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Research Article

CT BASED BRACHYTHERAPY IN CARCINOMA CERVIX: A SINGLE INSTITUTIONAL EXPERIENCE FROM INDIA

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ABSTRACT

Background: CT based 3 dimensional imaged based brachytherapy allows volumetric optimization with 3 D planning leading to better tumor coverage and critical organ sparing as compared to 2 D radiography based brachytherapy.

Material and Methods: Between Nov 2017 and Nov 2018, sixteen patientsdiagnosed cases of carcinoma cervix received EBRT 46Gy over 23 fractions or 50 Gy over 25 fractions with concurrent Inj Cisplatin 40 mg per metre square weekly. These patients were treated with 31 sessions of CT based Intracaviatary brachytherapy. After intracavitary application non-contrast CT simulation was performed. HRCTV, Bladder, Rectum and Sigmoid were contoured on Oncentra. Dose to point A, ICRU Bladder and Rectal points were recorded. DVH parameters HRCTV(D90, D100), Volumetric doses 1cc and 2 cc for bladder, rectum and sigmoid were recorded. The mean ICRU points were compared with mean 1cc, 2cc doses. Point A doses were also compared with HRCTV.

Results: The mean Point A dose delivered was 100.3% of prescribed dose as compared to mean D90 =76.6% and D100= 55.23% respectively. This study showed that mean HRCTV doses were lower than Point A doses. Organ at Risk OAR analysis showed that bladder received 88.7% of prescribed dose at ICRU bladder point. While Volumetric 1cc and 2cc mean doses were 113.4% and 102.4% of prescribed dose respectively. Dose delivered at rectal ICRU point was 81.7% as compared to 1cc and 2cc which were 69.4% and 62.03% of prescribed dose respectively. DVH analysis showed that Sigmoid received mean 1cc and 2cc dose 40.62 % and 34.39% of prescribed dose respectively.

Conclusion: Our study suggests that HRCTV doses are lower than point A doses while DVH parameters do not correlate with ICRU points. Volumetric 2cc and 1cc bladder doses are higher than ICRU bladder dose while 2cc and 1cc rectal doses are lower than ICRU rectal point dose.

INTRODUCTION

Cervical cancer is the third most common cancer in women worldwide with an estimated annual death rate more than 275000 (1,2). Surgery is often the treatment for early stage disease plus minus adjuvant radiotherapy. Definite radiotherapy is the option for patients not suitable for surgery. Definite radiation therapy, combination of external beam radiotherapy and brachytherapy is the standard of care for locally advanced disease (3,4). Intracavitary brachytherapy (ICBT) is a treatment technique of placing radiation source near or in the tumour situated in body cavity, is an integral part of cervical cancer treatment. Conventional ICBT is based on 2-dimensional (2D) point-based planning determined by International Commissioning Radiation Units (ICRU) definition of prescription and organ at risk (OAR) points on orthogonal x-ray images. This was used for dose calculation irrespective of tumour and OAR location, size and shape, thus proved to results in inadequate target coverage and inaccurate OAR doses (5,6). Computed tomography based three-dimensional (3D) planning for brachytherapy is being accepted and implemented for treatment of cervical cancer. Although 3D image based brachytherapy is lagging behind because of decreased availability of CT Simulators, planning software/hardware, increased cost, and lack of expertise. Image based brachytherapy can be performed with different modalities like MRI or CT. The Groupe European de Curietherapeutic-European Society for Therapeutic Radiology and Oncology Working Group (GEC-ESTRO) has developed guidelines for contouring and dosimetry based on MRI.

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Although MRI has better soft tissue delineation but MRI Simulator is not widely available as compared with CT. CT based brachytherapy allows confirmation of applicator, volumetric optimization which improves tumor coverage and critical organ sparing (7,8,9). Various studies have shown the potential advantages of image based brachytherapy in terms of improved local control 79%-100% with acceptable late complications 0%-14% (10,11,12).

MATERIAL AND METHODS

Between Nov 2017 and Nov 2018, sixteen patients diagnosed cases of carcinoma cervix received EBRT 46Gy over 23 fractions or 50Gy over 25 fractions with concurrent Inj Cisplatin 40 mg per metre square weekly. These patients were treated with 31 sessions of CT based Intracavitary Brachytherapy.

External beam radiotherapy (EBRT) – Contrast CT Simulation was performed in all patients. CT images were registered in TPS Monaco version 8. CTV, PTV and Organ delineation were performed. 3Dimensional Conformal Radiotherapy plans were generated and treatment was executed on Elekta Versa HD Machine. Patients were also given concurrent Injection Cisplatin 40mg per metre square weekly for 4-5 cycles.

Brachytherapy- Brachytherapy was performed under general anaesthesia. All patients underwent Examination under anaesthesia. Patients were catheterized after cleansing and draping. Intracavitary applications were performed with MRI compatible applicators in various arrangements with tandem length ranging from 4-6cm and ovoids diameter 2-3 cm. Rectal retractor and vaginal packing was performed. Urinary balloon filled with contrast saline and Non contrast CT simulation performed in all patients. CT images were transferred to Oncentra TPS. Contouring for HRCTV included gross disease at the time of brachytherapy, parametrial, vaginal extension and whole cervix. Organs at risk bladder, rectum and sigmoid were also contoured. Applicator reconstruction was done directly on CT, with dummy markers being used as the surrogate for source position. Treatment plans were generated so as to achieve pear shaped isodose curves in saggital plane with dose normalized and prescribed to Point A. Optimization was performed to reduce dose to bladder and rectum as much as possible without compromising prescribed dose to point A. Doses to ICRU rectum, bladder and point A were noted. DVH parameters HRCTV (D90, D100), 1cc,2cc volumetric doses to bladder, rectum and sigmoid were also recorded.

Brachytherapy doses 9Gy in two sessions after 46Gy/23 fractions or 7Gy in 3 sessions week apart after 50Gy/25 fractions of EBRT. Treatment was delivered on Flexitron Cobalt HDR Machine. Detailed evaluation was done for dosimetry and statistically analysis was performed in SPSS V20.

RESULTS

Between Nov 2017 and Non 2018, a total of 16 patients diagnosed cases of squamous cell carcinoma cervix with age ranging from 30-75 years were studied. 15 patients received EBRT 46Gy/23fractions followed by Intracavitary Brachytherapy 9Gy in two fractions a week apart. Calculated EQD2 for 46Gy followed 9Gy in two sessions was 74.5Gy. One patient received 50Gy/25fractions followed by 7Gy in 3 sessions weekly of Intracavitary brachytherapy with calculated EQD2 of 79.75. Total 31 sessions of Intracavitary brachytherapy were performed. Patients also received concurrent chemotherapy with injection Cisplatin weekly with EBRT.

***Patient Characterstics*:** A total of 16 patients with Median age 50 years, diagnosed case of carcinoma cervix were evaluated. 9 patients had FIGO Stage IIB and 7 patients had FIGO Stage IIIB, with 10 patients having KPS more than 80 while 6 patients had KPS less than 80. Histopathology showed all patients had Squamous cell carcinoma.(Table1)

Table 1

Patients Characterstics		No. of patients
Age	<60	10
	>60	6
SAGE (FIGO)	IIB	9
	IIIB	7
Histology	SCC	16
	Others	0
KPS	>80	10
	<80	6

***Target Dose*:** The point A dose and HRCTV (Target volume) Parameters for target coverage were noted. The mean Point A dose delivered was 100.3% of prescribed dose as compared to mean D90 which was 76.6%. While D100 was 55.23%. This study showed that for point A dose prescription doses to HRCTV was lower than Point A doses (Table 2).

Table 2

Dose	Point A(mean)	HRCTV	p-value
Dose(%)	100.3(±2.6)	D90=76.6(±18.5)	0.2
Dose (Gy)	9.02(±0.23)	6.89(±1.6)	-
Dose(%)	100.3(±2.6)	D100=55.2(±14.8)	0.9
Dose Gy	9.02(±0.23)	4.97(±1.3)	-

***OAR Doses*:** Organ at Risk OAR analysis showed that bladder received 88.7% of prescribed dose at ICRU bladder point. While Volumetric 1cc and 2cc mean doses were 113.4% and 102.4% of prescribed dose respectively. Dose delivered at rectal ICRU point was 81.7% as compared to 1cc and 2cc which were 69.4% and 62.03% of prescribed dose respectively. DVH analysis showed that Sigmoid received mean 1cc and 2cc dose 40.62 % and 34.39% of prescribed dose respectively (Table 3).

Table 3

OAR	ICRU Point dose	1cc dose	2cc dose
Bladder (Dose %)	88.7(±17.9)	113.4(±22.03)	102.4(±17.8)
Bladder (Dose Gy)	7.9(±1.6)	10.2±(1.90	9.1(±1.6)
Rectum (Dose%)	81.7(±50)	69.4(±17)	62.03(±15.7)
Rectum (Dose Gy)	7.35(±4.5)	6.2(±1.5)	5.58(±1.4)
Sigmoid (Dose %)	-	40.62(±16.75)	34.39(±14.51)
Sigmoid (Dose Gy)	-	3.65(±1.5)	3.0(±1.3)

DISCUSSION

A number of imaging modalities have been used for imagebased brachytherapy planning. The GroupeEuropeende Curietherapie-European Society for TherapeuticRadiology and Oncology Working Group (GEC-ESTRO) and ABS have standardized contouringdefinitions and dosimetry for Tumor

andOrgan At Risks (13,14,15). GEC-ESTRO guidelines are based on MRI based brachytherapy, but MRI not universally available in radiation oncology departments. Various studies have shown that CT based brachytherapy is an alternative modality widely available and have results comparable to MRI based brachytherapy planning (16,17,18).Our study has shown that Mean Point A dose (100.3(±2.6) does not correlate with HRCTV D90-76.6(±18.5) and D100-55.2(±14.8). HRCTV doses were lower than point A dose, consistent with results of other studies(19,20,21,22).Mean Bladder and rectal doses at ICRU Points in our study were88.7(±17.9) and 81.7(±50) percent of prescribed dose at Point. ICRU Bladder point dose is lower than the Mean 2cc dose 102.4(±17.8) and 1cc dose 113.4(±22.03) percent of prescribed dose respectively. In Study by Madan *et al*, it was observed that 1cc and 2cc volume of bladder were 2.88±0.72, 2.5±0.65 and 2.2±0.57 times more than the ICRU bladder reference point (19). In another study by Krishnatry *et al*, it was observed that volumetric doses at 1cc and 2cc were higher than the Bladder ICRU points although not statistically significant (23). Hashim N *et al*, in their study observed the mean dose to the bladder was 6.00±1.90 Gy for D2cc and 5.10±2.03 Gy at DICRU. However, the mean D2cc dose did not differ significantly from the mean dose calculated at the ICRU reference point (p=0.307) (24).the observed mean ICRU Rectal dose in our study is 81.7(±50) percent of prescribed dose which is higher than the volumetric doses 1cc 69.4(±17) and 2cc 62.03(±15.7) percent of prescribed dose respectively. Other studies have also observed that ICRU rectal dose does not correlate with volumetric doses (19, 23,24). Jamaluddin *et al*, observed the rectum D2cc EQD2 which was lower than ICRU point dose by a mean of 12.3% (p-value=0.028) consistent with our study (25).Although MRI is the desired modality for image based brachytherapy, availability is the concern. CT for IBBT is an option which is widely available in Radiation departments around the world. In comparison with standard 2D point A and ICRU point dosimetry, 3D CT based planning allows better delineation of tumor and organs at risk. Optimization can be done with the aim for a HRCTV D90 ≥ 100% with a planned EQD2 80-85 Gy. Dose can be escalated to EQD2 85-90 for patients with a poor response to external beam radiotherapy with large residual tumors where based on the Vienna doseresponsedata to attempt to improve local control (26). While limiting the rectumD2cc EQD2 ≤ 70 Gy, sigmoid D2cc EQD2 ≤ 70 Gy, and bladder D2cc EQD2 ≤ 90 Gy.

CONCLUSION

Our study suggests that HRCTV doses are lower than point A doses while DVH parameters do not correlate with ICRU points. Volumetric 2cc and 1cc bladder doses are higher than ICRU bladder dose while 2cc and 1cc rectal doses are lower than ICRU rectal point dose. We suggest CT based IBBT should be used whenever possible with dose optimization to achieve HRCTV coverage and acceptable volumetric doses to organs at risk.

References

1. Parkin DM, Bray F, Ferlay J, Pisani P. Global cancer statistics, 2002. *CA Cancer J Clin*2005; 55: 74-108
2. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA Cancer J Clin*2011; 61: 69-90
3. Lanciano RM, Won M, Coia LR, Hanks GE. Pretreatment and treatment factors associated with improved outcome in squamous cell carcinoma of the uterine cervix: a final report of the 1973 and 1978 patterns of care studies. *Int J RadiatOncolBiol Phys* 1991; 20: 667-676
4. Landoni F, Maneo A, Colombo A, Placa F, Milani R, Perego P, Favini G, Ferri L, Mangioni C. Randomised study of radical surgery versus radiotherapy for stage Ib-IIa cervical cancer. *Lancet* 1997; 350: 535-540
5. Katz A, Eifel PJ. Quantification of intracavitary brachytherapy parameters and correlation with outcome in patients with carcinoma of the cervix. *Int J RadiatOncolBiol Phys* 2000; 48: 1417-1425
6. Eifel PJ, Morris M, Wharton JT, Oswald MJ. The influence of tumor size and morphology on the outcome of patients with FIGO stage IB squamous cell carcinoma of the uterine cervix. *Int J RadiatOncolBiol Phys* 1994; 29: 9-16
7. Kim RY, Pareek P. Radiography-based treatment planningcompared with computed tomography (CT)-based treatmentplanning for intracavitary brachytherapy in cancer ofthe cervix: analysis of dose-volume histograms. *Brachytherapy*2003; 2: 200-206
8. Datta NR, Srivastava A, Maria Das KJ, Gupta A, Rastogi N. Comparative assessment of doses to tumor, rectum, and bladder as evaluated by orthogonal radiographs vs. computer enhanced computed tomography-based intracavitary brachytherapy in cervical cancer. *Brachytherapy* 2006; 5:223-229
9. Kim H, Beriwal S, Houser C, Huq MS. Dosimetric analysis of 3D image-guided HDR brachytherapy planning for the treatment of cervical cancer: is point A-based dose prescription still valid in image-guided brachytherapy? *Med Dosim*2011; 36: 166-170
10. Pötter R, Georg P, Dimopoulos JC, Grimm M, Berger D, Nesvacil N, Georg D, Schmid MP, Reinthaller A, Sturdza A, Kirisits C. Clinical outcome of protocol based image (MRI) guided adaptive brachytherapy combined with 3D conformal radiotherapy with or without chemotherapy in patients with locally advanced cervical cancer. *RadiotherOncol*2011; 100: 116-123
11. Beriwal S, Kim H, Coon D, Mogus R, Heron DE, Li X, Huq MS. Single magnetic resonance imaging vs magnetic resonance imaging/computed tomography planning in cervical cancer brachytherapy. *ClinOncol*(R CollRadiol) 2009; 21: 483-487
12. Kang HC, Shin KH, Park SY, Kim JY. 3D CT-based highdose- rate brachytherapy for cervical cancer: clinical impact on late rectal bleeding and local control. *RadiotherOncol*2010; 97: 507-513
13. Pötter R, Haie-Meder C, Van Limbergen E, Barillot I, De Brabandere M, Dimopoulos J, Dumas I, Erickson B, Lang S, Nulens A, Petrow P, Rownd J, Kirisits C. Recommendations from gynaecological (GYN) GEC ESTRO working group (II): concepts and terms in 3D image-based treatment planning in cervix cancer brachytherapy-3D dose volume parameters and aspects of

3D image-based anatomy, radiation physics,radiobiology. *RadiotherOncol*2006; 78: 67-77
14. Haie-Meder C, Pötter R, Van Limbergen E, Briot E, De Brabandere M, Dimopoulos J, Dumas I, Hellebust TP, Kirisits C, Lang S, Muschitz S, Nevinson J, Nulens A, Petrow P, Wachter-Gerstner N. Recommendations from Gynaecological (GYN) GEC-ESTRO Working Group (I): concepts and terms in 3D image based 3D treatment planning in cervix cancer brachytherapy with emphasis on MRI assessment of GTV and CTV. *RadiotherOncol*2005; 74: 235-245
15. Nag S, Cardenes H, Chang S, Das IJ, Erickson B, Ibbott GS, Lowenstein J, Roll J, Thomadsen B, Varia M. Proposed guidelines for image-based intracavitary brachytherapy for cervical carcinoma: report from Image-Guided Brachytherapy Working Group. *Int J RadiatOncolBiol Phys* 2004; 60: 1160-1172
16. Beriwal S, Kim H, Coon D, Mogus R, Heron DE, Li X, Huq MS. Single magnetic resonance imaging vs magnetic resonance imaging/computed tomography planning in cervical cancer brachytherapy. *ClinOncol*(R CollRadiol) 2009; 21: 483-487
17. Tan LT, Coles CE, Hart C, Tait E. Clinical impact of computed tomography-based image-guided brachytherapy for cervix cancer using the tandem-ring applicator - the Addenbrooke's experience. *ClinOncol*(R CollRadiol) 2009; 21: 175-182
18. Viswanathan AN, Dimopoulos J, Kirisits C, Berger D, Pötter R. Computed tomography versus magnetic resonance imaging-based contouring in cervical cancer brachytherapy: results of a prospective trial and preliminary guidelines for standardized contours. *Int J RadiatOncolBiol Phys* 2007; 68: 491-498
19. Madan R, Pathy S and Subramani V 2014 Comparative Evaluation of Two-dimensional Radiography and Three Dimensional Computed Tomography Based Dose-volume Parameters for High-dose-rate Intravitary Brachytherapy of Cervical Cancer: A Prospective Study *Asian Pacific J. Cancer Prevention* 15:4717-21
20. Gao M, Albuquerque K, Chi A, Rusu I (2010). 3D CT-based volumetric dose assessment of 2D plans using GEC-ESTRO guidelines for cervical cancer brachytherapy. *Brachytherapy*, 9, 55-60.
21. Kim RY, Pareek P (2003). Radiography-based treatment planning compared with computed tomography (CT) based treatment planning for intracavitary brachytherapy in cancer of the cervix: analysis of dose-volume histograms. *Brachytherapy*, 2, 200-6.
22. Shin KH, Kim TH, Cho JK *et al* (2006). CT-guided intracavitary radiotherapy for cervical cancer: comparison of conventional point A plan with clinical target volume-based three dimentional plan using dose-volume parameters. *Int J RadiatOncolBiol Phys*, 64, 197-204.
23. Krishnatry R, Patel FD, Singh P, *et al* (2012). CT or MRI for image-based brachytherapy in cervical cancer. *Jpn J ClinOncol*, 42, 309-13.
24. Hashim N, Jamalludin Z, *et al*. CT based 3 dimensional treatment planning of intracavitary brachytherapy for cancer of the cervix: comparison between dose-volume histograms and ICRU point doses to the rectum and bladder. *Asian Pac J Cancer* Prev, 15(13), 5259-5264
25. Jamaluddin z, Min UN, Ishak WZ, Malik A. Preliminary experience on the implementation of CT based image guided brachytherapy of cervical cancer using high dose rate cobalt 60 source in University of Malaya Medical Centre (UMMC). *Journal of Physics; conference series* 694(2016)012016
26. Dimopoulos JC, Lang S, Kirisits C, Fidarova EF, Berger De Georg P, Dörr W, Pötter R. Dose-volume histogram parameters and local tumor control in magnetic resonance imageguided cervical cancer brachytherapy. *Int J RadiatOncolBiol Phys* 2009; 75: 56-63

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