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ORIGINAL ARTICLE

A Prospective Analytical Study of Pulmonary Toxicity Following Postmastectectomy Hypofractionated Radiotherapy Using Conventional Radiotherapy Techniques in Carcinoma Breast Patients

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ABSTRACT

Background: Breast cancer remains the most prevalent cancer among women, with a significant number of Indian patients being premenopausal and aged between 40–50 years. Radiotherapy plays a vital role in breast cancer treatment but may lead to pulmonary toxicity, including radiation pneumonitis (RP) and radiation fibrosis (RF), particularly in the lung tissue which is a critical organ at risk.

Objective: This study aims to assess pulmonary toxicity following post-operative hypofractionated radiotherapy using conventional 2D techniques in breast cancer patients. It specifically evaluates the incidence of RP and RF, correlates clinical and radiological findings, and analyzes associations with treatment-related factors.

Methods: A prospective observational study was conducted from March 2023 to March 2025 at the Department of Radiation Oncology, S.N. Medical College, Agra. Eligible post-mastectomy and breast conserving surgery patients receiving adjuvant hypofractionated radiotherapy (40 Gy in 15 fractions over 3 weeks) using conventional 2D techniques were enrolled. Baseline pulmonary function tests (PFTs), clinical assessments, chest radiographs, and simulation measurements (CLD, MLD, SLD, ILD) were recorded pre-treatment, and at 3 and 6 months post-treatment. CT imaging and PFTs (FEV1, FVC, TLC) will be used to assess RP and RF. Lung toxicity was graded using ATS criteria.

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KEYWORDS

• Breast cancer • Hypofractionated radiotherapy • Radiation pneumonitis • Radiation fibrosis • Pulmonary function test • Lung toxicity • 2D conventional radiotherapy

INTRODUCTION

Breast cancer is the most common type of cancer seen among females. In India, a higher proportion of patients with breast cancer tend to be premenopausal and the peak age is between 40 and 50 years. [1,2]

The management of breast cancer consists of the integration of surgery, chemotherapy, radiotherapy, hormonal therapy, and biological therapy.

Each mode of treatment is tailored according to the stage and characteristics of the particular patient's disease. Radiation therapy is an integral part of breast cancer management as it prevents local recurrence, reduces breast cancer related mortality and improves overall survival. In planning radiotherapy for breast cancer, lung is a major organ at risk. However, radiotherapy may induce lung tissue damage ranging from symptom free radiological changes to respiratory failure specially in 2D conventional radiation treatment. Lung toxicity after radiotherapy may present as radiation pneumonitis (RP) or radiation fibrosis (RF) with most common presenting symptom of dyspnoea.

Radiation pneumonitis is an early inflammatory reaction that occurs 4-12 weeks after completion of chest wall radiation while radiation fibrosis occurs after 6 months. [3] The reported frequency of radiation pneumonitis in breast cancer ranges from 1 to 80%. This wide range of incidence across studies is due to variations in simulation techniques, treatment schedules, treatment portals, total dose, use of photons/electrons and use of various grading systems and end points. [4]

Several risk factors for radiation pneumonitis following radiotherapy for breast cancer have been studied and a diversity of factors including age, BMI, irradiating lung volume, radiation dose, central lung disease, pre radiotherapy pulmonary functional level, and concurrent chemotherapy have been identified.

There are various studies on the changes in pulmonary function after loco-regional radiotherapy in carcinoma breast patients. In general, the studies have shown reduction in most pulmonary function parameters including Forced Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV1), Total Lung Capacity (TLC) within the first six months of radiotherapy completion.[5]

In developing countries there is scarcity of published data on hypofractionated radiation induced pulmonary toxicity.

This study was designed to assess the incidence of radiation pneumonitis (RP) in patients undergoing adjuvant hypofractionated radiotherapy by 2D conventional technique for breast cancer, to correlate the occurrence of radiological and clinical radiation pneumonitis and to evaluate the changes in pulmonary function test after adjuvant radiotherapy.

MATERIAL AND METHODS

This prospective analytical study was carried out during 1stMarch 2023 to 31st December 2024. All histo-pathologically confirmed post MRM patients with age range of 20 years to 70 years were included in the study. Patients having co-morbid diseases, on any respiratory medication, having past history of Tuberculosis or COPD, obese patients (having BMI >30) and patients with past history of Chest radiation therapy were excluded from this study.

Institutional Ethical Committee approval was taken before the enrolment of patients in this study.

All enrolled patients (fulfilling the inclusion criteria) underwent thorough clinical examination, lab investigations and imaging investigations.

Baseline pulmonary function tests (FEV1, FVC, FEV/FVC) were performed before radiotherapy. Patients received chest wall radiotherapy, with or without nodal areas, using hypofractionated radiotherapy (40 Gy in 15 fractions over 3 weeks) by Theratronics Phoenix Telecobalt machine. Positioning aids like breast boards ensured consistent alignment.

Tangential fields were used for chest wall treatment. Lung exposure was limited by maintaining a central lung distance (CLD) of 2–3 cm. Internal mammary and axillary fields were treated if indicated. Manual contouring and planning CT scans were used to assess irradiated lung volume and guide treatment.

Patients were followed up at 3 and 6 months with clinical evaluation, chest X-rays, and repeat PFTs. Radiation pneumonitis (RP) and fibrosis (RF) were assessed based on symptoms and radiological findings. Lung toxicity was graded using American Thoracic Guidelines. PFT changes were evaluated over time, and correlations with age, CLD, and lung volume were calculated.

Statistical method: All the data was entered in MS Excel and using a computer software, the data was analyzed statistically and presented as tables and graphs. The qualitative PFT parameters were presented as percentages and frequency. Their association was done using McNemar test by comparing the parameters at different time points among themselves. The final significance has been taken after applying Bonferroni corrections. The quantitative PFT parameters were also compared using Repeated Measure ANOVA followed by Tukey's test of multiple comparison. Pearson coefficient of Correlations was also calculated among the quantitative PFT parameters. Unpaired T-Test is used to study the correlation between percent of lung tissue involvement and Age and CLD parameter. A p-value <0.05 was considered significant.

RESULTS

A total 40 patients had been enrolled in this study. Out of these, 21 patients had completed the 6-month follow-up. So, 21 patients were eligible for the analysis.

Table 1: Demographic profile of patients and tumor characteristics

Age	
31-40 years	6 (29%)
41-50 years	13 (62%)
51-60 years	1 (4.5%)
61-70 years	1 (4.5%)
Laterality	
Right breast	14 (67%)
Left breast	7 (33%)
Histology	
Invasive ductal carcinoma	18 (86%)
Invasive lobular carcinoma	3 (14%)
Stage	
II A	3 (14.28%)
II B	5 (23.8%)
III A	11 (52.38%)
III B	2 (9.52%)

The mean age of the patient was 44 years with the minimum of 35 years and maximum of 61 years. Most predominated Stage was IIIA.

Table 2: Age Distribution and CLD

Parameter	% of Lung Tissue INV	N	Mean	Std. Deviation	P value (Unpaired t-test)	Significance
Age	16% (n=9)	9	43.11	6.17	0.335	Not Significant
	>26% l (n = 12)	12	46.00	6.94		
CLD	16% (n= 9)	9	2.72	0.67	<0.001	Highly Significant
	>26% (n=13)	12	4.35	0.49		

Age does not significantly differ between the two groups. The mean CLD was 3.65 cm with the minimum of 2 cm and the maximum of 5cm. (*p* value <0.001)

A mean CLD of 2.72 cm corresponds to 16% lung tissue involvement, which was observed in 42.85% (n=9) patients, while 57.14%(n=12) patients showed a mean CLD of 4.35cm, which corresponds to >26%of lung involvement. Thus, patients with higher lung tissue involvement (>26%) have significantly higher CLD scores, suggesting worse lung disease severity in this group.

Table 3: Showing Descriptive statistic of the FEV, FVC and FEV/FVC at different time points of measurement

Parameter	Time period	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
							25	50	75
FEV	Baseline	21	80.67	20.17	29	115	69.0	83.0	95.5
FVC		21	81.43	25.00	23	123	64.5	83.0	98.0
FEV/FVC		21	98.52	17.08	65	128	84.0	100.0	109.5
FEV	3 Months	21	78.43	15.68	48	113	67.5	73.0	88.0
FVC		21	80.57	17.74	43	117	68.0	83.0	94.0
FEV/FVC		21	98.38	12.53	74	130	92.5	98.0	102.0
FEV	6 Months	21	80.67	15.63	54	112	68.0	80.0	94.0
FVC		21	80.48	16.01	52	118	69.0	80.0	92.0
FEV/FVC		21	97.38	13.94	74	122	86.0	100.0	107.0

At baseline (before the start of treatment) mean FEV was found to be 80.67 with a minimum 29 and maximum 115 which reduced to a mean of 78.43 (minimum 48 and maximum 113) after 3 months, post radiation therapy. Later at 6 months mean FEV increased to 80.67 with minimum of 54 and maximum of 112.

At baseline mean FVC was 81.43 with minimum of 23 and maximum of 122 which reduced to a mean of 80.57 (minimum of 43 and maximum of 117) post 3 months of radiation therapy. Post 6 months, the mean FVC was 80.48 with minimum of 52 and maximum of 118.

At baseline FEV/FVC mean was 98.52 with the minimum of 65 and maximum of 128 which reduced to a mean of 98.38 (min 74 and maximum of 130) 3 months of post radiation therapy. At 6 months mean of 97.38 was observed with minimum of 74 and maximum of 122.

Table 4: Showing Descriptive statistic of SPO2

Parameter	Time period	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
							25	50	75
SPO2	Baseline	21	97.52	0.87	96	98	97.0	98.0	98.0
SPO2	3 months	21	96.67	0.97	96	98	96.0	98.0	98.0
SPO2	6 months	21	96.95	1.16	95	99	96.0	96.0	98.0

At baseline mean SpO2 was 97.52 with minimum of 96 and maximum of 98 that reduced to a mean of 96.6 (min 96 & max 98) after 3 months, post radiation treatment. At 6 months mean of 96.95 was observed with minimum of 95 and maximum of 99.

Table 5: Showing frequency distribution of all the qualitative parameters at different time points of measurement

Parameter		Base line		3 Months		6 Months	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
ATS	Mild	3	14.3	4	19.0	4	19.0
	Moderate	3	14.3	5	23.8	5	23.8
	Normal	13	61.9	11	52.4	11	52.4
	Severe	2	9.5	1	4.8	1	4.8
	Mixed	1	4.8	0	0.0	0	0.0
PLD	Normal	12	57.1	10	47.6	10	47.6
	Obstructive	1	4.8	0	0.0	0	0.0
	Restrictive	7	33.3	11	52.4	11	52.4

Symptoms	Cough Fever	2	9.5	1	4.8	1	4.8
	Dry Cough	1	4.8	2	9.5	3	14.3
	Wet Cough	0	0.0	0	0.0	1	4.8
	Nil	18	85.7	18	85.7	16	76.2
X-Ray	Consolidation	1	4.8	0	0.0	0	0.0
	Ggo	1	4.8	0	0.0	0	0.0
	Bronchtis			1	4.8	1	4.8
	Ned	19	90.5	18	85.7	18	85.7
	Nil	0	0.0	2	9.5	2	9.5

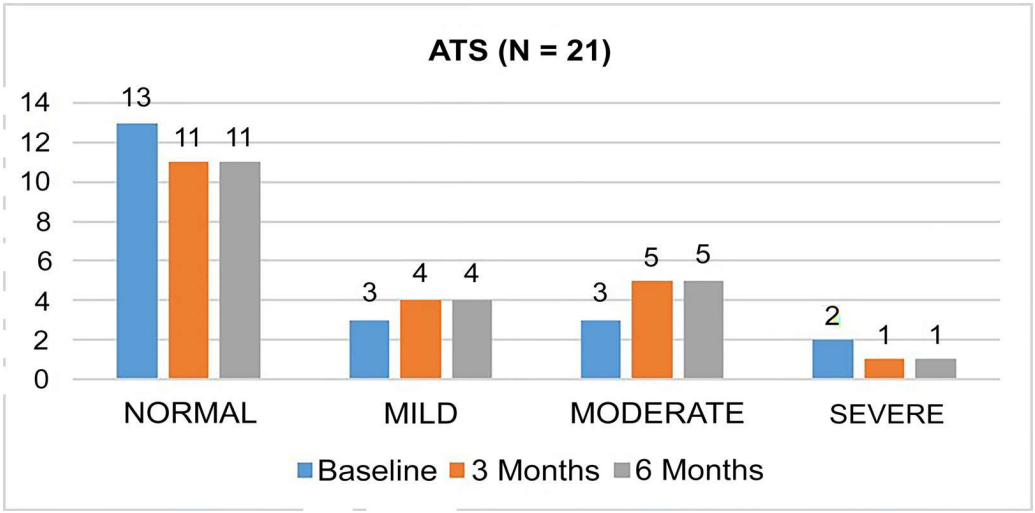

Figure 1: Grading of patients according to American Thoracic Guidelines

According to American Thoracic Society grading, patients belonging to normal grading were 61.9%, mild severity - 14.3%, moderate severity - 14.3% and for severe were 9.5%. At 3 months of completion of radiation therapy normal were 62.4%, mild 19.0%, moderate were 23.8% and severe were 4.8% (p value 0.504 insignificant). At 6 months of radiation therapy patients belonging to normal grading were 62.4%, mild 19.0%, moderate was 23.8% and severe were 4.8%.

According to ATS guidelines the percentage of patients in mild, moderate and severe grades increased at 3 months from baseline but remained stable at 6 months.

Pattern of lung disease

At baseline 57.15 of patients were normal, 4.8% of patients showed obstructive lung disease and 33.3% showed restrictive lung disease with 4.8% showing mixed type of lung disease pattern. After 3 months of completion of radiation therapy 47.6% of patients were normal whereas 52.4% of patients showed restrictive lung disease. At 6 months therapy 47.6% of patients were normal whereas 52.4% of patients showed restrictive lung disease.

Symptoms

At baseline, 85.7% of patients showed no symptoms, 9.5% of patients showed cough and fever 4.8% patients experienced dry cough. After 3 months of radiation therapy, 85.7% of patients had no symptoms, 4.8% patients experienced cough and fever and 9.5% of patients presented with dry cough. At 6months 76.2% showed no symptoms, 4.8% experienced cough and fever, 14.3% presented with dry cough and 4.8% experienced wet cough.

X-ray findings

At baseline 90.5% of patients showed no evidence of disease whereas 4.8% of patients showed consolidation and 4.8% showed ground glass opacity. After 3 months of radiation therapy 95.2% of patients showed no

evidence of disease whereas 4.8% of patients showed evidence of bronchitis. At 6 months 95.2% of patients showed no evidence of disease whereas 4.8% of patients of patients showed evidence of bronchitis.

Table 6: Showing comparative analysis of all the quantitative parameters measured at different time points

Parameter	Baseline (n =21)		3 Months (n = 21)		6 Months (n = 21)		P-value*	Significance
	Mean	Std. Deviation	Mean	Std. Deviation	mean	Std. Deviation	(F-test)	(Tukey test at 5%)
FEV	80.67	20.17	78.43	15.68	80.67	15.63	0.574	Not Significant
FVC	81.43	25.00	80.57	17.74	80.48	16.01	0.939	Not Significant
FEV/FVC	98.52	17.08	98.38	12.53	97.36	13.94	0.9.9	Not Significant
SPO2	97.52	0.87	96.67	0.97	96.95	1.16	0.032	Significant

The change in each lung volumes when compared baseline with 3 months and baseline with 6 months was insignificant. The change in each lung volumes when compared baseline with 3 months and baseline with 6 months was found to be significant but clinically inapparent since value of SpO2 of all candidates was in normal range.

Table 7: Showing Correlation of percent of lung tissue involvement with PFT parameters at different time points

Parameter	% of Lung Tissue INV	Baseline		3 Months		6 Months		P-value*	Significance
		Mean	Std. Deviation	mean	Std. Deviation	mean	Std. Deviation	(F-test)	(Tukey's test at 5%)
FEV0	16% (n=9)	82.67	20.06	78.11	17.01	82.33	13.44	0.517	Not Significant
	>26% (n=12)	79.17	21.00	78.67	15.38	79.42	17.58		
	P-Vakye (F-test)	0.79 (Not Significant)							
FEV3	16% (N=9)	81.22	24.13	81.78	17.79	77.44	14.63	0.909	Not Significant
	>26% (n=12)	81.58	26.69	79.67	18.43	82.75	17.25		
	P-Vakye (F-test)	0.888 (Not Significant)							
FEV6	16% (n=9)	107.89	11.40	101.44	9.41	101.22	11.67	0.806	Not Significant
	>26% (n=12)	91.50	17.61	96.08	14.41	94.50	15.26		
	P-Vakye (F-test)	0.086 (Not Significant)							
SPO2	16% (n=9)	98.00	0.00	96.44	0.88	97.11	1.05	0.016	Significant*
	>26% (n=12)	97.17	1.03	06.83	1.03	06.83	1.27		
	P-Vakye (F-test)	0.334 (Not Significant)							

*Baseline versus 3 months and Baseline versus 6 months are statistically significant only for percent of lung tissue involvement as 16% (n=9) (f test– repeated measure Anova)

Table 8: Showing Pearson coefficient of Correlation among all the quantitative parameters

Pearson Cofficient of Correlation (N=21)		AGE	CLD	FEVO	FVCO	FEV/ FVCO	FEV3	FVC3	FEV/ FVC3	FEV6	FVC6	FEV/ FVC6	SPO2-0	SPO2-3	SPO2-6
AGE	t-value	1.00	0.13	-0.33	-.474*	-0.10	-0.22	0.11	0.11	-0.15	-0.21	-0.03	-.557**	0.04	0.10
	p-value		0.58	0.15	0.03	0.66	0.65	0.34	0.63	0.50	0.35	0.89	0.01	0.88	0.68
CLD	t-value	0.13	1.00	0.11	00.13	-0.38	0.21	0.12	-0.23	0.09	0.30	-0.30	-0.35	0.17	-0.13
	p-value	0.28		0.63	0.56	0.09	0.36	0.60	0.31	0.69	0.19	0.19	0.12	0.46	0.58
FEV0	t-value	-0.33	0.11	1.00	.943**	-0.08	.782**	.874**	-0.23	.808--	.855**	0.07	0.28	-0.05	-0.27
	p-value	0.15	0.63		0.00	0.73	0.00	0.00	0.31	0.00	0.00	0.75	0.22	0.81	0.24

table cont...

FVC0	t-value	-4.74*	0.13	.943**	1.00	-0.10	.684**	.798**	-0.22	.715**	.819**	0.12	0.26	0.00	-0.29
	p-value	0.03	0.56	0.00		0.67	0.00	0.00	0.34	0.00	0.00	0.62	0.25	0.99	0.21
FEV/ FVC0	t-value	-0.10	-0.38	-0.08	-0.10	1.00	0.06	0.00	.634**	0.02	-0.07	0.01	0.44	0.04	0.66
	p-value	0.66	0.09	0.73	0.67		0.81	1.00	0.00	0.93	0.77	0.01	0.44	0.04	0.66
FEV3	t-value	-0.22	0.12	.874**	.789**	0.00	.919**	1.00	-0.19	.832**	.848**	0.06	0.13	-0.02	-0.04
	p-value	0.34	0.60	0.00	0.00	1.00	0.00		0.41	0.00	0.00	0.79	0.56	0.92	0.86
FEV/ FVC3	t-value	0.11	-0.23	-0.23	-0.22	.634**	-0.12	-0.19	1.00	-0.20	-0.22	.651*	0.12	-.460*	0.25
	p-value	0.63	0.31	0.31	0.00	0.62	0.41		0.39	0.34	0.00	0.61	0.04	0.25	
FEV6	t-value	-0.15	0.09	.808**	.715**	0.02	.850**	.832**	-0.20	1.00	.830**	0.02	0.18	-0.29	-0.24
	p-value	0.50	0.69	0.00	0.00	0.93	0.00	0.00	0.39		0.00	0.93	0.44	0.20	0.30
FVC6	t-value	-0.21	0.30	.855**	.819**	-0.07	.837**	.848**	-0.22	.830**	1.00	0.03	0.05	-0.17	-0.25
	p-value	0.35	0.19	0.00	0.00	0.77	0.00	0.00	0.34	0.00		0.91	0.84	0.46	0.28
FEV/ FVC6	t-value	-0.03	-0.30	0.07	0.12	.581**	0.07	0.06	.651**	0.02	0.03	1.00	-0.02	-0.14	-0.20
	p-value	0.89	0.19	0.75	0.62	0.01	0.77	0.79	0.00	0.93	0.91		0.94	0.55	0.39
SPO2-0	t-value	-.557**	-0.35	0.28	0.26	0.18	0.07	0.13	0.12	0.18	0.05	-0.02	1.00	-0.32	0.17
	p-value	0.01	0.12	0.22	0.25	0.44	0.75	0.56	0.61	0.44	0.84	0.94		0.18	0.45
SPO2-3	t-value	0.04	0.17	-0.05	0.00	-.453*	-0.15	-0.02	-.460*	-0.29	-0.17	-0.14	-0.32	1.00	-0.06
	p-value	0.86	0.46	0.81	0.99	0.04	0.51	0.92	0.04	0.20	0.46	0.55	0.16		0.80
SPO2-6	t-value	0.10	-0.13	-0.27	-0.29	-0.10	-0.07	-0.04	0.25	-0.24	-0.25	-0.20	0.17	-0.06	1.00
	p-value	0.68	0.58	0.24	0.21	0.66	0.75	0.86	0.28	0.30	0.28	0.39	0.45	0.80	

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

All correlations between CLD and lung volumes were weak and not statistically significant (p-values > 0.05). The highest correlation was with FVC6 (r = 0.30, p = 0.19), but it was still not strong or statistically significant. This suggests that CLD does not have a meaningful relationship with lung volume measurements in this dataset.

DISCUSSION

In our study mean age of presentation was 45(44.76). Most of the patients were case of Ca Right breast (66.66%). Most patients were ER positive (57%). PR and HERneu-2 positivity was seen in nearly equal patients which was less than ER positivity. Most of the patients presented with invasive ductal carcinoma (86%). Majority of patients belonged to Stage IIIA (52.38%) followed by Stage IIB (23.8%). The results showed that lung function parameters such as FEV, FVC, and FEV/ FVC ratio experienced a slight decrease at 3 months, post radiotherapy but returned to baseline levels after 6 months, indicating a temporary effect of the radiotherapy on lung function. The p-values for FEV, FVC, and FEV/FVC were not significant (p = 0.574, p = 0.939, p = 0.909, respectively). In contrast, the SpO2 level showed a significant decrease after 3 months of treatment (p = 0.032), but this decrease was found to be within the normal range of 96-100%, and it also improved after 6 months, indicating a transient impact on oxygen saturation during the radiotherapy period. FEV0, FEV3, and FEV6: No significant changes were found over time using the F-test and Tukey's test (not significant). SPO2: The F-test found significant differences (P=0.016), and Tukey's test confirmed

statistical significance. All correlations between CLD and lung volumes were weak and not statistically significant (p-values > 0.05). The highest correlation was with FVC6 (r = 0.30, p = 0.19), but it was still not strong or statistically significant.

This suggests that CLD did not have a meaningful relationship with lung volume measurements in this dataset. CLD score was significantly higher in patients with greater lung tissue involvement, indicating a strong association between lung damage and disease severity. At baseline, the majority of patients (61.9%) were classified as normal according to ATS grading, with small changes in severity observed at 3 months (62.4% normal, 19.0% mild, 23.8% moderate) and no further changes at 6 months. In terms of lung disease patterns, 57.15% of patients were normal at baseline, while 33.3% exhibited restrictive lung disease. After 3 months, 52.4% showed restrictive lung disease, a pattern that remained stable at 6 months. Symptom-wise, 85.7% were asymptomatic at baseline, but some developed dry or wet coughs after treatment, likely due to seasonal changes or mild infections. Chest X-rays showed little to no change, with the majority (95.2%) having no significant findings at both 3 and 6 months.

In conclusion, radiation therapy led to temporary changes in lung function and symptoms, with an increase in restrictive lung disease patterns at 3 months, which stabilized by 6 months. There were no notable radiographic changes, and the observed symptoms were likely mild and short-lived.

Jeba J *et al*. conducted a study that revealed a notable decrease in the mean values of FEV1, FVC, and TLC 12 weeks after radiotherapy, compared to the initial baseline measurements, with a statistically significant ($p<0.001$) across all patients. Among those who developed radiation pneumonitis (RP), there was a greater decline in TLC compared to those who did not, with a significant difference ($p=0.02$). If we compare it to our study FEV reduced by 2% at 3 months from baseline and later increased by 2%. Similary FVC reduced by 1% and increased by 2% at 6 months.[6] We did not include TLC in our study so no comparison for TLC between both the studies could be done. Patients with RP showed an average reduction of 9% in FEV1 and FVC, and a 14% decrease in TLC, whereas patients without RP experienced a smaller reduction of 6% in these parameters. Since our study was limited to a certain time period, we could not assess radiation pneumonitis and radiological fibrosis, nevertheless amongst the patient that we followed up till 6 months none showed Radiation pneumonitis.

Shaaban *et al*. observed a 4.7% incidence of radiation pneumonitis in patients treated with the 40 Gy/15 fraction regimen. While our study did not show any patient with radiation pneumonitis. We observed only 1 case with consolidation and another with ground glass opacity which was clinically not symptomatic. [7]Similarly, Rastogi *et al*. reported that Grade II or higher radiation induced pneumonitis occurred in 6% of patients in the conventional fractionation group, compared to 2% in those receiving hypofractionated radiotherapy.[8] In a separate study, Lingos *et al*. found that the incidence of radiation pneumonitis was 2.9%. [9]Shaltout *et al*. and Plataniotis *et al*. examined the occurrence of radiation pneumonitis following hypofractionated radiotherapy in patients with early-stage breast cancer, using high-resolution computed tomography (HRCT) of the chest to monitor radiation pneumonitis. They found minimal effects of radiation on the lung parenchyma.[10,11] Increasing the radiation dose per fraction in hypofractionated treatments may heighten the risk of late normal tissue damage. However, the linear quadratic model suggests that normal tissue toxicity remains relatively unchanged when the dose per fraction is moderately raised while the total dose is reduced, as seen in our case. Research has indicated that hypofractionated radiotherapy protocols are as effective as conventional radiotherapy, regardless of the disease stage or the type of breast surgery performed. Radiation-induced toxicity to the heart and lungs is a significant concern due to their close proximity to the chest wall. Pulmonary toxicity, particularly radiation pneumonitis, is directly related to the amount of lung tissue that is irradiated. Radiation pneumonitis typically involves interstitial inflammation in the irradiated area, along with symptoms such as a dry cough and/or mild fever.

Most studies examining radiation-induced pulmonary changes have focused on conventionally fractionated radiotherapy, offering insights into pulmonary effects in patients who underwent BCS. However, there is limited research on the impact of

hypofractionated radiotherapy on lung function, especially in postmastectomy breast cancer patients, as evaluated by pulmonary function tests (PFTs).

In a nut shell our study did not show any significant change in PFTs at baseline, 3 months and 6 months. Neither there was any change in signs and symptoms or radiological findings of X Ray Chest, which would mean that 2DRT can be used to deliver radiation in the modern era of 3DCRT and IMRT in financially deprived set up.

Limitations

The relatively small sample size means that the statistical findings should be viewed with caution. Additionally, being a single-center study, the results may not be generalized to the wider population. The overall duration of the study, which was about 24 months, included phases such as patient recruitment, treatment, and evaluation. As a result, it was not possible to assess long-term toxicity, as well as locoregional control and survival rates. In a resource-limited, high-demand government setting, 2D radiation therapy for breast cancer has been shown to be non-inferior to 3D radiation therapy, demonstrating effective outcomes despite the limited availability of resources.

CONCLUSION

The results of our study shows that there is no clinically meaningful and statistically significant difference in the incidence rates of radiation induce pulmonary toxicity between patients treated with hypofractionated radiotherapy by 2D RT techniques. However, evaluating late lung fibrosis requires a longer follow-up period than was conducted in this study. Our results support that hypofractionated radiotherapy (RT) is safe and does not lead to unacceptable levels of pulmonary toxicity. Furthermore, the use of 3D treatment planning, which focuses on minimizing the lung dose according to specific constraints, seems to effectively reduce pulmonary injury.

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