

THE FREQUENCY OF ACUTE PNEUMONITIS AS COMPARED TO IPSILATERAL LUNG DOSE IN PATIENTS OF BREAST CANCER RECEIVING POST-OPERATIVE RADIOTHERAPY INCLUDING INTERNAL MAMMARY NODES

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ABSTRACT

Objectives: To determine the frequency of acute pneumonitis in patients of breast including internal mammary nodal irradiation receiving Post-operative Radiotherapy.

Materials and Methods: After ethical approval, 57 patients were enrolled with informed consent and received post-operative radiotherapy (3D-CRT/IMRT). Ipsilateral lung dosimetric parameters (V5, V10, V20, MLD) were calculated. Patients were followed for three months to assess acute pneumonitis, which was graded using CTCAE v5.0. Data were collected via a structured questionnaire and analyzed using SPSS Version 25.

Results: The mean age was 53.64±12.06 years, with most patients aged 41–60 years. Mean dosimetric values were V5: 42.1±7.3%, V10: 30.2±6.1%, V20: 20.3±4.5%, and MLD: 12.8±2.6 Gy. Acute pneumonitis occurred in 33.3% of patients, mostly Grade 1, and all participants were non-smokers. Higher dosimetric values were significantly associated with pneumonitis ($p=0.00$), while age showed no significant association ($p=0.13$).

Conclusion: It was concluded that a significant association was found between higher ipsilateral lung radiation dose and acute radiation pneumonitis in breast cancer patients, while age had no significant effect, highlighting the importance of limiting lung dose (V5, V10, V20, MLD) to reduce risk.

KEYWORDS: acute pneumonitis, internal mammary nodal irradiation, breast cancer

INTRODUCTION:

Breast Cancer is the most common malignancy amongst females.(1) In today's era, post operation radiotherapy to the conserved breast or chest wall and regional nodes is the standard of care in appropriate T stage.(2) It significantly reduces loco-regional recurrence and overall recurrence. Axillary nodal irradiation is done in all N2 or higher stage patients. For N1 (1-3 nodes) patients, regional nodal irradiation is done if there are other risk factors for example T4 disease, lymphovascular space invasion, extensive extra nodal extension etc. There are separate indications of internal mammary nodal radiotherapy. Metastasis to Internal mammary nodes (IMN) has been demonstrated to occur in 28-52% of cases of axillary lymph node positive patients.(3) Standard treatment for breast cancer often includes surgery, followed by adjuvant radiotherapy to reduce the risk of local and regional recurrence.(4) Post-operative radiotherapy plays a particularly vital role in patients with lymph node involvement, as it targets potential microscopic disease in the chest wall and regional nodal basins, including the internal mammary nodes (IMNs), supraclavicular nodes, and axillary lymph nodes.

The inclusion of internal mammary nodes in the radiation field, while beneficial for oncologic control, poses a significant challenge due to their anatomical proximity to critical structures such as the heart and lungs.(5) Consequently, the adjacent lung tissue—particularly the ipsilateral lung (the lung on the same side as the treated breast) often receives incidental radiation exposure. This exposure increases the risk of developing radiation-induced lung toxicity, most notably acute radiation pneumonitis (ARP). Acute pneumonitis is a potentially serious complication characterized by inflammation of the lung parenchyma, typically presenting within weeks to a few months following the completion of radiotherapy.(6) Clinical manifestations may include cough, dyspnea, fever, and radiological findings of pulmonary infiltrates.(7) Although the incidence of ARP in breast cancer radiotherapy is generally lower compared to thoracic malignancies, its occurrence can significantly affect patient quality of life and may necessitate treatment interruption or medical intervention.

This study aims to determine the frequency of acute pneumonitis in patients with breast cancer receiving post-operative radiotherapy including internal mammary nodes, **and to** analyze its correlation with ipsilateral lung dose parameters. Understanding this relationship is crucial for optimizing treatment planning, balancing therapeutic benefits with the risk of complications, and improving overall patient outcomes.

Objective: To evaluate the response of elderly patients diagnosed with glioblastoma Multiforme (GBM) to hypo-fractionated radiation therapy in our population.

MATERIALS AND METHODS:

Study Design: Cross sectional study

Study setting: Department of Radiation Oncology, Combined Military Hospital, Rawalpindi.

Duration of the study: Duration of the study was 6 month (from June 2025 to Dec 2025).

Sampling Technique: Non-probability Consecutive sampling

SAMPLE SIZE: The sample size for this study was calculated using the WHO Sample Size Calculator version 1.1. With a confidence level of 95% and an anticipated population proportion of 18% (0.18), the required sample size is estimated to be 57 patients.

Selection criteria:

Inclusion criteria:

- Histologically confirmed breast cancer patients who have undergone surgical management
- Female patients of age 18 to 70 years.
- Patients scheduled to receive post-operative radiotherapy including coverage of internal mammary lymph nodes (IMNs).
- Patients receiving radiotherapy using 3D Conformal Radiotherapy (3D-CRT) or Intensity-Modulated Radiotherapy (IMRT) techniques.
- Clinical and/or pathological stage T1 to T4, N2, M0 according to the AJCC (American Joint Committee on Cancer) TNM staging system.

Exclusion criteria:

- Patients with distant metastasis (M1) at the time of diagnosis.
- Patients having history of prior thoracic radiotherapy for any other malignancy or condition.
- Presence of pre-existing pulmonary disease such as chronic obstructive pulmonary disease (COPD), interstitial lung disease, or pulmonary fibrosis that may confound the diagnosis of radiation pneumonitis.
- Patients with uncontrolled comorbidities, including severe cardiovascular disease, uncontrolled diabetes, or active infections.
- Patients receiving concurrent chemotherapy during radiotherapy, as it may increase the risk of radiation-induced lung injury and act as a confounding variable.
- ECOG performance status ≥ 3 .
- Patients who are pregnant or lactating.

METHODS

Following approval from the ethical committee of CMH and CPSP, patients meeting the selection criteria were enrolled in the study after obtaining written informed consent. A total of 57 patients were included. All enrolled patients received post-operative radiotherapy using advanced and standardized techniques, specifically Three-Dimensional Conformal Radiotherapy (3D-CRT) or Intensity-Modulated Radiotherapy (IMRT). These techniques were selected to ensure precise targeting of the treatment area while minimizing radiation exposure to surrounding healthy tissues. Radiotherapy planning for each patient was performed using specialized treatment planning systems, from which dosimetric parameters were extracted and documented for analysis.

For each patient, specific dosimetric values related to the ipsilateral lung, i.e., the lung on the same side as the treated breast, were calculated. These parameters included V5, V10, and V20, representing the percentage of lung volume receiving at least 5 Gy, 10 Gy, and 20 Gy of radiation, respectively, as well as the Mean Lung Dose (MLD), indicating the average radiation dose received by the entire ipsilateral lung.

Following completion of radiotherapy, all patients were closely monitored for a minimum duration of three months through clinical evaluation and radiological imaging (such as chest X-rays or CT scans) to identify the onset and severity of acute radiation-induced pneumonitis. The presence and severity of pneumonitis were graded and classified according to the Common Terminology Criteria for Adverse Events (CTCAE), version 5.0.

RESULTS

The mean age of the participants was 53.64 ± 12.06 years. Most patients belonged to the 41–60 years age group (49.1%), followed by those aged >60 years (31.6%) and 18–40 years (19.3%). The mean dosimetric parameters were as follows: V5 was $42.1 \pm 7.3\%$, V10 was $30.2 \pm 6.1\%$, and V20 was $20.3 \pm 4.5\%$, while the mean lung dose was 12.8 ± 2.6 Gy (Table 1). Acute pneumonitis was observed in 19 (33.3%) patients, while 38 (66.7%) did not develop pneumonitis. Regarding severity based on CTCAE v5.0, Grade 1 pneumonitis was seen in 10 (17.5%) patients, Grade 2 in 6 (10.5%), and Grade 3 in 2 (3.5%) patients. All participants were non-smokers, accounting for 57 (100%) of the study population (Table 2). Patients who developed acute pneumonitis had higher mean dosimetric values compared to those who did not. The mean V5 was $48.6 \pm 6.2\%$ in the pneumonitis group versus $39.4 \pm 5.8\%$ in the non-pneumonitis group. Similarly, V10 ($35.2 \pm 5.4\%$ vs $27.8 \pm 4.9\%$), V20 ($24.1 \pm 4.3\%$ vs $18.6 \pm 3.7\%$), and mean lung dose (15.3 ± 2.5 Gy vs 11.2 ± 2.1 Gy) were all higher among patients with pneumonitis. These differences were statistically significant ($p = 0.00$), indicating a strong association between increased ipsilateral lung dose and the occurrence of acute pneumonitis (Table 3). Acute pneumonitis was

observed across different age groups, with 1 (9.1%) case in patients aged 18–40 years compared to 10 (90.9%) without pneumonitis. In the 41–60 years group, 12 (42.9%) developed pneumonitis while 16 (57.1%) did not. Among patients aged >60 years, 6 (33.3%) had pneumonitis and 12 (66.7%) did not. The association between age groups and acute pneumonitis was not statistically significant ($p = 0.13$) (Table 4).

Table 1: Baseline Characteristics and Dosimetric Parameters of Study Participants ($n = 57$)

Variables	
Age (Years)	53.64± 12.06
Age Groups	
18-40 Years	11(19.3%)
41-60 Years	28(49.1%)
>60 Years	18(31.6%)
Dosimetric parameters	
V5 (%)	42.1±7.3
V10 (%)	30.2±6.1
V20 (%)	20.3±4.5
Mean Lung Dose (Gy)	12.8±2.6

Table 2: Frequency of Acute Pneumonitis, Severity Grade, and Smoking Status ($n = 57$)

Variables	no(%)
Acute pneumonitis	
Yes	19(33.3%)
No	38(66.7%)
Severity Grade (CTCAE v5.0)	
Grade 1	10(17.5%)
Grade 2	6(10.5%)
Grade 3	2(3.5%)
Smoking Status	
Non Smoker	57(100%)

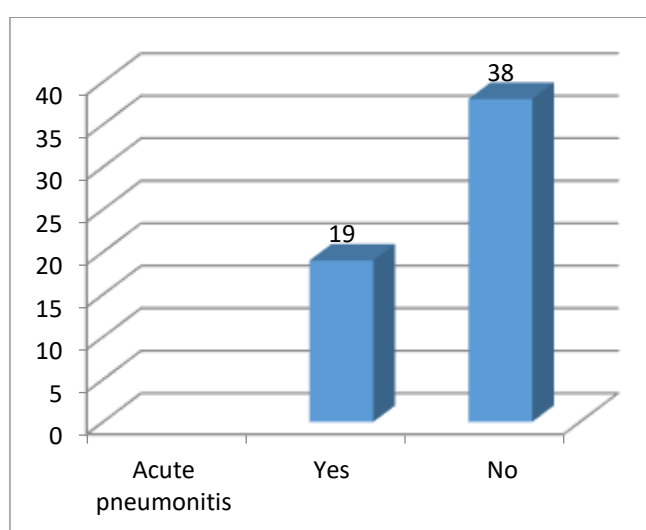


Fig 1: Frequency of patients on the basis of Acute pneumonitis

Table 3: Comparison of Dosimetric Parameters between Patients with and Without Acute Pneumonitis ($n = 57$)

Variables	Acute pneumonitis		p-value
Dosimetric Parameter	Yes	No	
V5 (%)	48.6±6.2	39.4±5.8	0.00
V10 (%)	35.2±5.4	27.8±4.9	0.00

V20 (%)	24.1±4.3	18.6±3.7	0.00
Mean Lung Dose (Gy)	15.3±2.5	11.2±2.1	0.00

Table 4: Stratification of Acute Pneumonitis by Age Groups (n = 57)

Variables	Acute pneumonitis		p-value
	Yes	No	
Age Groups			
18-40 Years	1(9.1%)	10(90.9%)	0.13
41-60 Years	12(42.9%)	16(57.1%)	
>60 Years	6(33.3%)	12(66.7%)	

DISCUSSION

The present study determines the frequency of acute pneumonitis in patients of breast including internal mammary nodal irradiation receiving Post-operative Radiotherapy. According to the findings, about one-third of the patients experienced acute pneumonitis, most of which had mild to moderate severity (grades 1-2). This is in line with earlier research showing that although contemporary radiation methods lower the risk, radiation-induced lung damage cannot be totally avoided. A key finding of this study was the significant association between elevated dosimetric parameters (V5, V10, V20, and mean lung dose) and the occurrence of acute pneumonitis. Patients receiving higher radiation doses to the ipsilateral lung showed a significantly increased risk, highlighting the importance of careful treatment planning. In particular, the parameters V20 and mean lung dose are considered important predictors of radiation-induced lung injury in the literature, a finding further supported by the present results.

According to the findings, 66.7% of patients had no symptoms and 33.3% had acute radiation pneumonitis. While severe cases (grade 3) were uncommon, the majority of cases were mild to moderate (CTCAE grades 1-2). These results are in line with previous research showing that, depending on the radiation technique, target volume, and individual risk factors, the incidence of acute radiation pneumonitis following contemporary breast cancer radiotherapy usually varies from 5% to 40%. The substantial correlation between higher ipsilateral lung dosimetry data and the incidence of pneumonitis was one of the study's main conclusions. V5, V10, V20, and mean lung dose (MLD) levels were considerably higher in pneumonitis patients than in those without pulmonary problems. The statistical significance of these differences was quite high ($p = 0.00$). This confirms previous studies showing that the parameters V20 and MLD, in particular, are strong predictors of the development of radiation-induced pneumonia. Because it increases the irradiated lung volume, irradiation of the internal mammary lymph nodes poses an additional challenge. This unavoidably increases the ipsilateral lung's radiation exposure, which raises the possibility of radiation-induced lung damage. However, contemporary methods like intensity-modulated radiation therapy (IMRT) and 3D conformal radiation therapy (3D-CRT) enable improved preservation of healthy lung tissue. The employment of these cutting-edge methods may have contributed to the study's modest pneumonia rates.

Overall, the study's findings support the notion that ipsilateral lung exposure plays a critical role in the development of acute radiation pneumonitis. Therefore, careful radiation planning with constant V20 and mean lung dose limitations is still crucial, particularly when internal mammary nodes are involved.

CONCLUSION

It was concluded that a significant relationship between increased ipsilateral lung radiation dose and the occurrence of acute radiation pneumonitis in breast cancer patients following postoperative radiotherapy involving the internal mammary lymph nodes. Higher values of V5, V10, V20, and mean lung dose were associated with an increased risk. Age showed no significant influence. Careful lung dose limitation remains crucial for reducing this complication.

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