Results

I. Demographic and risk factors data

- **All Study population**

The mean age was 52±10 years (range 37-77), 25% were males, while 75% were female, the mean BMI was 28±3 kg/m^2 (range 21-35), the mean duration of DM was 10±7 years (range 1- 28). 81% of the patients were on oral hypoglycemic drugs while the resting was using insulin. 17% were smokers, 36% were hypertensive, 50% had family history of cardiovascular disease (CV diseases), and 70% had dyslipidaemia.

- **Group analysis**

Diabetic participants with microalbuminuria (group II) and macroalbuminuria (group III) were older than those without albuminuria (group I) as the mean age (years) in group I was 42±4, 55±8 in group II and 60±6 in group III with significant difference ($p = 0.001$).

Group I was found to be significantly less obese than group II and group III. The mean BMI (kg/m^2) was 26±3 in group I, 29±3 in group II and 32±3 in group III with significant difference ($p = 0.008$).

The duration of DM was significantly shorter in group I than group II and group III, the mean duration of DM (years) was 3±2 in group I, 11±5 in group II, and 15±6 in group III with significant difference ($p = 0.001$). No significant difference between groups as regard sex distribution. Step-wise increases were seen in prevalence of

hypertension: 10% of group I, 50% of group II and 50% of group III were hypertensive with significant difference (p = 0.010).

No significant difference in the prevalence of family history of ischemic heart disease (IHD) between groups as it was 40% of group I, 40% of group II and 70% of group III had family history of C.V disease with non significant difference (p = 0.091).

Normoalbuminuric subjects were more often treated with oral antidiabetic medications in comparison to microalbuminuric and macroalbuminuric persons, 100% of the patients of group I, 85% of group II and 60% of group III were on oral hypoglycemic drugs with significant difference (p = 0.004).

Contrary, subjects with micro- and macroalbuminuria were significantly more often treated with insulin only or insulin in combination with oral hypoglycemic than normoalbuminuric persons. (Table 8 & figures 11-14)

Table (8): Demographic data and cardiovascular risk factors

	Group I N = 20	**Group II N = 20**	**Group III N = 20**	**P value ***
Age (years) Mean ±SD	42±4	55±8	60±6	0.001*
Male sex (No & %)	5 (25 %)	4 (20 %)	6 (30%)	0.766
BMI (kg/m2) Mean ±SD	26±3	29±3	32±3	0.008*
Duration DM (years) Mean ±SD	3±2	11±5	15±6	0.001*
Smokers (No & %)	2 (10)	3 (15)	5 (25%)	0.432
Hypertensive (No & %)	2 (10%)	10 (50%)	10 (50%)	0.010*
Dyslipidaemia (No & %)	13 (65%)	14 (70%)	15 (75%)	0.788
F.H of IHD (No & %)	8 (40%)	8 (40%)	14 (70%)	0.091
Antidiabetic Oral	20 (100%)	17 (85%)	12 (60%)	0.004*
Insulin (No & %)	0 (0%)	3 (15%)	8 (40%)	

- IHD (ischemic heart disease)
- P value of difference between group I and either group II and III.

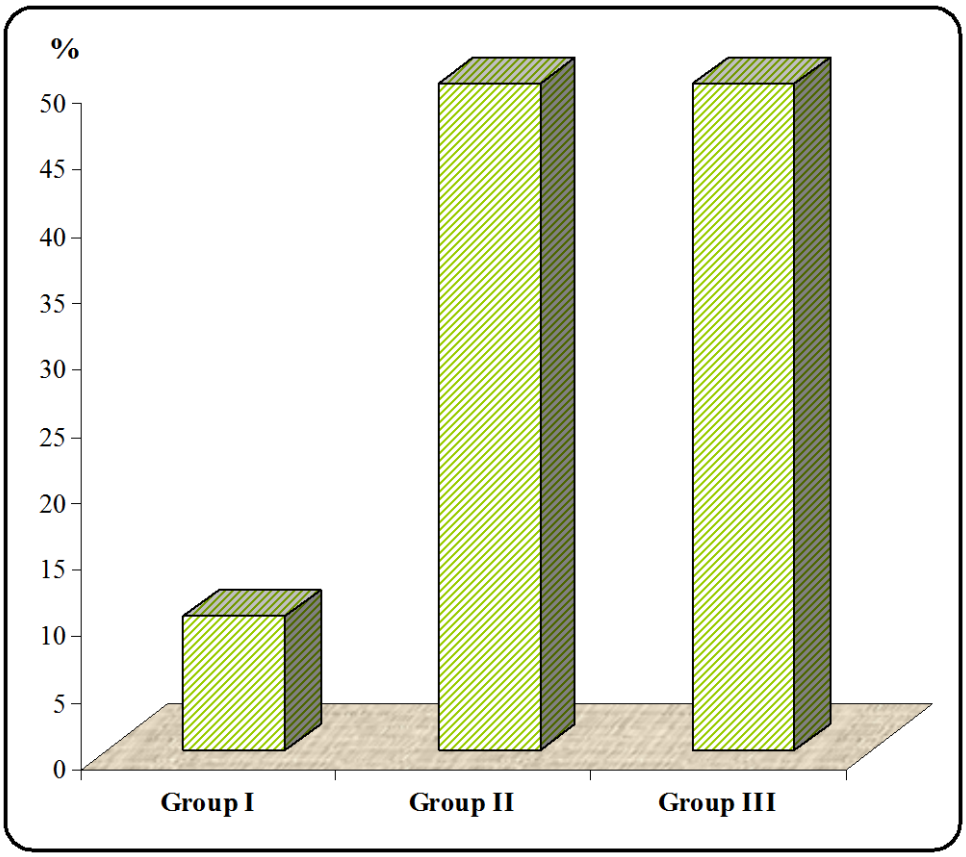

Figure (11): prevalence of hypertension in study groups (p = 0.010)

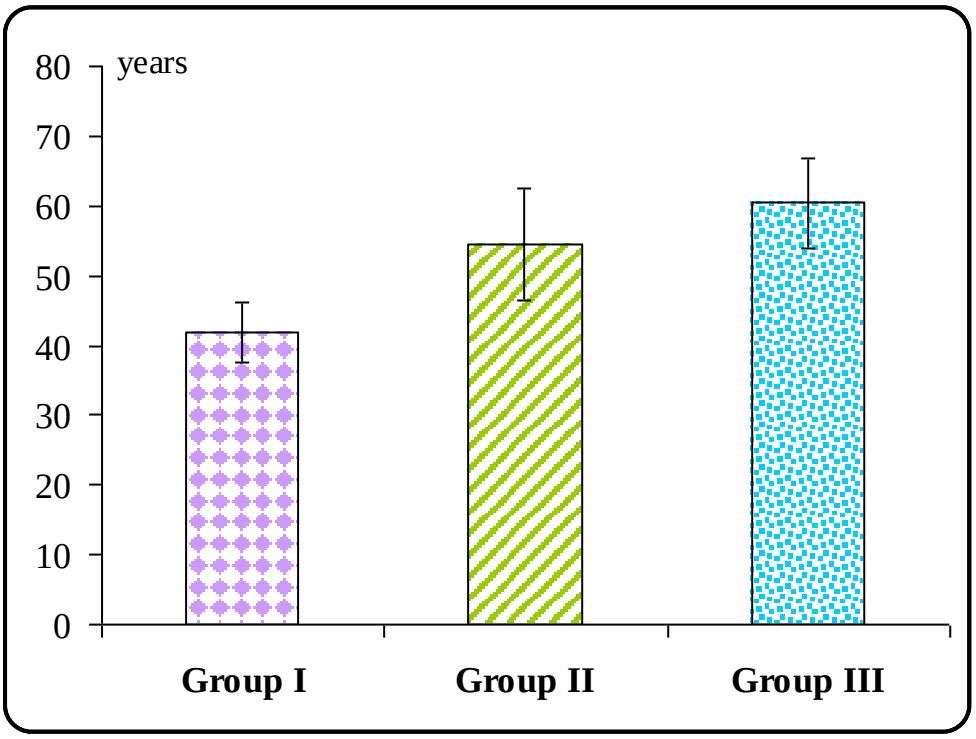

Figure (12): Comparison between different groups according to age (p = 0.010)

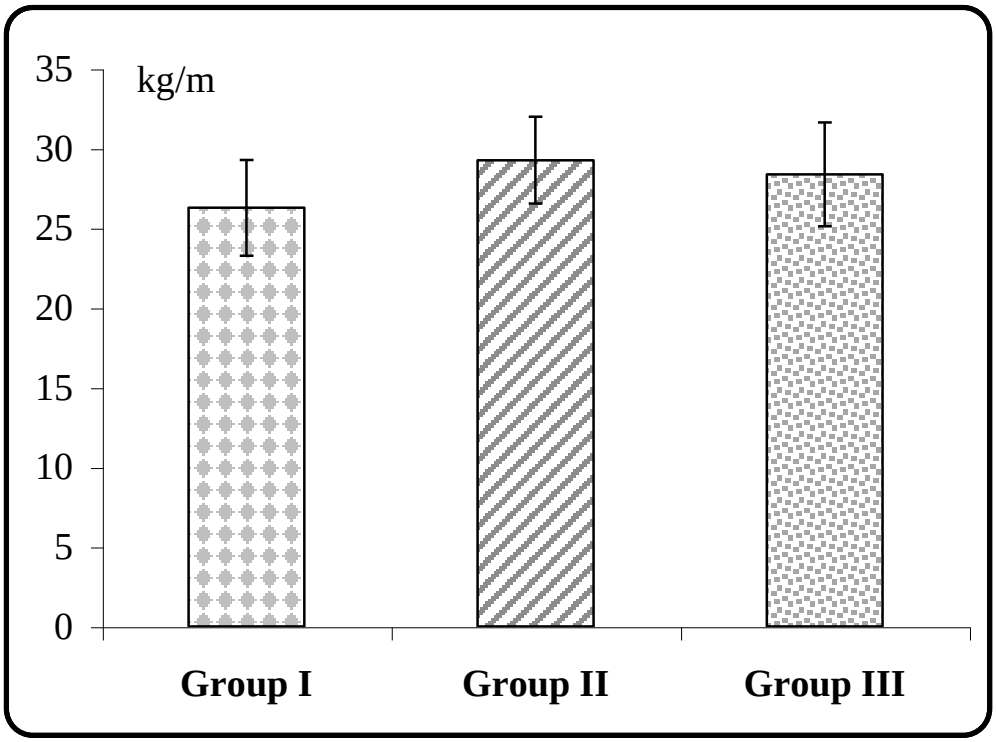

Figure (13): Comparison between different groups according to body mass index (p = 0.008*)

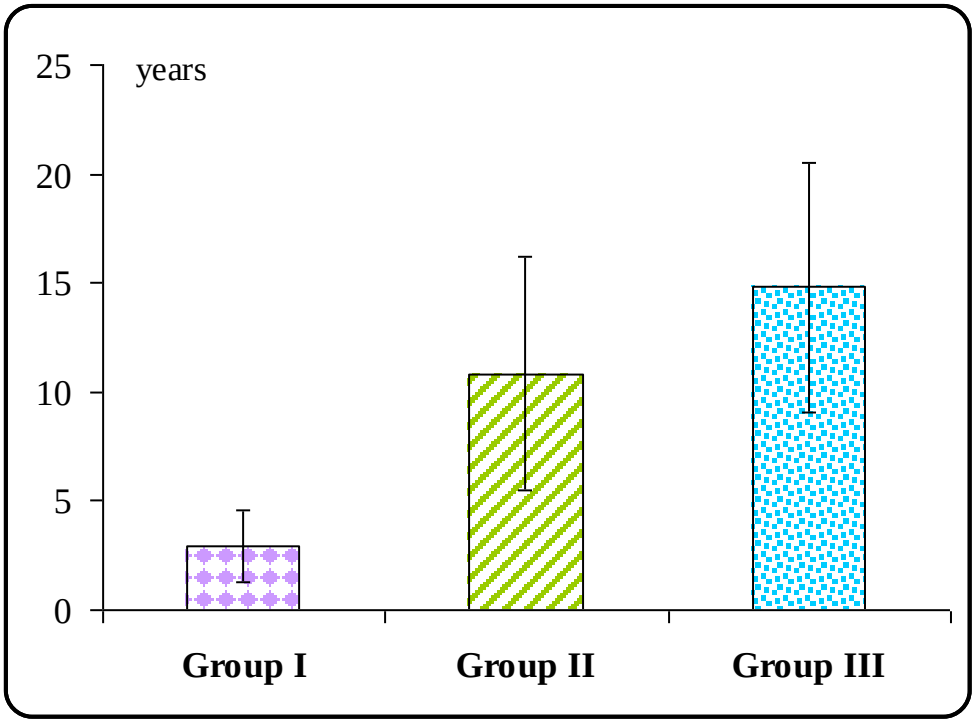

Figure (14): Comparison between different groups according to duration of DM (p =0.001*)

II. Routine laboratory investigations

- **All Study population**

The mean fasting blood sugar (mg/dl) was 165±40 (range 110-298), and the mean 2hpp (mg/dl) was 239±36 (range 188-352), the mean serum urea (mg/dl) was 37±12, creatinine (mg/dl) 0.9±0.2, Hb (gm/dl) 13±1.5, cholesterol (mg/dl) 211 ±51, LDL (mg/dl) 131±42, HDL (mg/dl) 44±14 and T.G (mg/dl) 148 ± 41.

- **Group analysis**

Subjects with microalbuminuria or macroalbuminuria had less glycemic control than subjects with normoalbuminuria, the mean fasting blood sugar (mg/dl) in group I was 147±31, 161±29 in group II, and 187±49 in group III with significant difference (p = 0.001).The mean 2hPP (mg/dl) was 214±21 in group I, 240±24 in group II and 263±40 in group III with significant difference (p = 0.001).There were no significant difference between group I and other groups as regard other variable studied in table 9.

Table (9) Laboratory investigations in different groups

Variable	Group I No = 20	Group II No = 20	Group III No = 20	P-value
Fasting sugar (mg/dl) **Mean±SD**	147±31	161±29	187±49	0.005*
2hpp sugar (mg/dl) **Mean±SD**	214±21	240±24	263±40	0.001*
Urea (mg/dl) **Mean±SD**	34±11	37±10	37±13	0.689
Creatinine (mg/dl) **Mean±SD**	0.9±0.2	0.9±0.2	1±0.2	0.443
Hb (gm/dl) **Mean±SD**	14±1	13±1.5	13±2	0.551
Cholesterol (mg/dl) **Mean±SD**	208±43	208±45	218±63	0.789
LDL (mg/dl) **Mean±SD**	132±32	123±33	139±55	0.476
HDL (mg/dl) **Mean±SD**	44±17	48±15	39±8	0.159
T.G (mg/dl) **Mean±SD**	162±37	143±42	138±41	0.164

Hb: haemoglobin, LDL: low density lipoprotein, HDL: high density lipoprotein, T.G: triglyceride

(III) Albuminuria

The mean albumin/creatinine (A/C) ratio (gm/mg) was 221±250 in whole study population (range 3 – 1054), the mean ratio in group I 14.2±7.4, group II 140.5±89.7 and 508.5±218.7 in group III with significant difference (p = 0.001).

In the multiple logistic regression analysis using albuminuria as the dependent variable a number independent predictors were detected: age (OR 3.5), hypertension (OR 7.2), body mass index (OR 2.2) and duration of diabetes (OR 19.6) were significantly associated with albuminuria (p < 0.05).

(IV)Albuminuria and LV functions

(A) Systolic indices

In the whole study population, the mean EF (%) was 58±9 (range 36-75), the mean FS (%) was 31±6 (range 18:45), the mean LV mass (gm) was 210±71 (range 50 -375).

The mean EF (%) in group I was 67±5, 60±4, in group II and 47±5 in group III with significant difference (p = 0.001). The mean FS (%) was 37±4 in group I, 32±3 in group II and 24 ± 2 in group III with significant difference (p = 0.001).The mean LV mass (gm) was 161±62 in group I, 209±52 in group II and 260±63 in group III with significant difference (p = 0.001). (Table 10 & figures 15-17)

Table (10) LV systolic function in different groups.

Systolic indices	Group I	Group II	Group III	P-value
EF (%) Mean±SD	67±5	60±4	47±5	0.001*
FS (%) Mean±SD	37±4	32±3	24±2	0.001*
LV mass(gm) Mean±SD	161±62	209±52	260±63	0.001*

EF = Ejection Fraction. FS = Fraction shortening

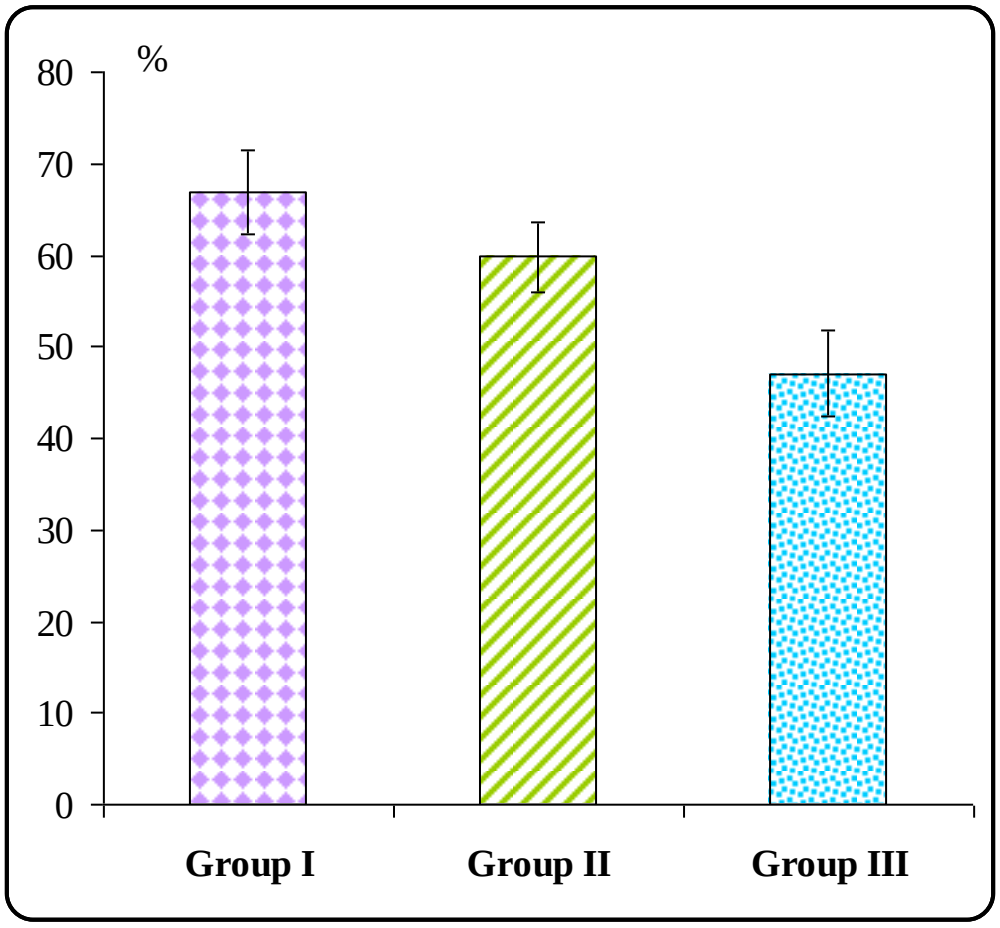

Figure (15): Comparison between groups according to ejection fraction (p = 0.001).

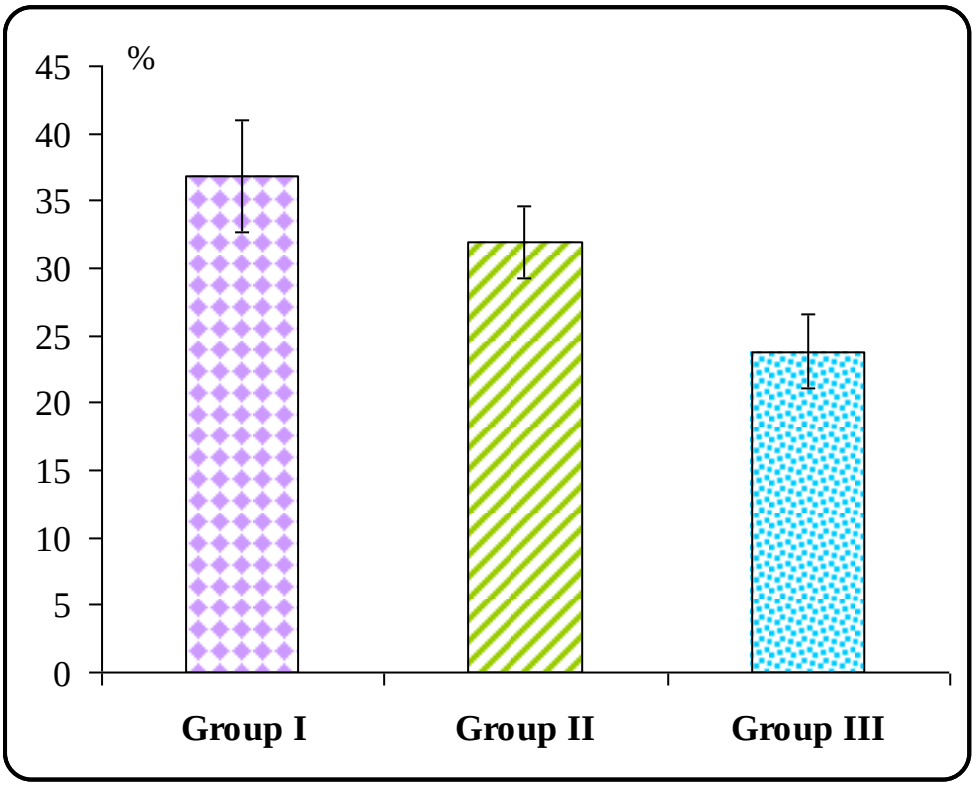

Figure (16): Comparison between groups according to fraction of shorting (p = 0.001).

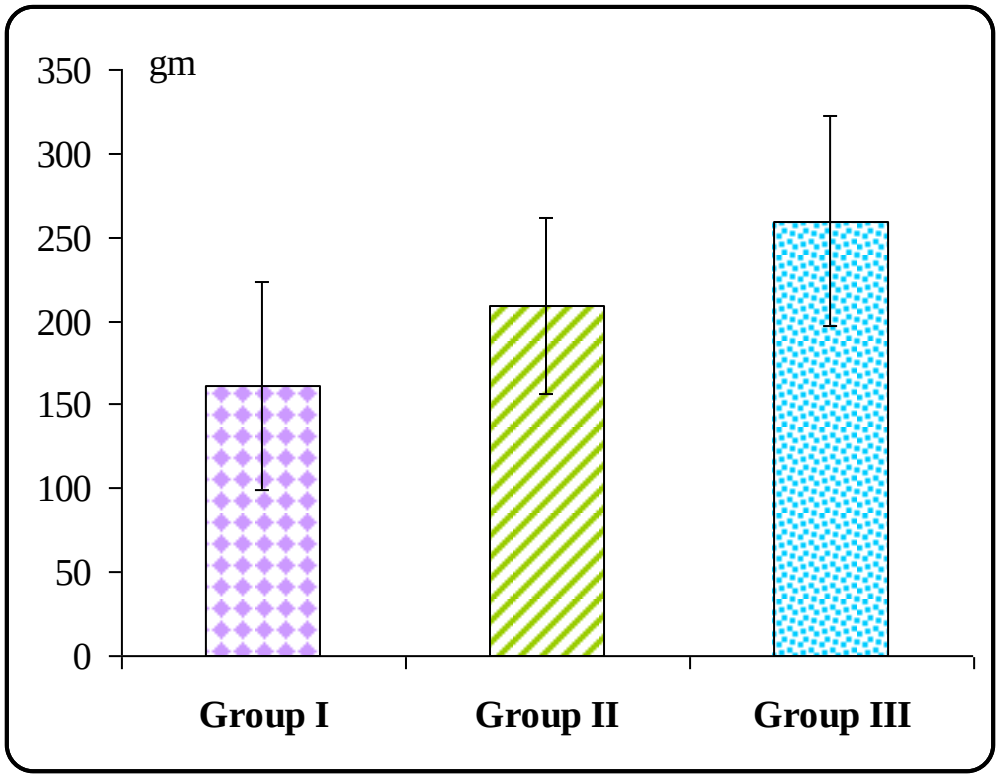

Figure (17): Comparison between groups according to left ventricular mass (p = 0.001).

(B) Left ventricular dimensions

The mean LVESd (cm) was 3±0.6 (range 2-5), the mean LVEDd (cm) was 5±0.6 (range 3-6), the mean PWT (cm) was 0.9±0.1 (range 0.7-1.4), the mean septal T (cm) was 1±0.1 (range 0.7-1.4).

The mean LVESd (cm) was 3±0.4 in group I, 3.3±0.4 in group II and 4±0.5 in group III with significant difference (p = 0.001). The mean LVEDd (cm) was 4.5±0.6 in group I, 4.7±0.5 in group II and 5.2±0.6 in group III with significant difference (p = 0.004). The mean PWT (cm) was 0.9±0.1 in group I, 1±0.1 in group II and 1.1±0.1 in group IIII with significant difference (p = 0.003). The mean septal T (cm) was 0.9±0.1 in group I, 1±0.1 in group II and 1.1±0.1 in group III with significant difference (p = 0.001). There was step-wise increase in prevalence of LV hypertrophy seen from group with no albuminuria to group with macroalbuminuria. Thickness of posterior wall was higher in the two groups of patients with albuminuria as compared with no albuminuria group (Table 11 & figures 18-21).

Table (11) M.mode L.V measurements

Dimensions	Group I	Group II	Group III	P-value
LVESd(cm) Mean±SD	3±0.4	3.3±0.4	4±0.5	0.001*
LVEDd(cm) Mean±SD	4.5±0.6	4.7±0.5	5.2±0.6	0.004*
PWT(cm) Mean±SD	0.9±0.1	1±0.1	1.1±0.1	0.003*
Septal T(cm) Mean±SD	0.9±0.1	1±0.1	1.1±0.1	0.001*

EDD = End Diastolic Dimension. ESD = End Systolic Dimension
PWT =posterior wall thickness

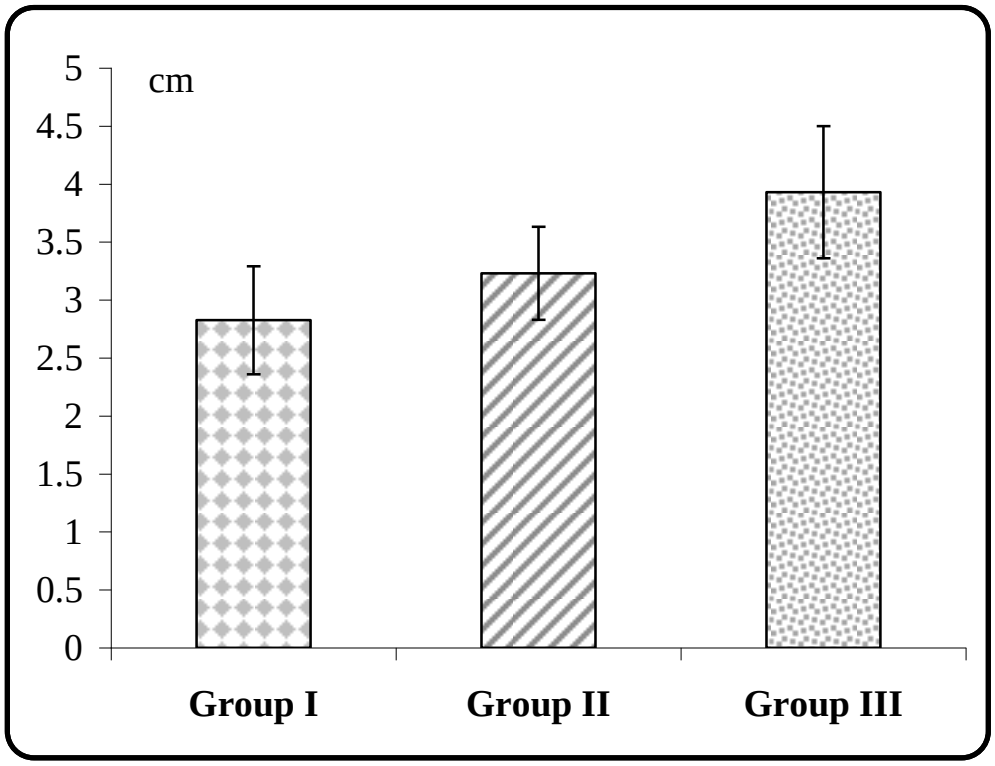

Figure (18): Comparison between groups according to LV end systolic diameter (p = 0.001).

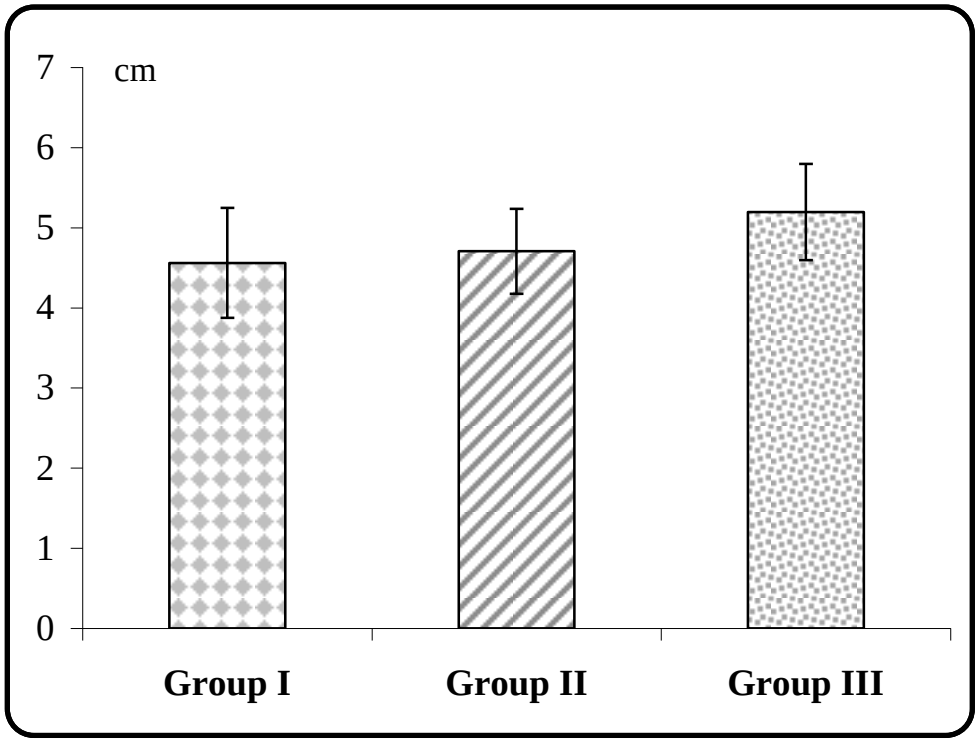

Figure (19): Comparison between groups according to LV end diastolic diameter (p = 0.004).

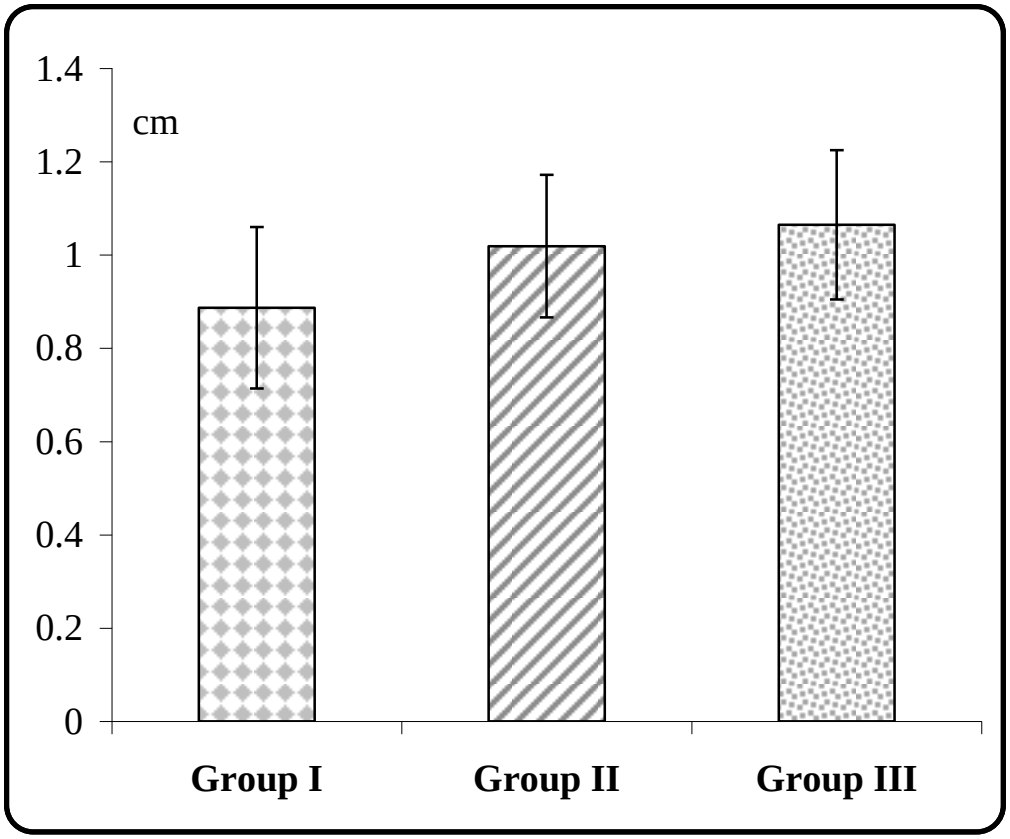

Figure (20): Comparison between groups according to PWT (p = 0.003).

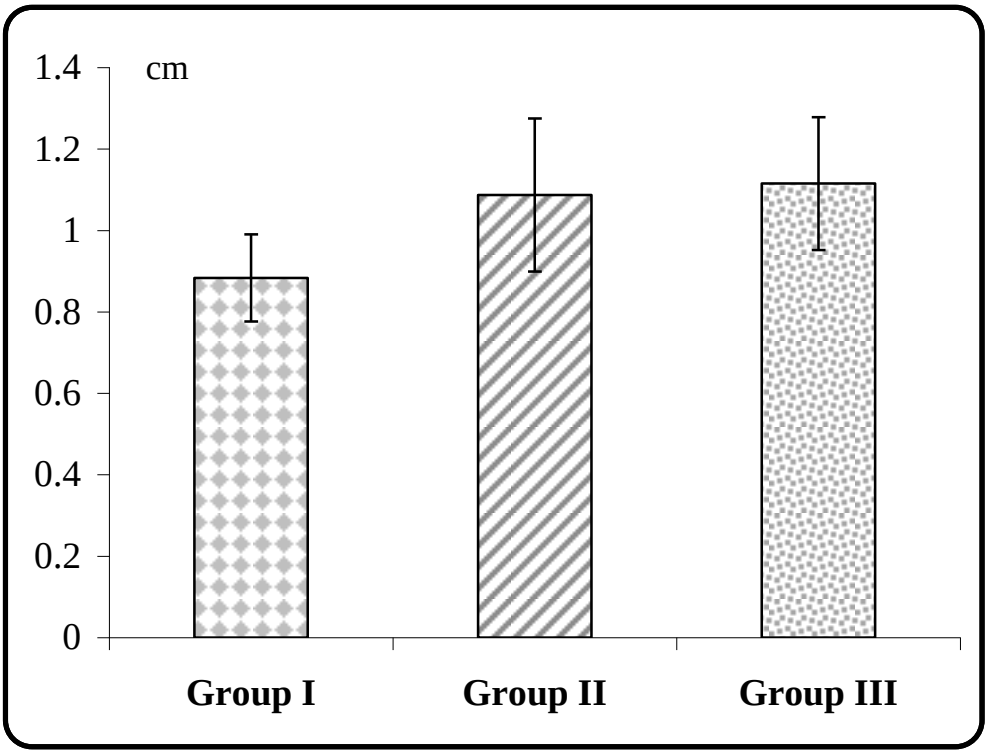

Figure (21): Comparison between groups according to septal thickness (p = 0.001).

(C) Diastolic indices

The mean E (cm/s) wave velocity was 0.6±0.2 (range 0.3-1.1), the mean A wave (cm/s) was 0.6±0.2 (range 0.2-1.3), the mean E/A ratio was 1.1±0.5 (range 0.1-3), and the mean DT (m/s) was 223±51 (range 111- 407).

The mean E wave (cm/s) was 0.8±0.1 in group I, 0.5±0.1 in group II and 0.6±0.2 in group III with significant difference (p = 0.001). The mean A wave (cm/s) was 0.53±0.1 in group I, 0.74 ± 0.1 in group II and 0.74±0.2 in group III with significant difference (p = 0.001). The mean E/A ratio was 1.5±0.1 in group I, 0.7±0.1 in group II and 0.95±0.7 in group III with significant difference (p = 0.001). The mean DT (m/s) was 183±20 in group I, 247±19 in group II and 238±70 in group III with significant difference (p = 0.001). (Table 12) Mitral E velocity was lower and mitral A velocity was higher in the two groups with albuminuria. Consequently, the mitral E/A ratios were lower in the groups with micro- or macroalbuminuria than in the group without albuminuria. Mitral deceleration time was longer with albuminuria than without albuminuria. The prevalence of abnormal diastolic function showed stepwise increases from no albuminuria to macroalbuminuria. (Table 12 & figures 22-25)

Table (12) Doppler mitral flow data in different groups.

Diastolic indices	Group I	Group II	Group III	P-value
E(cm/s) Mean±SD	0.8±0.1	0.5±0.1	0.6±0.2	0.001*
A(cm/s) Mean±SD	0.53±0.1	0.74±0.1	0.74±0.2	0.001*
E/A (%) Mean±SD	1.5±0.1	0.7±0.1	0.95±0.7	0.001*
DT(m/s) Mean±SD	183±20	247±19	238±70	0.001*

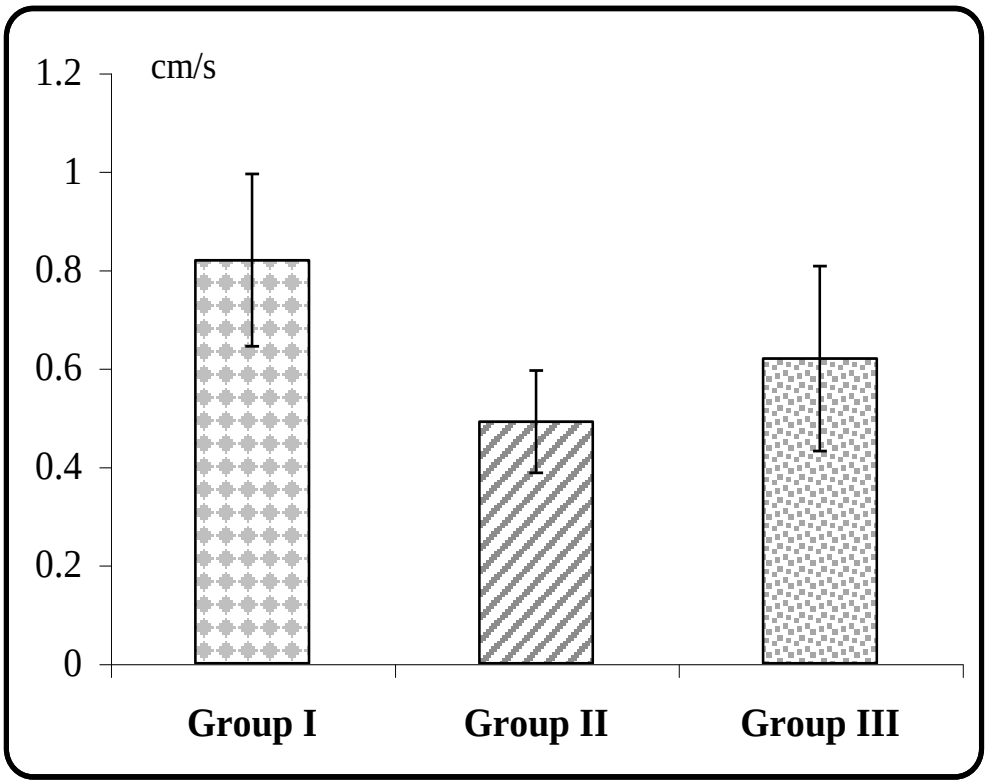

Figure (22): Comparison between groups according to E wave (p = 0.001).

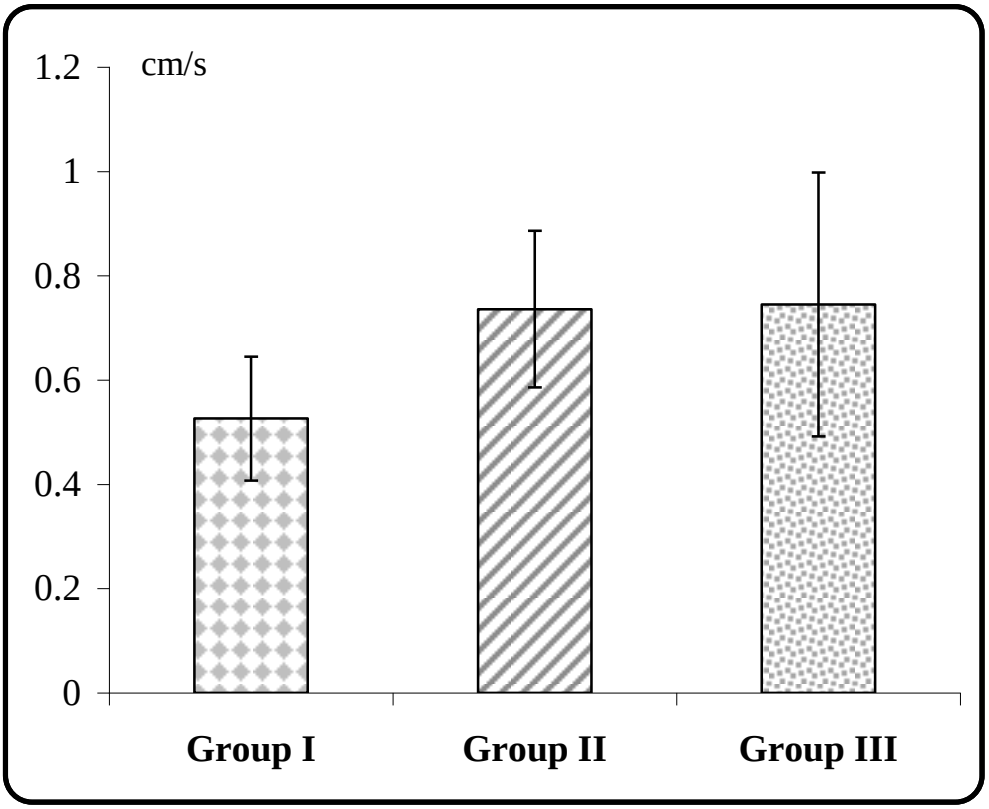

Figure (23): Comparison between groups according to A wave (p = 0.001).

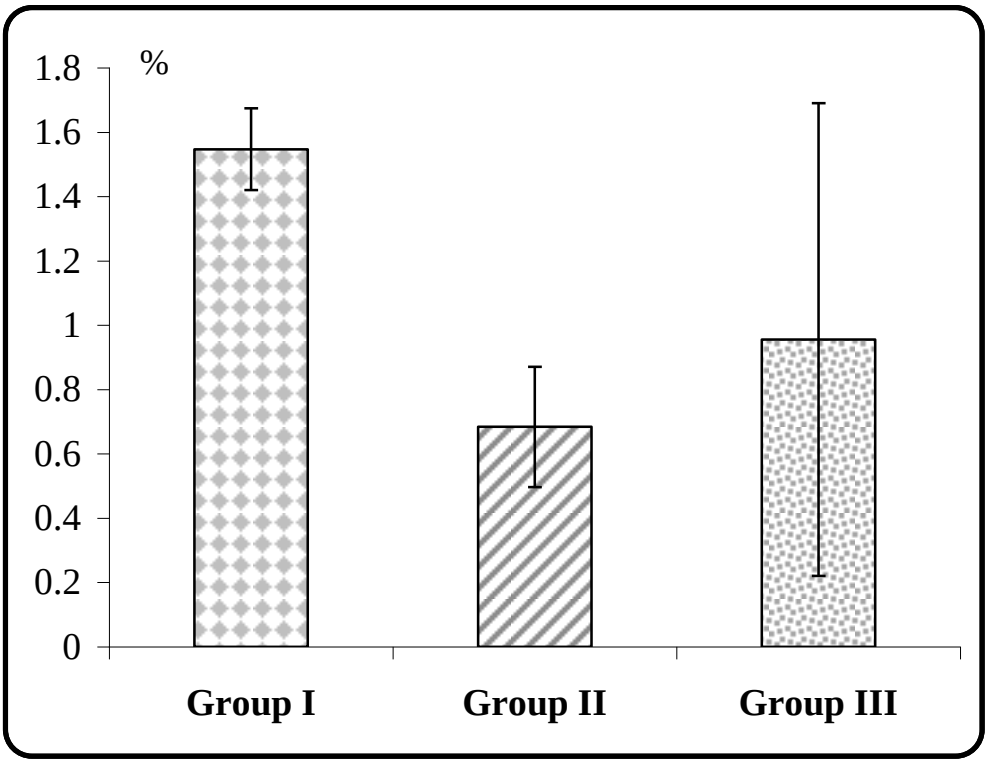

Figure (24): Comparison between groups according to E/A ratio (p = 0.001).

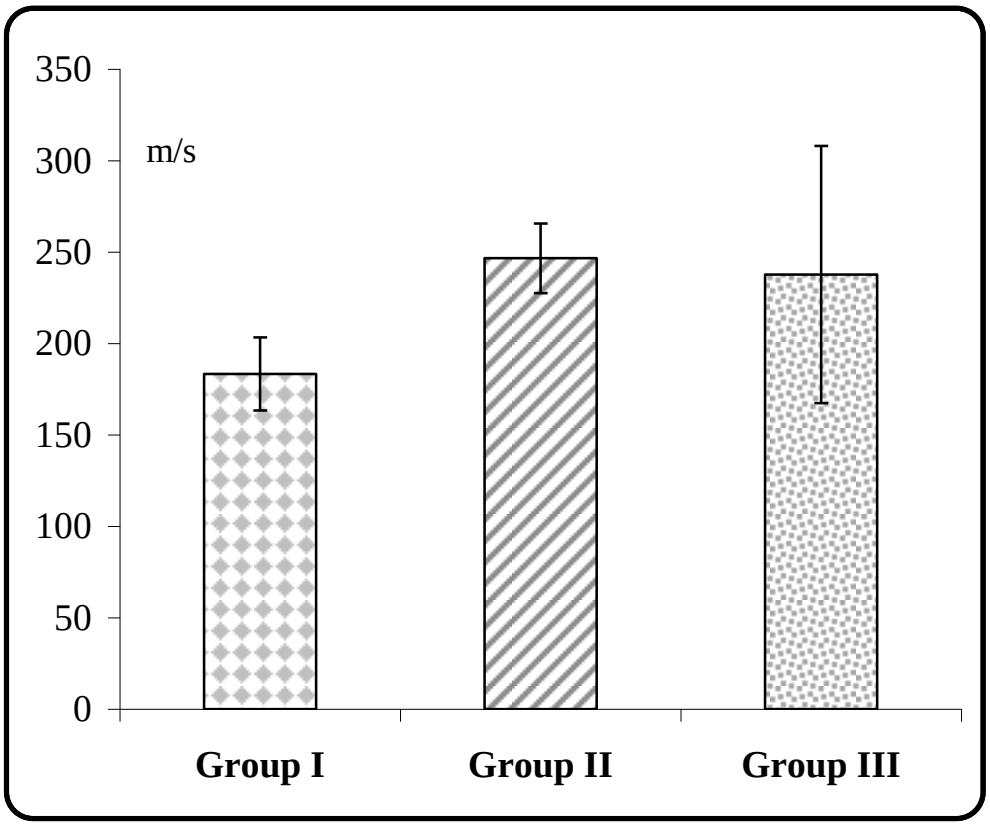

Figure (25): Comparison between groups according to DT (p = 0.001).

Table (13) shows that there is highly positive correlation between albuminuria / creatinine ratio and different studied variable except for diastolic parameters. (figures 26-38)

Table (13) Correlation coefficient between albuminuria and different variables

Variables	A/C ratio	
	r	P-value
1. Age	0.666	<0.001*
2. Systolic B.P	0.339	0.008*
3. Diastolic .B.P	0.351	0.006*
4. Duration DM	0.624	<0.001*
5. Fasting blood sugar	0.330	0.010*
6. 2hpp blood sugar	0.480	<0.001*
7. EF	-0.874	<0.001*
8. FS	-0.831	<0.001*
9. LV mass	0.526	<0.001*
10. LVESD	0.727	<0.001*
11. LVEDD	0.451	<0.001*
12. PW thickness	0.349	0.006*
13. Septal thickness	0.324	0.011*
14. E-velocity	-0.198	0.130
15. A-velocity	0.232	0.075
16. E/A ratio	-0.191	0.144
17. DT	0.206	0.114

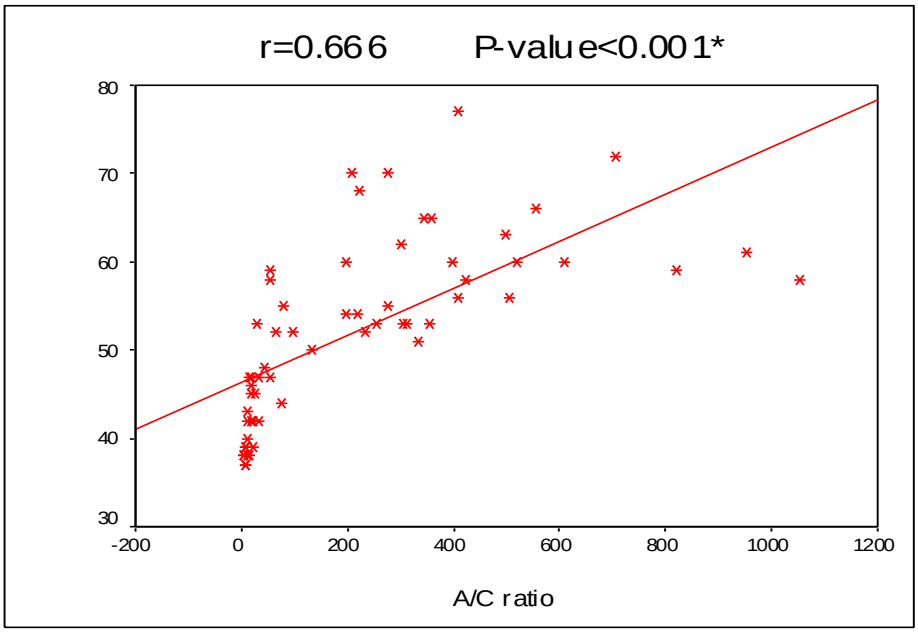

Fig (26): Correlation of A/C ratio with age.

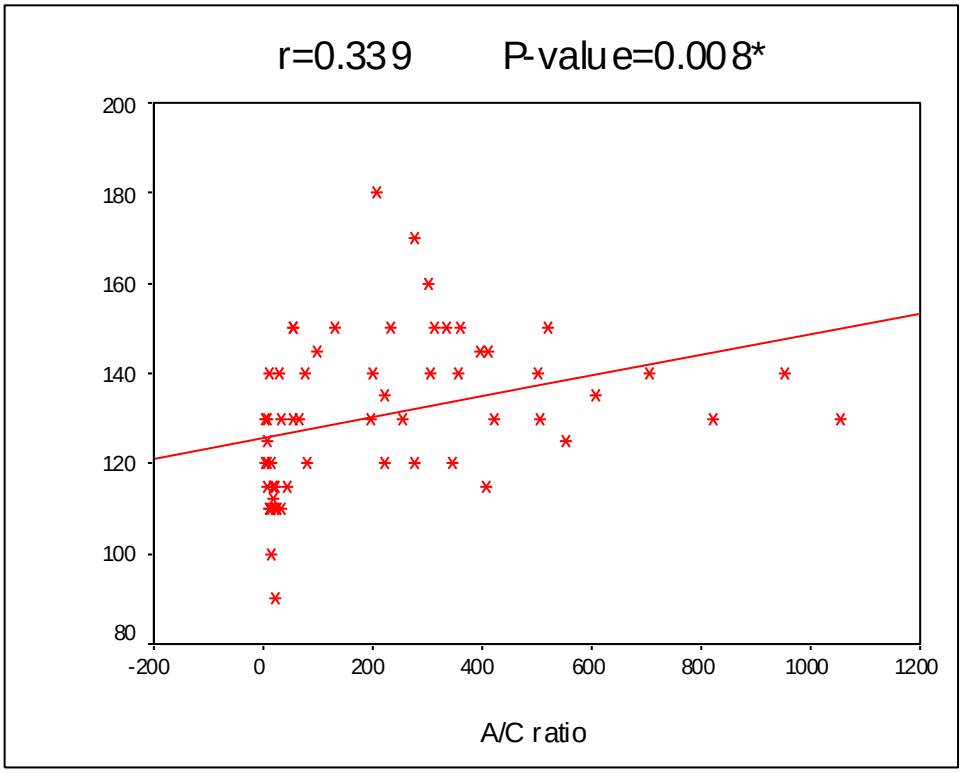

Fig (27): Correlation of A/C ratio with systolic BP.

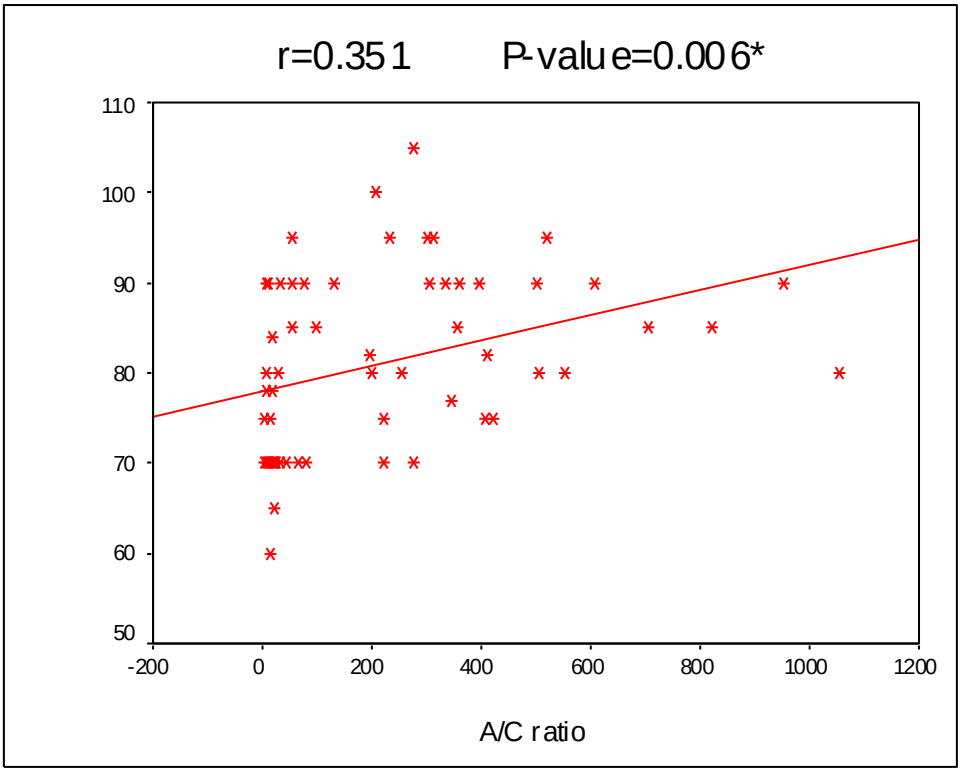

Fig (28): Correlation of A/C ratio with diastolic BP

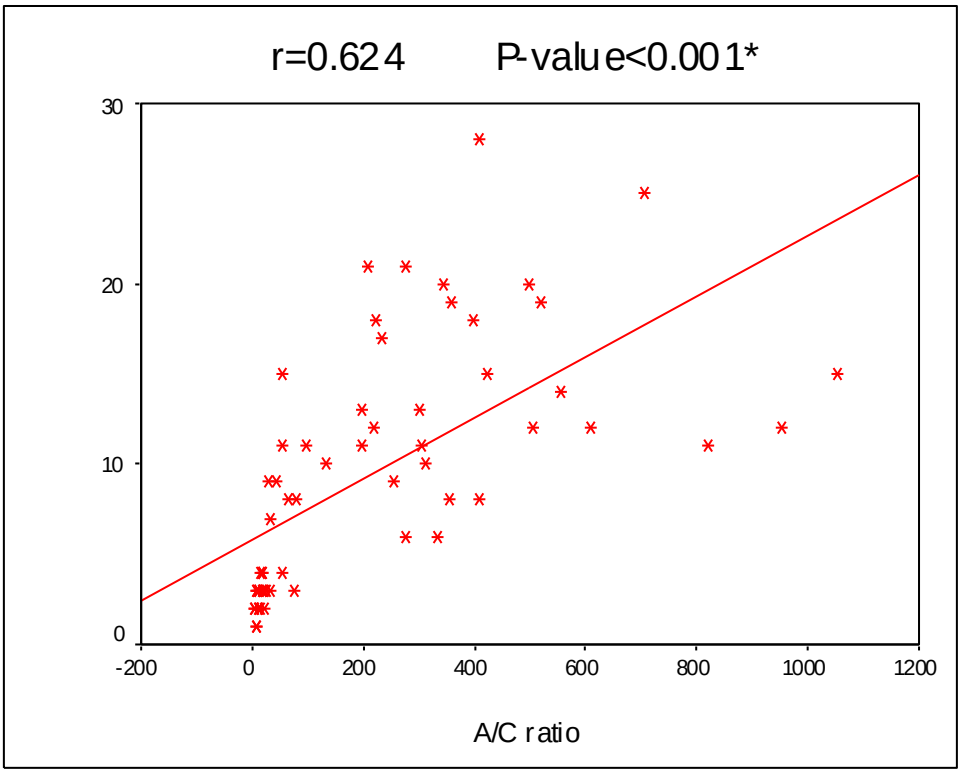

Fig (29): Correlation of A/C ratio with duration of diabetes (DM).

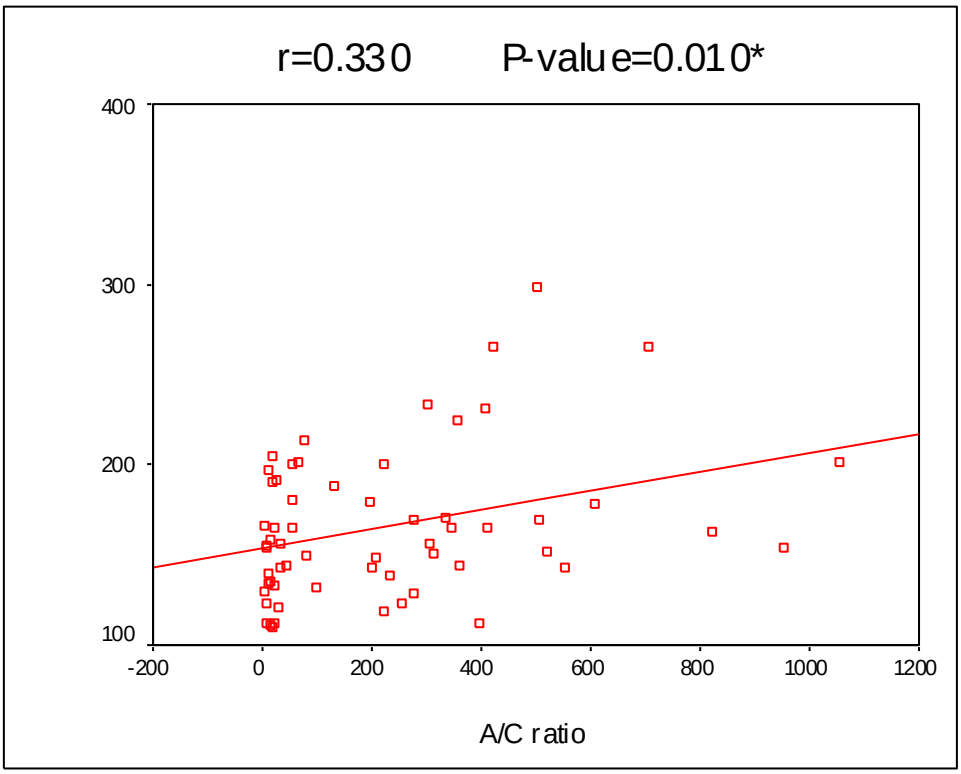

Fig (30): Correlation of A/C ratio with fasting blood sugar.

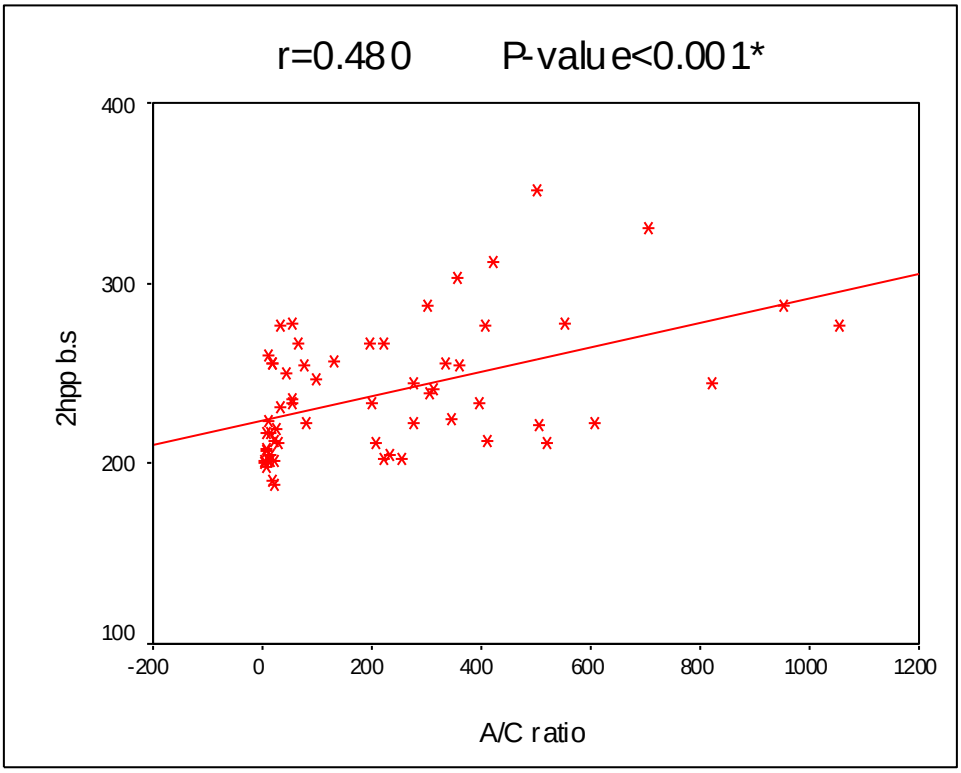

Fig (31): Correlation of A/C ratio with 2 hours post prandial (2h PP)

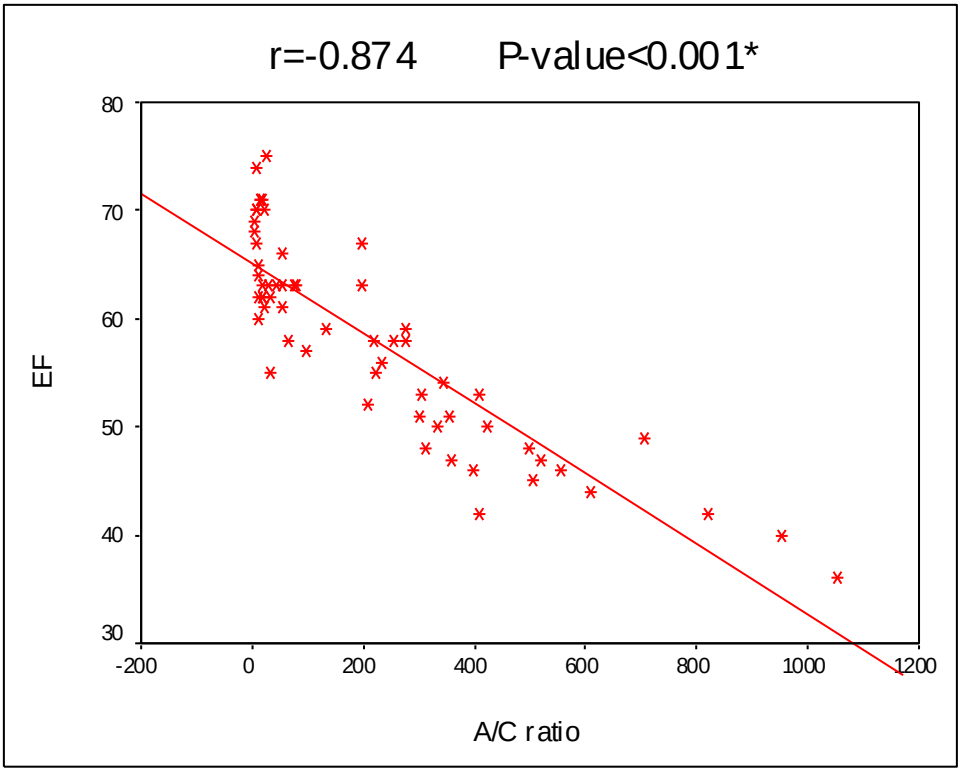

Fig (32): Correlation of A/C ratio with ejection fraction.

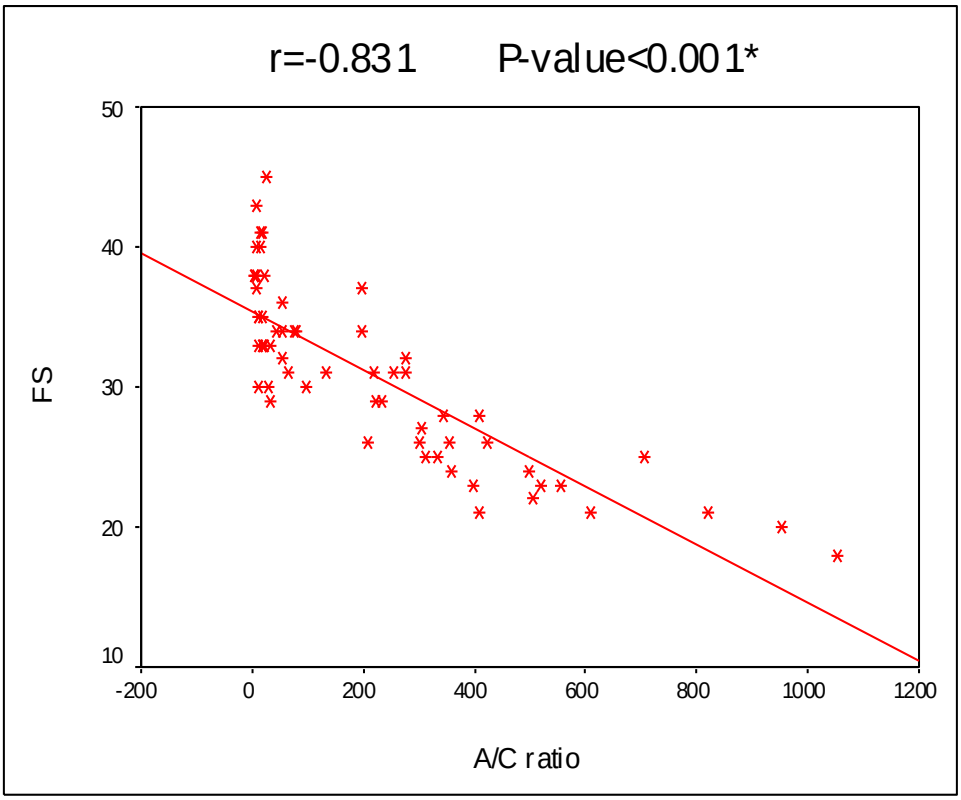

Fig (33): Correlation of A/C ratio with fraction of shorting.

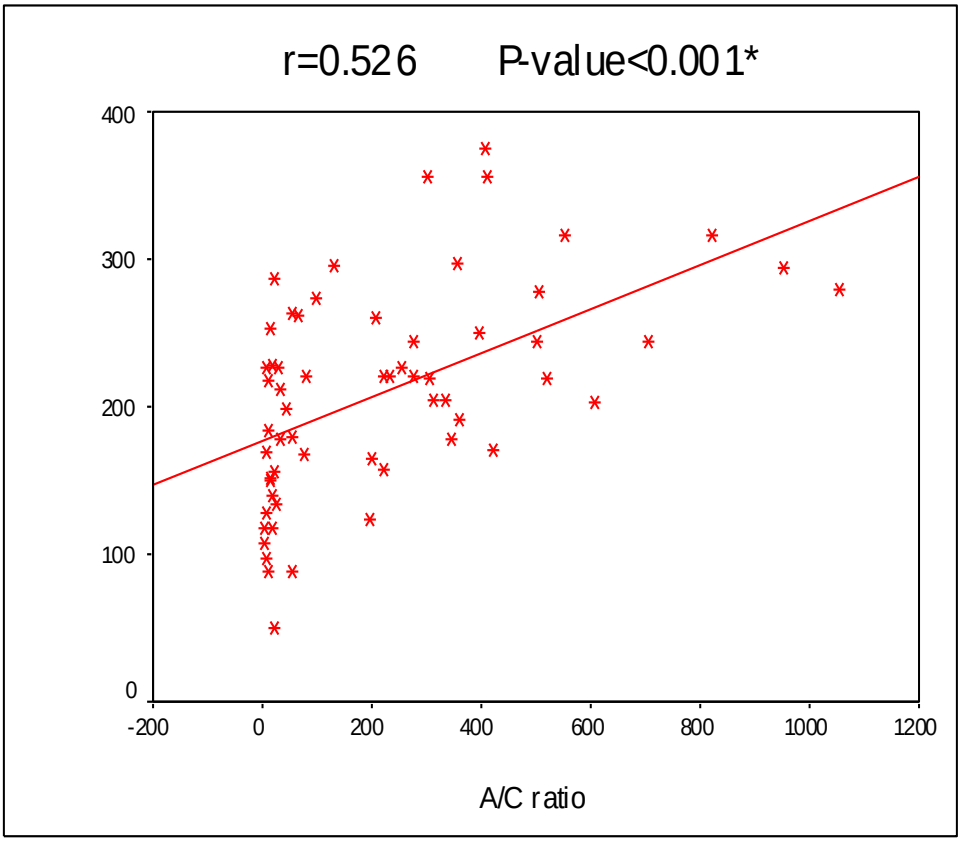

Fig (34): Correlation of A/C ratio with LV mass.

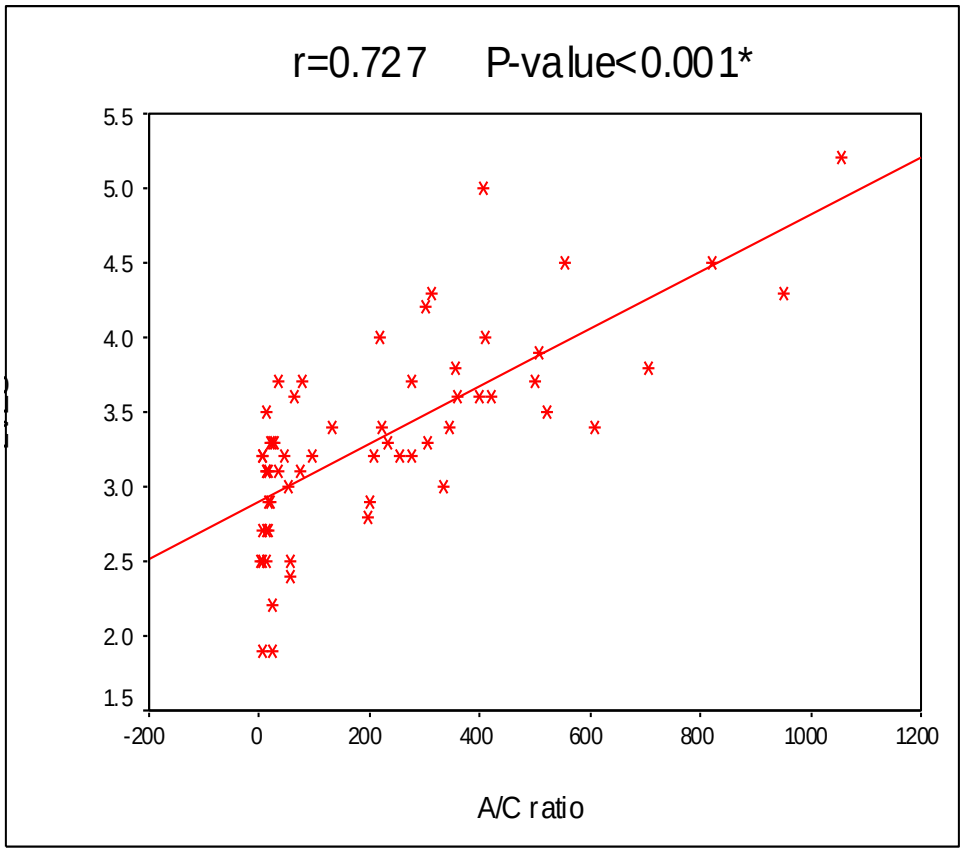

Fig (35): Correlation of A/C ratio with LV end systolic diameter (ESD).

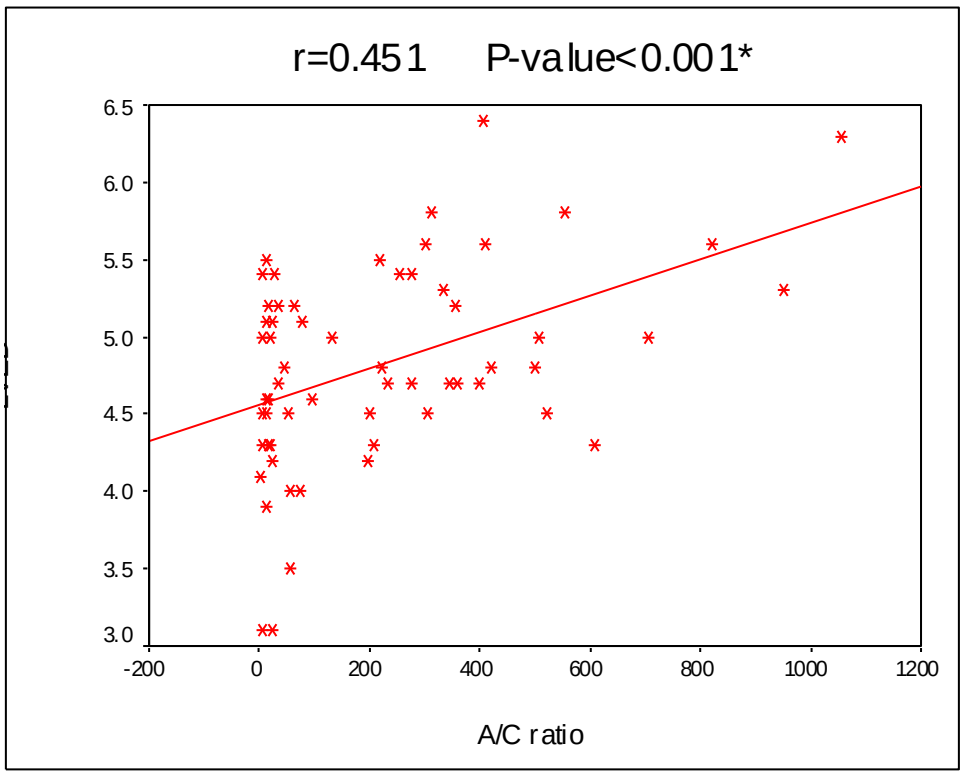

Fig (36): Correlation of A/C ratio with LV end diastolic diameter (EDD).

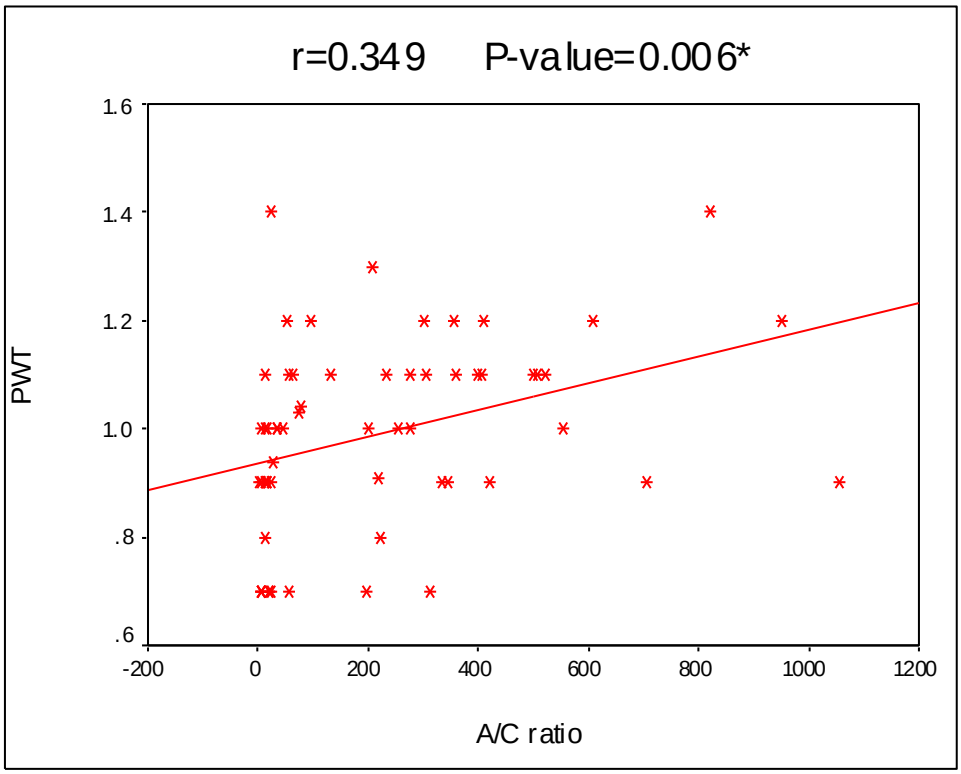

Fig (37): Correlation of A/C ratio with posterior wall thickness (PWT).

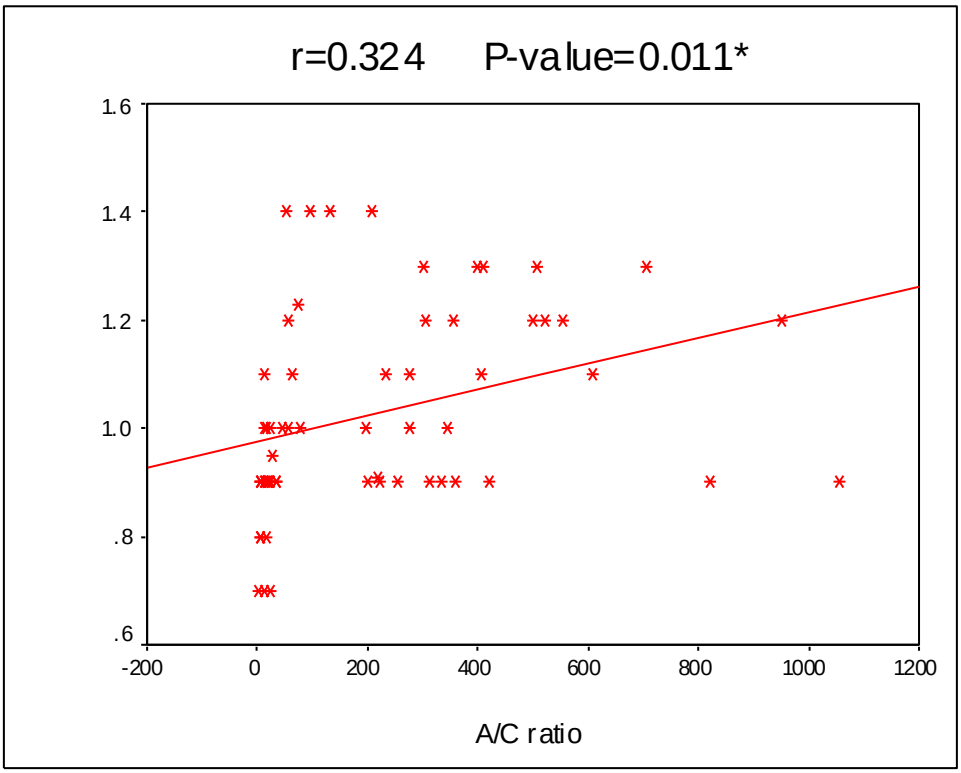

Fig (38): Correlation of A/C ratio with septal thickness.