Retrospective dose volume histogram analysis of high dose rate prostate brachytherapy patients with hydrogel spacer implantation

Cavanaugh SX1, Crawford SD1,2, Dick JS1,2, Schantz PN1,2, Tsui T1,2, Swanson JW1,2

1Cancer Treatment Centers of America, Newnan, GA, USA
2Landauer Medical Physics, Glenwood, IL, USA

INTRODUCTION

A commercially available bioabsorbable hydrogel system—a mixture of a precursor (trilysine buffer solution and polyethylene glycol powder) and accelerator (salt buffer)—is implanted between the prostate and rectum of men undergoing radiation therapy for prostate cancer. Use of this device, shown by Figure 1, provides additional separation between the prostate and rectum, ostensibly reducing rectal injury due to proximity of the high dose target. This study investigates rectal sparing achieved in high dose rate (HDR) prostate brachytherapy patients with hydrogel spacer implantation.

Figures 1: Anatomy with and without hydrogel spacer implantation

PATIENTS & METHODS

Forty eight monotherapy HDR prostate brachytherapy cases were selected from the patient population treated from July 2015 to July 2016. Patients were selected based on a treatment regimen of 13.5 Gy per fraction. Of these cases, 42 fractions were delivered to patients with implanted hydrogel rectal spacers while 32 fractions were treated without the use of this or any other rectal sparing device. For this patient cohort, the dose volume histogram (DVH) from the previously calculated plan was used to obtain D1cc, D2cc, mean and maximum rectal dose statistics based on rectum contours drawn on the planning CT dataset by the dosimetrist at the time of treatment planning.

To compare to conventionally fractionated external beam radiation therapy (EBRT), the equivalent dose in 2 Gy fractions (EQD2) was calculated for the maximum dose to the rectum. Statistical analysis software was employed for data analysis.

RESULTS

The D1cc, D2cc, maximum and mean doses to the rectum for cases in which the hydrogel spacer was implanted prior to treatment were compared to cases treated without a rectal sparing device. Results with and without hydrogel spacer implantation were shown by Table 1:

Table 1: Results with and without hydrogel spacer

<table>
<thead>
<tr>
<th></th>
<th>With Spacer (Gy)</th>
<th>Without Spacer (Gy)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>11.0±0.6</td>
<td>11.9±0.6</td>
<td>0.042</td>
</tr>
<tr>
<td>Mean</td>
<td>3.1±0.2</td>
<td>3.1±0.2</td>
<td>0.929</td>
</tr>
<tr>
<td>D1cc</td>
<td>7.9±0.4</td>
<td>8.4±0.4</td>
<td>0.050</td>
</tr>
<tr>
<td>D2cc</td>
<td>7.0±0.4</td>
<td>7.5±0.4</td>
<td>0.091</td>
</tr>
</tbody>
</table>

Considering a typical HDR prostate brachytherapy dose prescription of 27.0 Gy (two 13.5 Gy fractions) and an α/β = 3.0 for rectum, the average maximum EQD2 rectal point dose for patients receiving hydrogel implants was 63.5±6.1 Gy compared to 71.9±4.8 Gy (p = 0.048) for those treated without the device—approximately 90-95% of a typical prescription dose for a conventionally fractionated prostate IMRT treatment.

CONCLUSIONS

DVH analysis for the patient sampling with hydrogel implantation demonstrates statistically significant reduction in small volumetric doses like D1cc as well as maximum rectal point dose. Future clinical evaluation of these patients may allow for a statistical relationship between the observed dose reduction and clinical toxicity.

CONTACT INFORMATION

Sean Cavanaugh, M.D.
Cancer Treatment Centers of America®
W: www.cancercenter.com
E: sean.cavanaugh@ctca-hope.com
O: 770-400-6418

John Swanson, Ph.D.
Landauer Medical Physics®
W: www.landauermp.com
E: john.swanson@ctca-hope.com
O: 770-400-6487