A Comparison of 3DCRT, IMRT, and VMAT Pelvic Radiation for Qualitative and Quantitative Toxicity

Lomas S, Bachand F, Lim P, Fong M, Stewart E, Aquino-Parrsons C
BC Cancer Agency, Radiation Oncology, Vancouver, BC, Canada

Background

Patients receiving post-operative adjuvant radiation to the pelvis most commonly experience morbidity of the bowels, bladder, skin, sexual function, and fatigue. Nout et al found that 62% of patients experienced acute morbidity, and these patients also had an increased risk of late RT complications. When this study began, three-dimensional conformal radiotherapy (3DCRT) was the standard radiation treatment technique. By using static intensity modulated radiation therapy (IMRT) or volumetric-modulated arc therapy (VMAT) more control over the shape of the irradiated volume is possible, allowing for greater sparing of normal tissues with the expectation of a reduction in side effects. Jhingran et al found that 28% of patients receiving IMRT experienced grade ≥2 bowel side effects, which is a small non-significant reduction over 3DCRT.

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Objective

1) To compare the occurrence of acute bowel, bladder and sexual toxicity of three techniques for endometrial cancer patients receiving adjuvant pelvic radiation treatment: 3DCRT, IMRT, and VMAT.

2) To assess if there is a relationship between the subjective assessment of toxicity from the patients’ perspective and the objective measure of acute toxicity CRP.

Eligibility Criteria

Women with a diagnosis of a gynecological malignancy receiving post-operative adjuvant pelvic radiotherapy.

Patients could not have concurrent chemotherapy, hip prosthesis, extended field RT to the pelvis and para-aortic area or whole abdomen, or an external beam boost.

Methods

This study planned to have three sequential cohorts of 30 consenting patients.

Table 1: A comparison of the three study arms

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<th>Table 1: Data collection points (weeks). Weeks 6 and 7 data collection was done via a mailed in survey.</th>
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<td>CTCAEv3</td>
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Patients were positioned supine with two foam donuts under their head, hands on their chest, a triangle foam under their knees, and with a rigid ankle rest that keeps the ankles at a set distance from each other (see Figure 2).

Figure 2: Standard supine pelvis positioning

A cone beam CT (CBCT) of the pelvis was performed for arm 2 and 3 patients before the first three fractions and then weekly to assess bladder and rectal fullness compared with the planning CT.

Acute side effects were documented using the CTCAEv3 tool. Arm 3 patient also completed the LENT-SOMA questionnaire.

Discussion

Acute toxicity decreased with IMRT and further reduced with VMAT. The overall Grade 2 toxicity may not be as decreased as expected with VMAT, as this figure also includes fatigue. The decrease in grade 2 bowel and sexual toxicity was not statistically significant, although the decrease in grade 3 toxicity, many of which was bowel toxicity, was significant. More patients may have been needed to show a statistically significant difference, as our sample size was small to thirsty-nine patients in each arm.

The grade 2 bladder toxicity was significantly lower with VMAT compared with our baseline 3DCRT toxicity rate of 30%. This baseline rate is comparable to Nout et al who found 40% of 3DCRT patients experienced urinary frequency. The extra modulation possible with VMAT to restrict bladder dose could explain the significant reduction in GU toxicity with VMAT. The low dose area patients experienced urinary frequency. The extra modulation possible with VMAT as this figure also includes fatigue. The decrease in grade 2 bowel toxicity could also be due to the change in daily imaging of Arm 3 patients, although this better targeting was a bone match. The CBCT to check OAR volumes was weekly, or about 20% of the treatments, and the patient would not be treated if the bladder was less than 10% full as that planned.

Conclusion

Adjuvant pelvic radiation treatment delivered via VMAT sees the greatest decrease in acute GU toxicity and an elimination of grade 3 toxicity compared with 3DCRT and thus justifies its use for this patient population.

