Volume : 5 | Issue : 8 | August 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

Post-Operative Radiotherapy to Cancer Breast: is Dose to Contra Lateral Breast is Significant?

Medical Science

KEYWORDS : contralateral breast dose, breast malignancy, thermoluminescent disc, scattered radiation

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ABSTRACT

Breast cancer is the most common malignancy in women worldwide. With improving survival figures and early breast cancer detection, treatment related long term adverse effects of radiotherapy have become a concern. Contralateral breast cancer due to scattered radiation during radiotherapy of diseased breast is one of them. This prospective clinical study was conducted to measure the dose received by the contralateral breast and compare the different techniques which influence this dose. It was found that in post mastectomy patients, treatment with telecobalt unit, medial tangential field contribute more dose to contralateral breast compared to supraclavicular field and lateral tangential fields. The mean dose received by contralateral breast during irradiation of chest wall was 168.29 cGy which was 3.36 percentage of the prescribed dose.

Introduction

Breast cancer is the most common malignancy among the women worldwide.[1]With improved survival figures due to early breast cancer detection and multimodality treatment, long term adverse effects in the form of second malignancy of contralateral breast (CLB) has become a concern. In patients getting radiotherapy to the affected breast, CLB also receives radiation in the form of scattered radiations due to scattered from primary. Second malignancy is a late sequel of radiation appearing at an interval of 10-15 years.[2-7]Since breast is highly radiosensitive structure this dose to CLB is a major concern especially in younger women and patients with longer life expectancy. Although radiation induced malignancy is a stochastic effect but the intensity increases linearly with increase in dose.[8] Studies have measured CLB dose on phantom and patients and have observed that the dose to CLB is more for medial tangential (MT) field than supraclavicular(SCL) field and lateral tangential (LT) field. In our center, 22% of female patients are suffering from breast cancer and majority of them belong to low socio economic status and presented with advanced disease. In the present study we measure the dose to CLB in patients receiving radiotherapy following modified radical mastectomy (MRM). The radiation dose to CLB was measured with the help of CaSO4: Dy thermoluminescent discs (TLD). The TLD are highly sensitivity and can measure even very small doses.

Materials and methods

Measurement of CLB was done in 25 patients undergoing for (external beam radiotherapy)EBRT by cobalt teletherapy machine(THERATRON 780 C and E) following MRM. pre-calibrated TLD (9mm×13mm) were placed on the surface of CLB. Total three discs were placed one at the nipple and other vertically on either side of nipple 3 cm apart. We tried our best to place the TLD on the same position each time. Skin tattooing was done to demarcate the exact position at the first sitting and this was used subsequently to replicate the position. After delivery of radiation dose for a particular field the discs were removed and another set of three discs were placed for next reading. In this way total six discs were used daily, three for SCL field and three for MT or LT field as MT and LT fields were treated on alternate days and SCL field was treated daily. For MT and LT fields breast cone was used for half beam block. Total dose delivered was 50 Gy in 25 fractions, 2 Gy per fraction, 5 fractions per week in 5 weeks. The exposed chips were stored in radiation free zone and the readings were taken after 24 hours and within 7 days after exposure because after seven days the TLD start to loose electrons. The scattered doses received by chips were measured on NUCLEONIX TL 10091 TLD reader. After one set of measurement, the discs were annealed by heating 400 degree Celsius and then used for next measurement. For each patient, measurements were carried out at first week, third week and last week, total three times during the course of treatment.

Statistical Analysis

We calculate the mean dose received by CLB. We also calculate the total dose received by CLB, this was calculated by multiplication of mean dose to number of fractions (mean dose× no. of fractions). The percentage of radiation dose received by CLB with respect to the prescribed dose to diseased breast (Total dose× 100 / prescribed dose to diseased breast) was calculated.We also stratified data based on gantry angle at which EBRT was delivered (≤50degree and > 50 degree).The statistical software SPSS version 20.0 was used for the data analysis.

Results

The age wise distribution of patients and the mean dose received by CLB is shown in table 1. 19 out of 25 patients in our study were 50 years or younger. 52% patients had left sided breast cancer. Table 2 shows the contribution of SCL, MT and LT field dose with the gantry angle at which the radiation dose was delivered. Total dose received by CLB varies from 1.22% to 5.82% of the prescribed dose of 50 Gy to the affected breast. Mean total dose received by CLB was 105.55 cGy with MT field followed by SCL field, (33.96 cGy) and LT field (28.97 cGy) as shown in table 2. This data shows that the maximum contribution of dose to CLB was with MT field followed by SCL field and LT field. Mean dose with all three fields received by CLB was 168.48 cGy with SD ±62.23 which corresponds to 3.36% of prescribed dose to affected breast. 11 patients were treated on cobalt unit with gantry angle ≤ 50 degree having 3.00% contribution of CLB dose (table 3). 14 patients treated with gantry angle > 50 degree had 3.79% contribution of CLB dose (p=0.199). The mean, median and range were 3.66, 3.34 and 4.60 respectively.

Discussion

It is well known that exposure to ionizing radiation causes carcinogenesis in healthy tissues. Although it is a stochastic effect having no thresholddose but the intensity increases with increase in radiation dose. CLB must be considered as an organ at risk during radiotherapy planning for treatment of cancer breast. Many previous studies conducted to calculate the dose received by CLB, were based on patients, phantom or treatment planning system.

Boice et al analyzed the record of 41109 patients of cancer breast and they found the mean CLB dose was 2.82 Gy.[9] They also hypothesized that there was increased relative risk of CLB malignancy due to exposure to ionizing radiation given to diseased breast. The relative risk was 1.19 for all patients, however the relative risk was more (1.49) for younger patients who were less than 45 years old. In our study, the maximum dose received by CLB in women below 40 years which was 3.93 percentage (196.437 cGy) of prescribed dose.The minimal dose was received in patients who were above 60 years of age (1.96 %)(97.875 cGy). The possible reason could be the increased laxity of breast tissues in older women because more lateral shifting of CLB away from the radiation at the time of exposure.

Half beam block technique is routinely used while irradiating the breast with tangential beams.[10, 11]Kelly et al measured CLB dose on Anderson Rando phantom using TLD with four different techniques of breast cancer treatment using 6 MV photon beam on linear accelerator.[12] The used half beam block with asymmetrical jaws, custom blocks and symmetrical collimator jaw. Another technique used was isocentric method with non-divergent posterior border. They observed highest dose to CLB in MT field with wedge. In our study radiation was delivered using half beam block with breast cone. The dose to CLB was maximum with MT field because in half block beam, the breast cone is placed near to surface of breast which cause increased dose due to secondary collimator scattering.

Bhatnagar et al compared dose to CLB during EBRT to chest wall irradiation using conventional tangential technique and intensity modulated radiotherapy (IMRT).[13] They observed 20 percentage reduction of dose to CLB using IMRT.

According to a study by Chougule, the average contralateral nipple dose was 152.5-254.75cGy and the percentage was 3.05-6.05% for a dose of 5000cGy in 25 fractions for post mastectomy breast cancer. [14]In our study, the measured mean contralateral nipple dose on was 171.88cGy(55.5-303.80cGy) which accounts to 3.47% (1.11%-6.07%) of prescribed dose (table 2). Dose measured at the level of nipple as compared to dose received by whole CLB was higher. This may be due to TLD at level of nipple being closest to the radiation source. According to Rankel et al with high gantry angle the beam will be closer to the surface leading higher dose to the CLB. [15] In this study, it was found that with gantry angle>50°, more dose was delivered to the CLB though the difference is not statistically significant (p=0.199).

In our patient cohort, higher inadvertent CLB dose was delivered in younger patients with MT field;overall, dose being 3.36 percentage of prescribed dose

Tables

Table1: Mean dose received by contralateral breast according to age.

Characteristics	Radiation dose (cGy)			
		Mean	S.D.	Percentage
Age in years	31-40	196.437	±44.80	3.93
	41-50	158	±72.26	3.16
	51-60	175.5	±50.69	3.51
	>60	97.875	±41.54	1.96
All Patients		168.29	±62.23	3.36

Table 2: Dose received by CLB with MT, LT and SCL fields.

CLB; Contralateral Breast, MT; Medial Tangential, LT; Lateral Tangential, SCL; Supraclavicular

S.NO.	AGE	SIDE	GANTRY ANGLE	DOSE(cGy)			TOTAL	T.DOSE (cGy)	Percentage	NIPPLE			TOTAL	TOTAL DOSE	Percentage
				MT	LT	SCL				MT	LT	SCL			
1	31	LT	52	6.88	1.22	1.46	9.56	239	4.78	7.94	1.18	1.29	10.41	260.25	5.21
2	31	RT	45	5.66	0.47	0.94	7.07	176.75	3.54	6.6	0.45	1.32	8.37	209.25	4.18
3	35	RT	50	3.44	1.15	1.02	5.61	140.25	2.81	3.51	1.17	0.92	5.6	140	2.8
4	35	RT	52	4.78	0.54	1.56	6.88	167	3.34	5.16	0.53	1.37	7.06	176.5	3.53
5	35	LT	59	7.01	2.48	1.72	11.2	280.25	5.61	7.07	2.8	1.59	11.46	286.5	5.73
6	38	RT	48	3.36	1.83	1.87	7.06	176.5	3.53	3.71	1.9	1.91	7.52	188	3.76
7	40	LT	56	5.17	1.35	1.19	7.71	192.75	3.86	5.19	1.17	1.22	7.58	189.5	3.79
8	40	RT	47	5.36	1.28	1.32	7.96	199	3.98	4.4	1.71	1.37	7.48	187	3.74
9	45	RT	60	6.93	1.01	1.59	9.53	238.5	4.76	6.6	0.89	1.73	9.22	230.5	4.61

Volume : 5 | Issue : 8 | August 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

10	45	LT	58	7.25	1.35	3.05	11.7	291.25	5.82	7.7	1.22	3.23	12.15	303.75	6.07
11	45	LT	45	3.23	0.45	1.55	5.23	130.75	2.62	2.3	2.02	1.13	5.45	136.25	2.72
12	45	LT	48	2.01	0.51	0.65	3.17	79.25	1.59	2.08	0.41	0.67	3.16	79	1.58
13	48	LT	46	2.56	0.78	1.14	4.48	112	2.24	2.26	0.76	1.07	4.09	102.25	2.04
14	50	LT	57	3.81	1.22	1.08	6.11	152.75	3.06	4.12	1.2	1.06	6.38	159.5	3.19
15	50	RT	59	1.55	0.42	0.46	2.43	60.75	1.22	1.83	0.42	0.41	2.66	66.5	1.33
16	50	RT	49	6.61	0.24	2.14	8.99	224.75	4.49	6.95	0.22	2.63	9.8	245	4.9
17	50	RT	60	4.14	2.63	1.21	7.98	199.5	3.99	4.33	1.75	1.32	7.4	185	3.7
18	50	LT	56	3.76	0.62	1.48	5.86	146.5	2.93	4.51	0.72	1.42	6.65	166.25	3.32
19	50	LT	45	2.72	0.59	0.77	4.08	102	2.04	3.21	0.58	0.73	4.52	113	2.26
20	55	LT	45	3.64	0.99	1.08	5.71	142.75	2.85	4.25	0.95	0.89	6.09	152.25	3.04
21	55	LT	55	6.86	1.57	1.44	9.87	246.75	4.93	7.35	1.88	1.76	10.99	274.75	5.49
22	60	RT	56	2.17	1.9	2.99	7.06	176.5	3.53	2.3	1.91	1.48	5.69	142.25	2.84
23	60	RT	65	2.89	1.48	1.07	5.44	136	2.72	2.5	1.53	1.19	5.22	130.5	2.61
24	64	RT	56	2.24	2.04	0.81	5.09	127.25	2.55	2.04	1.88	0.79	4.71	117.75	2.35
25	70	LT	50	1.52	0.85	0.37	2.74	68.5	1.37	1.46	0.41	0.35	2.22	55.5	1.11

Table 3: Medial Gantry Angle

Characteristics	Medial Gantry Angle		P Value
	≤50 Degree	>50 Degree	
Number of Patients	11	14	
Percentage of dose contribution	3.00	3.37	0.199

Legends

Table1: Mean dose received by contralateral breast according to age.

Table 2: Dose received by CLB with MT, LT and SCL fields.

CLB; Contralateral Breast, MT; Medial Tangential, LT; Lateral Tangential, SCL; Supraclavicular

Table 3: Medial Gantry Angle

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