ORIGINAL RESEARCH

A Comparative Study of Cardiotoxicity by MUGA Scan and 2D Echo In Left Sided Breast Cancer Patients Treated With 2D Conventional Versus 3D Conformal Radiotherapy Technique

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Received: 29 October, 2023 Accepted:29 November, 2023

Abstract:
Background: As the number of long-term breast cancer survivors has increased, the side effects of adjuvant cancer therapy, such as cardiac toxicity, remain clinically important.
Aims and objectives: To assess radiation-induced cardiotoxicity by estimating LVEF with 2D-ECHO and MUGA scan in left sided breast cancer patients treated with 2D RT vs 3DCRT technique.
Material and methods: This a prospective study was conducted in the Department of Radiation Oncology at Guru Gobind Singh Medical College, Faridkot for a period of one year with a follow-up of 6 months started in February 2020, and included histologically proven patients with breast cancer. 50 patients fulfilling the inclusive and exclusive criteria were randomized into two arms (A and B) with 25 patients in each arm. Dosage was 50Gy/25#/5weeks
Results: In both the ARM A and ARM B, there was RTOG grade I cardiac function toxicity post 6 months of RT that is LVEF decrease (<20%) from baseline. With 2D-Echo, the mean LVEF in ARM A before RT was 58.08, after 8 weeks of RT was 53.44 and after 6 months of RT was 52.04. With 2D-Echo, mean LVEF in ARM B before RT was 59.32, after 8 weeks of RT was 56.96, and after 6 months of RT was 55.48. LVEF with 2D-Echo was less in ARM A as compare to ARM B post 8 weeks and 6 months of RT with significant p value (0.001) Hence proving ARM A was more carditoxic as compared to ARM B. Whereas no significant difference was seen at baseline while comparing ARM A and ARM B. With Cardiac MUGA scan, mean LVEF in ARM A before RT was 67.03, after 8 weeks of RT was 62.31, and after 6 months of RT was 59.62. With the Cardiac MUGA scan, the mean LVEF in ARM B before RT was 66.54, after 8 weeks of RT was 63.87 and after 6 months of RT was 62.36. The difference in both arms was not statistically significant. On comparing of LVEF with 2D-ECHO mean LVEF before RT was 58.70, 8 weeks post-RT was 55.16 and 6 months of RT was 53.76 and with Cardiac MUGA scan mean LVEF before RT was 66.79, after 8 weeks of RT was 63.09 and 6 months of RT was 60.99 indicating the significant difference between 2D-ECHO and Cardiac MUGA scan with a p value of (0.001).
Conclusion: Clinician must be aware that cardiotoxicity in left-sided breast cancer patients is a multifactorial issue, choosing and monitoring the type of radiotherapy according to patient condition is very important for decreasing late cardiotoxicity. New radiotherapy techniques using 3D- Conformal RT has resulted in minimal doses to the heart leading to declining cardiotoxicity and death.
Keywords: breast cancer, cardiotoxicity, radiotherapy,

INTRODUCTION

Female breast cancer is the leading cause followed by lung cancer of global cancer incidence in 2020. According to GLOBOCON 2020, estimates of 2.3 million new cases were seen, representing 11.7% of all cancer cases. Breast cancer is the fifth leading cause of cancer mortality worldwide, with 685,000 deaths among both sexes. Among females, breast cancer accounts for 1 in 4 cancer cases and 1 in 6 cancer deaths. Therefore, ranks first for incidence in the majority of countries. (1)Breast cancer is because of higher prevalence of reproductive and hormonal risk factors (early age at menarche, later age at menopause, advanced age at first child birth, fewer number of children, less breastfeeding practices, menopausal status, hormone therapy and use of oral contraceptives) and lifestyle risk factors (alcohol intake, excess body weight, physical inactivity), as well as increased detection through organized or opportunistic mammographic screening. An exceptionally high prevalence of mutations, such as BRCA1 and BRCA2 among women of Ashkenazi Jewish heritage (range, 1%-2.5%) also contribute to breast cancer. (1)Life expectancy after the diagnosis and treatment of cancer has increased significantly in the past 2 decades (4). Cancer therapy-induced cardiotoxicity is responsible for considerable morbidity and mortality. Developing and understanding optimal prevention, early detection, and treatment strategies for cancer therapy-induced cardiotoxicity is a critical aspect of cancer patient care and may have a significant impact on the overall prognosis and survival of cancer patients.(2)The use of 3DCRT & IMRT techniques help in better sparing of heart as compared to conventional techniques, especially in left-sided cancers (3)Conventional two-dimensional radiation therapy (2D-RT) consists of a single beam from one to four directions. 3D- CRT plan generally uses an increased number of radiation beams to improve dose conformation and conventional beam modifiers (e.g. 2 wedges and/or compensating filters) are used. 3D-CRT or CT- based planning was a major advancement because it took into account axial anatomy and complex tissue contours. Compared with 2D-RT, 3D-CRT shows smaller exposed volumes of ipsilateral lung, contralateral breast, and heart. (4)A change in left ventricular ejection fraction determined by 2 D- Echo and TC-99 MUGA (Multiple Gated Acquisition Scan) is a very good indicator of developing cardiomyopathy (51). TC-99 scanning is highly reproducible and probably more sensitive than Echo at detecting the early change in LVEF (5).In breast cancer, most of the studies have been performed on whole-breast radiotherapy after BCS, the data on Post mastectomy RT is less, So the present study is to be conducted in our department for assessing radiation-induced cardiotoxicity in breast cancer patients with 2D Echo and MUGA scan by estimating LVEF.

MATERIAL AND METHODS

STUDY SETTING: This study was conducted in the Department of Radiation Oncology at Guru Gobind Singh Medical College, Faridkot.

STUDY POPULATION: As per the hospital record, according to the availability of the patients, non-probability sampling was applied. The patients fulfilling the inclusive and exclusive criteria were randomized into two arms (A and B) with 25 patients in each arm.

STUDY DESIGN: It was a prospective study of 1 year period with a follow-up of 6 months, started in February 2020, and included histologically proven patients with breast cancer.

SAMPLE SIZE: As per the hospital record, according to the availability of the patients, non-probability sampling was applied. 50 patients fulfilling the inclusive and exclusive criteria were randomized into two arms (A and B) with 25 patients in each arm.

SAMPLING METHOD/TECHNIQUE: The computer-generated random number table was used for the allocation of the participants.

DOSE: 50Gy/25#/5weeksARM A: Histologically biopsy-proven Her 2 Neu- negative left side breast carcinoma patients will be first staged clinically & by using imaging modalities i.e. CECT Chest, USG Abdomen, and Routine blood investigations. Then the patient will undergo left-sided MRM (Modified Radical Mastectomy) either directly or after neoadjuvant chemotherapy. Adjuvant chemotherapy in the form of 4 cycles of EC (Epirubicin 100mg/m2 and Cyclophosphamide 830mg/m2) followed by 4 cycles of Paclitaxel 175 mg/m2 will be given. Then baseline 2D-Echo & MUGA Scan will be done. Then the patient will receive EBRT using a 2D conventional technique to the chest wall, axilla, and supraclavicular region to the dose of 50Gy delivered in 25# over 5 weeks. 2D-Echo & MUGA Scan are again done on follow up firstly after 8 weeks then after 6 months of completion of radiation therapy to see the toxic effect on the heart over 5 weeks. ARM B: Histologically biopsy-proven Her 2 Neu-negative left side breast carcinoma patients will be first staged clinically & by using imaging modalities i.e. CECT Chest, USG Abdomen, and routine blood investigations. Then the patient will undergo left-sided MRM (Modified Radical Mastectomy) either directly or after neoadjuvant chemotherapy. Adjuvant chemotherapy in the form of 4 cycles of EC (Epirubicin 100mg/m2 and Cyclophosphamide 830mg/m2) followed by 4 cycles of Paclitaxel 175 mg/m2 will be given. Then baseline 2D-Echo & MUGA Scan will be done. Then the patient will receive Conformal Radiotherapy using 3D –RT to the chest wall, axilla, and supraclavicular region to the dose of 50Gy delivered in 25# over 5 weeks. 2D-Echo & MUGA Scan are again done on follow up firstly after 8 weeks then after 6 months of completion of radiation therapy to see the toxic effect on the heart over 5 weeks.

INCLUSION CRITERIA

1. Biopsy proven post-mastectomy carcinoma breast patients.
2. ECOG Performance Scale(less than or equal to three).
3. ER+/-, PR+/-, Her 2 neu -ve.
4. Age 25-75 years.
5. Early and locally advanced breast cancer.
6. Available for follow up

EXCLUSION CRITERIA

1. Metastatic breast cancer.
2. Pregnancy and lactation.
3. Comorbid conditions relating to CVS such as HTN, arrhythmias, and other cardiac diseases and history of diabetes mellitus.

4. Dextrocardia

PRETREATMENT EVALUATION

1. Complete history, medical and physical examination.
2. Biopsy proved.
3. Haematological investigations (Hemogram, renal function tests, liver function tests, serum electrolytes).
4. Chest X-Ray.
5. Planning CT.
6. 2D-ECHO.
7. Cardiac MUGA scan

PROCEDURE FOR MUGA SCAN:- A modified in-vivo method is used for labeling RBC in which 1 ml of stannous pyrophosphate is injected into the patient after 20-30 minutes, 15-30 milli Curie of technetium 99 M eluted from the technetium generator is injected into the patient through a peripheral vein. After 20 minutes, ECG gated static image is acquired and the planar acquisition was done by using a large field of view gamma camera equipped with low energy, high-resolution collimator. A cine image is acquired into the system, where LVEF is calculated by outlining the left ventricle manually and automatically For 50 consecutive post-mastectomy breast cancer patients, Conventional 2D-RT and 3D-CRT were planned for the radiotherapy of the chest wall. Informed consent of the patient was taken.

POSITION: Supine, with the arm abducted (90 degrees or greater). A breast tilt board with arm-rests was used that maintains the patient's daily position with the slope of the chest wall parallel to the table. Radiopaque wires were placed on the mastectomy scar.

TREATMENT TECHNIQUES: Conventional 2D-RT Technique: - The chest wall radiation dose prescription was delivered to the mid-separation of the chest wall. Clinical markup was done close to the mid sternal line. Port films were taken to ensure that <2 cm of the lung was seen at the central lung distance. There was no specified heart constraint. The breast board was angled 15 degree so that the sternum was parallel to the table Clinical Markup of

1) Supraclavicular Field:-

Superior Border: - Extends laterally across the neck and trapezius to the acromial process.

Inferior Border - At the first intercostal space, abutting the tangential breast field.

Medial Border: - Vertical line 1cm across the midline extends from first intercostal space to thyroid-cricoid groove, medial to the sternocleidomastoid muscle.

Lateral Border: - From acromioclavicular joint, bisecting the humeral head, to exclude much of shoulder as possible.

2) Chest Wall:-

Superior Border: - To match Supraclavicular field

Inferior Border: - Xiphoid process.

Medial Border: - Midsternal line

Lateral Border: - Mid Axillary line.

PLANNING CT FOR CONFORMAL RT (3D-CRT): Planning CT was taken from the zygomatic arch to the level of the umbilicus. Targeted areas of interest were then contoured on the CT slices. The target volumes were defined and the dose prescribed according to the International Commission on Radiation Units and Measurement Reports (ICRU) 50 and 62 recommendations. Accordingly, the target volume was covered by the 95% isodose line. The planning target volume (PQ definition for the chest wall was done according to the breast cancer atlas for radiation therapy planning consensus definitions of the Radiation Therapy Oncology Group. The PTV included the chest wall with the pectoralis muscle, chest wall muscles, ribs, and excludes the outermost 3 mm from the superficial skin surface. The heart was defined as all visible myocardium, from the apex to the right auricle, atrium, and infundibulum of the ventricle. The pulmonary trunk, the root of the ascending aorta, and superior vena cava were being excluded. Tangential beam 3D- CRT Two tangential semi-opposed beams, physical wedges, and a multileaf collimator — used for 3D-CRT. The beam angles, wedge angles, and beam weighting were chosen to optimize coverage of the PTV while minimizing exposure to the ipsilateral lung, heart and contralateral breast.

FOLLOW UP

2D - ECHO and Cardiac MUGA scan was done before RT, after 8 weeks of completion of RT, and after 6 months following RT. Left Ventricular Ejection Fraction changes were noted.

ETHICAL CONSIDERATIONS: The identity of participating patients was kept confidential. To obtain the consent, a consent form was given to the patient. The purpose of the study was explained to them in their local language. After obtaining informed, written consent from them, they were enrolled in the study. Patients were free to withdraw herself from the study at any time.

STATISTICAL ANALYSIS: Data was described in terms of range, mean, +/- standard deviation (SD), frequencies (number of cases), and relative frequencies (percentages) as appropriate. Comparison of quantitative variables between the study groups was done using the Student t-test. For comparing categorical data, the Chi-square(X *) test was performed and an exact test was used when the expected frequency is less than 5. A probability value (p-value) less than 0.05 was considered statistically significant. AII statistical calculations were done using SPSS 21 (Statistical Package for the Social Science) version statistical program for Microsoft Windows.

RESULTS AND OBSERVATIONS

TABLE 1: LOCATION OF BREAST LUMP

		ARM A		ARM B		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
LOCATION OF BREAST LUMP	LUMP L- LIQ	1	4.0%	3	12.0%	4	1.667	0.435
	LUMP L- LOQ	4	16.0%	2	8.0%	6		
	LUMP L- OUQ	20	80.0%	20	80.0%	40		
Total		25	100.0%	25	100.0%	50		

TABLE :2 PATHOLOGICAL STAGE WISE DISTRIBUTION BETWEEN ARM A & ARM B

		ARM A		ARM B		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
Ptnm	pT2N0	1	4.0%	3	12.0%	4	8.281	0.308
	pT2N1	0	0.0%	3	12.0%	3		
	pT2N1	14	56.0%	8	32.0%	22		
	pT2N2	5	20.0%	4	16.0%	9		
	pT2N3	1	4.0%	2	8.0%	3		
	pT3N0	0	0.0%	2	8.0%	2		
	pT3N1	1	4.0%	1	4.0%	2		
	pT3N2	3	12.0%	2	8.0%	5		
Total		25		25		50		

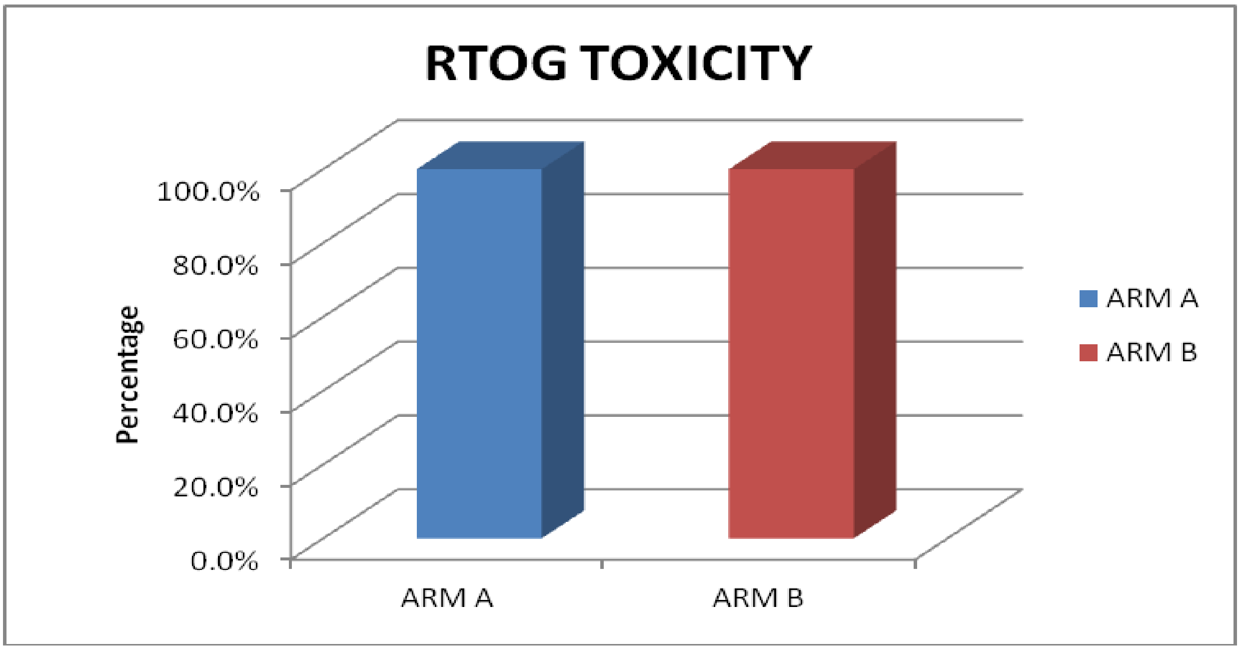
TABLE: 3 CLINICAL STAGE WISE DISTRIBUTION BETWEEN ARM A & ARM B

		ARM A		ARM B		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
c TNM	T2N0	5	20.0%	5	20.0%	10	1.177	0.758
	T2N1	14	56.0%	15	60.0%	29		
	T2N2	3	12.0%	4	16.0%	7		
	T3N1	3	12.0%	1	4.0%	4		
Total		25		25		50		

TABLE: 4 COMPOSITE STAGING BETWEEN ARM A & ARM B

		ARM A		ARM B		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
STAGE	II	19	76.0%	21	84.0%	40	0.500	0.480
	III	6	24.0%	4	16.0%	10		
Total		25	100.0%	25	100.0%	50		

FIGURE: 1 RTOG CARDIAC FUNCTION TOXICITY



		ARM A		ARMB		Total
		No.of cases	**%age**	**No.of cases**	**%age**	
RTOG CARDIAC FUNCTION TOXICITY AFTER6 MONTHS OF RT	GRADE I	25	100.0%	25	100.0%	50
Total		25	100.0%	25	100.0%	50

In 50 females taken in our study, both the ARM A and ARM B there was grade IRTOG cardiac function toxicity post 6 months of radiotherapy (that is LVEF decreased <20% from baseline.)

TABLE : 5 CARDIOTOXICITY COMPARISON OF LVEF WITH 2D –ECHO BETWEEN ARM A & ARM B

	ARMA		ARMB		T	p-value
	Mean	SD	Mean	SD		
2D-ECHO (LVEF)_BEFORE RT	58.08	3.94	59.32	3.44	-1.187	0.241
2D-ECHO (LVEF)_8 WEEKS OF RT	53.44	3.04	56.96	3.30	-3.923	0.001
2D-ECHO (LVEF)_6 MONTHS OF RT	52.04	3.12	55.48	3.31	-3.787	0.001

2D -Echo was done before RT, post8 weeks of RT, and 6 months ofRT to assess and co-relate cardiotoxicity in both the ARMS A and ARMB.With 2D-Echo, the mean LVEF in ARM A before RT was 58.08, After 8weeks of RT 53.44 and after 6 months of RT was 52.04. With 2D-Echo, mean LVEF in ARM B before RT was 59.32, After 8 weeks of RT 56.96, and after 6 months of RT was 55.48 It was seen that LVEF with 2D-ECHO was less in ARM A as compared to ARM B post 8 weeks and 6 months of radiation with a significant pvalue of 0.001 hence proving that ARM A was more cardiotoxic as compared to ARM B. Whereas p value was insignificant when LVEF between the two ARMS was compared before the start of radiation

FIGURE 2: LEVF WITH 2D- ECHO

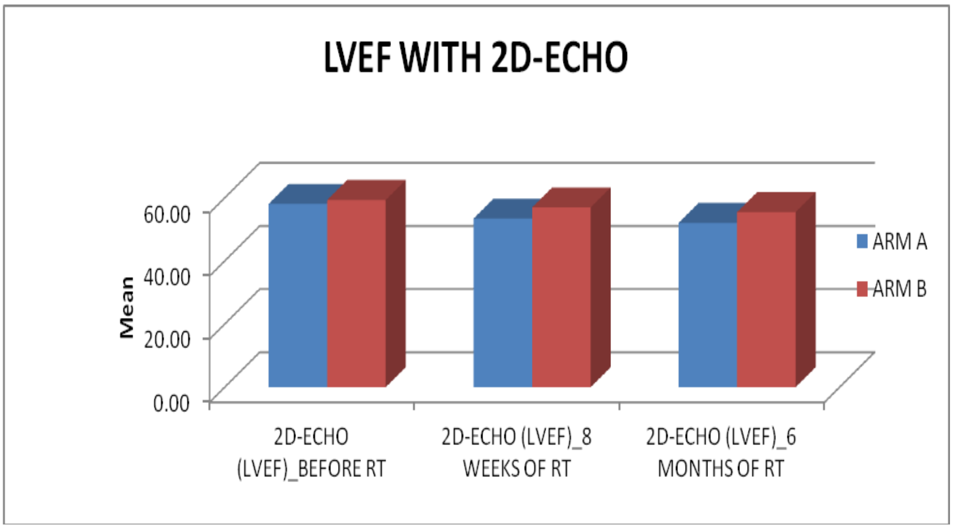


FIGURE 3: CARDIAC TOXICITY BAR GRAPH SHOWING COMPARISON OF LVEF WITH CARDIAC MUGA SCAN BETWEEN ARM A & ARM B

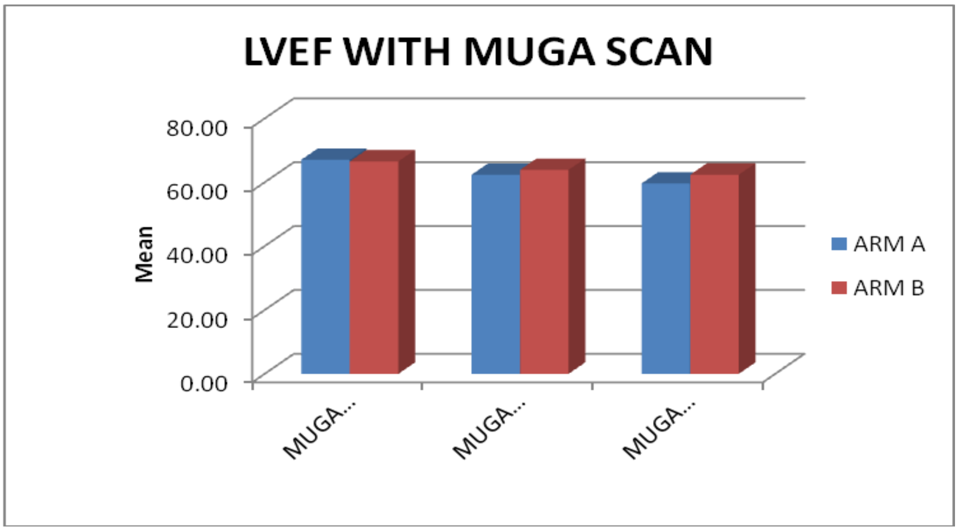


FIGURE 4: COMPARISON OF 2 MODALITIES: - 2D-ECHO AND CARDIAC MUGA SCAN

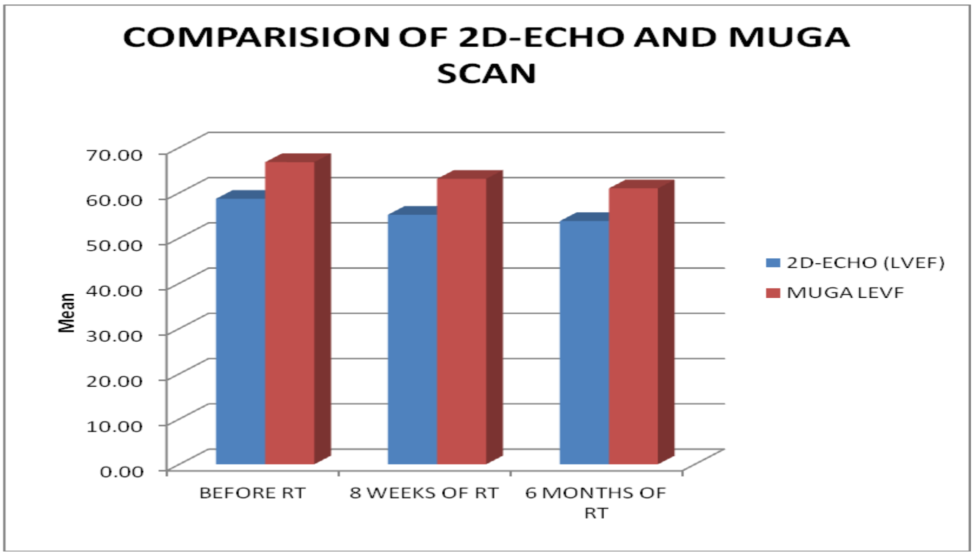


TABLE 6: MUGA (LVEF)- IN ARM A & ARM B

	ARM A		ARM B		t	p-value
	Mean	SD	Mean	SD		
MUGA (LVEF)-BEFORERT	67.03	5.16	66.54	5.27	0.333	0.74
MUGA (LVEF)-8 WEEKS OF RT	62.31	4.76	63.87	5.33	-1.092	0.28
MUGA (LVEF)-6 MONTHS OF RT	59.62	4.95	62.36	5.38	-1.875	0.067

A cardiac MUGA scan was done as a baseline before RT, post 8 weeks of RT, and 6 months of RT to assess and co-relate the cardiotoxicity in both the ARM A and ARM B. With Cardiac MUGA scan, mean LVEF in ARM A as baseline before RT was 67.03, post 8 weeks of RT 62.31, and after 6 months of RTwas 59.62 , and the mean LVEF in ARM B as baseline before RT was 66.54, post 8 weeks of RT 63.87 and after 6 months of RT was 62.36. The difference in both arms was not statistically significant

TABLE 7: COMPARISON OF 2 MODALITIES:- 2D-ECHO ANDCARDIAC MUGA SCAN

	2D-ECHO (LVEF)		MUGA LEVF		t	p-value	Difference	
	Mean	SD	Mean	SD			Mean	SD
BEFORE RT	58.70	3.71	66.79	5.17	-8.645	0.001	-8.09	6.61
8 WEEKS OF RT	55.16	3.68	63.09	5.07	-9.405	0.001	-7.93	5.97
6 MONTHSOF RT	53.76	3.62	60.99	5.30	-7.916	0.001	-7.23	6.46

While comparing LVEF done via 2D-ECHO and Cardiac MUGA scan done at baseline before RT, post 8 weeks and 6 months of radiotherapy. With 2D-Echo the mean LVEF before RT was 58.70, 8 weeks post-RT was 55.16 and 6 months of RT was 53.76.
With Cardiac MUGA scan mean LVEF before RT was 66.79, after 8 weeks of RT was 63.09 and 6 months of RT was 60.99. Thus, indicating the significant difference seen at baseline before RT, post 8 weeks and 6 months of RT between the two modalities that is 2D-Echo and Cardiac MUGA scan with a significant p-value of (0.001

DISCUSSION

In left sided breast cancer patients, Post mastectomy radiotherapy has always been linked with cardiotoxicity in various studies. Radiotherapy-associated cardiotoxicity using myocardial imaging have demonstrated perfusion defects, wall abnormalities, and subtle changes in ejection fraction in 0% to 70% of patients within 1 to18 years post-radiotherapy (6).
Out of 50 patients in our study, 36% of patients were <50 years of the age and 64% of patients were >50 years of the age. The majority of the patients in ARM A were in the age group of >60 years (36%) and the majority of patients in ARM B were in the age group of 51-60 years (40%).The median age of total females in our study was 53 years. The median age in ARM A was 54 years and ARM B was 53 years.The mean age of females was 52.76 ± 9.84 years. The mean age in ARM A was 55.6 years and ARM B was 50.36 years. Our study findings were in concordance with the study conducted by Demaria S et al, Chin SN et al, Vasudevan D et al and Gahine R et al (7, 8, 9, 10). Out of total 50 patients, 60% patients belonged to rural areas and 40% patients belonged to urban areas. The distribution of the patients according to their locality (rural/urban) in both groups was comparable. 52% patients in Arm A and 68 % patients in Arm B belonged to rural areas and 48% patients in ARM A and 32% patients in ARM B belong to urban areas. According to ICMR data, Breast cancer is the commonest malignancy in urban Indian females and the second commonest in rural Indian females. (11) The cause of strong rural /urban difference in breast cancer incidence is not known, although it is likely to be due to one or more westernized lifestyle which differs between rural and urban females (12) In our Study 42% females were post-menopausal, 28% were premenopausal and 30% females were perimenopausal. Our study findings were in concordance with the study conducted by Surakasula A et al and Kunnuru SK et al where the majority of breast carcinoma patients were postmenopausal (13, 14). Present study reported that out of 50 females, 4% females were nulliparous, 16% of women had first childbirth at less than 20 years of age, 72% of women had first childbirth at the age range of 21-25 years, and 8% of females had first childbirth >25 years with mean age of first child birth 23.50 years.

With reference to number of children and breast feeding 10% of women have <2 children, 90% of women were having 2-4 children where 94% of women breastfed their children, 6% of women did not breastfeed their children. In our study it was observed that 90% of women did not use any kind of OCP as a birth control method, whereas 10% of women used OCP as a birth control method. In our study the risk factor Hypertension was found to have no concordance with study conducted by Hooning et al, Kannel et al hypertension & left-sided breast cancer patients have higher mortality rates (15, 16). In the current study majority of the Breast cancer patients presented with painless breast lump along with axillary lump, the location of breast lump was comparable in both the ARM A and ARM B. Out of 50 patients in our study, 80% have a lump in the upper outer quadrant of the breast, 12% have breast lump in the lower outer quadrant, and 8% in the lower inner quadrant of the breast. In ARM A 20% women have breast lump in the upper outer quadrant, 16% in the lower outer quadrant, and 4% in the lower inner quadrant while in ARM B 80% women have breast lump in the upper outer quadrant, 8% in the lower outer quadrant and 12%have breast lump in the lower inner quadrant. The staging of breast cancer plays a very important role in estimating the prognosis of the disease, planning the treatment strategy as well as interpreting and comparison of the outcome of the disease. 92%patients were reported up to cT2N2 and 8% were reported up to cT3N1. In Arm A, 56% of patients belonged to the stage pT2N1, 20% to the stage pT2N2 while in Arm B, 32% of patients belonged to the stage pT2N1, 16 % to the stage pT2N2. 76% patients were reported up to stage pT2N2 and 24 patients were till stage pT3N2. Out of 50 patients taken in our study, 80% of patients belonged to stage II, while 20% belonged to stage III. Raina V et al study has reported that 45% of patients presented with Stages III and IV of breast cancer disease. Similarly, another study found that 45.7% of patients presented with Stages III and IV breast cancer. (17) Hormonal receptor status ER, PR, and HER2/NEU were evaluated in 50 cases. Out of 50 females taken in our study IHC expression of ER and PR was positive in 40%, ER-positive, and PR negative in 44% cases while TNBC expression was noted in 16% cases. In ARM A 40 % females expressed ER+/PR+, 40% ER+/PR- and 20% expressed TNBC. In ARM B 20% females expressed ER+/PR+ , 48% ER+/PR- and 12% expressed TNBC. Almost similar results were reported by Kinsella MD et al and Zhou X et al et al who reported 45% and 49.5%, of positive PR expression in their studies (18, 19). In our study to compare the cardiotoxicity in both the arms and to correlate them clinically, 2D-Echo (2-Dimensional Echocardiography) and MUGA scan (Multiple Gated Acquisition Scan) were done in the patients undergoing post-mastectomy radiotherapy before RT, after 8 weeks of RT, and 6 months of RT. Changes in left ventricular ejection fraction for the heart were noted in both the arms before and after RT. New insights are necessary to improve the understanding of cardiac toxicity. The issue of whether systemic agents, radiotherapy, hormonal therapy, or predisposing factors lead to cardiac toxicity or not, seems to be settled now. It is now obvious that it is a combination of these. (20). A study conducted by Demirci S et al where there was a relative increase of 30% in cardiac death among women treated with radiotherapy before the 1980s. In the era, breast, chest wall, axillary area, and internal mammary lymph nodes were irradiated. Excess risk of cardiovascular events is difficult to define due to the lack of reliable dosimetric data. The radiotherapy technique at that time was 2 D treatment planning with the large volume of the heart included (21) In our study a comparision of 2DRT and 3D-CRT in post- mastectomy left sided breast cancer patients was made to assess the cardiotoxicity . 2D -Echo was done before RT, after 8 weeks of RT, and 6 months of RT to assess and co-relate cardiotoxicity in both the ARM A and ARM B. With 2D-Echo, the mean LVEF in ARM A before RT was 58.08, after 8 weeks of RT 53.44 and after 6 months of RT was 52.04 and the mean LVEF in ARM B before RT was 59.32, after 8 weeks of RT 56.96 and after 6 months of RT was 55.48 Cardiotoxicity was found to be lower in ARM B as compared to ARM A with a significant p-value (0.001) seen at 8 weeks and 6 months of postmastectomy radiotherapy in left-sided breast cancer patients. With the improvement in radiotherapy planning, uniform treatment of chest wall in all the patients & the advent of computed tomography for planning purposes, the results are expected to be less detrimental.

A study conducted by Sheela B, et al showed that patients with subclinical cardiotoxicity that is the drop in LVEF <50% from baseline were advised to close cardiac monitoring.(22) A comparision of 2DRT and 3D-CRT in post- mastectomy left sided breast cancer patients was made to assess the cardiotoxicity . A cardiac MUGA scan was done before RT, after 8 weeks of RT, and 6 months of RT to assess and co-relate the cardiotoxicity in both the ARM A and ARM B. With cardiac MUGA scan mean LVEF in ARM A before RT was 67.03, after 8 weeks of RT 62.31, and after 6 months of RT was 59.62. and the mean LVEF in ARM B before RT was 66.54, after 8 weeks of RT 63.87 and after 6 months of RT was 62.36. Since the sample size of our study was small, the difference in LVEF with cardiac MUGA scan in ARM A and ARM B was 3 , at 6 months which is showing non- significance value. On comparision of LVEF with 2D-ECHO mean LVEF before RT was 58.70, 8 weeks post-RT was 55.16 and 6 months of RT was 53.76. and with Cardiac MUGA scan mean LVEF before RT was 66.79, after 8 weeks of RT was 63.09 and 6 months of RT was 60.99 indicating the significant difference between 2D-ECHO and Cardiac MUGA scan with a p-value of (0.001). Although there was a significant p-value (0.001) between 2D-ECHO and Cardiac MUGA scans, the two techniques cannot be compared hand in hand due to limited resources present in our institute. Gold Standard test for monitoring of LVEF is Cardiac MRI but due to its limited availability and technical complexity it is not so commonly. (23) The limitation of this study was small number of patients and short follow -up, but the results were similar to the previous studies.

CONCLUSION

We conclude from this study that clinician must be aware that cardiotoxicity in left-sided breast cancer patients is a multifactorial issue, choosing and monitoring the type of radiotherapy according to patient condition is very important for decreasing late cardiotoxicity. Six months is a relatively short time for follow-up of radiotherapy-related injuries. Therefore, additional follow-up is needed to gain a better understanding of persistence and functional consequences of cardiac dysfunction in patients who receive radiotherapy for breast cancer. In the meantime, new radiotherapy techniques using 3D- Conformal RT has resulted in minimal doses to the heart leading to declining cardiotoxicity and death and every effort should be made to minimize incidental irradiation of the heart while maintaining adequate coverage of target volumes.

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