

Parameters of Radiotherapy Techniques in Early Breast Cancer

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Abstract

Carcinoma breast comprises 22.9% of invasive cancers in female and 16% of all female cancers. Worldwide breast cancer causes 13.7% of cancer deaths in women and 6.0% of all cancer deaths for men and women together. 55% of breast cancer is invasive ductal carcinoma. BCS followed by radiation therapy to the intact breast is most acceptable standard of care for the early stage invasive breast cancer. Various radiotherapy techniques are used for breast irradiation. Precise and accurate delivery of radiation to the target volume reduces the relapse and increases the overall survival. 50 patients of early breast cancer with age range of 20-60yrs, who received radiotherapy as a treatment modality, were included in the study. Radiotherapy treatment procedure was analyzed and advantage of different radiotherapy parameters were compared on basis of side effects recorded. Median age of the patients was 45yrs and 70% were of stage-II breast cancer. 44% patients were treated with bolus and 56% were treated without any accessory. 46% minor side effects were recorded after radiotherapy treatment. There was no simulation and verification system for evaluation of radiotherapy treatment, because of lack of facility in the department. It is concluded that there must be availability of all the radiotherapy treatment parameters including simulation, accessories and treatment verification system for accurate delivery of radiotherapy. These parameters can also reduce the side effects of radiotherapy and increase the beneficial ratio of radiotherapy.

Keywords: Carcinoma breast, invasive ductal carcinoma, radiotherapy techniques.

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INTRODUCTION

Cancer of the breast ranks as one of the first recorded cancers in humans and today it is the leading cause of cancer death among females (Wynder *et al.*, 1960; Ferlay *et al.*, 2010). Breast cancer comprises 22.9% of invasive cancers in female and 16% of all female cancers (World Cancer Report, 2008). Approximately 42% cases of breast cancer occur in the developing countries. Worldwide breast cancer causes 13.7% of cancer deaths in women and 6.0% of all cancer deaths for men and women together. In Pakistan breast cancer accounts for one-third of the cancers in the females (Bhurgri *et al.*, 2000).

Breast cancer is usually classified primarily by its histological appearance. Most of the breast cancers are classified as ductal or lobular carcinoma. In contrast, invasive carcinoma does not confine itself to the initial tissue compartment. Carcinoma breast is diagnosed initially by Fine Needle Aspiration (FNA), Core Needle

Biopsy (CNB), Vacuum-assisted Core Needle Biopsy (VAB), USG and biopsy. Non-palpable mass is diagnosed by excisional biopsy, stereotactic and ultrasound guided core biopsies, breast MRI, USG and chest radiographs. Metastatic workup of breast carcinoma includes bone scan, liver scan and brain scan (CDC, 2016).

Treatment of early breast cancer after diagnosis and staging is surgery followed by systemic therapy which includes chemotherapy, radiotherapy and/or hormonal therapy to improve the chances of recovery. Surgery involves breast-conserving surgery, Lumpectomy and Mastectomy. Whereas in locally advanced breast cancer (LABC) Stage-III disease, neo-adjuvant chemotherapy is given followed by mastectomy. If tumor shows good results than radiation therapy is given otherwise 2 more cycles of chemotherapy are given before radiotherapy. According to the ERPR status hormone therapy is given. Different cancers respond differently to radiation therapy (Bomford *et al.*, 2002). Optimal radiotherapy utilization rate for breast

cancer is 83%. Recently, there have been a number of randomized trials evaluating optimal approaches to the delivery of radiation therapy after BCS (Breast-Conserving Surgery) (Bartelink et al., 2001). Ali et al. (2015) demonstrated that mutation is responsible for causing Hepatocellular carcinoma cancer.

Various radiotherapy techniques are used for breast irradiation. These techniques include Multifield Breast Fields “tangential fields to chest wall and Supraclavicular field (anterior)”, IMRT (Pingol et al., 2008) (Intensity Modulated Radiotherapy) and Proton therapy (Ares et al., 2010). Moreover breast cancer is also radiated by internal radiotherapy and Intraoperative radiotherapy. Intraoperative therapy is given after BCS usually in ductal carcinoma in situ (DCIS). In brachytherapy or implantation therapy, implantation seeds of radioactive material are inserted inside the breast and radiation dose is delivered in contact with the tissue. There are a number of radiotherapy induced side effects after radiating the breast cancer which may be short term or long term side effects. Accurate and precise radiation treatment planning and execution of the plan can reduce the risk of these side effects.

This research elaborated the parameters which are necessary for accurate and reproducible delivery of radiation therapy in patients of early breast cancer.

MATERIALS AND METHODS

Materials and Subjects

Patients of early breast cancer

Questionnaire

Sampling technique

Non-probability sampling technique (Convenience Sampling)

Study design

Observational Study Design (Retrospective)

Sample size

Fifty patients

Sample Selection

Inclusion criteria

Patients in age range of 20-60yrs

Patients of stage-I and stage-II

All the patients with BCS as well as MRM

Patients diagnosed on histopathological basis

Patients with WHO performance status of 0-3

Exclusion criteria

Patients above the age of 60yrs

All the patients of stage-0, stage-III and stage-IV

Patients with WHO performance status of 4 and 5

Data Collection Procedure

This study was conducted in Clinical Oncology Department Mayo Hospital Lahore. In this study parameters for accurate radiotherapy in patients of early breast cancer were elaborated which mainly include dose calibration, depth dose, precise patient geometric positioning during treatment of radiation, simulation, dosimetry, treatment units and treatment verification. The

respective variables were defined to evaluate the radiotherapy treatment and different parameters required for reproducible delivery of radiotherapy. These variables include: age, disease site (right or left breast), stage, treatment modalities used, indications of radiotherapy, accessories used during radiation treatment and side effects observed after irradiation. Whole study was conducted under the ethical considerations of WMA declaration of Helsinki and it was preceded according to the rules of ethical review board (ERB) of Mayo Hospital Lahore.

Data Analysis

For qualitative variables descriptive statistics were used which include percentages and proportion using SPSS version 16.

RESULTS

The results showed that maximum patients included in the study were 45yrs of age 30%. While 20% patients were of 50yrs and 16% were 40yrs of age. Minimum age was 24yrs and maximum was 60yrs. The mean of patients' ages was 45±8.90 (Table 1).

Table 1. Prevalence of breast cancer among various ages.

Age	Frequency	%age	Cumulative Percentage	Mean ±S.D
60	5	10	10	45±8.90
55	6	12	22	
50	10	20	42	
45	15	30	72	
40	8	16	88	
33	2	4	92	
30	1	2	94	
25	2	4	98	
24	1	2	100	
Total	50	100		

Our results showed that 30% patients were of stage-I and 70% patients of stage-II breast cancer (Figure 1).

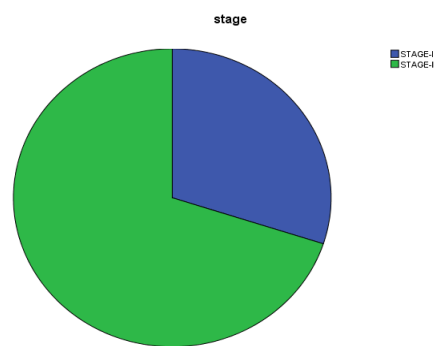


Fig. 1. Stage wise distribution of breast cancer

The results of our study showed that 42% patients have disease in left breast and 58% have right sided breast carcinoma (Figure 2).

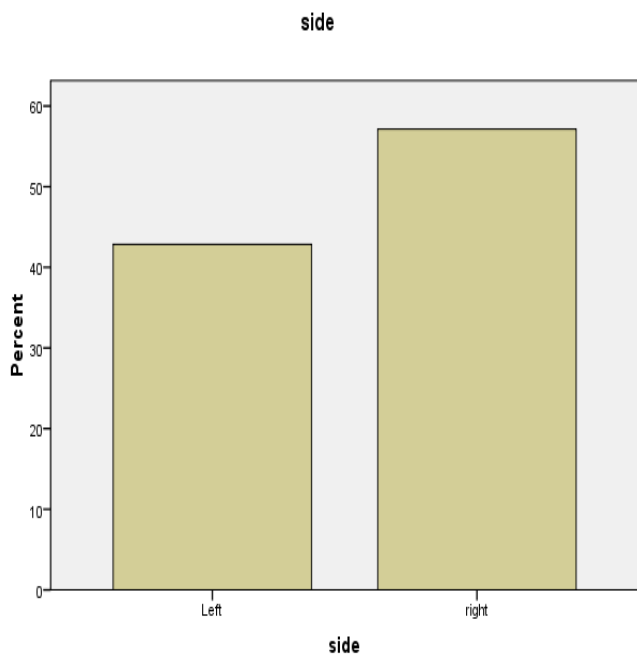


Fig. 2. Location of breast carcinoma

This study results showed that 42% patients have received radiotherapy only on chest wall while 58% have received RT on both chest wall and SCF (Table 2).

Table 2. Field of radiotherapy

Field	Frequency	%age	Cumulative Percentage	Mean ±S.D
CWRT	21	42.0	42.0	2.16±0.99
CWRT +SCF	29	58.0	100	
Total	50	100		

This study showed that 10 patients 20% were treated with surgery and radiotherapy, 23 patients 46% with surgery, chemotherapy and radiotherapy, only 4 patients 8% received hormone therapy after surgery and radiotherapy and 12 patients 24% were treated with all four modalities including surgery, radiotherapy, chemotherapy and hormone therapy (Table 3).

Table 3. Treatments used for breast cancer.

Treatment	Frequency	Percent	Valid Percent	Cumulative Percent	Mean±S.D
Valid SG+RT	10	20	20.4	20.4	3.61±1.46
SG+ CT + RT	23	46	46.9	67.3	
SG+RT+ HT	4	8	8.2	75.5	
SG+CT+ RT+HT	12	24	24.5	100.0	
Total	49	98	100		
Missing System	1	2			
Total	50	100			

*SG: Surgery, RT: Radiotherapy, CT, Chemotherapy, HT: Hormone therapy

The results of our study showed that 23 patients 46% with tumor size greater than 5cm (T3) were indicated for RT, 17 patients 34% have multiple nodal involvement, 7 patients 14% were indicated on BCS basis and 2 patients 4% only on basis of stage-I breast cancer (Table 4).

Table 4. Indications for radiotherapy of breast cancer

Indications	Frequency	Percent	Valid Percent	Cumulative Percent
Valid BCS	7	14	14.3	14.3
STAGE-I	2	4	4.1	18.4
Tumor>5cm	23	46	46.9	65.3
Multiple nodal involvement	17	34	34.7	100
Total	49	98	100	
Missing System	1	2		
Total	50	100		

*BCS: Breast-Conserving Surgery

The results showed that 22 patients (44%) of early breast cancer were irradiated using bolus, 28 patients

(56%) were irradiated without any accessory and no patient 0% was treated using breast board (Table 5).

Table 5. Accessories for treatment of breast cancer

Accessories	Frequency	%age	Cumulative Percentage
Bolus	22	44.0	42.0
No	28	56.0	100
Total	50	100	

Our study demonstrated that there were complications in 23 patients (46%) in which 15 patients (30%) showed skin burning (erythema) and 8 patients (16%) represented with recurrent chest wall disease, while 27 patients (54%) represented with no complications after radiotherapy (Table 6).

Table 6. Complications after radiotherapy of breast cancer

Complications	Frequency	%age	Cumulative Percentage
Skin burning	15	30	30
Recurrent chest wall disease	8	16	46
None	27	54	100
Total	50	100	

DISCUSSION

Role of radiotherapy in the treatment of early breast cancer has a long and controversial history (Paterson and Russel, 1959). There is enough evidence available which demonstrates that radiotherapy reduces the local relapse rate. However, there is reduction in relapse rate not in mortality rate of the breast cancer patient (Stjern, 1997).

Ancient reports of Rutqvist *et al.* (1992) and Cuzik *et al.* (1994) clearly demonstrated that deaths of breast cancer patients were potentially due to cardiac deaths not because of breast disease. It was proved by many larger subsequent trials that radiotherapy was causing cardiac deaths (Early Breast Cancer Trialists' Collaborative Group, 2000).

This published data strongly proposed that radiotherapy is best treatment modality for breast cancer, but to reduce the harmful risks of radiotherapy to heart, other vital and sensitive structures, there must be certain changes in the administration of radiotherapy, so that there is reduced mortality rate. Radiation Oncologists modify the radiotherapy planning, field portals and plan execution method; these factors greatly reduced the cardiac disease. In recent trials breast cancer breast cancer deaths are indeed reduced (Overgaard *et al.*, 1997; Hojris *et al.*, 1999). Recent data suggests that radiotherapy after mastectomy or breast conserving surgery BCS has beneficial effect on survival (Vin-Hungh and Verschraegen, 2004).

Three randomized clinical trials of post mastectomy radiotherapy (Overgaard *et al.*, 1997; Regaz *et al.*, 1997; Overgaard *et al.*, 1999), have shown 9%-10% improvement in overall survival after 10yrs, for patients who received radiotherapy compared with those patients who do not receive radiotherapy.

In Canadian and Danish trials it is proved that radiotherapy given to the loco regional sites prevent dissemination, thus being the potentially protective modality. According to the randomized clinical trials of adjuvant radiotherapy, the radiotherapy administered after breast conserving surgery BCS, has favorable effects on survival (Whelan *et al.*, 2000).

Multiple trials have shown a substantial risk of local recurrence, if radiotherapy is omitted after breast conserving surgery BCS. Analysis of registry data by some authors (Vin-Hungh and Verschraegen, 2004; Vin-Hungh *et al.*, 2003; Vallis *et al.*, 2002), suggests large survival benefit from use of radiotherapy after breast conserving surgery BCS. Radiotherapy in intact breast with modern techniques reduces the cardiac toxicity. In addition high precision radiotherapy techniques such as intensity modulated radiotherapy IMRT, 3-D conformal radiation therapy, partial breast irradiation PBI etc. improve the benefits ratio of using radiotherapy. The meta-analysis presented by Vinh Hungh *et al.* (2003) reinforces the view that patients undergoing BCS should also receive radiotherapy. These trials proved that irradiation in early breast cancer not only reduces the relapse rate but also improves the overall survival OS. Alongside radiotherapy various medicinal plants have also been used to treat cancer due to their anti-tumor activity. Al- Mahweety (2016) isolated four compounds from resin of *Dracaenaceae* plant famous for their anti-tumor activity.

This study on Parameters of radiotherapy techniques in early breast cancer revealed that with certain parameters, radiotherapy can accurately be given to breast and chest wall with large benefits ratio of radiotherapy and minimum side effects.

CONCLUSION

In this study the sample size was 50 patients with early breast cancer including stage-I and stage-II disease.

The mean age of the patients in the study was 45yrs and 58% were having disease in right breast. 35 patients 70% were of stage-II breast cancer while 15 patients 30% were having stage-I breast cancer. 29 patients 58% received CWRT as well as SCF, 21 patients 42% received only CWRT. 23 patients 46% received surgery, radiotherapy and chemotherapy as treatment modalities. 22 patients 44% irradiated using bolus, 56% without bolus and no patient was irradiated using alpha cradle. 23 patients 46% represented with side effects after radiotherapy, these patients were irradiated without any accessory. There was no simulation and port filming of the patients because of lack of facility.

RECOMMENDATIONS

The research on parameters of radiotherapy techniques elaborated various essential radiotherapy techniques and parameters for accurate radiotherapy in patients of early breast cancer.

This study revealed that patients irradiated without these parameters, may represent with radiotherapy side effects after irradiation. Although the percentage of patients with no side effects is higher as compared to the patients who complained for acute side effects of radiotherapy. To reduce the number of effected patients after radiotherapy treatment, following features are recommended according to the study:

- Patient must be simulated before treatment, so that any geometric uncertainties regarding treatment volume may be removed
- Complications of the skin can be removed by using such accessories and radiotherapy techniques
- Patients with superficial disease and BCS must be irradiated after using bolus
- For monitoring and accurate delivery of planned radiotherapy treatment to the patient, there must be treatment verification system. PFI (port filming) is most common.

These parameters will enhance the quality and reproducibility of radiotherapy treatment.

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CONFLICT OF INTEREST

There is no conflict of interest.

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