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Effect of Hysterectomy on Volume of Bowel Irradiated in Gynaecological Malignancies: A Comparative Dosimetric Study

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Abstract: ***Our study aims to compare dosimetrically the dose received by the bowel during pelvic irradiation in patients receiving definitive or adjuvant radiation therapy for gynaecological malignancies. 60 patients with gynaecological malignancies receiving radiation therapy were selected. They received external beam radiation therapy by 3 dimensional conformal radiation therapy (3DCRT). The volume of bowel receiving 90% and 100% of the dose was significantly higher. The bowel dose is drastically increased in the post-operative gynaecological malignancies undergoing radiation therapy.***

Keywords: 3DCRT, IMRT, Radiotherapy, Gynaecological malignancy

1. Introduction

Radiation therapy (RT) has a major role in the treatment of gynaecological malignancies. It has been used both as a definitive therapy and adjuvant treatment to surgery. Four field box technique is the commonly used technique [1]. Complications of pelvic irradiation is mainly due to the dose to bowel and bladder. The acute effects of radiation on bowel can lead to symptoms like nausea, vomiting, diarrhea. These toxicities increase the morbidity of treatment and at times, can also be dose limiting. The dose to the bowel can be minimized by displacing it out of the radiation field [2].Various methods have been used for bowel displacement.

In carcinoma of the uterine cervix radiation therapy is predominantly used as a definitive treatment along with concurrent chemotherapy. However, the role of pre-operative or definitive radiation therapy in carcinoma of uterine endometrium had gradually faded away [3]. Adjuvant radiation therapy is still a standard of care in this malignancy. Following hysterectomy the bowel loops occupy the post-operative bed in the pelvis. Adhesion of the bowel is commonly present post surgery. These factors lead to increased dose to the bowel and have increased radiation induced bowel toxicity.

Our study aims to compare dosimetrically the dose received by the bowel during pelvic irradiation in patients receiving definitive or adjuvant radiation therapy for gynaecological malignancies.

2. Methodology

Patients with either carcinoma of the uterine cervix or endometrium receiving radiation therapy were selected for the study. They received external beam radiation therapy by 3 dimensional conformal radiation therapy (3DCRT).

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.

Four field box technique using Antero-posterior, Postero-anterior and two lateral fields were used. 6 MV and 15 MV energy photon beams generated from a medical linear accelerator were used. A dose of 50 Gy in 25 fractions was delivered to the PTV.

The volume of the bowel bag receiving 90% (V90) and 100% (V100) of the prescribed dose were calculated using

the Dose Volume Histogram. Total Volume (TV) of the bowel bag was also noted.
V90% = 100-[{(TV-V90)/TV} x 100]
V100% = 100-[{(TV-V100)/TV} x 100]
Statistical analysis was done by paired t test using SPSS version 21 software.

3. Results & Discussion

60 patients were included in the study between January 2015 and December 2017. 30 patients received definitive radiation therapy and 30 received post-operative adjuvant radiation therapy. The patient characteristics in the two arms are described in table 1.

The volume of bowel receiving 90% of the dose was significantly higher (p 0.042) in the post-operative arm with a mean V90 of 665.40 cc compared to 525.59 cc in the definitive RT arm. Similarly the volume of the bowel receiving 100% of the dose was also higher in the post-operative arm with mean V100% of 317.64 cc and 196.96 in the post-operative and definitive RT arms respectively (p 0.003). A difference was also noted in the total volume of the bowel bag. Mean total volume of the bowel in the post-operative arm as 2394.76 cc and in the definitive RT arm was 1942.73 cc (p 0.01). However, no significant difference was noted in the V90% (p 0.869) and V100%(p 0.137) between the two arms. The dosimetric data are summarized in table 2.

Small bowel is the most radiosensitive organ in the pelvis. Radiation therapy induces both early and late toxicities due to the bowel irradiation. Thus bowel is the dose limiting organ [4].

Estimating the volume of the bowel irradiated can help in determining and reducing the acute and late toxicities. A study by Letschert et al on patients receiving radiation therapy for rectal carcinoma concluded that there is a volume effect in diarrhea induced by irradiation of the bowel at a dose of 50 Gy in 25 fractions [5].

Our study demonstrated a significant increase in the volume of the bowel getting irradiated in post-operative radiation therapy. Being a dosimetric study we have not analysed the clinical incidence of acute toxicity in these patients. However, several studies on patients receiving radiation therapy to pelvis have observed the volume effect [2], [6], [7], [8].Thus radiation therapy should be used cautiously in the post-operative gynaecological malignancies.

4. Conclusion

The volume of small bowel irradiated during pelvic radiation therapy in gynaecological malignancies is significantly higher in post hysterectomy patients.

Table 1: Patient Characteristics

	Definitive RT arm	Post-operative RT arm
Number of cases	30	30
Age		
<60 years	16	20
>60 years	14	10
Diagnosis		
Carcinoma Cervix	30	14
Carcinoma Endometrium	0	16
Stage		
IB – IIA	0	30
IIB – IIIA	22	0
IIIB – IVA	8	0
Histopathology		
Squamous Cell Carcinoma	29	12
Adenocarcinoma	1	2
Endometroid carcinoma	0	16

Table 2: Dosimetric analysis

	Definitive RT arm	Post-operative RT arm	p value
Mean V90 (cc)	525.59	665.40	0.042
Mean V100 (cc)	196.96	317.64	0.003
Mean TV (cc)	1942.73	2394.76	0.010
Mean V90%	27.43	27.77	0.869
Mean V100%	10.30	12.50	0.137

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