

Dosimetric comparison of tandem and ovoids with tandem and ring for intracavitary brachytherapy for carcinoma cervix

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SUMMARY Background: Carcinoma Cervix is the most common gynecological malignancy in India. Treatment of Cervical cancer includes a combination of External Beam Radiotherapy (EBRT) with Intracavitary Brachytherapy (ICBT) with or without concurrent chemotherapy. ICBT helps to boost radiation dose to the primary disease. Most commonly used applicators for ICBT are Tandem and Ovoid (TO) and Tandem and Ring (TR) applicators. With this study, we want to do a dosimetric comparison between TR and TO applicators.

Materials and Methods: Dosimetric details of 60 ICBT applications done in 20 patients during the period from 01/01/2018 to 31/12/2018 were retrospectively analyzed. Among that 30 were ICBT with TO applicator and rest 30 with TR applicator. All patients received EBRT dose of 50.4 Gy in 28 fractions. All patients had ICBT, three sessions with 7 Gy prescribed to point A. Dosimetric data including dose to right and left point A and dose to OARs were recorded from Oncentra Planning System.

Results: Mean dose to Right and left Point A with TO applicator was 6.83 Gy and 6.97Gy and with TR applicator was 6.90 Gy and 6.93 Gy respectively without statistically significant difference. Mean Rectal doses D2cc, D1cc and D0.1cc with TO applicator was 3.90Gy,4.37Gy,5.47Gy and with TR applicator was 3.30Gy,3.73Gy, and 4.83Gy respectively without statistical significance. Mean Bladder doses D2cc, D1cc and D0.1cc with TO applicator was 5.37Gy,5.97Gy,7.47Gy and with TR applicator was 5.53Gy,6.07Gy, and 7.73Gy respectively without statistical significance. Mean Sigmoid doses D2cc, D1cc and D0.1cc with TO applicator was 4.47Gy,5.07Gy,6.37Gy and with TR applicator was 4.87Gy,5.47Gy, and 6.97Gy respectively without statistical significance. Mean Small bowel doses D2cc, D1cc and D0.1cc with TO applicator was 3.27Gy,3.70Gy,4.67Gy and with TR applicator was 3.10Gy,3.60Gy, and 4.30Gy respectively without statistical significance. Volumes treated with different isodose lines like V95, V85, V50, V20 with TO applicator was 89.37cc, 105.43cc, 230.60cc, 856.45cc and with TR applicator was 83.03cc,97.73cc,211.10cc,826.56cc respectively without statistical significance.

Conclusion: TO and TR applicators delivered the same prescription dose to points A, with no statistically significant difference between both applicators in terms of OAR doses. Compared to TO, TR applicators treated smaller volumes but was not statistically significant. Since point A, OAR doses and treated volumes were not significantly different for TR and TO applicators and these findings suggest a dosimetric equivalence of both applicators. Based on the result of our study we would suggest that both applicators can be used interchangeably. However further studies with larger sample size are needed to validate our study finding.

Key words: brachytherapy, carcinoma cervix, tandem, ovoids

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INTRODUCTION

Background

Worldwide the annual incidence of Carcinoma Cervix is around 570,000. Carcinoma Cervix is the fourth leading cause of cancer death in women worldwide [1]. In cervical cancer patients, the clinical outcome has improved with intracavitary Brachytherapy [2-4]. Most common site treated with Brachytherapy is Carcinoma Cervix as per the survey was done by the American Brachytherapy Society (ABS) [5]. The two most common applicators used are Tandem and Ovoid (TO) and Tandem and Ring (TR) as per ABS survey [6]. Manufacturers came in with TR applicator claiming that it is clinically identical to TO applicator [7]. Studies have documented increased patient comfort in certain anatomical situations with Tandem and ring applicator [8] and due to the fixed geometry of TR applicator, it is reproducible [9].

Erickson et al in their study, compared dose distributions of the TR with those of the TO applicator. Their study did not have any volumetric information since it used orthogonal X rays instead of a CT scan for Brachytherapy planning and did only point dose comparisons. TO applications had higher bladder and rectal point doses with similar point B doses as compared to the TR, but the isodose volumes were greater for TO in their study [10]. Rangarajan et al in their study showed a higher mean D2cc dose to bladder and rectum and slightly higher point B dose treated volume and high dose volume with TO applicator compared to TR applicator [11].

Our present study wants to do a dosimetric comparison of the TR and TO applicators, using CT-based information rather than orthogonal radiographs.

METHODOLOGY

Aim

Dosimetric comparison of intracavitary brachytherapy with tandem and ovoids and tandem and ring applicator for patients with Carcinoma Cervix

Objectives

To assess the dose to the rectum, sigmoid, small bowel and urinary bladder (OAR) with intracavitary brachytherapy according to GEC-ESTRO guidelines (0.1cc, 1cc, and 2cc)

2. To assess the point A dose on right and left side with T and O and T and R applicators.

3. To assess and compare V95, V85, V50, V20 and total treatment time with T and O and T and R.

MATERIALS AND METHODS

This retrospective study was done in the Department of Radiation Oncology at Malabar Cancer Centre. Data of patients treated with ICBT from 1st January 2018 to 31st December 2018 were analyzed.

Inclusion criteria

All Carcinoma cervix patients who underwent intracavitary BT with a dose fractionation of 7Gy × 3 fractions during the period January 2018 to December 2018.

Exclusion criteria

Intracavitary BT with dose fractionation other than 7Gy × 3 fractions, will be excluded from the study.

The study was approved by the Institutional Review Board (Ethics committee approval waived off as this is a retrospective study). All patients received External Beam Radiotherapy (EBRT) with a dose of 50.4 Gy in 28 fractions. This study retrieved dosimetric data of 20 patients who underwent HDR-ICBT with Tandem and ovoid(TO)/ Tandem and Ring (TR) applicator as a routine treatment from the period 01/01/2017 to 31/12/2017. All patients had three ICBT sessions. Hence dosimetric analysis was done for 60 ICBT applications (30 with Tandem and ovoid applicator and 30 with Tandem and Ring applicator).

ICBT procedure

After completion of EBRT, the patient is given a date for ICBT. All patients who receive an EBRT dose of 50.4 Gy in 28 fractions, will undergo three sessions of ICBT with 7Gy each in our institution. ICBT was done in operation theatre under spinal anesthesia. Before the ICBT procedure, a thorough per vaginal and per speculum examination was done under anesthesia and findings are noted and suitable applicator was selected.

For ICBT, either TO or TR Applicators were used. After the applicator was put the patient was shifted to CT simulator and planning CT was taken after administering contrast into the bladder. 1 mm slice thickness planning CT scan was taken. The CT images were imported to the Oncentra Treatment Planning System and the Radiation Oncologist meticulously contoured the OARs. The dose of 7Gy was prescribed to point A. Once the plan was generated the plan was approved after carefully noting the point A and OAR doses from the dose volume histogram (DVH). Various 3D DVH parameters including 0.1cc, 1cc, 2cc doses and mean doses to the OARs were noted. Mean dose to right and left points were noted. Volumes treated with different isodose lines like V95, V85, V50, and V25 were also noted. These values were noted from ONCENTRA Planning system (Figures 1-3). Once the plan was approved, the same was sent to Nucleotron 16 channel HDR Brachytherapy machine and treatment was delivered.

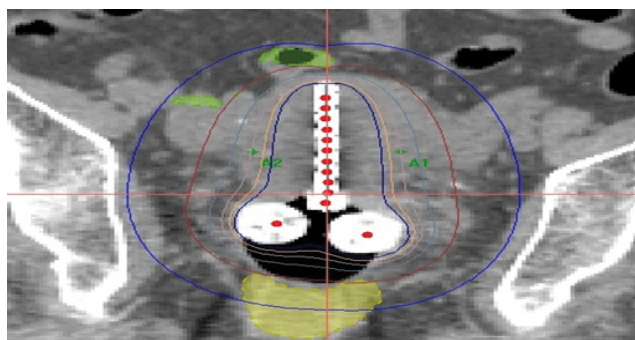


Fig. 1. CT image of ICBT with TO applicator

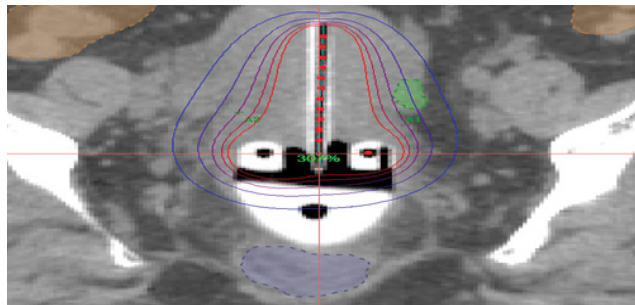


Fig. 2. CT image of ICBT with TR applicator

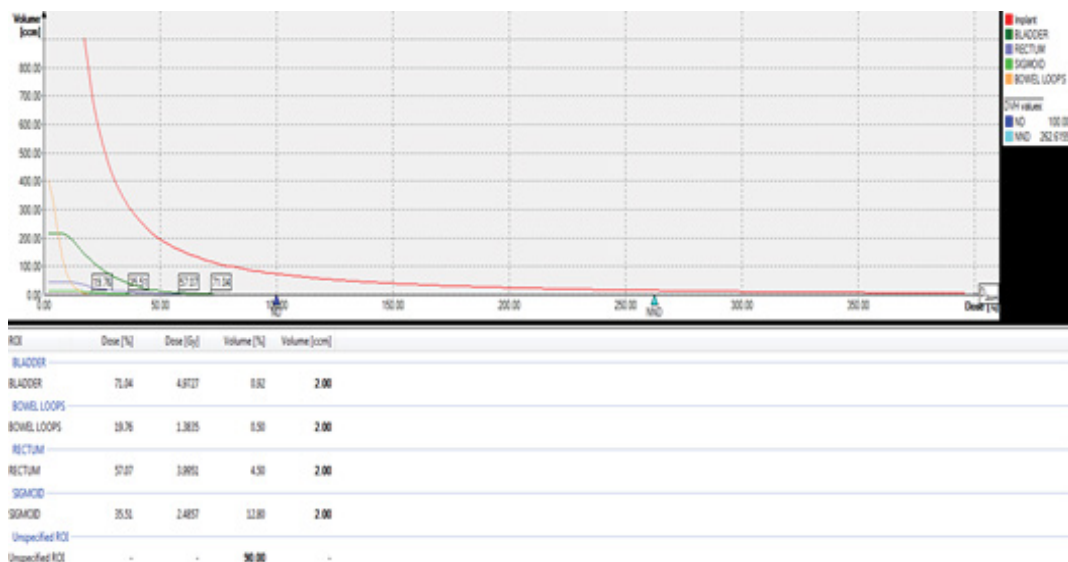


Fig. 3. Dose-volume histogram (DVH) for ICBT

Tab. 1. Demographic details	Variable	Number of patients
	Age	Median: 57years
	FIGO Stage	
	Stage IB1	2 (10%)
	Stage IB2	3 (15%)
	Stage IIB	10 (50%)
	Stage IIIB	5 (25%)

Tab. 2. Point A dose with TR and TO applicators	Point A dose	TR (mean dose)	TO (mean dose)	p-value
	Right Point A	6.9	6.83	0.17
	Left point A	6.93	6.97	0.45

Tab. 3. OAR doses with TR and TO applicators	OAR	Dose to OAR	TR	TO	p-value
Rectum		D2cc	3.3	3.9	0.84
		D1cc	3.73	4.37	0.11
		D0.1cc	4.83	5.47	0.269
Bladder		D2cc	5.53	5.37	0.167
		D1cc	6.07	5.97	0.1
		D0.1cc	7.73	7.47	0.567
Sigmoid		D2cc	4.87	4.47	0.25
		D1cc	5.47	5.07	0.32
		D0.1cc	6.97	6.37	0.301
Small bowel		D2cc	3.1	3.27	0.663
		D1cc	3.6	3.7	0.819
		D0.1cc	4.3	4.67	0.534

Tab. 4. Volumes treated with different isodose lines	Volume	TR	TO	p-value
	V95	83.03	89.37	0.141
	V85	97.73	105.43	0.136
	V50	211.1	230.6	0.087
	V20	826.56	856.45	0.254

RESULTS

Details of 60 ICBT applications in 20 patients were analyzed. Among those 30 ICBT were done with Tandem and ovoid applicator and in the rest, Tandem and Ring.

Applicator was used. Demographic details of patients who underwent ICBT are given in Table 1.

Point doses with TR and TO applicators are shown in Table 2. There was no statistically significant difference with both applicators.

Volumetric OAR doses, D2cc, D1cc, D0.1 cc to the rectum, bladder, the sigmoid and small bowel is shown in Table 3. There was no statistically significant difference with both applicators in terms of OAR doses.

Volumes treated with different isodose lines are shown in Table 4. There was no statistically significant difference with both applicators for volumes like V95, V85, V50, V20.

DISCUSSION

After the Fletcher type applicator, which consists of tandem and 2 ovoids the second most commonly used applicator for intracavitary brachytherapy for Carcinoma Cervix is Tandem and Ring applicator [6]. TR applicator is used in view of increased patient comfort, applicability where anatomy does not permit usage of TO applicator [8]. TO and TR applicators

are used interchangeably in many institutions. Manufacturers of TR applicator claims it to be dosimetrically equivalent to TR applicator. A study by Rangarajan et al showed that there was no significant difference in point A dose and OAR doses with both TR and TO applicators [11]. Since the prescription dose was 8Gy in their study and was 7Gy in our study the absolute doses point A and OAR doses were not matching. Similar to that study our study also showed no significant difference in point A dose and dose to OARs like D2cc to the rectum, bladder and sigmoid with both applicators. Erickson et al in their study showed a significantly higher bladder and rectal point doses with TO applicator compared to TR applicator and brachytherapy planning was Xray based in their study [10]. But in our study since brachytherapy planning was CT based we documented volumetric doses like D2cc, D1cc, D0.1cc to OARs like the rectum, bladder, sigmoid and small bowel, and OAR doses were comparable with both applicators.

Volumes treated with different isodose lines like 95%, 85%, 50%, and 20% were assessed in the study. The numerical values of V95, V85, V50, and V20 were almost the same as in the study done by Rangarajan et al. [11]. In the study by Rangarajan et al TR applicators treated a smaller volume compared to TO applicators and the difference was statistically significant. Even though our study also showed a slightly lower V95, V85, V50, and V20 with TR applicators compared to TO, it was not statistically significant.

Since our study showed no significant difference in point A dose, volumetric OAR doses and volumes treated with different isodose with TR and TO applicators, we suggest that both applicators are dosimetrically equivalent.

CONCLUSION

TO and TR applicators delivered the same prescription dose to points A, with no statistically significant difference between both applicators in terms of OAR doses. Compared to TO,

TR applicators treated smaller volumes but was not statistically significant. Since point A, OAR doses and treated volumes were not significantly different for TR and TO applicators and these findings suggest a dosimetric equivalence of both applicators. Based on the result of our study we would suggest that both applicators can be used interchangeably. However further studies with larger sample size are needed to validate our study finding.

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