



A Prospective Study to Compare Concomitant Boost Radiotherapy and Conventional Radiotherapy in Oral Cavity Cancer



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Abstract

Background: India accounts for the highest incidence of oral and oropharyngeal cancers. For early stages, chemoradiotherapy or surgery are equally effective. For advanced stages require multimodality treatment. Standard chemoradiotherapy requires 2Gy per fractions, 5 fractions per week for 7 weeks. Accelerated repopulation sets in the 4th week of conventional radiation. To offset this effect, concomitant boost radiotherapy may be used. This study was designed to compare prospectively conventional chemoradiotherapy with concomitant boost chemoradiotherapy.

Materials and Methods: Total 60 patients (30 for Arm A- conventional chemoradiation and 30 for Arm B- concomitant Boost) were selected from the cross section of patients registered at the J. K. cancer institute and other associated hospitals of G. S. V. M Medical College, Kanpur from December 2016 to August 2018. Histologically proven carcinoma patients by way of biopsy were evaluated. The data thus obtained were assessed, analyzed and compared to find out difference in all the groups in terms of tumor response and quality of life by using t test.

Results: Out of 30 patients, in Arm A, 13 (43.33%) and in Arm B, 12 patients (40%) had complete response (CR) and the rest of the patients had partial response except for 3 patients and 4 patients in Arm A and 5 patients and 4 patients in Arm B they had stable disease progressive disease respectively.

Conclusion: Concomitant boost radiotherapy with concomitant cisplatin has a response comparable to the conventional chemoradiotherapy regimen with not significantly higher cases of oral mucositis. CBT is easily tolerated by patients, with slight enhancement in acute reactions and so far, has given much better results as compared to conventional RT alone.

Keywords: Concomitant Boost; Chemoradiotherapy; Mucositis; Oral Cavity; Oropharyngeal Cancers

Introduction

Head and neck cancer are the sixth most common type of cancer in the world, more than 2 lakh new cases of head and neck cancer are diagnosed each year. India contributes to up to 7.8% of the global cancer burden and 8.33% of global cancer deaths [1]. India accounts for the highest incidence of oropharyngeal cancer in the world with over 1,00,000 cases registered annually [2]. In head and neck cancers, the chemoradiotherapy has been identified as a standard therapeutic method in [3-4]. Work of Maciejewski [5] & Withers [6], showed that with increasing overall time the total dose to cure a tumour of the head and neck area had to be raised, this was attributed to repopulation, which may not be important until the third week of a course of treatment. Accelerated regimens with shortened overall duration of treatment were therefore investigated with the aim of reducing the time in which cel-

lular repopulation could occur. Several randomized clinical trials have shown an increase in local control using accelerated or hyper fractionated radiotherapy [7-10]. A meta-analysis showed that altered radiotherapy with new fractionating schedules, achieved an increase of 7% in local control and 3% in survival at 5 years [11].

Several studies have attempted to determine the dose of radiation necessary to overcome the effects of tumor regeneration. Withers et al. [6] analyzed the dose equivalent of regeneration during therapy. They suggested that tumor clonogens undergo an accelerated repopulation after a certain period of time, and that an additional 0.6 Gy is required for each day of therapy beyond the time when repopulation sets in [12]. It was estimated that this phenomenon of accelerated repopulation begins in the fourth week of a conventionally fractionated schedule, based on

a retrospective analysis of local control rates in tonsillar carcinomas achieved at different international centers using a variety of fractionation schedules [13]. Unfortunately, simply adding this supplementary dose to overcome repopulation could potentially increase late effects on normal tissue. An alternative method was to shorten the time of therapy to prohibit accelerated repopulation from occurring. Multiple fractions per day might not be required if one could deliver larger doses per fraction to the tumor only, while maintaining lower doses per fraction to subclinical disease and normal tissues. Butler and colleagues have described an initial experience with this approach, with encouraging results that warrant further study [14]. Two randomized trials, in Denmark [15] and Poland [16], evaluated conventional therapy with five fractions per week, compared to accelerated regimens using six to seven fractions per week. Total dose and fraction size remained the same, resulting in a shortening of treatment time by 1 or 2 weeks. In Vancouver, Canada, Jackson and associates attempted a greater reduction in overall treatment time, delivering 66 Gy in 33 fractions in either 45 to 48 days or 22 to 25 days [17].

Radiation for head and neck cancers involves delivery of both a planned dose to the gross tumor and a lesser dose to sites of microscopic or subclinical disease. Conventional radiation delivers 50 to 54 Gy to these subclinical sites, and then the radiation portals are reduced in size to deliver the "boost" to the gross disease. Concomitant-boost therapy delivers this boost on the same days that the therapy to subclinical disease is given. Concomitant boost radiotherapy (CBT) despite being a variant of accelerated fractionation, is associated with minimal increase of acute reactions because it uses the concept of accelerated fractionation while minimizing the volume of tissue that is irradiated with high doses.

Materials and Methods

This study accrued a total of 60 patients (30 for Arm A- conventional chemoradiation and 30 for Arm B- concomitant Boost) registered in the J. K. cancer institute, Kanpur from December 2016 to August 2018. The eligibility criteria included histopathologically confirmed squamous cell carcinoma of the oral cavity.

Patients accrued for study underwent pretreatment evaluation which included complete history, physical examination, complete systemic examination. Patients were assessed their general condition by KPS and BSA. Their hematological assessment was done by complete hemogram, biochemical assessment of kidney and liver function, radiological assessment. Dental assessment and care. Patients were staged according to AJCC staging system.

Based on the above assessment the patients for the study were selected depending on histologically proven cases of Carcinoma, Karnofsky Performance Status > 70, early and locally advanced oral cavity cancer. Complete hemogram with Hb>10gm/dL; TLC-4000 to 11000/cmm, Platelet count >100,000/cmm. Renal function tests with Blood urea < 40mg/dL and Serum creatinine< 1.5mg/dL. Liver function tests with SGOT < 35 IU/L and SGPT < 40 IU/L. Patients who sign the informed consent and are ready

to be on follow up as required. The patients having any of the following conditions were excluded from the study: Prior radiation, surgery or chemotherapy for the disease, poor general condition with Karnofsky Performance Status of <70, pregnant or lactating patient, associated medical condition such as renal disease, liver disease or heart disease

And thus, the patients fulfilling the Inclusion criteria and exclusion criteria were randomized into two Arms as followed:

Arm A: Received RT as conventional fractionation (200cGy per fraction), 5 days a week, shrinking the field anterior to the cord after 46 Gy. A total of 70 Gy was given with concurrent Inj. Cisplatin 100mg/m² 3 weekly.

Arm B: Received RT in the form of concomitant boost. In this group, the large field was given 45 Gy (1.8 Gy per fraction) daily for 5 days a week for 5 weeks. The remaining 27 Gy were given as boost in 15 fractions to the small field at an interval of 6 hrs. in the first 3 weeks of treatment. A total of 72 Gy was given with concurrent Inj. Cisplatin 100mg/m² 3 weekly.

From the commencement of treatment, all the patients included in the study were carefully and regularly assessed weekly during treatment. Radiation reactions were assessed by Radiation Therapy Oncology Group (RTOG) criteria. Tumor response (both primary and nodal response) were assessed by RECIST (1.1) response criteria 2 months after completion of Radiotherapy. The major study endpoints were tumor response, acute and late toxicities and quality of life using University of Washington quality of life questionnaire version 4.0.

All the patients were assessed two weeks after the completion of treatment, to detect acute complications like mucositis, skin reaction, late reactions based on RTOG criteria. Patients were followed monthly up to a minimum of 6 months. Tumor response was assessed based on RECIST response criteria 1.1. All the patients were followed up regularly on OPD basis for a period of at least 6 months, once every month after completion of the treatment. At every visit, each patient was clinically evaluated for local control of disease and treatment related complications. The patients were assessed for any evidence of distant metastasis during each follow up. On suspicion of any local recurrence, biopsy was taken for histopathology and correlated clinically. The QOL were assessed at the beginning of treatment, on the day of completion of treatment and one month after completion of planned treatment using University of Washington QOL questionnaire. The data thus obtained was assessed, analyzed and compared to find out difference in all the groups in terms of tumor response and quality of life by using student t test.

Results

Total number of patients identified for the trial based on inclusion and exclusion criteria were randomized to arm A and arm B. All patients in both arms completed the assigned treatment. In our study age wise distribution in both arms were maximum

in age group 31 to 40 years. The median of age of both groups were 40 years. Chi-square = 1.19, degrees of freedom = 3, P value = 0.755, not significant. Sex wise distribution in both arms were maximum in male. Chi-square = 1.92, df = 1, P value = 0.166, not significant. Residence wise distribution in Arm A was more in rural i.e. 16 (53.33%) than in urban i.e. 14 (46.67%). However, in Arm B was more in urban 17 (56.67%). Chi-square = 0.601, df = 1, P value = 0.438, not significant. In our study, maximum involvement of the site was buccal mucosa followed by tongue. Chi-

square = 2.82, df = 5, P value = 0.728, not significant. Our study showed stages of cancer in patient of Arm A was more is stage third i.e. 13 (43.33%), followed by stage fourth i.e. 11 (36.67%), stage second were 6 (20%). However, in Arm B maximum were stage fourth 12 (40%), followed by stage third 11 (36.67%), stage second were 7 (23.33%). However, no patient of Arm A or Arm B was found in stage first. Chi-square = 0.373, df = 2, P value = 0.830, not significant (Table 1).

Table 1: distribution of patients into two groups.

	Parameter	Arm A (n=30)	Arm B (n=30)
Sex	Male	27	23
	Female	3	7
Median Age		40 years	40 years
Residence	Rural	16	13
	Urban	14	17
	Total	30	30
Site	Tongue	11	9
	Alveolus	4	3
	Buccal mucosa	13	15
	RMT	2	1
	GBS	0	1
	Hard Palate	0	1
	Stage	II	6
	III	13	11
	IV	11	12

Table 2: Histological Differentiation.

Characteristics No.		Arm A		Arm B	
		%	No.	%	No.
Histological differentiation	Well	17	56.67	19	63.33
	Moderate	10	33.33	7	23.33
	Poor	3	10	4	13.33
Total		30	100	30	100

Table 3: Duration of treatment and skin, mucosal reaction.

		Arm A	Arm B
Duration of treatment		49 – 72 days	35 – 70 days
No. of Chemo		1-3	0-3
Dermatitis	I	19	13
	II	6	12
	III	5	5
Mucositis	I	4	0
	II	26	18
	III	0	12
Ryle's tube		1 patient	3 patients

In our study histological differentiation in Arm A were well differentiated i.e. 56.67%, moderate 33.33% and poor was 10%. However, in Arm B, well differentiated were 63.33%, followed by

moderate 23.33% and poor 13.33% (Table 2). Our study showed that the duration of the treatment was 49 to 72 days in Arm A however 35 to 70 days in Arm B and number of chemotherapy 1-3

in Arm A and 0-3 in Arm B. In Arm A the dermatitis I was 63.33%, II was 20% and III was 16.67% in comparison to Arm B the I was 43.33%, II was 40% and third was 16.67%. In Arm A the mucositis

I was 13.33%, II 86.67% and III was 0% in comparison to Arm B I was 0%, II was 60% and III was 40%. Ryle's tube in Arm A was one patient and in Arm B 3 patients (Table 3).

Table 4: Shows response of the treatment.

Response	Arm A		Arm B	
	No.	%	No.	%
Complete Response (CR)	13	43.33	12	40
Partial Response (PR)	10	33.33	9	30
Stable Disease (SD)	3	10.00	5	16.67
Progressive Disease (PD)	4	13.33	4	13.33
Total	30	100	30	100

Our study showed the response of the treatment in Arm A 43.33% showed complete response, 33.33% showed partial response, 10% showed stable disease and 13.33% showed progressive disease in comparison to Arm B 40% showed complete response, 30% showed partial response, 16.67% showed stable disease and 13.33% showed progressive disease. Chi-square = 1.91, df = 3, P value = 0.591 (Table 4).

Our study showed post treatment most common complications in Arm A was dryness of mouth 56.67%, followed by pain

20%, trismus 6.67% and dysphagia 6.67% and loss of taste 3.33% in comparison to Arm B dryness of mouth 53.33%, followed by loss of taste 16.67%, neck lymphedema 13.33%, decreased mouth opening 13.33% and difficulty in swallowing 6.67% (Table 5). Our study showed disease free survival in Arm A was 2-24 (average 12) and in Arm B 3-20 (average 8). Duration of follow up in Arm A was 6-24 (average 15) and in Arm B 6-24 (average 8). Status on last follow up was in Arm A- NAD 19, salvage chemo 7 and BSC 4 and in Arm B NAD 21, salvage 7 and BSC 2 (Table 6).

Table 5: Post treatment most common complication.

	Arm A		Arm B	
	No.	%	No.	%
Dryness of mouth	17	56.67	15	53.33
Pain	6	20	0	0
Loss of taste	1	3.33	5	16.67
Neck lymphedema	2	6.67	4	13.33
Trismus	2	6.67	4	13.33
Disphagia	2	6.67	2	6.67

Table 6: Disease free survival, duration of follow up and status on last follow up.

	Arm A		Arm B	
Disease free survival	(2 - 24) Average=12		(3 - 20) Average=8	
Duration of follow up	(6 - 24) Average=15		(6 - 24) Average=8	
Status on last follow up	NAD	19	21	
	Salvage chemo	7	7	
	BSC	4	2	

Discussion

Concomitant boost radiotherapy was taken in the study keeping in mind the radiobiological aspects of accelerated fractionated radiotherapy. Concomitant boost radiotherapy has shown a better response than conventionally fractionated radiotherapy in various studies done [18-19,21-23]. Most successful treatment schedules attempt to administer the highest possible doses during the shortest possible time without doing much damage to the normal tissues and vital organs at risk. Concomitant boost radiotherapy has been tried keeping in mind the radiobiological aspects of accelerated fractionation RT [20], which gives beneficial results by decreasing the number of clonogen cells to a considerable extent

and without doing much harm to the normal cells [24]. The concomitant boost technique of administering twice daily radiation therapy during only part of the treatment course allows for an aggressive fractionation schedule and limits the volume of normal mucosa exposed to twice daily radiation therapy. The significance of accelerated repopulation in conventionally irradiated head and neck tumors has been reported [23-24]. The iso effective dose for tumor control significantly increases after 30 treatment days. Most successful treatment schedules attempt to administer the highest possible doses during the shortest time tolerable to early and late responding normal tissues.

Prolonged treatment time, for the purpose of this study was defined as completing treatment with a delay of more than 5 days. Patients who were able to complete their treatment within the stipulated time plus a 5-day allowance for logistical problems and public holidays were considered to have completed on time. Similar results were seen in the study by Rishi A, Ghoshal S et al. [25] where 74% patients in concomitant boost arm showed complete response as compared to 68% patients in chemoradiotherapy arm and the difference was statistically insignificant [25]. In a study by K Shrivastava, M Shrivastava et al. [26], out of 40 patients, 30 patients (75%) in concomitant boost arm and 24 patients (60%) in conventional chemoradiotherapy arm had complete response and the rest of the patients had partial response except for one patient in chemoradiotherapy arm who showed no response. The follow-up of the present study was relatively short and prevents us from commenting on the long term disease free survival, overall survival, and a more comprehensive evaluation of the late toxicities too. Another limitation of our study was the relatively smaller sample size and consequently, subgroup analyses could not be done.

Conclusion

The observations made in our study helped us arrive at a conclusion that concomitant boost radiotherapy with concomitant cisplatin has a response comparable to the conventional chemoradiotherapy regimen with not significantly higher cases of oral mucositis. But the need of the hour is that studies with larger sample sizes and longer follow-up should be instituted for further validation of the feasibility of concomitant boost radiotherapy and to get significant results so that we are able to consider concomitant boost radiotherapy as a routine practice in treatment of locoregionally advanced oral cavity and oropharyngeal carcinomas in future.

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