Original Research Article

A Prospective Comparitive Study of Intensity Modulated Radiotherapy Versus Volumetric Modulated Arc Therapy Plannng and Dosimetry in Carcinoma Cervix Patients Treated with Concurrent Chemoradiation

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Abstract

Background: For patients with cervical cancer, radiation therapy improves target coverage and allows dose escalation while reducing the radiation dose to organs at risk (OARs). **Aims**: To study dosimetry and treatment plan of Intensity Modulated Radiotherapy (IMRT) and Volumetric Modulated Arc Therapy (VMAT) in carcinoma cervix patients . **Materials and methods**: A prospective study titled was taken up in Department of Radiotherapy form September 2017 to July 2019. A total 40 patients who achieved eligibility criteria were taken into study and randomized to 2 arms .In this study 20 patients were treated with IMRT and 20 patients were treated with VMAT .Dosimetric comparision is done between these two techniques. **Results**: It is observed that both IMRT plans and VMAT plans showed equally conformal . Homogeneity index in both IMRT and VMAT plans is almost equal in this study. In this study Monitor Units are significantly reduced with VMAT plans ,when compared to IMRT plans. So treatment delivery time is significantly reduced with VMAT plans . In this study Dose to bladder is reduced with VMAT technique but it is not statistically significant , when compared to IMRT.**Conclusion**: VMAT plans are advisable in carcinoma cervix patients to achieve reduced doses to OARs and reduced treatment delivery times.

Keywords: Intensity Modulated Radiotherapy (IMRT), Volumetric Modulated Arc Therapy, organs at risk (OARs).

Introduction

Worldwide, cervical cancer remains the most common gynecologic cancer and the fourth most common malignancy in women, with over 560,000 women globally developing this tumor as reported in 2018 and 311,000 dying of the disease every year (2018).Adjusting for population growth and aging, the global incidence rate for cervical cancer declined by 1.2% from 2005–2015. The majority of cases are in Africa, because of the paucity of screening measures and the prevalence of immunodeficiency because of human immunodeficiency virus (HIV). Unfortunately, it often affects young women, resulting in loss of the ability to bear future children. In developing countries like India, majority of the patients present in late or advanced stages. Concurrent radiotherapy with Cisplatin-based chemotherapy has been considered the standard of treatment in patients presenting in stage IB to IVA, which is based on the five randomized control trials . However grade 3 and 4 gastrointestinal and hematological toxicities are significantly higher in patients who are treated with chemo radiation as compared to patients who are treated with radiation alone[1].Conventional radiotherapy using bony landmarks to define treatment volume has resulted in good tumour control with acceptable normal tissue toxicity. However these techniques has resulted increased doses to normal tissues like small bowel, bladder, rectum and bone marrow. These problems can be solved using 3-dimensional treatment planning system and conformal radiotherapy like 3DCRT or intensity modulated radiotherapy. Conventional 3DCRT is accomplished with a set of fixed radiation beams that are shaped using the projection of the target volume and normally have a uniform intensity across the field. When appropriate, conventional fields can be modified by simple devices such as compensating filters or wedges[2,3].IMRT represents a new technology in radiotherapy in computer treatment software and linear accelerator collimation capabilities, delivery that combines high-resolution imaging, advances inverse planning, and radiation beam flux modulation to produce highly conformal dose distributions unachievable using conventional approaches. Use of IMRT in pelvic malignancies has shown reduced radiation exposure to adjacent bowel and bladder while preserving tumor coverage[4,5].The recent techniques like IMRT gives excellent planning treatment volume (PTV) coverage with reduced acute gastro intestinal and hemato-logical sequelae compared to conventional whole pelvis radiotherapy Under similar target coverage, IMRT is superior to conventional techniques in normal tissue sparing for the treatment of cervical cancer and a number of groups have explored IMRT in the gynecologic setting as a method to minimize the gastrointestinal, genitourinary and bone marrow toxicity that occurs in conventional RT.Although there are significant benefits of using IMRT, disadvantages also exist. IMRT requires multiple fixed-angle beams, and it may result in longer treatment delivery time and greater

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discomfort in patients. Furthermore, a large number of monitor units (MUs) are applied during IMRT, which may increase low-dose radiation received by surrounding tissues, posing a greater risk for secondary radiation-induced malignancies. Volumetric-modulated arc therapy (VMAT), a new form of IMRT, provides a dynamic multileaf collimator, one gantry rotation, variable dose rate, and gantry speed. Several studies have reported that compared with conventional IMRT, VMAT conveys significant dose reduction to OARs, fewer MUs, and enhanced plan quality. There were no significant differences in the volume of irradiated OARs (small bowel, rectum, and bladder) between IMRT and VMAT plans. In Indian population,incidence of carcinoma cervix is more ,when compared to western countries. To decrease the toxicities to OARs like bladder,rectum and small bowel and to decrease the treatment delivery time in Indian patients ,there is need to conduct a study on dosimetric comparision between IMRT and VMAT techniques .And comparative studies between these 2 techniques in Indian population are less in number so this study on dosimetric comparision of these two techniques is undertaken.

Material and Methods

The prospective randomised study was conducted at MNJ institute of oncology/RCC, Hyderabad. The study period was from September 2017 to July 2019. A total of 40 patients were taken for the study from OPD after taking informed consent. Complete history and physical examination including punch biopsy from the cervical lesion. Complete blood picture, renal function tests and liver function tests,Chest x-ray PA view,Ultrasound of the abdomen and pelvis were done to patients.

Inclusion Criteria: Age 20-60 yrs of Positive biopsy for squamous cell carcinoma, Adenocarcinoma, Adenosquamous carcinoma, Stage IB-IIIB Carcinoma cervix patient according to FIGO Guidelines, Eastern Cooperative Oncology Group (ECOG) Performance status 0-2.

Exclusion Criteria: Distant metastatic patients, with poor performance status, Immuno-compromised patients and HIV positive and existence of synchronus multiple malignancies .

After patients signed the consent form, they were randomized into either Group A or Group B by Simple Randomization. Group A – Concurrent chemo-radiation using IMRT followed by Brachytherapy. Group B – Concurrent chemo-radiation using VMAT followed by Brachytherapy. Patients in both the groups were treated with a total dose of 50 Gy in 25 fractions, 2Gy per fraction for 5 days a week along with concurrent chemotherapy, injection cisplatin i.v. 40 mg per m^2 followed by brachytherapy, 3 fractions, 7Gy per week. Patients with cervical cancer were screened according to the above inclusion and exclusion criteria. Patients satisfying the criteria were eligible to participate in the study. Benefits and risks of the procedure were explained in detail and informed consent was obtained after explaining the procedure in detail. The uterine motion is accounted for by giving an ITV margin on the uterus. An asymmetrical margin with CTV 2-ITV expansion of 15 mm antero-posteriorly, 15mm supero inferiorly and 7 mm laterally, is taken from the uterus. CTV 1 and CTV primary are combined and named as total CTV, which is further given a margin of 10mm all around for the total PTV to account for the set up errors. The ITV margin given over CTV2 for uterine motion is added to the total PTV and this is taken as the total target volume (final PTV) to be treated. Thus, in the final PTV, the margin from the uterine surface remains same as given for ITV, i.e., 15 mm in both anteroposterior and supero-inferior direction. The final PTV is manually or automatically trimmed upto 3 mm from the skin surface, if necessary to spare skin, provided that the CTV is still included entirely within the PTV. Bladder - V50Gy <50% Rectum - V50Gy<50% Bowel -V45Gy<195 cm^3 Femoral head –V45Gy<5 %

The primary planning target volume (PTV) and nodal PTV receive 50 Gy in 25 fractions, Treatment is delivered once daily, 5 fractions per week, over 5 weeks. All targets are treated simultaneously. The dose prescription and reported to target volumes was done as per ICRU. Target and nodal volume delineation was done as per institutional protocols as per internationally accepted guideline.

Chemotherapy with cisplatin of a uniform dose of 50mgwas given to patients intravenously immediately the next day after the 1st fraction of cisplatin and was ensured that the patient had taken radiotherapy on the day of infusion after 4 hours after cisplatin therapy and even the next day after that. Patient was given tablet zofer 8 mg thrice a day for 3 days as routine anti emetic therapy after cisplatin. Thereafter it was repeated weekly for the entire duration of EBRT.

Hydration, protein and caloric intake and hygiene were adequately maintained for all the patients during the entire treatment course. Haemogram and biochemical investigation was done and noted before giving chemotherapy. All patients were examined once weekly during the treatment. The clinical appearance of the primary tumour and at the initiation of treatment was noted. The regression of primary tumour during the treatment was assessed and noted weekly. Any delay causing treatment interruption was noted and necessary gap correction for radiotherapy was done.

Statistical Analysis : The information collected regarding all selected cases was entered in a Master Chart .Data analysis was done with the help of computer using MS-Excel ,SPSS 22.0 (Trail version). Using this software ,percentages ,mean ,standard deviation ,student t'test and p values are calculated .A p value <0.05 is shown to have significant relationship .

Results

A total of 40 subjects were included in the final analysis. 20 patients were treated with IMRT plan and 20 patients were treated with VMAT plan .

Table 1: Age wise distribution of intensity modulated radiotherapy (IMRT) versus volumetric modulated arc therapy (VMAT)

Age	IMRT	VMAT
40 T0 45	6 (30%)	5 (25%)
46 TO 50	5 (25%)	4 (2%)
51 TO 55	6 (30%)	7 (35%)
56 TO 60	3 (15%)	4 (20%)
TOTAL	20 (100%)	20 (100%)
STAGE(FIGO)		
IB	4 (20%)	4 (20%)
IIB	8 (40%)	8 (40%)
IIIB	4 (20%)	4 (20%)
IIA	4 (20%)	4 (20%)
TOTAL	20 (100%)	20 (100%)

Among study population , stage wise distribution in both IMRT and VMAT is IB (20%) , IIA (20%) , IIB (40%) , IIIB (20%) .

Table 2: Planing of volume wise distribution of intensity modulate radiotherapy IMRT) versus volumetric modulated arc therapy (VMAT)

PTV(CM3)				
Group	**Subjects**	**Mean (Cm^3)**	**Std. Deviation**	**P-Value**

VMAT	20	1532.395	290.9592	0.001(<0.05)*
IMRT	20	1201.825	269.4870	
MEAN DOSE (GY)				
VMAT	20	50.0000	1.34866	0.806 (>0.05)
IMRT	20	50.0770	.34615	
D5% (GY)				
VMAT	20	51.6455	.37244	0.733 (>0.05)
IMRT	20	51.6995	.59477	
D95% (GY)				
VMAT	20	48.3635	.46883	0.211 (>0.05)
IMRT	20	48.0670	.93122	
V95% (cm^3)				
VMAT	20	1478.1020	234.22848	0.0001(<0.05)*
IMRT	20	1153.6430	266.49707	

The mean of PTV volume was 1201.82 ±269.48cm^3 and 1532.39± 290.9cm^3 in IMRT and VMAT respectively. Mean dose (Gy) received to PTV in IMRT and VMAT plans are 50.07 and 50.0 respectively. Standard deviation of mean doses in IMRT and VMAT plans are 0.34615 and 1.34866 respectively . D5% for PTV was 51.69±0.59 Gy and 51.64± 0.37for IMRT and VMAT plans respectively. The differences in mean between the two groups was statistically not significant (p=0.73) Gy for IMRT and VMAT plans respectively. The differences in mean between the two groups was statistically not significant (p=0.21).V95% for PTV was 1153.63 ±266.4 cm^3 and 1478.10±234.2 cm^3 for IMRT and VMAT plans respectively. The differences in mean between the two groups was statistically significant (p=0.0001)

Table 3: Homogenety and conformity index wise distribution of IMRT and VMAT

Homogenety Index				
Group	**Subjects**	**Mean**	**Std. Deviation**	**P-Value**
VMAT	20	.0605	.01317	0.325 (>0.05)
IMRT	20	.0665	.02346	
Conformity Index 95%				
Group	**Subjects**	**Mean**	**Std. Deviation**	**P-Value**
VMAT	20	.9640	.04441	0.371 (>0.05)
IMRT	20	.9505	.04957	

The mean of HI for PTV 60 is 0.0665±0.023 and 0.0605±0.013 for IMRT and VMAT plans respectively. The differences in mean between the two groups was not statistically significant (p=0.32).

The mean of CI 95% for PTV is 0.9505±0.495 and 0.0964±0.044 for IMRT and VMAT plans respectively. The differences in mean between the two groups was not statistically significant (p=0.37).

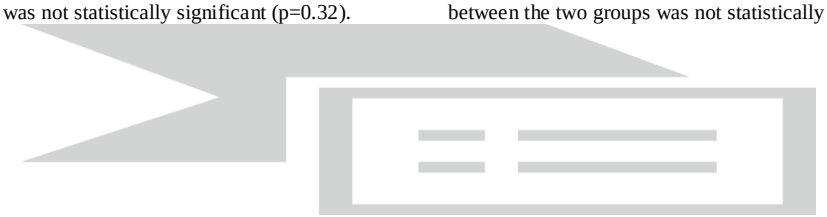

Fig 1: Monitor units wise distribution of IMRT and VMAT

The Mean of Monitor units was 1302.60±224.61 and 507.93±39.05 in IMRT and VMAT respectively .The p value is statistically significant (p=0.0001)

Table 4: Organ wise distribution of intensity modulate radiotherapy (IMRT) VERSUS volumetric modulated arc therapy (VMAT)

Bladder V50% (GY)				
Group	**Subjects**	**Mean**	**Std. Deviation**	**P-VALUE**
VMAT	20	12.2850	10.64954	0.075 (>0.05)
IMRT	20	20.1765	16.06833	
Rectum V50Gy (%)				
Group	**Subjects**	**Mean**	**Std. Deviation**	**P-Value**
VMAT	20	2.9625	3.25573	0.0001 (<0.05)**
IMRT	20	14.8420	12.82053	
Bowel V45Gy (cm^3)				
VMAT	20	36.1610	27.77493	0.001 (<0.05)**
IMRT	20	93.5740	67.57195	

The Mean of bladder V50Gy was 20.17±16.06 and 12.28±10.64 in IMRT and VMAT respectively.The p value is statistically not significant (p=0.075). The Mean of rectum V50Gy was 14.84± 12.82(%) and 2.96±3.25 (%) in IMRT and VMAT respectively .The p value is statistically significant (p=0.0001). The mean value of bowel V45Gy was 93.57±67.57 $cm^3$and 36.16±27.77 cm^3 in IMRT and VMAT .The p value was statistically significant (p=0.001)

Discussion

Carcinoma Cervix is the most common gynecologic cancer and the fourth most common malignancy in women. Concurrent chemoradiotherapy is the definitive treatment for carcinoma cervix stage IB to IV A. Treating the tumour and at the same time sparing the Organs at risk are important because normal tissue toxicity should be minimized. Evolution of radiotherapy from conventional to intensity modulated radiotherapy and a novel approach to volumetric modulated radiation therapy is making the future hopeful in reducing

normal tissue toxicity. Intensity-modulated radiation therapy (IMRT) has been the most widely used radiotherapy method across the globe but was associated with both advantages and disadvantages also. To avoid drawbacks offered by IMRT, a new approach (Volumetric Modulated Arc Therapy) VMAT or Rapid Arc has been evolved, which was reported to have faster delivery times, use fewer monitor units (MU) and to have superior dose distributions compared to IMRT plans. Dosimetric comparative studies in carcinoma cervix in Indian population are few. Homogeneity Index of PTV , has statistically no significant value in studies like Jia et al , Zhai et al[7] ,Guy JB et al[8] , penny knapp and was statistically significant in Cozzi et al study. Confirmity Index 95% of PTV , has statistically no significant value in studies like Jia et al[6], Zhai et al[7],Guy JB et al and was statistically significant in Penny knapp et al[10] and cozzi et al studies. In Cozzi et al[7] , Jia et al[3] , Zhai et al, Guy JB et al[8] studies showed significant reduction in Monitor Units with VMAT , with significant p value and in penny knap study , Monitor Units were equal in both arms . P value of bladder V40 Gy was statistically not significant in studies like Zhai et al, Guy JB et al, Jia et al[6], Penny knapp et al[10]and in Cozzi et al[9] study dose to bladder was reduced with VMAT plans. Dose to 74 rectum was reduced with VMAT plans in almost all studies but p value was not significant and p value was significant in Cozzi et al study. P value of dose to bowel was statistically significant in studies like Cozzi et al, Penny Knapp et al and p value was not significant in Guy JB et al and Zhai et al [7,8].This study presents a comparison of Volumetric Arc Therapy(VMAT) with Intensity Modulated Radiation Therapy (IMRT) in carcinoma cervix patients. A total 40 patients were taken into study and randomized to 2 arms. In this study 20 patients were treated with IMRT and 20 patients were treated with VMAT. Dosimetric comparision was done between these two techniques. Clinically acceptable plans were achieved with both techniques. In the present study Homogeneity Index, Conformity Index and Monitor Units and doses to OARs like bladder,rectum,bowel compared between IMRT and VMAT plans. In this study it was observed that both IMRT plans and VMAT plans were equally conformal. Homogeneity index in both IMRT and VMAT plans showed almost equal. P value was statistically not significant for conformity index and homogeneity index in this study. Monitor Units were significantly reduced with VMAT plans,when compared to IMRT plans as in standard published studies So treatment delivery time is significantly reduced with VMAT plans. In this study p value for Monitor Units was statistically significant. Dose to bladder was reduced with VMAT technique but it was not statistically significant , when compared to IMRT. As in many published studies , VMAT plans in this study showed significantly reduced doses to Rectum when compared to IMRT plans. Reduced doses to bowel noticed in VMAT plans, when compared to IMRT plans as in many published studies. P value was statistically significant for both rectum and bowel in this study. The mean of HI for PTV is 0.0665 ± 0.023 and 0.0605±0.013 for IMRT and VMAT plans respectively. The differences in mean between the two groups was statistically not significant (p=0.32). Homogeneity Index is almost same for both plans of IMRT and VMAT. In Penny knapp et al[10] study, the mean of HI for PTV is 0.08 ± 0.03 and 0.081±0.02 for IMRT and VMAT plans respectively. The differences in mean between the two groups was statistically not significant (p=0.575). Homogeneity Index is almost equal for both plans of IMRT and VMAT. Similar to present study, Zhai et al[7] study, showed the mean of HI for PTV is 1.07 ± 0.01 and 1.07±0.01 for IMRT and VMAT plans respectively. The differences in mean between the two groups was statistically not significant (p>0.05). Homogeneity Index is almost equal for both plans of IMRT and VMAT. Similar to present study, Guy JB et al[8]study, showed, the mean of HI was 0.084 for IMRT plans and difference between IMRT and VMAT plans was 0.011 . The differences in mean between the two groups was statistically not significant (P =0,092). IMRT and VMAT plans showed almost equal Homogeneity Index. In studies like Jia et al, Zhai et al, Guy JB et al, Penny Knapp,[10] HI values were compared between IMRT and VMAT plans. There was no significant p values (p>0.05) noted in above studies, that implies no significant dosimetric benefits were found with VMAT when compared with IMRT. In contrast to above studies, Cozzi et al[9] study, showed significant p value (p<0.05) of HI, between IMRT and VMAT plans. The mean of CI95% for PTV is 0.95±0.49 and 0.96±0.44 for IMRT and VMAT plans respectively. The difference in mean between the two groups was not statistically significant (p=0.371). This study showed that IMRT and VMAT both plans were almost equally conformal .Theoritically VMAT plans show more comformality than IMRT plans ,but in this study both plans are equally conformal because this study both plans were done in different patients . In contrast to present study , Penny knapp et al[10] study the mean of CI95% for PTV is 0.85±0.06 and 0.93±0.04 for IMRT and VMAT plans respectively. The difference in mean between the two groups was statistically significant (p=0.001). This study showed that VMAT plans showed more comformal than IMRT plans . Similar to present study , Zhai et al study showed the mean of CI95% for PTV is 0.92±0.03 and 0.93±0.02 for IMRT and VMAT plans respectively. CI95% values were are almost equal . The difference in mean between the two groups was statistically not 77 significant (p>0.05). This study showed that IMRT plans and VMAT plans were equally conformal . In studies like Jia et al[6], Zhai et al[7],Guy JB et al[8], mean of conformity index values were compared between IMRT and VMAT plans.There were no significant p values (p>0.05) noted in above studies ,that implies no significant dosimetric benefits were found with VMAT when compared with IMRT . So in these studies IMRT plans and VMAT plans both were equally conformal . In Cozzi et al[9]and Penny knap study ,VMAT plans showed significant p value (p<0.05) of mean of conformity index , compared to IMRT.So above studies showed VMAT plans were more conformal than IMRT plans. The mean of monitor units was 1302.60 ± 244.61 for IMRT plans and 507.93 ± 39.05 for VMAT plans. The differences in mean between the two groups was statistically significant (P =0.0001). VMAT plans resulted in a significant reduction in total MUs delivered per unit dose, when compared to IMRT plans. So reducing the no. of MUs resulted in a significant reduction of beam on time (treatment times). In contrast to present study,Penny knapp et al study, the mean of monitor units was 606.8 ± 96.16 for IMRT plans and 694.35± 126.5 for VMAT plans. The differences in mean between the two groups was statistically not significant (P =0.09). IMRT plans and VMAT plans delivered equal Monitor units in this study. Similar to present study,Zhai et al[7]study , showed ,the mean of monitor units was 1658 ± 53 for IMRT plans and 573± 21 for VMAT plans. The differences in mean between the two groups was statistically significant (P <0.05). VMAT plans showed ,significant reduction in Monitor Units ,compared to IMRT plans. In compared to Penny knapp et al , Guy JB et al[8] study , showed ,the mean of monitor units was1441 for IMRT plans and difference between IMRT and VMAT plans was 971 M Us. The differences in mean between the two groups was statistically significant (P <0.001). VMAT plans showed ,significant reduction in Monitor Units ,compared to IMRT plans. In all studies like Cozzi et al, Jia et al, Zhai et al, GuyJB et al, p-values of mean value of Monitor units are statistically significant (p<0.05) between IMRT plans and VMAT plans . VMAT plans resulted in a significant reduction in total MUs delivered in these all studies. The Mean of V50Gy of Bladder was 20.17±16.06 % in IMRT plans and 12.28±10.64 % in VMAT plans . Dose to bladder was reduced in VMAT plans ,when compared to IMRT plans .But the difference in mean between the two groups was statistically not significant (P value =0.07) between IMRT and VMAT plans. In Penny knapp et al[10] study,mean of V45Gy of Bladder was 50.11±25.82 % in IMRT plans and 46.96±24.85 % in VMAT plans. Dose to Bladder was reduced in VMAT plans ,when compared to IMRT plans ,But the difference in mean between the two groups was

statistically not significant (P value =0.09). In Guy JB et al[8]study, difference in mean of V40Gy of Bladder was only 0.8 %between IMRT plans and VMAT plans .The difference in mean between the two groups was statistically not significant (P value =0.43). Both IMRT and VMAT plans delivered almost equal doses to bladder. In studies like Jia et al[6],Zhai et al[7],Guy JB et al[8], Penny knapp [10], there was no significant p values (p>0.05) noted in above studies ,that implies no significant dose reduction to bladder were found with VMAT when compared with IMRT . In Cozzi et al[9] study ,mean of V40Gy was 62.2±11.1 in IMRT plans and 47.6±12.0 in VMAT plans. This study showed significant dose reduction to bladder , compared to IMRT.p value was significant in this study (p<0.01) between IMRT and VMAT plans. The Mean of V50Gy of Rectum was 14.84±12.82 % in IMRT plans and 2.96±3.25 % in VMAT plans .The difference in mean between the two groups was statistically significant (P value =0.0001). VMAT plans showed a significant dose reduction to rectum when compared to IMRT plans .

In Penny knapp et al[10] study , mean of V45Gy of Rectum was 44.9±29.65 % in IMRT plans and 40.67±26.12 % in VMAT plans . Dose to rectum is reduced in VMAT plans ,when compared to IMRT plans ,But the difference in mean between the two groups was statistically not significant (P value =0.064). In Zhai et al study, mean of V40Gy of Rectum was 48.8±32.6 % in IMRT plans and 48.2±32.6 % in VMAT plans . The difference in mean between the two groups was statistically not significant (P value >0.05).Both plans delivered equal dose to rectum. In Cozzi et al study , mean of V40Gy of Rectum was 78.7±25.3% in IMRT plans and 51.5±20.07 % in VMAT plans .The difference in mean between the two groups was statistically significant (P value =0.03). VMAT plans showed a significant dose reduction to rectum when compared to IMRT plans. In Guy JB et al study , difference in mean of V40Gy of Rectum was only 0.5 between IMRT plans and VMAT plans .The difference in mean between the two groups was statistically not significant (P value =0.79). Both IMRT and VMAT plans delivered almost equal doses to rectum. The Mean of V45Gy of bowel was 93.57±67.57 cm3 in IMRT plans and 36.16± 27.77Cm^3 in VMAT plans .The difference in mean between the two groups was statistically significant (P value =0.001). VMAT plans showed a significant dose reduction to bowel when compared to IMRT plans . In Penny knapp et al[10], the Mean of V30Gy of bowel was 47.27±16.25 % in IMRT plans and 37.66± 15.98% in VMAT plans The difference in mean between the two groups was statistically significant (P value =0.001). VMAT plans showed a significant dose reduction to bowel when compared to IMRT plans. In contrast present study, Zhai et al[7]study showed the Mean of V30Gy of bowel was 41.5±8.0 % in IMRT plans and 45.6± 5.1% in VMAT plans .The difference in mean between the two groups was statistically not significant (P value >0.05). Both IMRT plans and VMAT plans delivered almost equal doses to bowel. In Guy JB et al study , the mean of D200 cm3 of Bowel was 11.1 Gy .The difference in mean of Bowel was only 1.2 Gy between IMRT plans and VMAT plans. The difference in mean between the two groups was statistically not significant (P value=0.16). Both IMRT and VMAT plans delivered almost equal doses to bowel. In Cozzi et al , the Mean of V40Gy of bowel was 18.7±8.6 % in IMRT plans and 12.3± 8.2% in VMAT plans .The difference in mean between the two groups was statistically significant (P value =0.002). VMAT plans showed a significant dose reduction to bowel when compared to IMRT plans.

Limitations

In this study dosimetric comparision is done between different patients. This is a single institutional study . Sample size is small.

Conclusion

The conclusion is VMAT should produce better conformity of target volume than IMRT as it utilizes full gantry rotation. In this study it is observed that both IMRT plans and VMAT plans showed equally conformal.Homogeneity index in both IMRT and VMAT plans is almost equal in this study. In this study Monitor Units are significantly reduced with VMAT plans ,when compared to IMRT plans as in standard published studies So treatment delivery time is significantly reduced with VMAT plans.In this study Dose to bladder is reduced with VMAT technique but it is not statistically significant , when compared to IMRT.As in many published studies ,VMAT plans in this study showed significantly reduced doses to Rectum and Bowel, when compared to IMRT plans . By considering the above results , VMAT plans are advisable in carcinoma cervix patients to achieve reduced doses to OARs and reduced treatment delivery times .This comparative study was done in different patients. If this would done in same patient for comparision ,results may get more accurate.

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