Results

Demographic characteristics :

This study was conducted in order to investigate the effect of radiation therapy on the heart of patients with breast cancer. 50 patients were included in the study; their age ranged between 35 to 63 years with a mean of 49.54 ± 8.04. 15 patients (30%) were hypertensives , 6 patients (12%) had diabetes Mellitus, 5 patients (10%) had dyslipidemia.

Table (1): Demographic and clinical characteristics of the studied patients

Parameter	Total number = 50 patients
Age : Range (mean ± SD) in years.	35-63 (49.54 ± 8.04)
Hypertension: n (%)	15 (30%)
Diabetes : n (%)	6 (12%)
Dyslipidemia : n (%)	5 (10%)
+ve family history of CAD: n (%)	5 (10%)

Table (2) summarizes the baseline clinical data of all patients before, 6 months and 9 months after radiation therapy. The diastolic BP increased significantly from 69 ± 20.5 mm Hg to 89.3 ± 13.4 mm Hg after 6 months and then it still significantly higher compared to baseline after 9 months (78.9 ± 12.6 mm Hg) ($P < 0.05$). The pulse rate and systolic BP changed little on follow up; Six patients (12%) developed new hypertension after 9 months follow up period.

Before radiotherapy; no one had chest pain , dyspnea or cardiac murmur on cardiac examination. After 6 and 9 months of radiotherapy 3 patients (6%) and 2 patients (4%) had non ischemic chest pain respectively. In all patients, the chest pain was pleuritic in nature and was sharp, retrosternal and almost relieved by sitting forward and was not related to exercise. Those patients also had pericardial rub, and ECG, and echocardiographic evidences of pericarditis, No patient developed angina pectoris along follow up period.

In the present study 19 patients (38%) developed dyspnea after 6 months and the number rosed to 22 patients (44%) after 9 months . The dyspnea in all cases was mild to moderate degree (grade I -II) .

After 6 months follow up a cardiac cause for dyspnea was evident in 9 (18%) patients in the form of diastolic dysfunction . The other cases [10 patients (20%)] were found to have early post radiation pneumonitis and generalized fatigue caused by early doses of radiotherapy.

After 9 months follow up, cardiac causes of dyspnea was found in 11 cases (22%) ,systolic dysfunction in one case (2%),and diastolic dysfunction in 10 patients (20%). The other cases [11 patients (22%)] were found to have pneuminitis as diagnosed clinically , chest x-ray and by chest specialist.

ECG changes developed in 3 patients after 6 months in the form of low ECG voltage and sinus tachycardia. After 9 months of radiation 5 patients (10%) developed abnormal ECG ; 2 patients (4%) in the form of low ECG voltage and 2 cases (4%) developed infrequent premature ventricular contractions and 1 case developed ST – T wave changes .

Table (2): Results of clinical examination before and after radiotherapy

	Before N = 50 pt.	**After 6 months N = 50 pt.**	**After 9 months N = 50 pt.**	**P value**
Dyspnoea				
Yes**; n (%)**	0	19 (38%)	22 (44%)	NA
NO**; n (%)**	50	31 (62%)	28 (56 %)	> 0.05
Cardiac cause**; n (%)**	0	9 (18%)	11 (22%)	NA
Non cardiac cause**; n (%)**	0	10 (20%)	11 (22%)	NA
Chest pain				
Non ischemic**; n (%)**	0	3 (6%)	2 (4%)	NA
Ischemic**; n (%)**	0	0 (0%)	0 (0%)	
Pulse (B/min.)	73.5±10.5	75 ± 9.5	78.5 ± 9.0	> 0.05
SBP (mm Hg)	120 ±15.5	122.7 ± 17.3	125 ± 14.3	> 0.05
DBP (mm Hg)	69 ± 20.5	89.3 ± 13.4	78.9 ± 12.6	< 0.05
Hypertensive; n (%)	15(30%)	15(30%)	21(42%)	> 0.05
Pericardial rub; n (%)	0	3 (6%)	2 (4%)	NA
Abnormal ECG*; n (%)**	0 (0)	3 (6%)	5 (10%)	NA

●NA: Not applicable as compared to baseline before radiotherapy.

●Abnormal ECG: sinus tachycardia, premature beats, and ST-T changes

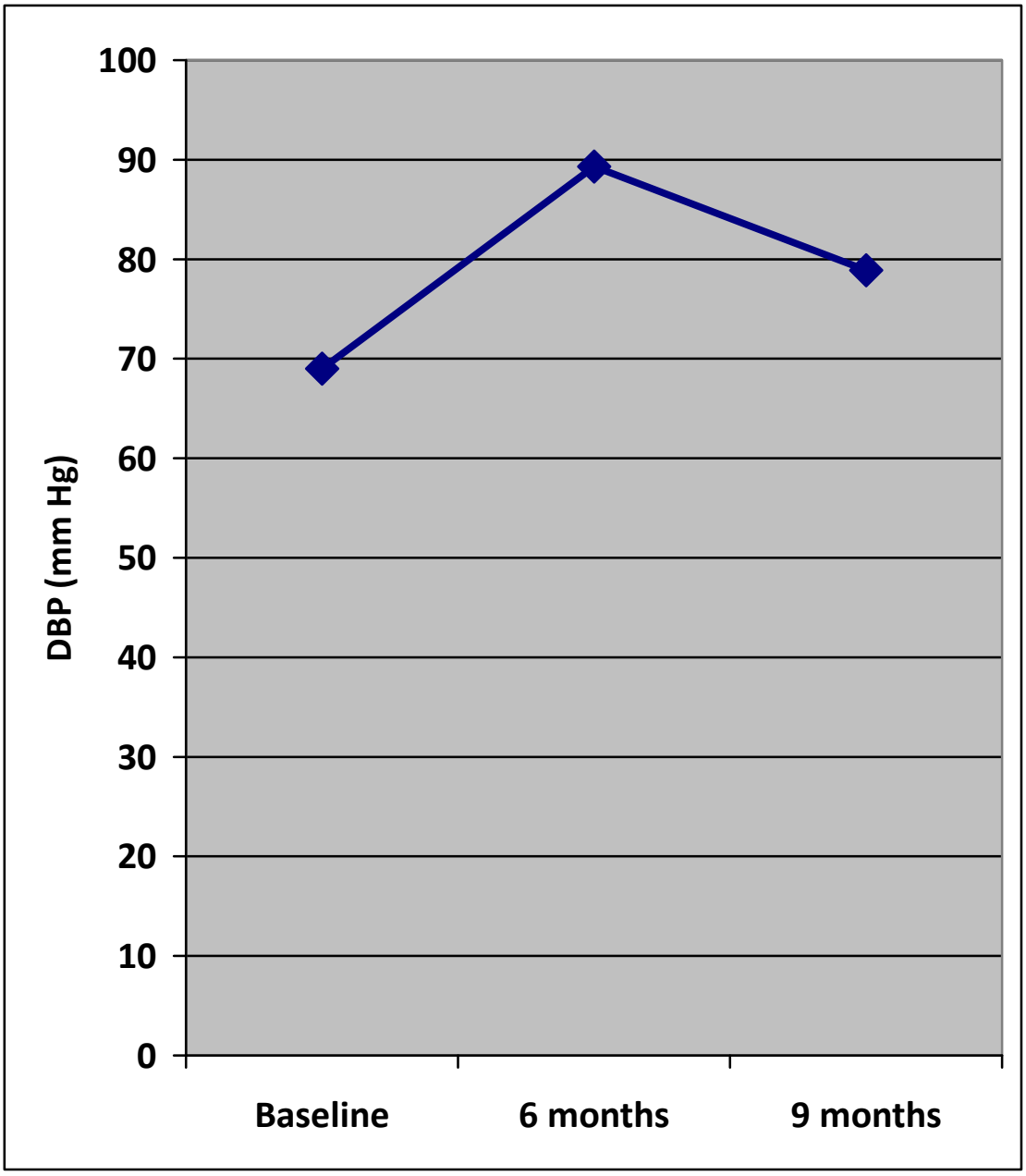

Fig. (1): Diastolic blood pressure changes at baseline and after 6 and 9 months of radiotherapy

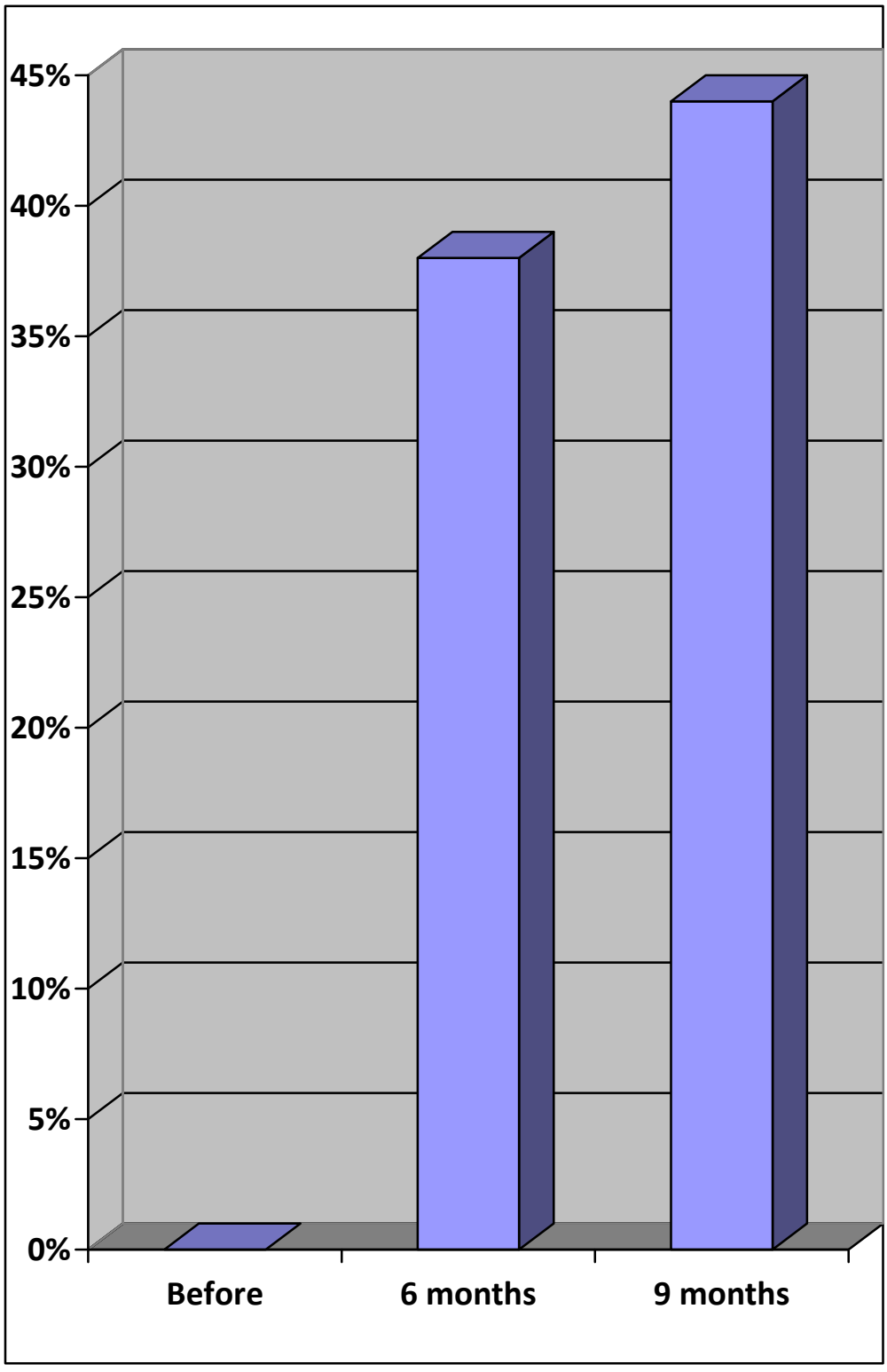

Fig. (2): Incidence of dyspnea after radiotherapy

Table (3) presents the comparison of different echocardiographic measurements before, 6 months, and 9 months after radiotherapy.

There were a trend for non significant increase in LV dimensions at end systole and end diastole together with a slight decrease in global LV systolic function (percentage of FS and EF).

The pulmonary artery systolic pressure increase little on follow up; no patients developed pulmonary hypertension.

One patient (2%) developed systolic dysfunction as evident by significant decrease of EF from 60% to 39.9%.

Table (3): Echocardiographic measurements before, 6 months and 9 months after radiotherapy.

Studied variables	*Radiotherapy*			P-Value
	Pre *radiation (N=50)* Mean ± SD	After 6 months *(N=50)* Mean ± SD	After 9 months *(N= 50)* Mean ± SD	
ESD (mean ± SD in Cm)	28.78 ± 2.99	29.1 ± 3.23	29.7 ± 3.57	> 0.05
EDD (mean ± SD in Cm)	45.64 ± 4.69	44.9 ± 3.59	46.41 ± 4.47	> 0.05
FS *(mean ± SD in Cm)*	37.42 ± 3.87	36.8 ± 4.22	35.64 ± 5.69	> 0.05
EF% *(mean ± SD)*	69.11 ± 4.81	67.8 ± 5.76	67.08 ± 8.1	> 0.05
PWT *(Mean ± SD) (Cm)*	0. 8 ± 0.1	0.85 ± 0.1	0.90 ± 0.1	> 0.05
SWT *(Mean ± SD) (Cm)*	0.76 ± 0.1	0.79 ± 0.1	0.82 ± 0.1	> 0.05
PASP *(mean ± SD in mm Hg)*	18.62 ± 3.31	19.3 ± 3.05	20 ± 3.92	> 0.05

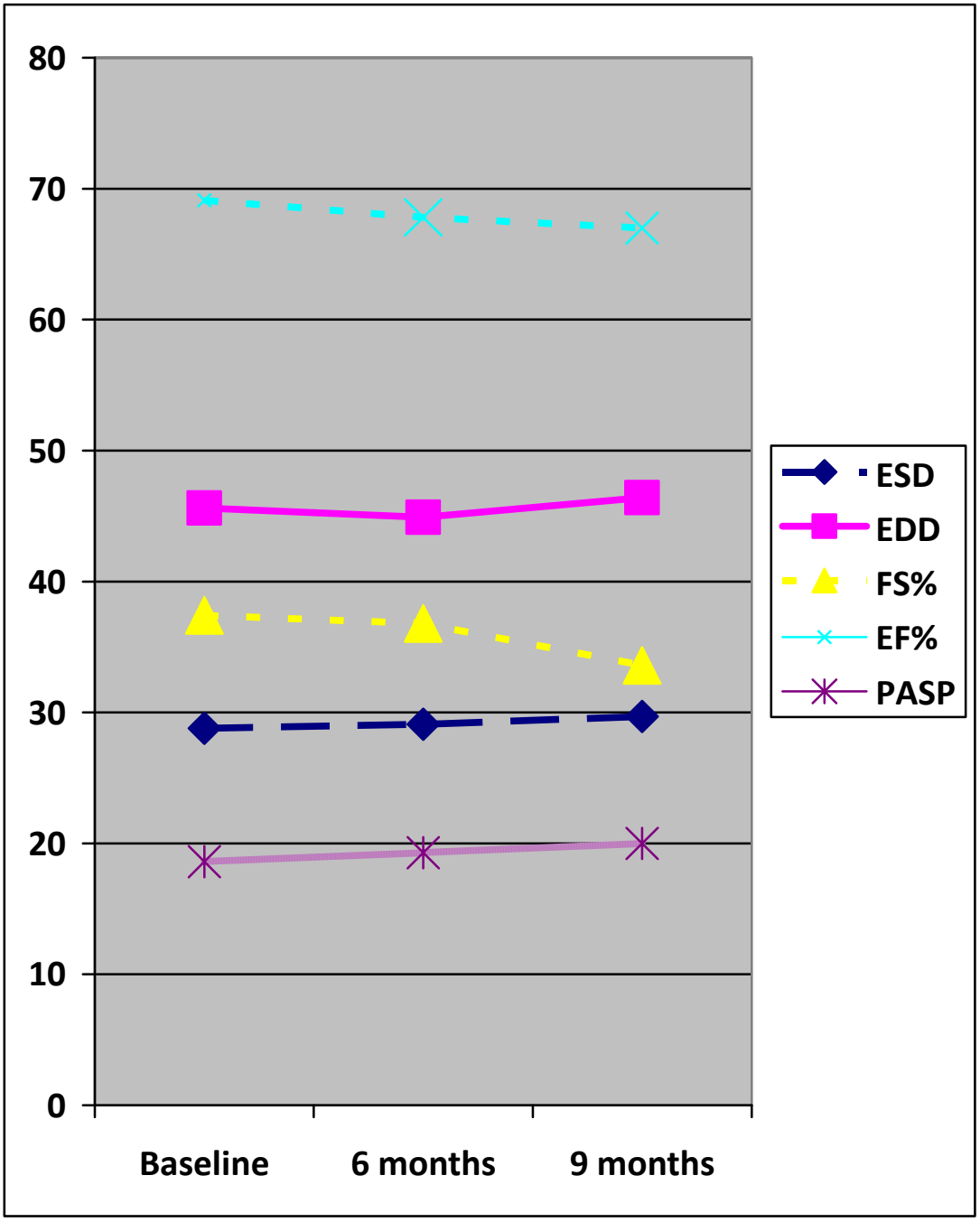

Fig. (3): Echocardiographic measurement at the baseline, 6 months and 9 months after radiotherapy

Table (4) shows that 9 patients (18%) developed diastolic dysfunction at 6 months ; 5 cases (10%) in stage I diastolic dysfunction and 4 cases (8%) in stage II. No one developed stage III dysfunction.

After 9 months 10 cases (20%) developed diastolic dysfunction ; five cases (10%) in stage I and the other five in stage II.No one developed stage III.

Table (4): Diastolic mitral flow pattern before and 6 and 9 months after radiation therapy

	Before n(%)	**After 6 months n(%)**	**After 9 months n(%)**
Normal; n(%)	50(100%)	41(82%)	40(80%)
Stage I ; n(%)	0 (0%)	5 (10%)	5 (10%)
Stage II; n(%)	0 (0%)	4 (8%)	5 (10%)
Stage III; n(%)	0 (0%)	0 (0%)	0 (0%)
Total	0 (0%)	9(18%)	10(20%)

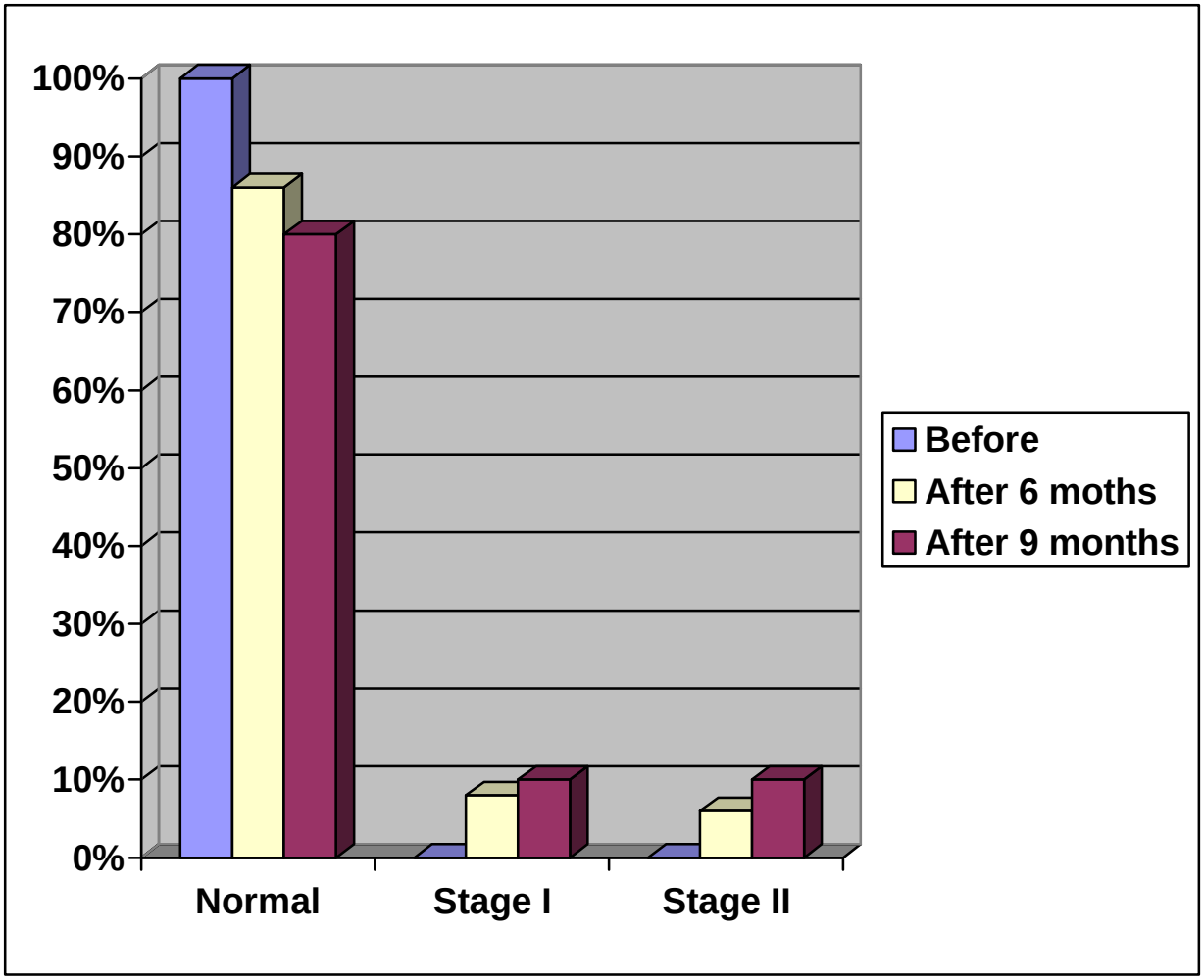

Fig. (4): Diastolic mitral flow pattern in the studied patients before and after radiation therapy

Table (5) shows that the patients with diastolic dysfunction were significantly older than those with normal diastolic function [53.5 ± 5.9 years vs. 43.5 ± 5.5 years ($p < 0.01$)]. Also the prevalence of hypertension was significantly higher among patients with diastolic dysfunction (30%) than those with normal diastolic function (15%) ($p < 0.001$). The incidence of ECG changes was significantly higher among patients with diastolic dysfunction (30%) than those with normal diastolic function (5%) ($p < 0.01$).

There was no significant difference between patients with diastolic dysfunction and those with normal diastolic function regarding the prevalence of dyslipidemia and diabetes Mellitus ($P > 0.05$).

Table (5): Comparison between patients with and without diastolic dysfunction as regard baseline demographic data and ECG changes

	Normal diastolic function N of pt. = 40	**Diastolic dysfunction N of pt. = 10**	**P value**
Age; (mean ± SD) (years)	43.5 ± 5.5	53.5 ± 5.9	**< 0.01**
HTN; n (%)	17 (42%)	4 (40%)	**< 0.01**
DM; n (%)	4 (10%)	1 (10%)	**> 0.05**
Dyslipidemia; n (%)	4 (10%)	1 (10%)	**> 0.05**
ECG changes;	2 (5%)	3 (30%)	**< 0.01**

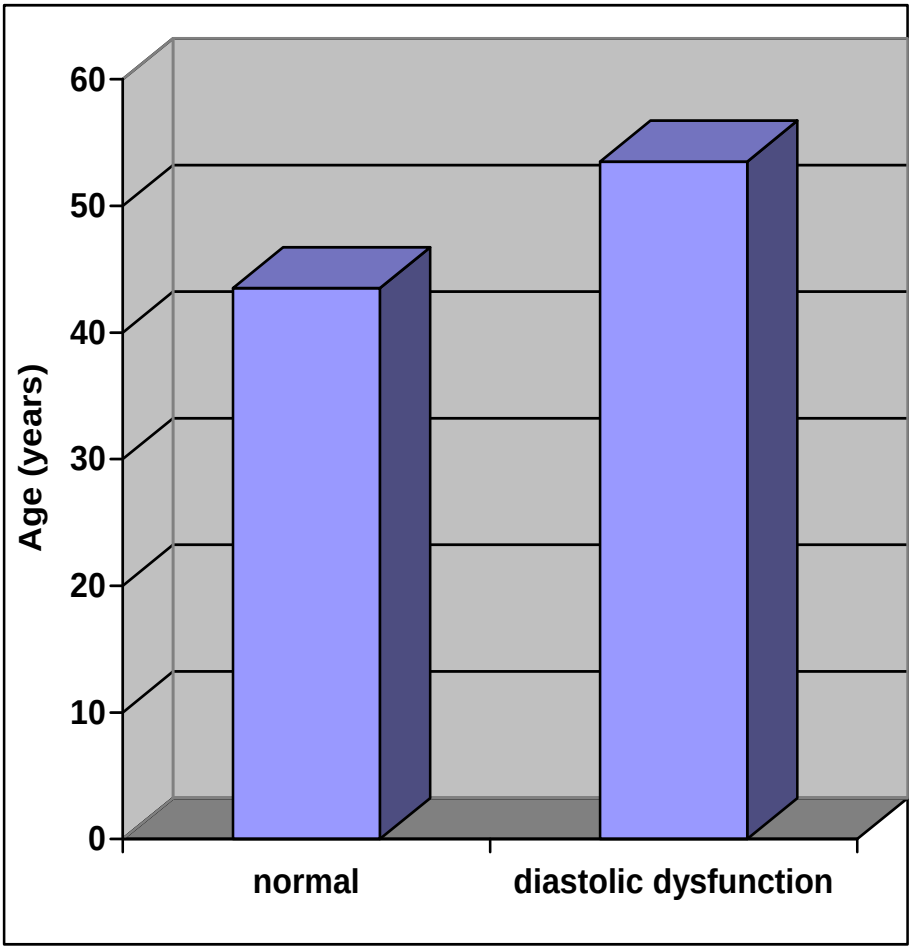

Fig. (5): Age of the patients with and without diastolic dysfunction

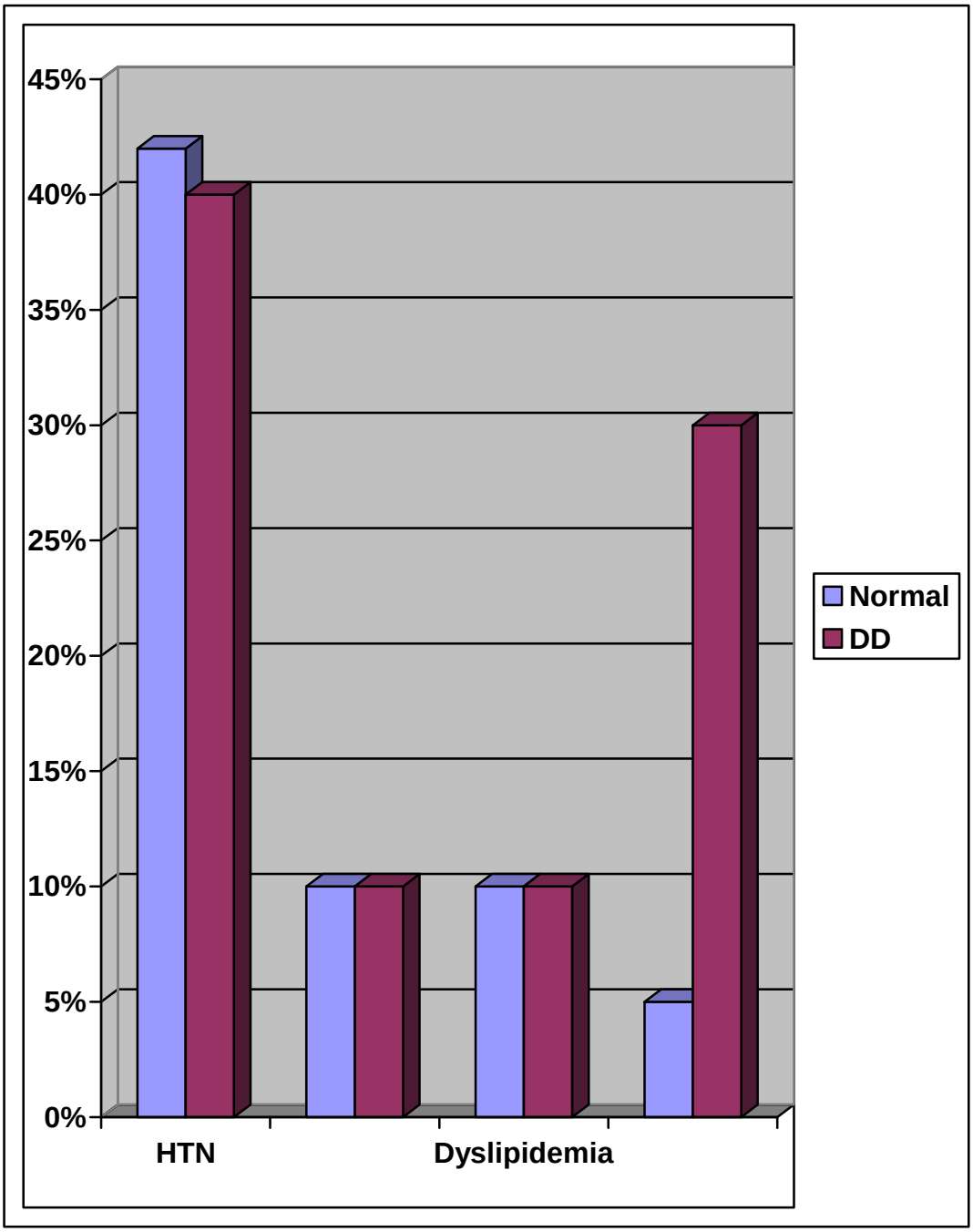

Fig. (6): prevalence of HTN, DM, Dyslipidemia and ECG changes of the patients with and without diastolic dysfunction

Table (6) summarizes the incidence of complications that developed 6 and 9 months after radiotherapy.

One patient (2%) developed systolic dysfunction and wall motion abnormality with significant decrease of EF from 60% to 39% after 9 months of radiotherapy , while 9 patients (18%) developed diastolic dysfunction 6 months after radiotherapy, and additional one case of diastolic dysfunction was detected at 9 months.

Three patients (6%) developed mild to moderate pericardial effusion after 6 months:- one case from those patients, effusion was resolved completely at 9 months and the remainder 2 cases (4%) still have pericardial effusion after 9 months .

One Patient developed valvular affection in the form of mild to moderate mitral regurge. No patient developed LVH, or pulmonary hypertension.

The percentage of patients who developed one or more cardiac complications after 6 and 9 months of radiotherapy were 30% and 50% of total population studied respectively.

Table (6): The overall incidence of complications after 6 and 9 months of radiotherapy (number and percentage)

Complication	Incidence after 6 months N=50	Incidence after 9 months N=50
Cardiac failure	**9(22%)**	**11(22%)**
Systolic heart failure*	0 (0%)	1 (2%)
Diastolic heart failure*	9 (20%)	10 (20%)
New cases of hypertension	**0 (12%)**	**6 (12%)**
ECG abnormalites	**3 (10)**	**5 (10)**
Pulmonary hypertension	**0 (0%)**	**0 (0%)**
Valvular affection	**0 (0%)**	**1(2%)**
Pericardial effusion	**3 (6%)**	**2 (4%)**
Total patients with complications	**15 (30%)**	**25 (50%)**

*Abnormal systolic function associated with exertional dyspnea.

*Abnormal E/A ratio and E- deceleration time is associated with exertional dyspnea.

Table (7) shows that the patients with complications were significantly older than those without complications (44.7 ± 4.5 years vs. 52.5 ± 6.0 years ($p < 0.05$)).

There was no significant difference between patients with and without complications regarding the prevalence of hypertension, Diabetes Mellitus or dyslipidemia ($p > 0.05$).

Table (7): Comparison between patients with and without cardiac complications as regard baseline demographic data

	Without complications N of pt. = 25	With complications N of pt. = 25	P value
Age (mean ± SD) (years)	44.7 ± 4.5	52.5 ± 6.0	< 0.05
HTN n (%)	10 (28.6%)	5 (33.3%)	> 0.05
DM (n (%)	4 (8.6%)	2 (13.3%)	> 0.05
Dyslipidemia	4 (11.4%)	1 (6.7%)	> 0.05

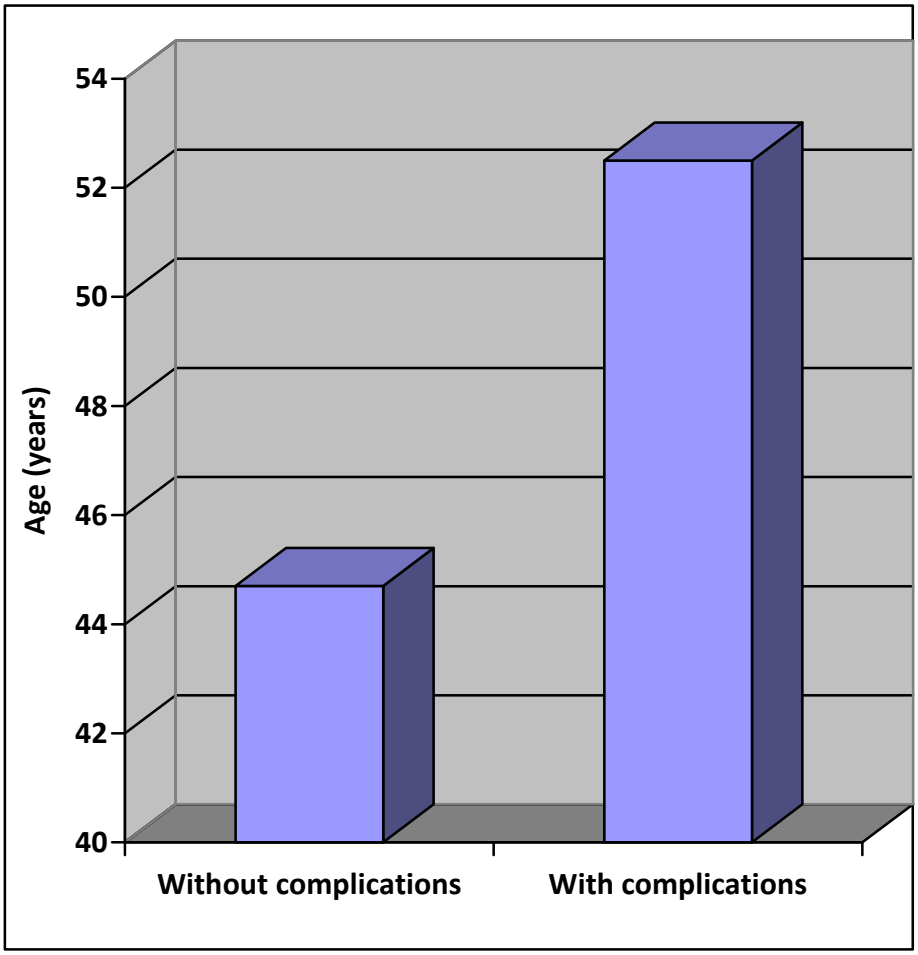

Fig. (7): Age of the patients with and without cardiac complications

Multivariate analysis of the different risk factors for the occurrence of cardiovascular complications after radiation therapy showed that the only significant predictor of the occurrence of complications was the age (relative risk = 3.4, with a 95% confidence interval between 1.7 – 6.2,(P < 0.01)

Table (8): multivariate analysis of the relative risk for significant predictors of the occurrence of complications after radiation therapy

Risk factor	Relative risk	95% confidence interval	P value
Age	3.4	1.7 – 6.2	< 0.01
Diabetes Mellitus	0.9	0.6 – 1.4	> 0.05
Hypertension	1.1	0.8 – 1.7	> 0.05
Dyslipidemia	1.2	0.7 – 1.9	> 0.05