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Radiation Dose to Oesophagus in Breast Cancer Patients Receiving Radiation Therapy: A Retrospective Study

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Abstract

Background: Breast cancer is the most common cancer in women worldwide. Management of Breast cancer requires multidisciplinary team approach (viz, Surgery, Chemotherapy, Radiation therapy, Hormonal therapy & Targeted therapy). Radiotherapy reduces the risk of breast cancer mortality for women after breast conserving surgery and for women after mastectomy for node-positive disease. One of the organs at risk in breast cancer therapy is esophagus. As such, there is potential to expose greater volumes of esophagus to radiation. This may result in increased frequency and severity of acute radiation esophagitis during treatment.

Aims and Objectives: To evaluate dosimetric parameters such as mean dose (D_{mean}) maximum dose (D_{max}) which may influence the incidence and severity of esophagitis in breast cancer patients receiving radiotherapy**.**

Material and Methods: Treatment plans of post mastectomy patients who had already received adjuvant RT of dose 50 Gy in 25 # over 5 weeks to the chest wall along with Supraclavicular field (SCF) using 3-Dimensional Conformal Radiation Therapy (3D CRT) and Intensity Modulated Radiation Therapy (IMRT) were selected. Mean dose (D_{mean}) and maximum dose (D_{max}) to esophagus was assessed.

Results: Dosimetric parameters assessed are D_{mean} and D_{max}. D_{mean} assessed up to less than or equal to 11Gy and Dmax assessed upto less than or equal to 34Gy. The average of D_{mean} in this study is 8.34Gy which is within normal limits of prescribed dose. The mean Of Dmax in this study is 24.80Gy which is in limits of prescribed dose.

Conclusion: Increased dose to esophagus in observed when IMRT is used especially when supraclavicular or internal mammary nodes are involved. Routine contouring of esophagus and planning accordingly may reduce oesophageal dose and acute oesophageal toxicity.

Keywords: Breast Cancer, Radiation Therapy, Esophagus, 3-Dimensional Conformal Radiation Therapy (3D CRT), Intensity Modulated Radiation Therapy (IMRT) , Mean dose (D_{mean}) and maximum dose(D_{max})

Introduction

Breast cancer is the most common cancer among women worldwide. Less developed regions of the world have slightly a greater number of cases compared to more developed regions [1]. Breast cancer has ranked number one cancer among Indian women with age adjusted rate as high as 25.8 per 100,000 women and mortality 12.7 per 100,000 women [1]. Management of breast cancer requires multidisciplinary team approach with includes surgery, chemotherapy, radiation therapy and hormonal therapy. Most women diagnosed with early breast cancer receive adjuvant radiotherapy [2]. Radiotherapy reduces the risk of breast cancer mortality for women after breast conserving surgery and for women after mastectomy for node-positive disease [2]. As such, there is potential to expose greater volumes of the esophagus to radiation when following these guidelines [3]. This may result in increased frequency and severity of acute radiation esophagitis during treatment [3]. Radiation dose received by the esophagus has consistently been shown to influence the risk of developing esophagitis, either as a dose delivered or as a function of the volume of esophagus that receives a clinically significant dose [3]. The general direction of the esophagus is vertical, but it presents two slight curves in its course [3]. At its commencement, it is placed in the middle line, but it inclines to the left side as far as the root of the neck, gradually passes to the middle line again at the level of the fifth thoracic vertebra, and finally deviates to the left as it passes forward to the esophageal hiatus in the diaphragm and joints with stomach [3]. Multivariate analysis showed the mean dose (D_{mean}) had a better correlation with Esophageal toxicity [3]. Another study by Wijsman et al. also demonstrated that the mean dose was good predictor of acute esophagitis [3].

Aims and Objectives

The primary objective is to evaluate dosimetric parameters such as mean dose (D_{mean}) maximum dose (D_{max}), which may influence the incidence and severity of esophagitis in breast cancer patients receiving Radiotherapy.

Materials and Methods

Source of Data: All patients attending outpatient department of A.J. Institute of Medical Sciences and who meet inclusion criteria were considered for the study. It is a hospital based Retrospective study.

Sample Size: 20 patients (N=20) of Ca Breast who met inclusion criteria.

Sample Technique: Purposive sampling of all cases of Ca breast during the study period, who met the inclusion criteria.

Inclusion Criteria: Histologically confirmed carcinoma Breast. Post-operative and post chemotherapy. Age more than 18 years up to 80 years. ECOG score of less than or equal to 2.

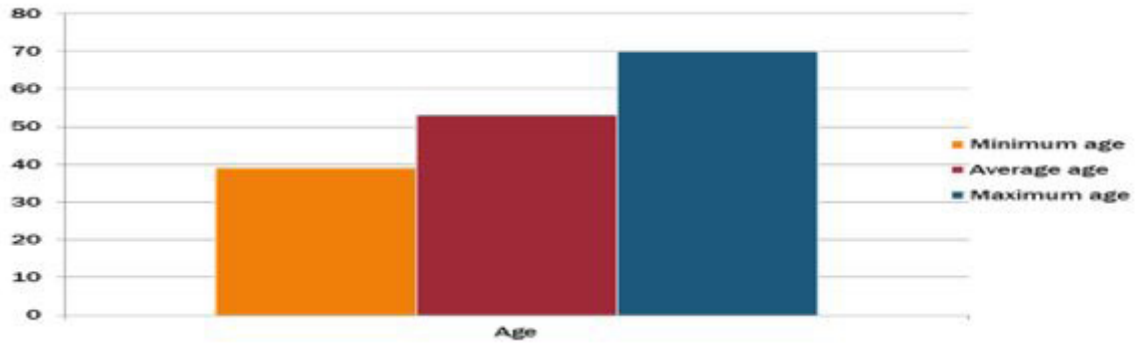
Exclusion Criteria: Patients receiving Radiation therapy with palliative intent. Patients with prior Radiation therapy. ECOG score of more than 2. Patients with prior oesophageal disease.

Treatment Planning

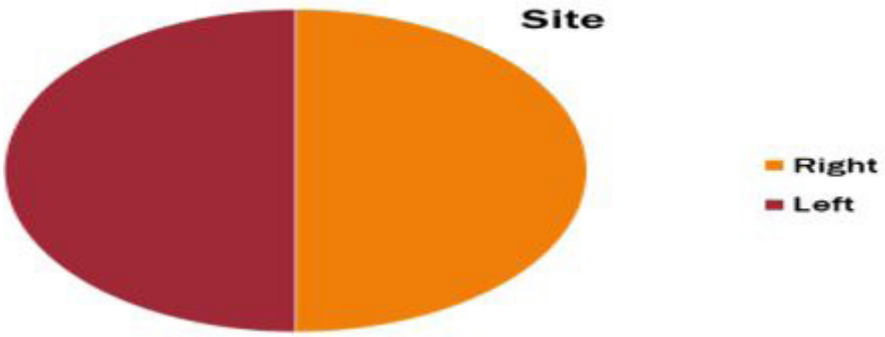
Treatment plans of post mastectomy patients who had already received adjuvant radiation of dose 50 Gy in 25 # over 5 weeks to the chest wall along with supraclavicular field using 3-DC RT and IMRT and contoured based on RTOG breast contouring atlas were selected. RTOG breast contouring guidelines was followed for delineation of Clinical Target Volume (CTV) and Organs at Risk (OARs). The OARs routinely contoured were bilateral lungs, heart, contralateral breast and spinal cord. Esophagus is contoured and included as OAR. The esophageal volume was contoured from the inferior border of cricoid cartilage to the Carina. Dosimetric parameters like the mean dose (D_{mean}) maximum dose (D_{max}) received by esophagus were estimated from dose volume histogram (DVH) data.

Results

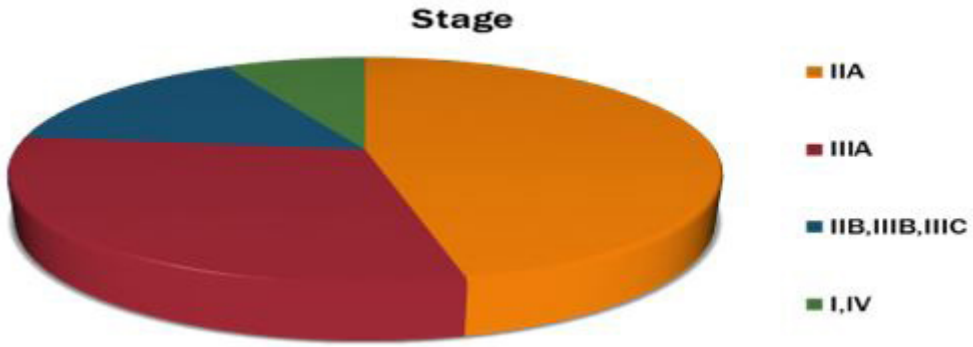
Age: The minimum age was 39 years, the maximum age was 70 years. Average age: 53.2 years.



Site: 20 patients were included out of which 10 patients treated for Carcinoma Right Breast and 10 patients treated for Carcinoma Left Breast.

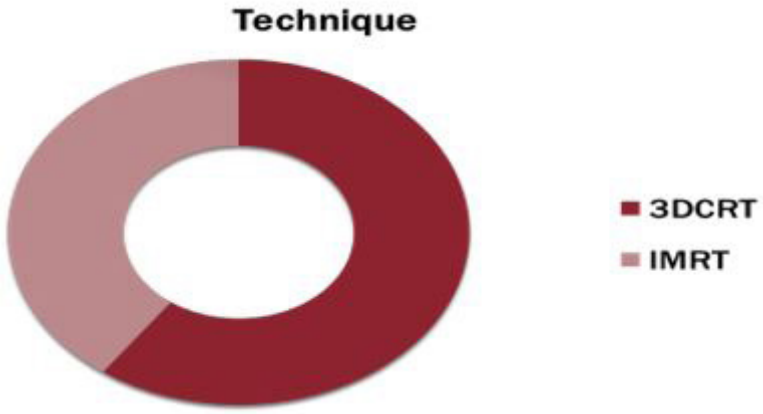


Stage: Out of 20 patients 30% patients belongs to IIA, 20% belongs to IIIA, 10% belongs to IIIB, IIIC, IIB, 5% belongs to I and IV.



Lymph Nodes: supraclavicular lymph nodes and internal mammary chain of lymph nodes were included in 30% of patients, supraclavicular nodes alone included in 20% of patients and both supraclavicular nodes and internal mammary chain of lymph nodes are not included in 50% of patients.

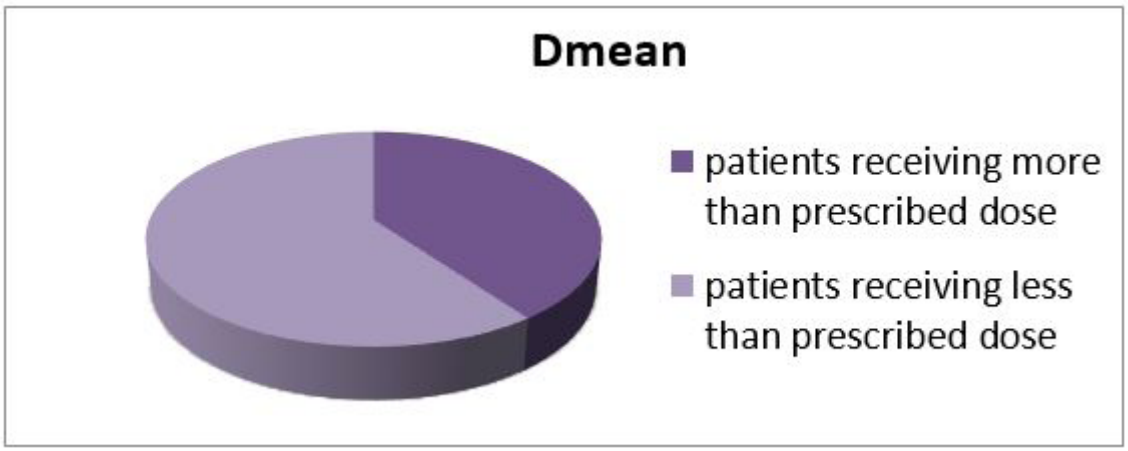
Technique: 3-Dimensional Conformal Radiation therapy (3DCRT) used in 60% of patients and Intensity Modulated Radiation therapy (IMRT) used in 40% of patients.



RT Dose: According to RTOG guidelines and studies, D_{mean}</=11Gy. Dose of 20 patients: 14.67, 1.01, 13.66, 14.67, 22.27, 1.20, 1.14. 12.83, 1.22, 0.76, 0.76, 1.22, 12.83, 1.14, 1.20, 22.27, 14.67, 13.66, 1.01, 14.67. The average of D_{mean} is 8.34Gy which is within normal limits of prescribed dose.

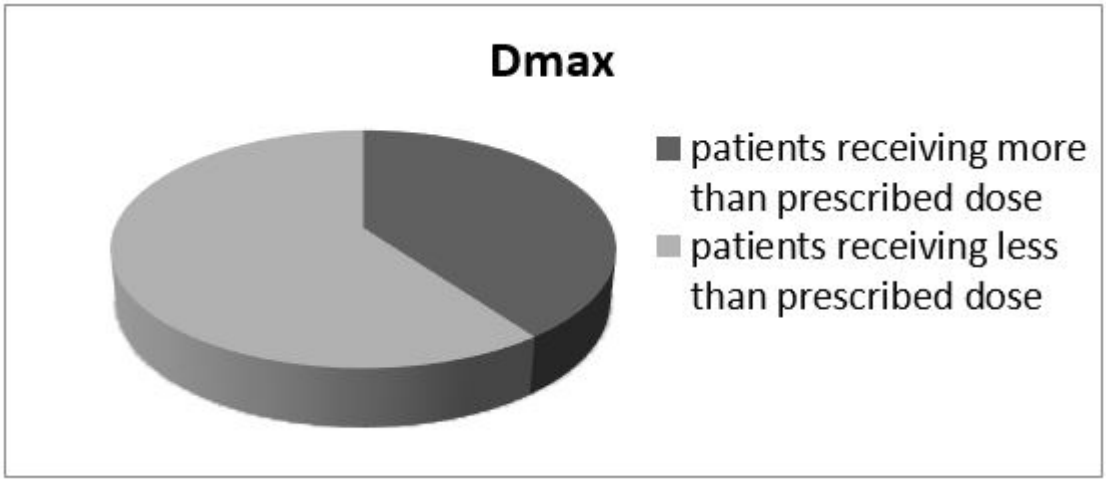
Forty percent of patients included in the study received more than prescribed dose of D_{mean}

Dmean	Minimum	Maximum	Mean
Dose	0.76	22.27	8.34



RT Dose: According to RTOG guidelines and studies, D_{max}</=34Gy. D_{max} of 20 patients: 50.50, 3.42 50.98, 50.50, 51.26, 5.67, 2.21, 30.62, 1.83, 1.05, 1.05, 1.83, 30.62, 2.21, 5.67, 51.26, 50.50, 50.78, 50.98, 2.42, 50.50. The mean Of D_{max} is 24.80Gy which is in limits of prescribed dose. Forty percent of patients included in the study received more than prescribed dose of Dmax.

Dmax	Minimum	Maximum	Mean
Dose	1.05	51.26	24.80



Discussion

Breast cancer is the major cause of morbidity and mortality among females. Factors as marital status, location (urban/rural), BMI, breast feeding, waist to hip ratio, low parity, obesity, alcohol consumption, tobacco chewing, smoking, lack of exercise, diet, environmental factors were major risk factors in India leading to increasing incidence cancer. A multidisciplinary approach to breast cancer including awareness programs, preventive measure, screening programs for early detection and availability of treatment facilities are vital for reducing both incidence and mortality of breast cancer [1]. Management of breast cancer requires multidisciplinary team approach with includes surgery, chemotherapy, radiation therapy and hormonal therapy. Most women diagnosed with early breast cancer receive adjuvant radiotherapy [2]. Breast cancer radiotherapy can increase the risk of esophagitis with risk increasing according to esophagus radiation dose. The main determinant of both mean and maximum esophagus dose was inclusion of lymph nodes. Oesophagus dose is reported infrequently compared with heart and lung doses, suggesting that it may not be routinely considered in radiotherapy planning [2]. The oesophagus is located adjacent to the supraclavicular fossa and behind the internal mammary nodes, so fields used to treat these nodes may exit through it, particularly when rotational IMRT is used. The oesophagus is often close to field edges, so small changes to field boundaries or angles, can cause substantial changes to esophagus dose[2]. Routine esophagus contouring during breast cancer radiation therapy is usually not done and hence a chance of finding dose to esophagus is usually missed. The esophagus should be routinely contoured uniformly on all patients from the inferior border of cricoid to the carina as an OAR to avoid risk of developing Esophagitis [3]. So Routine contouring of esophagus, providing proper dose constraints and monitoring patients during radiation therapy for esophagitis and proper management with planning accordingly may reduce esophageal toxicity and risk of developing esophagitis.

Conclusion

In this study, all dose constraints that is D_{max} and D_{mean} were within the prescribed dose especially in 3DCRT technique when radiation is given only to chest wall/ breast without involving supraclavicular or internal mammary nodes. Increased dose to esophagus in observed when IMRT is used especially when supraclavicular or internal mammary nodes involved as esophagus is located adjacent to the supraclavicular fossa and behind the internal mammary nodes, so fields used to treat these nodes may exit through

it, particularly when rotational IMRT is used. Given the lack of a consensus definition for contouring the esophagus OAR for RNI, esophagus should be routinely contoured uniformly on all patients from the inferior border of cricoid to the carina as an OAR to avoid risk of developing Esophagitis. There is room to improve, particularly in patients that receive IMRT, and future prospective study is warranted to determine if it is feasible to further reduce the proportion of patients with esophageal mean dose above the prescribed dose constraints. Prospective clinical correlative studies with a greater number of patients were required to assess Dmean esophagus and grade acute toxicities. Routine contouring of esophagus and planning accordingly may reduce esophageal dose and acute esophageal toxicity.

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