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Research Article

DOSIMETRIC COMPARISON OF 3DCRT VS IMRT TECHNIQUES IN CARCINOMA UTERINE CERVIX

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ABSTRACT

There is significant treatment related toxicity due to irradiation of bowel and bladder during the treatment of carcinoma of the uterine cervix. Our study aims at dosimetrically comparing the dose received by various organs at risk such as bladder, rectum, bowel bag, femoral heads in patients planned to receive radiation therapy to uterine cervix using 3 Dimensional Conformal Radiation Therapy (3DCRT) and Intensity Modulated Radiation Therapy (IMRT) technique. 30 patients with carcinoma of uterine cervix stage IIB2 to IVA were selected for the study. The mean dose received by the Organs At Risk (OAR) was significantly lesser in the IMRT technique ($p < 0.001$).The dose to bladder can be reduced by 47.21% using IMRT technique, whereas the reduction in dose to rectum was 17.21%. The reduction in dose to the right and left femoral heads were 55.95% and 66.80% respectively. The bowel bag received a lesser dose by 35.96% using the IMRT technique. We conclude thatIMRT is associated with significant reduction in the dose delivered to organs at risk during treatment of carcinoma of uterine cervix by definitive radiation therapy.

INTRODUCTION

Carcinoma of the uterine cervix is the eighth most common cancer in the world and fourth most common cancer in women globally.[1] In India, it is the third most common malignancy overall and second most common in females.[2] For patients presenting with carcinoma cervix stages IIB2 to IVA, concurrent chemoirradiation has become the standard of care.[3-7] There is significant treatment related toxicity due to irradiation of bowel and bladder.[8, 9]

Conventional 3 dimensional conformal radiation therapy (3DCRT) uses a set of fixed radiation beams which have a uniform intensity across the field. Intensity Modulated Radiation Therapy (IMRT) is a newer technique of treatment in which the intensity of the beam across a field can be modulated. Studies have demonstrated adequate dose coverage of the target volume and dose escalation along with lesser toxicity with IMRT than 3DCRT in the treatment of carcinoma cervix.[10]

Our study aims at dosimetrically comparing the dose received by various organs at risk such as bladder, rectum, bowel bag, femoral heads in patients planned to receive radiation therapy to uterine cervix using 3DCRT and IMRT technique.

METHODOLOGY

Patients with carcinoma of uterine cervix stage IIB2 to IVA were selected for the study.

The Gross Tumor Volume (GTV) in the definitive radiation therapy arm comprised of the gross disease visualized on the Computed Tomography (CT) scan and/or the Magnetic Resonance Imaging (MRI) scan. The Clinical Target Volume (CTV) consisted of the uterus, cervix, vagina up to 2 cm below the gross disease, bilateral par ametria, lymph node stations including common iliac, external iliac, internal iliac, and obturator lymph nodes. The inguinal lymph nodes were included in case of the disease extension to the lower thirds of the vagina. A margin of 7 mm around the CTV was given to form the Planning Target Volume (PTV).The bladder, rectum, bowel bag, bilateral femoral heads were contoured as the organs at risk.

3DCRT technique consisted of four field box technique using Antero-posterior, Postero-anterior and two lateral fields. IMRT

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technique was planned using 7 to 9 beams using the inverse planning technique.

The doses received by bladder, rectum, femoral heads and bowel bags by 3DCRT and IMRT techniques were compared and analysed. The statistical analysis was done by paired t test usung SPSS version 21 software.

RESULTS

30 patients were included in the study between January 2015 and December 2017.

The mean dose received by the Organs At Risk (OAR) was significantly lesser in the IMRT technique ($p < 0.001$) as summarized in table 1.

Table 1 Dosimetric Analysis

	3DCRT	IMRT	p value
Mean Bladder Dose (Gy)	49.15	33.91	<0.001
Mean Rectal Dose (Gy)	49.50	42.47	<0.001
Mean Right Femoral Head Dose (Gy)	45.58	29.30	<0.001
Mean Left Femoral Head Dose (Gy)	45.81	27.81	<0.001
Mean Bowel Bag Dose (Gy)	47.40	35.45	<0.001
Percentage of the prescribed dose to bladder (%)	98.30	67.82	<0.001
Percentage of the prescribed dose to rectum (%)	98.99	84.95	<0.001
Percentage of the prescribed dose to right femoral head (%)	91.16	58.60	<0.001
Percentage of the prescribed dose to left femoral head (%)	91.61	55.63	<0.001
Percentage of the prescribed dose to bowel bag (%)	94.64	70.90	<0.001

The dose to bladder can be reduced by 47.21% using IMRT technique, whereas the reduction in dose to rectum was 17.21%. The reduction in dose to the right and left femoral heads were 55.95% and 66.80% respectively. The bowel bag received a lesser dose by 35.96% using the IMRT technique.

DISCUSSION

Adequate coverage of the desired target volume along with minimal dose to the surrounding radiosensitive structure is very vital in radiation therapy. IMRT helps in achieving the same. IMRT is the standard technique in the treatment of many subsites. However, 3DCRT is still widely practiced in the treatment of carcinoma cervix.Our study demonstrated significant dosimetric reduction in the dose to bowel, bladder and femoral heads. A dosimetric study by Naik *et al* demonstrated significant reduction in the irradiated volume of bowel and rectum when IMRT technique was used for the treatment of locally advanced cervical carcinoma. It was also associated with more conformal dose distribution in the PTV.[11]

A meta-analysis by Lin *et al* compared the clinical outcome and toxicity in cervical cancer patients who were treated with definitive radiation therapy by 2 dimensional radiation therapy or 3DCRT or IMRT. They found no improvement in the overall survival by using IMRT technique. However, fewer instances of gastrointestinal and genitourinary toxicities were associated with IMRT technique.[12]

CONCLUSION

IMRT is associated with significant reduction in the dose delivered to organs at risk during treatment of carcinoma of uterine cervix by definitive radiation therapy.

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