Clinical Investigation

Original paper

Comparison of iso-effective and cost-effective high-dose-rate brachytherapy treatment schedules in cervical cancer – regional cancer center experience

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Abstract

Purpose: The study is to evaluate the difference between outcomes of two high-dose-rate fractionation schedules in the treatment of intracavitary brachytherapy (ICBT) of cervical cancer.

Material and methods: A retrospective analysis of 163 cervical cancer patients was completed. All patients received external beam radiotherapy (EBRT) to whole pelvis with concurrent weekly chemotherapy, followed by ICBT with either 7 Gy per fraction in three fractions (arm A) or 9 Gy per fraction in two fractions (arm B). Median follow-up was 19 months. The outcomes were compared in terms of 2-year actuarial local control, disease-free survival, overall survival, and late toxicity in the two treatment arms.

Results: The 2-year actuarial local control rates in arm A and arm B were 88.5% and 91.5%, respectively. The actuarial 2-year disease-free survival rates in arm A and arm B were 85.9% and 82.6%, respectively. The actuarial 2-year overall survival in arm A and arm B were 95.7% and 100%, respectively ($p = 0.06$). There were 12.7% and 15.2% local failures in arm A and arm B, respectively. Distant metastases were seen in 8.5% and 7.6% in arm A and arm B, respectively. The 2-year actuarial risk of developing late rectal toxicity in arm A and arm B were 5.6% and 5.4%, respectively. The 2-year actuarial risk of developing late bladder toxicity in arm A and arm B were 2.8% and 2.2%, respectively.

Conclusions: ICBT treatment with 9 Gy in two fractions offers equivocal local control rates and survival rates in cancer cervix cases with many advantages of short overall treatment time, improved patient compliance, cost effectiveness, and reduced exposure to aesthetic agents. The toxicities observed were few, low grade, and easily manageable.

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Key words: brachytherapy, high-dose-rate schedules, cancer cervix.

Purpose

Cervical cancer is the fourth most common cancer in women and the eighth most common cancer overall worldwide [1,2]. It is the cause of third largest cancer mortality in India, accounting for nearly 10% of all cancer-related deaths in the country [3,4]. Rural women are at higher risk of developing cervical cancer as compared to their urban counterparts [5].

There are 96,322 new cases of cervical cancer in India every year. At our institute, carcinoma of uterine cervix accounts for approximately 58.7% of all gynecological malignancies, with about 80-90% of patients presenting in locally advanced stage with bulky central disease. Thus, radiation therapy remains the preferred treatment modality in majority of patients.

Optimal treatment requires a combined approach including intracavitary radiation for in situ tumor and external radiation for parametrial tissue and pelvic draining lymph nodes. High-dose-rate (HDR) brachytherapy is now the standard brachytherapy modality used almost worldwide. It allows integration of external beam radiation therapy (EBRT) with brachytherapy as a sandwich regimen, reducing overall treatment time and providing better tumor control.

Even though published data of more than four decades are available, there is no consensus regarding optimal dose fractionation schedules of HDR brachytherapy for cancer cervix treatment.

A large number of different fractionation schedules of HDR ICBT (intracavitary brachytherapy) have been used varying from institution to institution, but an opti-

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mum schedule has not been established. The American Brachytherapy Society (ABS) has recommended an individual fraction size of less than 7.5 Gy in four to eight fractions, depending on the dose per fraction. These guidelines come with a word of caution stating that: "these recommendations are intended as guidelines and the suggested fractionation schemes have not been thoroughly tested" [6].

HDR fraction size of more than 7.5 Gy has been used in several centers, supported by findings of few studies [7,8,9]. There is a compelling need to increase the fraction size of HDR ICBT and thus, reduce the treatment time, keeping in view the ever-increasing patient load in Indian set up and limited availability of infrastructure.

Considering the high burden of disease and prolonged waiting time for ICBT, 9 Gy per fraction in two fractions and 7 Gy per fraction in three fractions are the two schedules followed at our institute.

With the aim to evaluate the difference between outcomes of two HDR fractionation schedules, a retrospective analysis of 163 cancer cervix patients was done. The outcomes were compared in terms of 2-year actuarial local control, disease-free survival, overall survival, and late toxicity: arm A (control) – 7 Gy per fraction in three fractions and arm B (study) – 9 Gy per fraction in two fractions.

Material and methods

This was a mono-institutional retrospective study conducted at the Regional Cancer Center, located at the Northern Himalayan region of India.

ICBT facility is available only in our institution in the State. Therefore, considering the high burden of disease and prolonged waiting time for ICBT, 9 Gy per fraction in two fractions and 7 Gy per fraction in three fractions are the two schedules followed at our institute.

We analyzed 163 patients of cancer cervix stage IB to stage IIIB, who underwent treatment from February 2016 to August 2018, including patients in follow-up till 30th January 2019. Institutional ethical committee clearance was obtained before commencement of the study. Age group of patients ranged from 35 years to 80 years.

All patients received EBRT delivered to whole pelvis by ^{60}Co by Theratron or Equinox by either two field or four field technique, depending on patient separation. Radiotherapy planning was completed on conventional simulator.

EBRT dose was either 45 Gy in 25 fractions or 50 Gy in 25 fractions in 5 weeks (1.8 Gy or 2 Gy per fraction, respectively, 5 fractions/week), with central shielding in last 3 fractions in patients receiving 50 Gy to spare bladder and rectum.

Additionally, all patients received concurrent weekly injection of cisplatin 40 mg/m^2 as a radiosensitizer with EBRT. Chemotherapy was planned for 5 cycles, but due to chemotherapy-induced acute toxicities, only 9 patients received 3 to 4 cycles of chemotherapy.

After completion of EBRT, patients received HDR ICBT in two treatment schedules: 71 patients in arm A received 7 Gy per fraction in three fractions, with 1-week interval between fractions, and 92 patients in arm B received 9 Gy per fraction in two fractions, with 1-week interval between fractions. Orthogonal anteroposterior and lateral simulation X-rays were taken using dummy sources on conventional simulator. These films were used in Oncentra 3D treatment planning system for applicator reconstruction, defining point A, prescribing point A dose, and calculating bladder and rectal doses as per ICRU 38 recommendations. HDR brachytherapy was delivered by HDR microSelectron, using ^{192}Ir source by Fletcher Williamson Asia Pacific applicators.

The total biological effective dose (BED) delivered to point A in arm A was $BED_{EBRT} + BED_{ICBT}$ = [25 × 2 (1 + 2/10)] + [3 × 7 (1 + 7/10)] = 60 + 35.7 = 95.7 Gy. Equivalent dose in 2 Gy fraction (EQD_2) to point A in arm A was BED/(1 + 2/10) = 79.75 Gy (or 74 Gy with 1.8 Gy per fraction of EBRT).

Similarly, the total BED delivered to point A in arm B was $BED_{EBRT} + BED_{ICBT}$ = [25 × 2 (1 + 2/ 10)] + [2 × 9 (1 + 9/10)] = 60 + 34.2 = 94.2 Gy. EQD_2 to point A in arm B was BED/(1 + 2/10) = 78.5 Gy (or 72.75 Gy with 1.8 Gy per fraction of EBRT).

Results

The basic characteristics of the patients in the two treatment arms are depicted in Table 1.

The median age of patients in arm A was 55 years and that of arm B was 52.5 years. In both arms, the majority of patients were diagnosed as stage IIB, with 66.2% in arm A and 62.0% in arm B, respectively. Pre-treatment hemoglobin level was > 10 gm/dl in 87.3% and 76.1% cases in arm A and arm B, respectively (Table 1).

Median follow-up in arm A was 22 months (range, 6-33 months), and median follow-up in arm B was 19 months (range, 8.9-34 months). Five patients in arm A and two in arm B were lost to follow-up. Three patients died in arm A after treatment completion and no death occurred in arm B. The cause of deaths in arm A can be attributed to distant spread of the disease.

The 2-year actuarial local control rates in arm A and arm B were 91.5% and 89.1%, respectively (Figure 1). Even though the local control rates were higher in arm A as compared to arm B, the difference between the two arms was not statistically significant (p = 0.3).

Patterns of failure

There were 12.7% (9 out of 71) and 15.2% (14 out of 92) local failures in arm A and arm B, respectively. Distant metastases were seen in 8.5% (6 out of 71) and 7.6% (7 out of 92) in arm A and arm B, respectively, mostly occurring in para-aortic lymph nodes and supraclavicular lymph nodes. Overall failure was seen in 38.1% and 43.5% of patients in arm A and arm B, respectively (Table 2).

Disease-free survival

The actuarial 2-year disease-free survival (DFS) rates in arm A and arm B were 88.7% and 84.8%, respectively (Figure 2). Although, the disease-free survival was higher in arm A, there was no statistically significant difference (p = 0.5) when compared to that of arm B.

Table 1. Patient characteristics in both the study arms

Patients characteristics	Arm A (7 Gy/session) *n* patients (%)	Arm B (9 Gy/session) *n* patients (%)	*P* value
Age group (years)			0.23*
< 50	27 (38)	42 (45.7)	
> 50	44 (62)	50 (54.3)	
Mean age (years)	54.5	53.6	
FIGO stage			
IB	3 (4.2)	3 (3.3)	0.81$
IIA	2 (2.8)	2 (2.2)	
IIB	47 (66.2)	57 (62.0)	
IIIA	4 (5.6)	3 (3.3)	
IIIB	15 (21.1)	26 (28.3)	
IVA	0 (0)	1 (1.1)	
Histology			
Squamous	68 (95.8)	85 (92.4)	0.37$
Adeno	3 (4.2)	7 (7.6)	
Differentiation			
Well	17 (23.9)	15 (16.3)	0.64$
Moderately	42 (59.2)	62 (67.4)	
Poorly	10 (14.1)	12 (13.0)	
Unspecified	2 (2.8)	3 (3.3)	
Fields			
Two	49 (69)	60 (65.2)	0.61*
Four	22 (31)	32 (34.8)	
Pre-treatment Hemoglobin levels (gm/dl)			
< 10	9 (12.7)	22 (23.9)	0.07*
> 10	62 (87.3)	70 (76.1)	

**using Chi-square test, $using Fischer exact test*

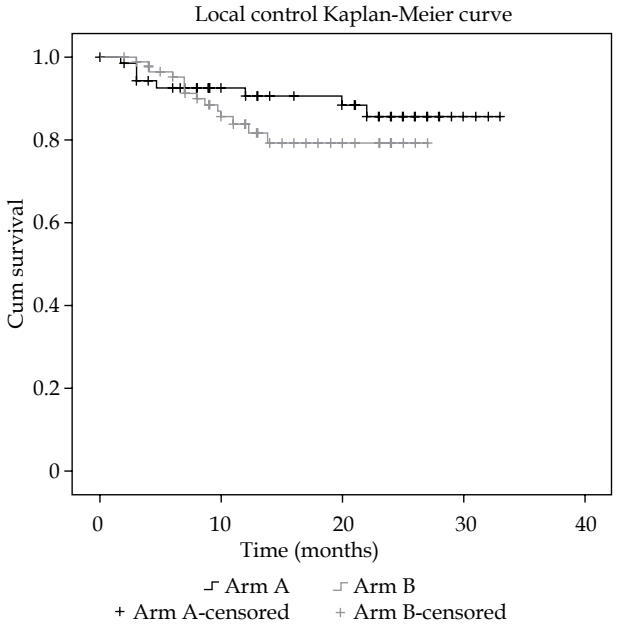

Fig. 1. Actuarial local control in 2 years, $p = 0.3$

Local response

Complete response was achieved on first follow-up at six weeks in 73.2% and 67.4% in arm A and arm B, respectively ($p = 0.53$), as presented in Table 3. In arm B, two patients reported progressive disease, with one presenting vesicovaginal fistula (VVF) on assessing local response (LR) at first follow-up. The margins of VVF were everted and tested positive for malignancy. On subsequent follow-up, this patient developed distant metastasis in the lumbar spine, pelvic nodes, and lungs.

Acute gastrointestinal toxicities were reported in 14.1% and 18.5% in arm A and arm B, respectively ($p = 0.66$). At the same time in arm A, acute hematological toxicities were reported amongst 16.9% and in 25% of cases in arm B ($p = 0.35$). The acute toxicities observed were mostly grade 1 and few of grade 2. These were easily manageable, and patients tolerated the treatment well. None of the patients experienced higher grade acute toxicities.

Table 2. Patterns of failure in the two brachytherapy treatment arms

Patterns of failure	Arm A (7 Gy/session) *n* patients (%)	Arm B (9 Gy/session) *n* patients (%)	*P* value
Local failure	9 (12.7)	14 (15.2)	0.9*
Distant failure	6 (8.5)	7 (7.6)	0.8*
Local along with distant failure	12 (16.9)	19 (20.7)	0.5*
Overall failure	27 (38.1)	40 (43.5)	0.06*

**using Chi-square test*

Overall survival

The actuarial 2-year overall survival (OS) rates in arm A and arm B were 95.7% and 100%, respectively (Figure 3), although the difference did not reach any statistical significance ($p = 0.06$).

Late toxicities

Late toxicities were graded according to RTOG/EORTC criteria (Table 4). Rectal toxicities were seen in 4 patients in arm A and in 5 patients in arm B. Although, there was an increased overall late toxicity in arm B when compared to arm A, the difference was not statistically significant ($p = 0.21$). Grade III or more severe late toxicities were not seen in patients in both treatment groups. The dose was also calculated at ICRU rectal and bladder points. The median total rectal EQD_2 in arm A from combined EBRT and brachytherapy sessions was 57.5 Gy (range, 49.5-67.8 Gy), and 57 Gy (range, 50.9-67.8 Gy) in arm B.

Grade 1 bladder toxicities were observed in 2 patients in both the arms. None of the patients experienced higher grade bladder toxicities in either treatment group.

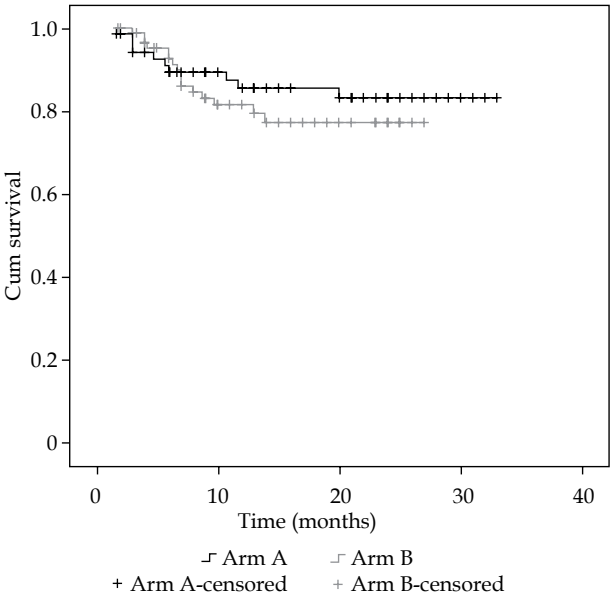

Fig. 2. Actuarial 2-year disease-free survival, Kaplan-Meier curve, $p = 0.5$

Table 3. Local response at first follow-up and acute toxicities

Local response at first follow-up			
Patterns of failure	**Arm A (7 Gy/session) *n* patients (%)**	**Arm B (9 Gy/session) *n* patients (%)**	***P* value**
Complete response	52 (73.2)	62 (67.4)	0.53*
Partial response	18 (25.4)	27 (29.3)	
Progressive disease	1 (1.4)	2 (2.2)	
Vesico-vaginal fistula	0 (0)	1 (1.1)	
GI toxicities			
Grade 1	5 (7.0)	7 (7.6)	0.66*
Grade 2	5 (7.0)	10 (10.9)	
Acute hematological toxicity			
Grade 1	9 (12.7)	13 (14.1)	0.35§
Grade 2	3 (4.2)	9 (9.8)	
Grade 3	0 (0)	1 (1.1)	
GU toxicity			
Grade 1	2 (2.8)	6 (6.5)	0.9*

**using Chi-square test, §using Fischer exact test*

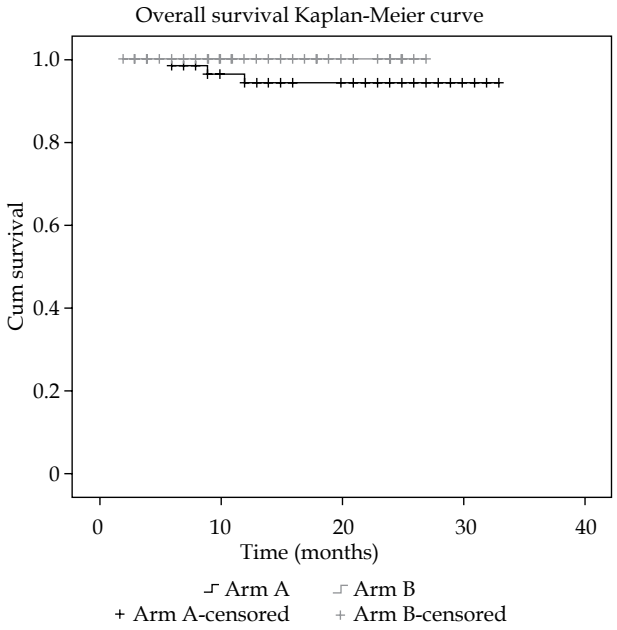

Fig. 3. Actuarial 2-year overall survival, $p = 0.06$

The median total bladder EQD_2 in arm A from combined EBRT and brachytherapy sessions was 55.9 Gy (range, 47.4-68 Gy), and 56.75 Gy (range, 49.4-73 Gy) in arm B.

No correlation was noted between the toxicity rate and the dose received at ICRU bladder and rectal points in both the arms.

When comparing late toxicities in terms of EBRT dose/fractionation schedules, six patients reported rectal toxicities in 50 Gy/25 fractions group and three patients in 45 Gy/25 fractions group, but p value was not significant. Three patients experienced late bladder toxicity in 50 Gy/25 fractions group and one patient in the other EBRT schedule group. However, the difference was not statistically significant (Table 5).

The 2-year actuarial risk of developing any late rectal toxicity in arm A and arm B were 5.6% and 5.4%, respectively. The 2-year actuarial risk of developing late bladder toxicity in arm A and arm B were 2.8% and 2.2%, respectively.

The actuarial 2-year disease-free survival was also compared in the two treatment groups in the early and locally advanced disease. Stages IA, IIA, and IIB were included in early stage, and stages III and IVA was included in locally advanced disease for evaluation of results. In early stage, two graphs could not be drawn since in both groups, only one event of each occurred, i.e., both 80%. In locally advanced stage, 2-year disease-free survival was better in arm A (89.4%) than arm B (85.1%), but the difference was not statistically significant ($p = 0.4$) (Figure 4).

Discussion

With availability of documented evidences, the treatment of cervical cancer is evolving. Despite the trends of declining utilization, brachytherapy is an integral component in the treatment of cancer cervix. ICBT has the advantage of delivering high dose to the tumor and restricting the dose to normal nearby structures, such as bladder and rectum. Therefore, for adequate tumor control, ICBT is irreplaceable.

Henschke *et al*. and O'Connell *et al*. introduced HDR remote afterloading brachytherapy in early 1960 [10,11]. Nowadays, HDR brachytherapy has replaced LDR

Table 4. Late toxicities in the two arms

Patterns of failure	Arm A (7 Gy/session) *n* patients (%)	Median time to toxicity (months)	Arm B (9 Gy/session) *n* patients (%)	Median time to toxicity (months)	*P* value
Rectal toxicity					
Grade 1	1 (1.4)	10.25	4 (4.3)	11.7	0.21$
Grade 2	3 (4.2)		1 (1.1)		
Grade 3	0 (0)		0 (0)		
Bladder toxicity					
Grade 1	2 (2.8)	19.5	2 (2.2)	18.2	
Grade 2	0 (0)		0 (0)		

**using Chi-square test, $using Fischer exact test*

Table 5. Late toxicities in the two treatment arms as per EBRT dose

Patterns of failure	EBRT dose 45/25 *n* patients (%)	EBRT dose 50/25 *n* patients (%)	*P* value
Rectal toxicity			
Arm A	1 (2.8)	3 (8.3)	0.94$
Arm B	2 (11.6)	3 (4.0)	
Bladder toxicity			
Arm A	1 (2.8)	1 (2.8)	0.25$
Arm B	0 (0.0)	2 (2.7)	

$using Fischer exact test

brachytherapy considering the advantages of delivering high dose in less time, better geometric placement, no hospital admission required, reduced immobilization time, lesser number of medical personnel needed, and decreased radiation to health care workers. Viani *et al*. in a meta-analysis of 5 RCT (2,065 patients) comparing HDR to LDR in cervical cancer cases showed no significant differences between HDR and LDR for OS, LR, and late complications for clinical stage I, II, and III [12]. Lertsanguansinchai *et al*. in a phase III randomized trial with 237 patients showed comparable outcomes between LDR and HDR intracavitary brachytherapy in cancer cervix. The 3-year pelvic control rates were 89.1% and 86.4% in LDR and HDR groups, respectively [13].

The efficacy of HDR brachytherapy can be improved by using 3D MRI-guided brachytherapy (IGBT). The use of 3D brachytherapy technique presented a trend towards an increased local control and improved overall survival with reduced toxicity, compared to the conventional 2D brachytherapy technique [14].

The aim of our present study was to compare two treatment schedules of HDR ICBT in cancer cervix in terms of late toxicities, local control, disease-free survival, and overall survival rates. In the past, many studies have compared higher dose per fraction with ABS recommended schedule, and the presented results are rewarding [7,8,9,15].

According to a survey conducted by Bandyopadhyay *et al*. amongst young radiation oncologist of India regarding treatment of locally advanced carcinoma cervix, the most common brachytherapy dose patterns practiced for all stages were 7 Gy in 3 fractions and 9 Gy in 2 fractions. They concluded, that although fractionation patterns may vary, the overall mean dose administered for cervical cancer is similar across the country, which is slightly lower than the recommended doses per stage by various international guidelines [16].

Sharma *et al*. provided the results of 42 locally advanced cervical cancers patients treated with two weekly sessions of HDR-ICBT, with 10 Gy each delivered 1 week after pelvic EBRT. The 3-year overall survival rates for all stages were 47%, and the 3-year recurrence-free survival for stage IIB, IIIB, and IVA were 67%, 34%, and 20%, respectively [17]. Clinical results have shown that weekly HDR-ICBT schedule (2 × 10 Gy) is associated with low toxicity, decent local control, and survival rates, thereby proving its clinical feasibility.

Patel *et al*. reported 5-year results of 121 patients of stage I to III cancer cervix treated with HDR brachytherapy with 9 Gy in two fractions, 1 week apart, interdigitated with EBRT. The 5-year actuarial local control and disease-free survival rates were 74.5% and 62.0%, respectively. None of the patients developed grade 3 rectal toxicity. Grade 3 bladder toxicities were observed in 2 patients. The actuarial risk of grade 3 or worse late toxicity was 3.31%. The authors concluded that HDR brachytherapy in cancer cervix at 9 Gy per fraction is both safe and effective, with good local control and acceptable normal tissue toxicity [7].

In another prospective randomized trial by the same author, the patients in HDR arm who received 2 fractions of 9 Gy per fraction had local pelvic control rates and 5-year DFS rates of 73.8% and 53.6%, respectively. Rectal complications were noted in 6.9% of patients and incidence of more severe complications of grades 3 to 5 was at the level of 0.5%. The bladder morbidity was 3.5% [18].

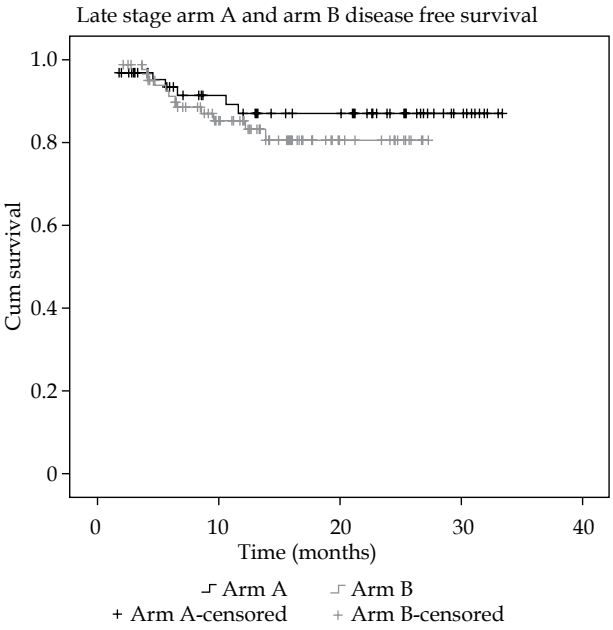

Fig. 4. Actuarial 2-year disease-free survival at locally advanced stage in two arms, Kaplan-Meier curve, $p = 0.4$

The ABS recommended schedules have not been thoroughly tested clinically. Due to paucity of clinical experience, bio effect dose models (mainly LQ model) has been used to convert HDR to LDR equivalent doses. However, clinical experience is far more superior to theoretical calculations for constituting treatment guidelines and can be implemented confidently. Thus, clinical studies are needed and HDR dose fractionation schedules are required to be tested, as this provides confidence in treating patients.

Orton *et al*. in an analysis of over 1,700 cervical cancer cases showed that morbidity rates were significantly lower in fraction size < 7 Gy as compared to fraction size > 7 Gy, but the cure rates in both groups were equivocal [19]. This suggests that normal tissue complication rates may be decreased by adequately using midline blocking techniques as well as proper vaginal packing and rectal retraction techniques.

Most of the data of HDR brachytherapy comes from developed countries, although cervical cancer is widely prevalent in developing countries. Cervical cancer is on the top of list of cancers in Indian females. Therefore, there is an urgent need to develop treatment guidelines suitable for our set up.

Patel *et al*. documented clinical experience of comparing their institutional protocol of 9 Gy per fraction in 2 fractions, one week apart, with a radiobiological equivalent dose of 6.8 Gy per fraction in total three fractions at weekly intervals. The 3-year actuarial LC rate for 9 Gy and 6.8 Gy arms (81.35% vs. 65.18%, respectively) and

DFS rates (64.97% vs. 49.47%, respectively) were significantly better in the 9 Gy arm [9].

In a similar study on Indian patients by Saptrishi Ghosh, 7 Gy in 3 fractions schedule was compared to 9 Gy in 2 fractions. The author concluded that HDR ICBT with 9 Gy per fraction in two fractions is as effective as that of 7 Gy per fraction in three fractions, in terms of local control, disease-free survival, and overall survival. Although the late toxicities were higher with the 9 Gy per fraction HDR ICBT schedule when compared to that of 7 Gy per fraction, most of them were of low grade and thereby easily manageable [8].

The results of a randomized controlled trial comparing similar ICBT schedules are awaited [20].

There appears to be a possibility of reducing treatment time in cancer cervix. It is a well-known fact that reducing the treatment time in cervical cancer has a radiobiological significance, which converts into better tumor control. Fyles showed a loss of local control, approximating 1% per day for treatment prolongation of 30 days, especially in locally advanced stages (III-IV) [21]. Lanciano *et al*. reported a highly significant decrease in pelvic tumor control and survival with prolongation of treatment time. They described a 4-year actuarial infield recurrence rise from 6% to 20%, when total treatment time increased from 6 weeks or less to 10 weeks ($p = 0.0001$) [22].

Treatment time in cancer cervix patients can be reduced by either interdigitating ICBT with EBRT or starting ICBT immediately after completion of EBRT. However, the majority of our patients present in locally advanced stage. In our study, more than 60% patients presented in stage IIB, and more than 28% patients presented in stage IIIB. Thus, interdigitation of ICBT with EBRT is insufficient due to anatomic distortion and bulky disease. Also, EBRT results in mucosal and skin toxicity, which becomes pronounced at the end of treatment and thus, requires a small interval for healing before ICBT could be started. In view of the above hurdles in early initiation of ICBT, the treatment time can be reduced by increasing brachytherapy fraction size. Thus, 9 Gy in 2 fractions remains an attractive option in a country like ours, where patients present in locally advanced stage, the burden of disease is high, and resources are limited. Lesser number of fractions will also reduce the cost of treatment.

Also, in a country like India, where infrastructure is limited and patient burden is ever-increasing, lesser number of HDR fractions will reduce brachytherapy waiting time and workload in an institute. Our institute caters the population of the whole state; therefore, there is a long waiting time for ICBT. Lesser number of HDR fractions will reduce this waiting time and further decrease the overall treatment time.

Few large fractions offer an additional advantage of improved patient compliance. It has been noticed in our institute that patients who are planned for 3 fractions of ICBT, usually default for third fraction. Patients come for treatment from various remote places, traveling in hilly areas every week for three or more weeks, which makes it difficult for patient to comply to treatment.

Khor *et al*., in a retrospective analysis, presented long-term results of 106 cervical cancer cases treated with HDR brachytherapy in a single center in Singapore. They summarized that the use of fewer fractions of HDR brachytherapy (compared with the ABS recommendations) with whole-pelvis XRT, without compromising tumor control, has positive economic implications for less developed countries having high cervical cancer prevalence and limited RT resources [23].

In our study, only 2 patients developed grade 1 bladder toxicity in 9 Gy arm and no patient developed higher grade. Also, grade 2 rectal toxicity was seen in 1 patient and grade 1 in 4 patients. This low rate of toxicities can be attributed to vaginal packing and rectal retractors (with ring applicators) judiciously used to displace the normal organs at risk as far as possible. The geometrical symmetry of applicators and vaginal and rectal packing is comfortably and effectively maintained, as HDR is a quick procedure. This advantage compensates for the radiobiologic loss of therapeutic ratio, when few large fractions are used.

However, two-year follow-up is sufficient to compare late toxicities, mainly rectal and bladder, but longer follow-up may lead to better evaluation of local control rates and overall disease-free survival rates. Thus, longer follow-up and more patient data may be needed to conclusively comment on the survival rates.

Conclusions

ICBT treatment with 9 Gy in two fractions offers equivocal local control rates and survival rates in cancer cervix cases, with many advantages including short overall treatment time, improved patient compliance, cost effective as less hospital admissions are required, and reduced exposure to anesthetic agents. Moreover, the toxicities observed are few, low grade, and easily manageable.

Disclosure

The authors report no conflict of interest.

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