T2W-MRIs and US images were co-registered based on the HDR-BT needle implant (figure 1). The same optimized treatment plan based on MRI contouring was applied on both MR- and US images. Rectum dose-volume parameters were evaluated for the 2 scenarios; 1) with the US probe in place (US images) and 2) with the US probe removed (MR images). Doses were evaluated as the total EBRT+BT EQD2 (α/β = 3 for rectum). Furthermore, absolute volumes irradiated to at least 70 Gy were evaluated.

Results: The mean rectum doses $D_{90}$, $D_{max}$ and $D_{50}$ were consistently higher for the case when the US probe was present in the rectum during the HDR-BT delivery (increase of 4, 5 and 13 Gy, respectively) (table 1). Furthermore, $V_{30 Gy}$ (probe in: 2.2 ± 1.1 Gy; probe out: 0.8 ± 0.5 Gy) and $V_{60 Gy}$ (probe in: 8.7 ± 1.8 Gy; probe out: 4.7 ± 1.4 Gy) decreased when the US probe was removed. Qualitative evaluation of the rectal anatomy with (US) and without (MR) probe indicated that the distance between prostate and rectum was increased at the base- as well as at the apex regions after removal of the US probe (figure 1).

Table 1. Rectum DVH parameters (total EQD2 EBRT+BT) with and without rectal US probe

<table>
<thead>
<tr>
<th>US Probe</th>
<th>$D_{90}$ cm$^3$</th>
<th>$D_{max}$ cm$^3$</th>
<th>$D_{50}$ cm$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>58.4 ± 1.3</td>
<td>65.7 ± 2.2</td>
<td>92.4 ± 6.9</td>
</tr>
<tr>
<td>Removed</td>
<td>55.5 ± 1.7</td>
<td>60.5 ± 2.1</td>
<td>83.8 ± 10.0</td>
</tr>
</tbody>
</table>

Conclusions: Our results indicate that by removing the US probe from the patient during the delivery of HDR-BT the dose to rectum can be reduced. This study did not evaluate potential deformations of target and consequential impact on target dose induced by the US probe removal. The advantages of decreased rectal dose by probe removal may compromise target dose in the setting of US guided prostate HDR-BT and should be further evaluated.

Preliminary results from HDR-BT alone at men with prostate cancer treated with LDR brachytherapy

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Purpose/Objective: To determine whether dosimetric parameters, biochemical control of prostate cancer and late toxicity in patients with large prostate glands is different to those with smaller sized glands after treatment with high dose-rate brachytherapy alone (HDR-BT).

Materials and Methods: From November 2003 to July 2009, 164 patients with locally advanced prostate carcinoma were sequentially enrolled and treated with 34 or 36 Gy (in 4 fractions) and 31.5 Gy (in 3 fractions) of $^{125}$I HDR-BT alone. Median follow up is 71 months. Prostate gland size was not considered a selection criteria in this study. Estimates of freedom from biochemical relapse (FFBR) and late morbidity, stratified by median clinical target volume (CTV), were obtained using the Kaplan-Meier method and differences compared using the Mantel-Cox log-rank test. Hazard Ratios were obtained using the Cox’s Proportional Hazard Model. Differences in IPSS scores grouped by median CTV were compared using Fishers Exact Test (2-tailed).

Results: Median CTV volume was 60 cc (range 15 to 208 cc). CTV volume parameters $D_{10}$ and $V_{100}$ (i.e. minimum dose to 90% of the