Results

This study included 100 patients presented to Shebin-El Kom Teaching Hospital, 50 patients presenting with first time ischemic cerebrovascular stroke, referred for admission in the Intensive Care Unit (stroke group) and the same number of matched patients without ischemic stroke presented to echocardiographic laboratory referred for echocardiographic examination(control group) in the period from March 2011 to March 2012.

I. Demographic and clinical characteristics:

Table (11): Demographic and clinical characteristics among studied groups:

	Stroke group(n=50)	Control group(n=50)	P value	Sig
Age ***($\bar{x}$ ± SD)***	**61** ± 10	**63** ± 9	0.23	N.S
Gender				
▪ Male	**26 (52%)**	**28 (56%)**	**0.68**	N.S
▪ Female	**24 (48%)**	**22 (44%)**		
Stroke Risk Factors				
▪ Hypertension**	**34(68.0%)**	**20(40.0%)**	**0.005****	H.S
▪ Diabetes	**15(30.0%)**	**19(38.0%)**	**0.398**	N.S
▪ Smoking				
Current	**7 (14.0%)**	**6 (12.0%)**	**0.211**	N.S
Ex-smoker	**3 (6.0%)**	**2 (4.0%)**		
▪ Hypercholesterolemia*	**19 (38.0%)**	**10 (20.0%)**	**0.04***	S.
▪ Obesity	**8 (16.0%)**	**10 (20.0%)**	**0.603**	N.S
▪ Congestive H.F	**7 (14.0%)**	**4 (8.0%)**	**0.538**	N.S
▪ Coronary artery dis.	**13(26.0%)**	**10(20.0%)**	**0.476**	N.S

*= significant ** =highly significant

- ✓ **Table (11)** shows that there was no statistically significant difference between the studied groups according to their mean age (stroke Group mean age was 61± 10 years versus 63± 9years in control Group). (P=0.23).

- ✓ **Also this Table and Figure (32)** show that the female subjects were found to represent 46% of the study population (total 46 females and 54 males) distributed almost equally among the study groups [stroke group included 24 females (48%), control group also included 22 females (44%)],and when comparing the two groups as regard sex there was no significant statistical differences(p=0.68) .

- ✓ There were no statistically significant differences between the study groups regarding DM, smoking , obesity , the presence of congestive heart failure and coronary artery disease , however, stroke group included significantly higher number of patients with hypertension than control group {34 patients in stroke group (68%) versus 20 patients in control group (40%), (P < 0.05)}.

- ✓ Also there was a statistically significant difference between the study groups regarding hypercholesterolemia; more hypercholesterolemic patients were included in stroke group {19 patients (38%) versus 10 patients (20%) in control group}.

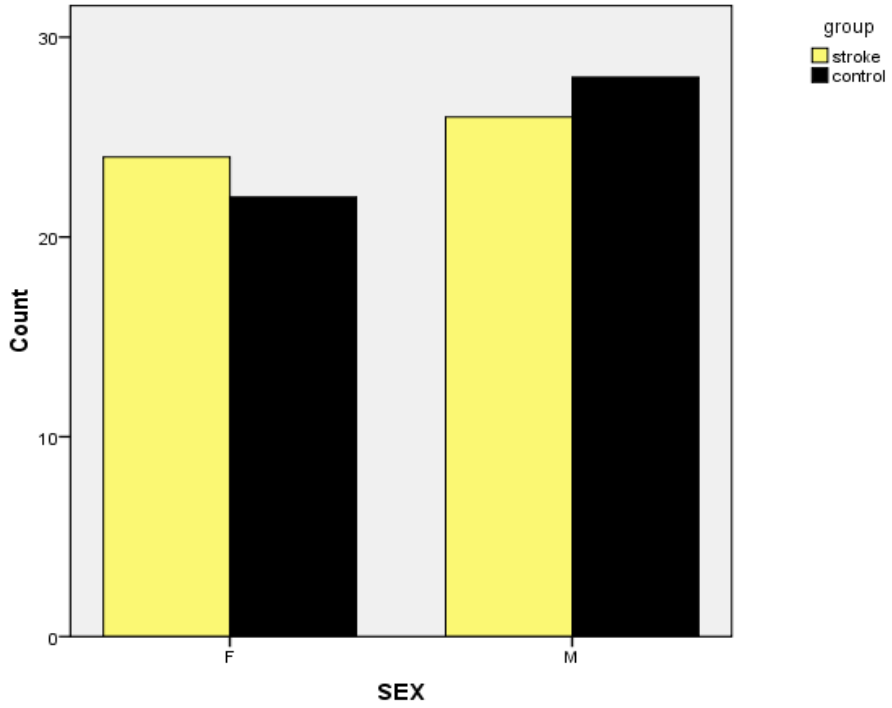

Figure 32 : Sex Distribution Among Studies Patients

II. Echocardiographic characteristics:

Table (12): Echocardiographic Parameters among stroke and control patients:

	group		P value	Sig.
	Stroke group(n=50)	**control group(n=50)**		
	($\bar{x}$ ± SD)	($\bar{x}$ ± SD)		
LA diameter *in mm*	**39.8 ± 4.8**	**37.1± 5.3**	**0.007****	H.S.
Interventricular septal diameter in mm	**12.3 ± 2.5**	**11.3 ± 1.8**	**0.012***	S.
Left ventricular posterior wall thickness diameter *in mm*	**11.9 ± 2.1**	**10.7 ± 1.45**	**0.001****	H.S.
Left ventricular internal diameter (diastole) *in mm*	**48.4 ± 6.4**	**44.7 ± 5.9**	**0.010***	S.
Left ventricular internal diameter (systole) *in mm*	**33.8 ± 7.0**	**30.5 ± 5.6**	**0.011***	S.
Ejection Fraction *in %*	**57.14 ± 9.94**	**60± 9.1**	**0.190**	N.S.
LV mass *(gm)*	**230.0 ± 69.2**	**182.0 ± 50**	**0.002****	H.S.
LV Mass index *(gm/m²)*	**133.0 ± 40.0**	**105.2 ± 29.4**	**0.002****	H.S.
L. atrial enlargement (ECHO) *No (%)*	**23(64.0%)**	**18(36%)**	**0.30**	N.S
L.V.H (ECHO) *No (%)*	**33(66.0%)**	**19(38.0%)**	**0.009***	H.S

*= significant ** =highly significant

✓ **Table (12)** showed that there was no statistically significant difference among the study groups regarding ejection fraction in (%) [57.14 ± 9.94 in stroke group, 60± 9.1 in control group, (P>0.05)].

- ✓ There were statistically significant difference among the study groups regarding interventricular septal thickness in diastole in mm [11.9 ± 2.1 in stroke group, 10.7 ± 1.45 in control group, (P<0.05)] and left ventricular internal diameter in mm during diastole and in systole [LVIDd was 48.4 ± 6.4 in stroke group versus 44.7 ± 5.9 in control group while LVIDs was 33.8 ± 7.0 and 30.5 ± 5.6 in stroke and control groups respectively (P<0.05)].

- ✓ There were high statistically significant difference among the study groups regarding LA diameter in mm [(39.8 ± 4.8 and 37.1± 5.3 in stroke group and control group respectively) (P=0.007)] , Left ventricular posterior wall thickness in diastole in mm (11.9 ± 2.1 and 10.7 ± 1.45 in stroke group and control group respectively) (P=0.001), LV mass in grams (230.0 ± 69.2 and 182.0 ± 50 in stroke group and control group respectively) (P=0.002),and LV Mass index (gm/m²) (133.0 ± 40.0and 105.2 ± 29.4 in stroke group and control group respectively) (p = 0.002).

- ✓ There was no statistically significant difference between the study groups regarding presence of left atrial enlargement by echocardiography , however, stroke group included significantly higher number of patients with left ventricular hypertrophy detected by echocardiography than control group {33 patients in stroke group (66%) versus 19 patients in control group (38%), (P < 0.05)}.

III. Electrocardiographic Abnormalities:

Table (13): Electrocardiographic Abnormalities

	Stroke group(n=50)	**control group(n=50)**	P value	Sig.
P-wave Duration ms ($\bar{x}$ ± SD)	**89 ± 20**	**85 ± 18**	**0.355**	N.S.
P-wave Duration ≥ 120ms	**4 (8%)**	**2 (4%)**	**0.4**	N.S.
P terminal force in V1(**PTFV1**) ≥40 n %	**35 (70.0%)**	**5 (10.0%)**	**<0.001****	H.S.
L.V.H(ECG) n %	**14 (28.0%)**	**6 (12.0%)**	**0.009****	H.S.

Table (13) showed that:

- ✓ There were no statistically significant differences among the study groups regarding P wave duration in milliseconds [89 ± 20 in stroke group, 85 ± 18 in control group, (P>0.05)].
- ✓ Stroke group included more patients with P wave duration >120ms [4 patients (8%)] than control group [2 patients (4%)] however this didn't reach statistical significance.
- ✓ There were highly significant statistical differences as regard P terminal force in V1 (PTFV1), [35 patients (70%) in stroke group had PTFV1 ≥40ms.mm, 5 patients (10%) in control group had PTFV1 ≥40ms.mm, (P<0.005)].
- ✓ As regard the left ventricular hypertrophy in ECG, there was a highly significant statistical difference among the study groups [L.V.H in ECG was found in 14 patients (28%) in stroke group and in 6 patients (12%)in control group (p =0.009)].

IV-Relations between Echocardiographic and ECG Parameters among studied patients:

Table (14): PTFV1 in relation to L.A ECHO diameters and LV mass index quartiles

		$PTFV_1$ ≥ *40*mm.ms (n =40)		P value	Sig.
		No	(%)		
LA diameter quartiles	Q1	1	2.5%	<0.001**	H.S.
	Q2	6	15.0%		
	Q3	12	30.0%		
	Q4	21	52.5%		
LV mass index quartiles	Q1	2	5.0%	<0.001**	H.S.
	Q2	4	10.0%		
	Q3	13	32.5%		
	Q4	21	52.5%		

In this table , the left atrial diameter and left ventricular mass index are divided into four equal quartiles and we studied the relation of abnormal PTFV1 to each of the four quartiles.

We found that there is significant increase in the incidence of abnormal PTFV1 among patients in higher quartiles left atrial echocardiographic diameters and LV mass index. (Figure 33).

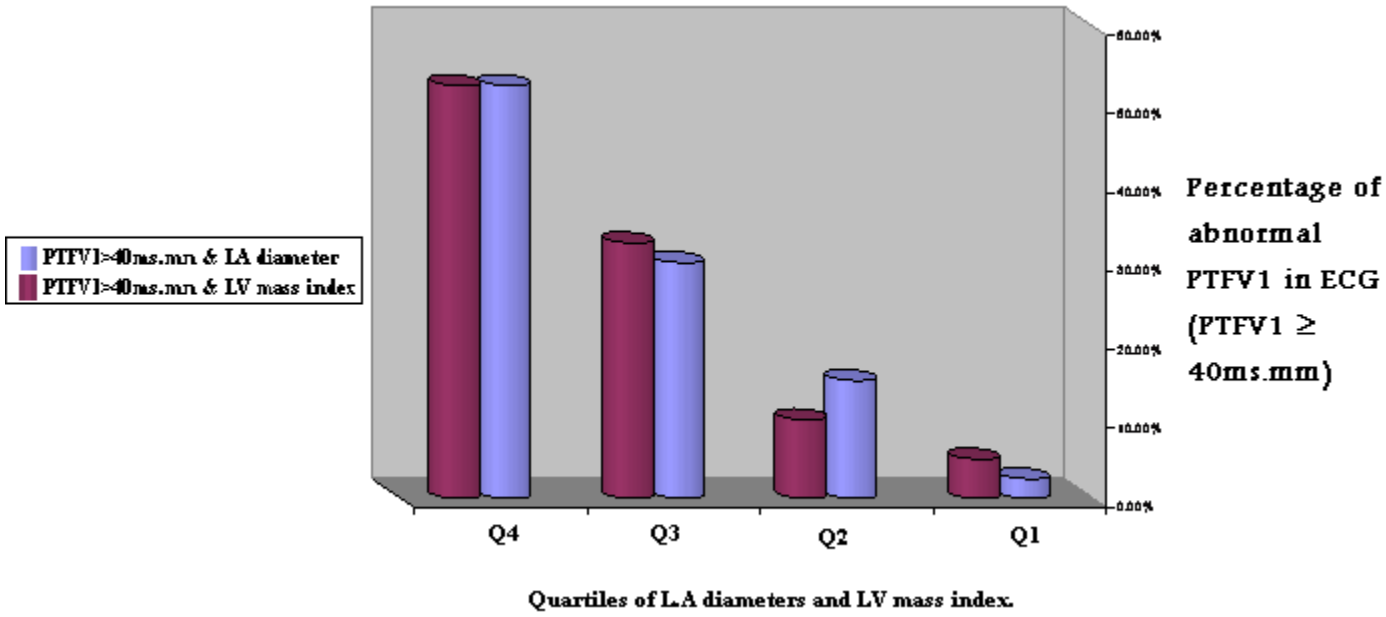

Figure 33: Relations Of PTFV1 TO quartiles of L.A ECHO diameters and LV mass index.

V- Risk of Ischemic Stroke for Various Criteria for LA Enlargement and Abnormality

Table (15): Risk of Ischemic Stroke for Various Echocardiographic and Electrocardiographic Criteria for LA Enlargement and Abnormality

	Unadjusted		Adjusted for Stroke Risk Factors		Adjusted for Stroke Risk Factors and Echo-LAE	
	OR (95% CI)	***P* Value**	**OR (95% CI)**	***P* Value**	**OR (95% CI)**	***P* Value**
Echo-LAE	**1.51(0.67-3.3)**	**0.33**	**1.62(0.71-4.3)**	**0.65**	**N/A**	
P-wave ≥120 ms	**2.07 (0.37-11.4)**	**0.47**	**3.8 (0.47-13.5)**	**0.59**	**3.8 (0.35-15.2)**	**0.54**
PFTV1 ≥40 mm-ms	**20.18(6.9-63.4)**	**<0.001****	**17.3(4.8 -83.5)**	**0.02***	**16.8(3.3 -86.5)**	**0.04***

As shown in **Table (15)**:

Abnormal PTF was associated with ischemic stroke in both a univariate analysis (odds ratio [OR] 20.18; 95% CI 6.9-63.4), and a multivariate analysis adjusting for common stroke risk factors (OR 17.3; 95% CI 4.8 -83.5). Such a strong association remained significant after further adjusting for echocardiographically measured LA size (OR 16.8; 95% CI 3.3 -86.5).

Table (16): Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and overall accuracy of some left Atrial &Ventricular (ECG and ECHO related variables) as predictors of stoke

variable	sensitivity	specificity	PPV	NPV	overall accuracy
P-wave Duration ≥ 120ms	**8%**	**96%**	**66.67**	**51%**	**52%**
P terminal force in V1(**$PTFV_1$**) ≥ 40mm-ms	**70%**	**90%**	**87.5%**	**75%**	**80%**
L.atrial enlargement (ECHO)	**46%**	**64%**	**56.1%**	**54.2%**	**55%**
L.V.H(ECG)	**28%**	**88%**	**70%**	**55%**	**58%**

Table (16) and Figure (34) demonstrate the following:

- ✓ In our study , the sensitivity and specificity of abnormal P wave duration (≥ 120ms) to predict ischemic stroke were 8% and 96% with positive and negative predictive values of 66.67 % and 51 % respectively and 52% overall accuracy.

- ✓ This study showed also that the sensitivity and specificity of abnormal PTFV1 to predict ischemic stroke were 70% and 90% with positive and negative predictive values of 87.5% and 75 % respectively and 80% overall accuracy.

- ✓ The sensitivity and specificity of the Left atrial enlargement detected by echocardiography to predict ischemic stroke in our study were 46% and 64% with positive and negative predictive values of 56.1% and 54.2 % respectively and 55% overall accuracy.

- ✓ Our study showed that, the sensitivity and specificity of the left ventricular hypertrophy detected by resting 12 lead ECG according to Cornell criteria to predict ischemic stroke were 28% and 88% with positive and negative predictive values of 70% and 55 % respectively and 58% overall accuracy.

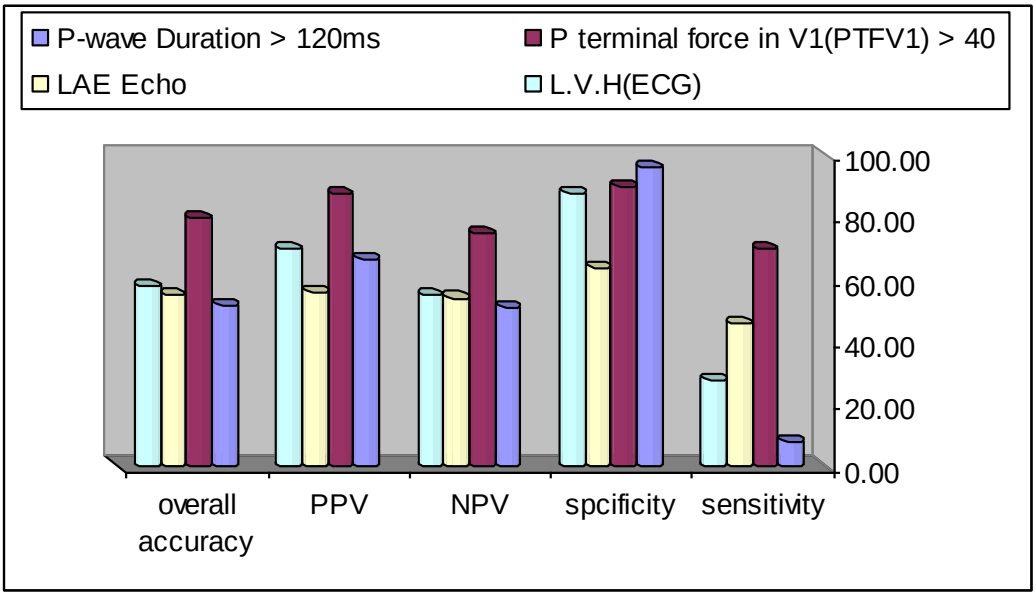

Figure 34: Sensitivity, specificity, PPV,NPV and overall accuracy OF PTFV1 ,P Duration & Echo Left Atrial Enlargement

Table (17): Correlations between both LA diameter & LV Mass index and some other studied variables.

Correlations

	LA diameter in mm		**LV Mass INDEX (gm/m²)**	
	r	p-vaue	r	p-vaue
AGE	**0.107**	**>0.05**	**-0.059**	**>0.05**
LA diameter mm	**1**		**0.678****	**<0.001****
Interventricular septal diameter mm	**0.450****	**<0.001****	**0.708****	**<0.001****
Left ventricular posterior wall thickness diameter mm	**0.454****	**<0.001****	**0.718****	**<0.001****
Left ventricular internal diameter (diastole) mm	**0.473****	**<0.001****	**0.665****	**<0.001****
Left ventricular internal diameter (systole) mm	**0.462****	**<0.001****	**0.533****	**<0.001****
Ejection fraction	**0.243***	**<0.05***	**0.303****	**<0.001****
P-wave Duration ms	**0.195**	**>0.05**	**0.178**	**>0.05**
Abnormal PTFV1	**0.614****	**<0.001****	**0.603****	**<0.001****

This table shows the correlation between the Left atrial diameter in mm, Left ventricular mass index in gm/m² and age, LA diameter in mm, Interventricular septal diameter in mm, Left ventricular posterior wall thickness diameter in mm, Left ventricular internal diameter (diastole) in mm, Left ventricular internal diameter (systole) in mm, Ejection fraction in percent (%), P-wave duration in ms, and abnormal PTFV1.

We found that only age and P-wave duration doesn't have any significant correlations with LA diameter & LV mass index, and all other variables have strong significant correlations with both measures.

Patient number(14) in master table of stroke group:

A 58 years old male patient, hypertensive, hypercholesetolemic, ex-smoker suffering from ischemic stroke , having increased P-terminal force in lead V1 , left atrial enlargement by echocardiography , electrocardiographic and echocardiographic left ventricular hypertrophy .

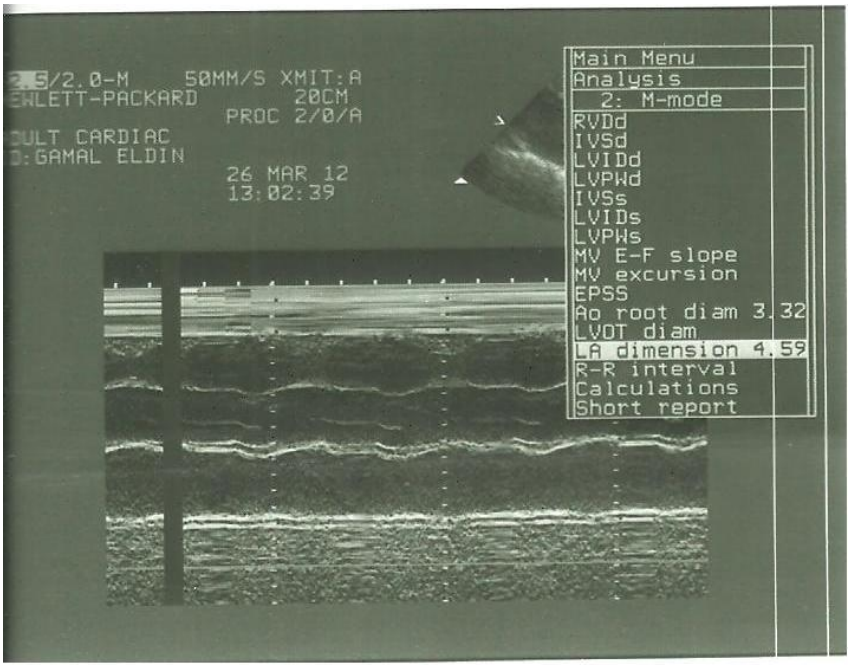

Figure (35): *resting echocardiogram showing left atrial diameter =4.59 cm*

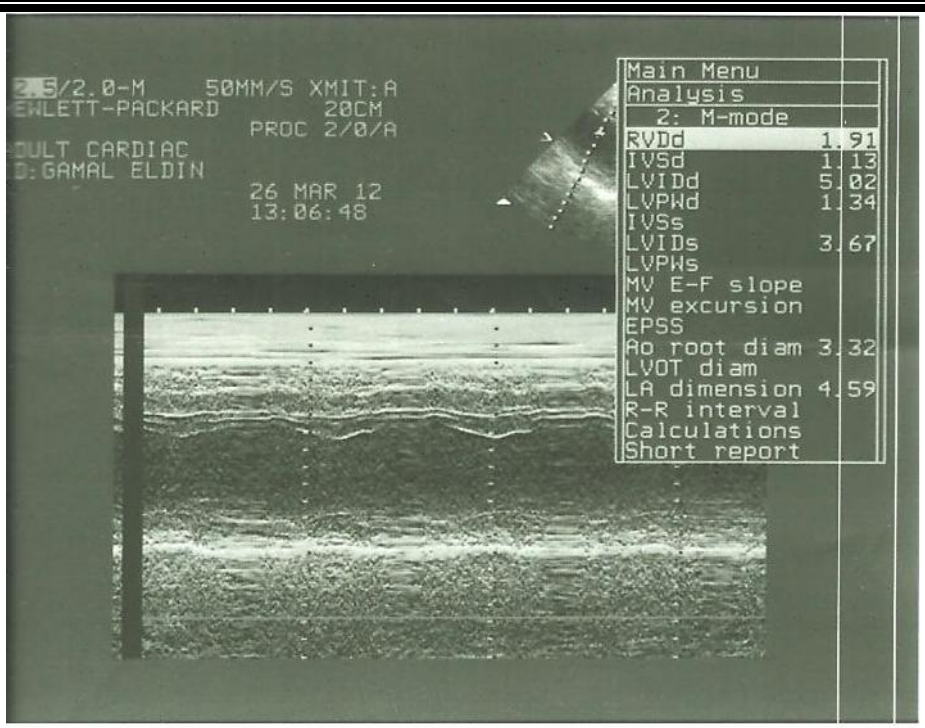

Figure (36): *resting echocardiogram showing left ventricular dimensions.*

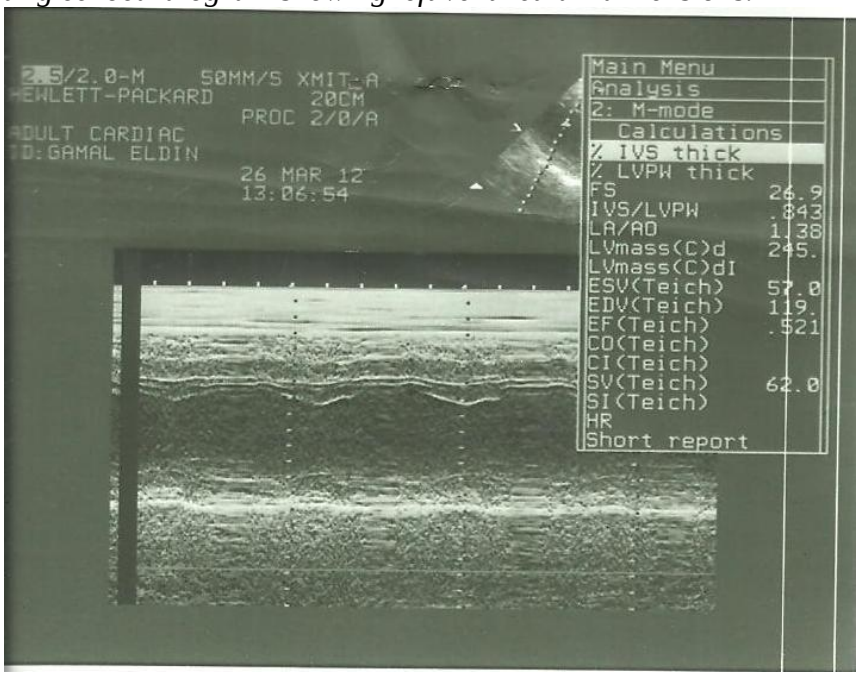

Figure (37): *showing the same patient with echocardiographic LVH(L.V mass 245 g and L.V mass index=141 g/m2)*

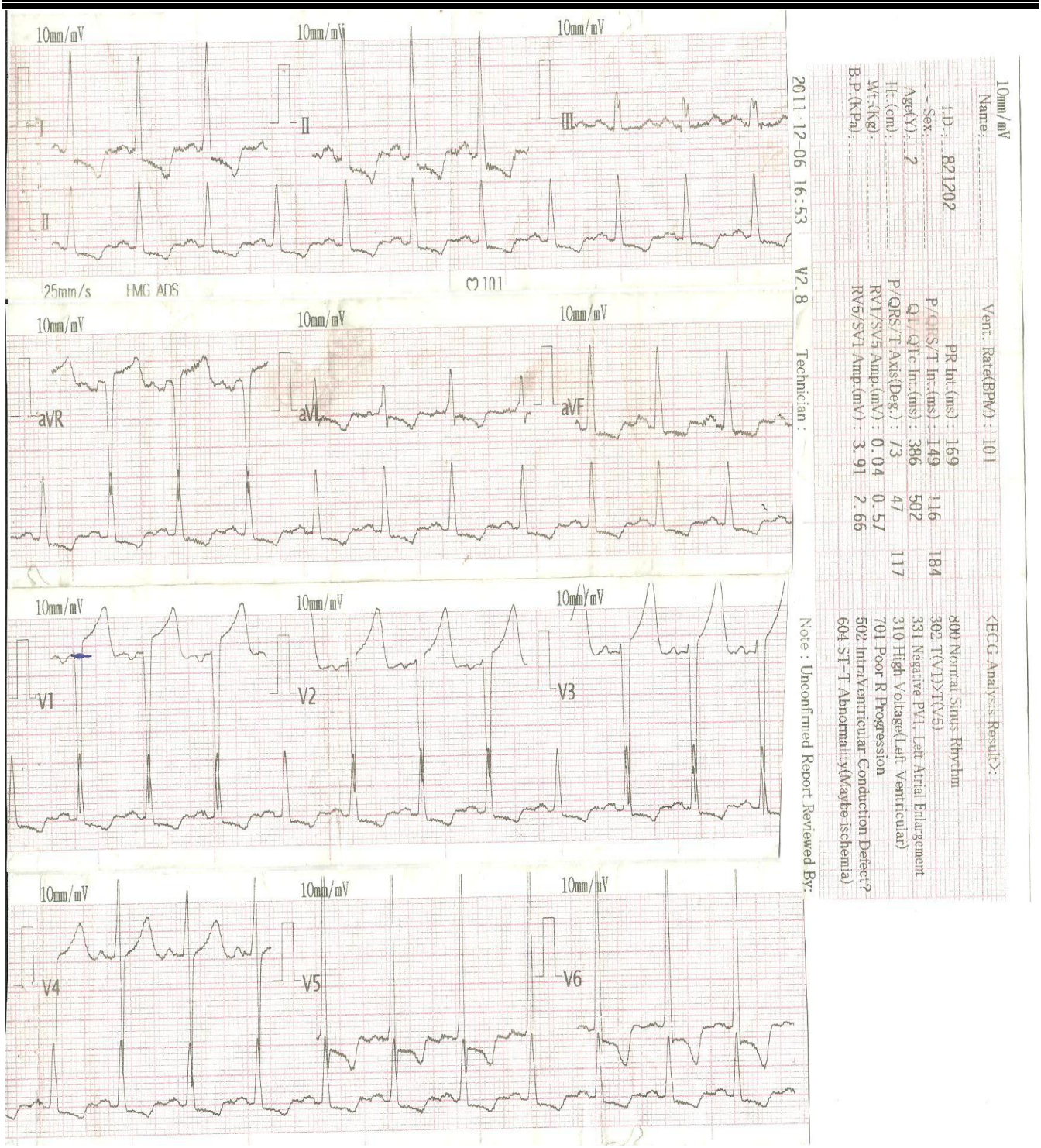

Figure (38): *showing 12 lead ECG of the same patient showing normal p wave duration, P-terminal force in lead V1 >40ms.mm and left evntricualr hypertrophy detected by sex specific cornell voltage criteria(S in lead v3=25 +R in lead avl=6 , the sum is 31 that is considered L.VH)*

Patient number(29) in master table of control group:

A 78 years old male patient, diabetic , having increased P-terminal force in lead V1 , normal p wave duration in ECG , normal left atrial diameter by echocardiography and left ventricular hypertrophy detected by echocardiography but not with ECG.

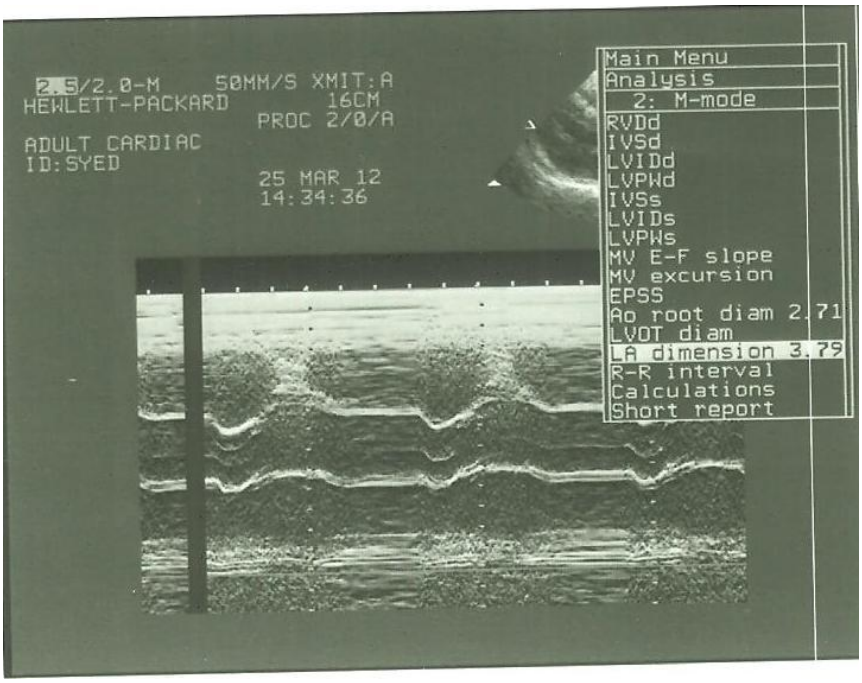

Figure (39): *resting echocardiogram showing left atrial diameter =3.79 cm*

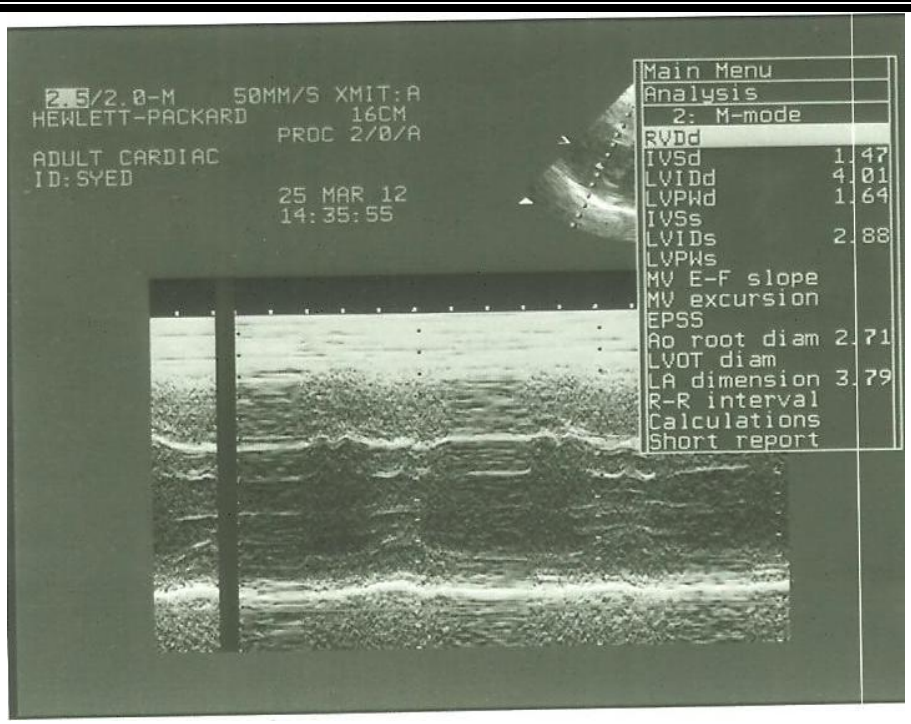

Figure (40): *resting echocardiogram showing left ventricular dimensions.*

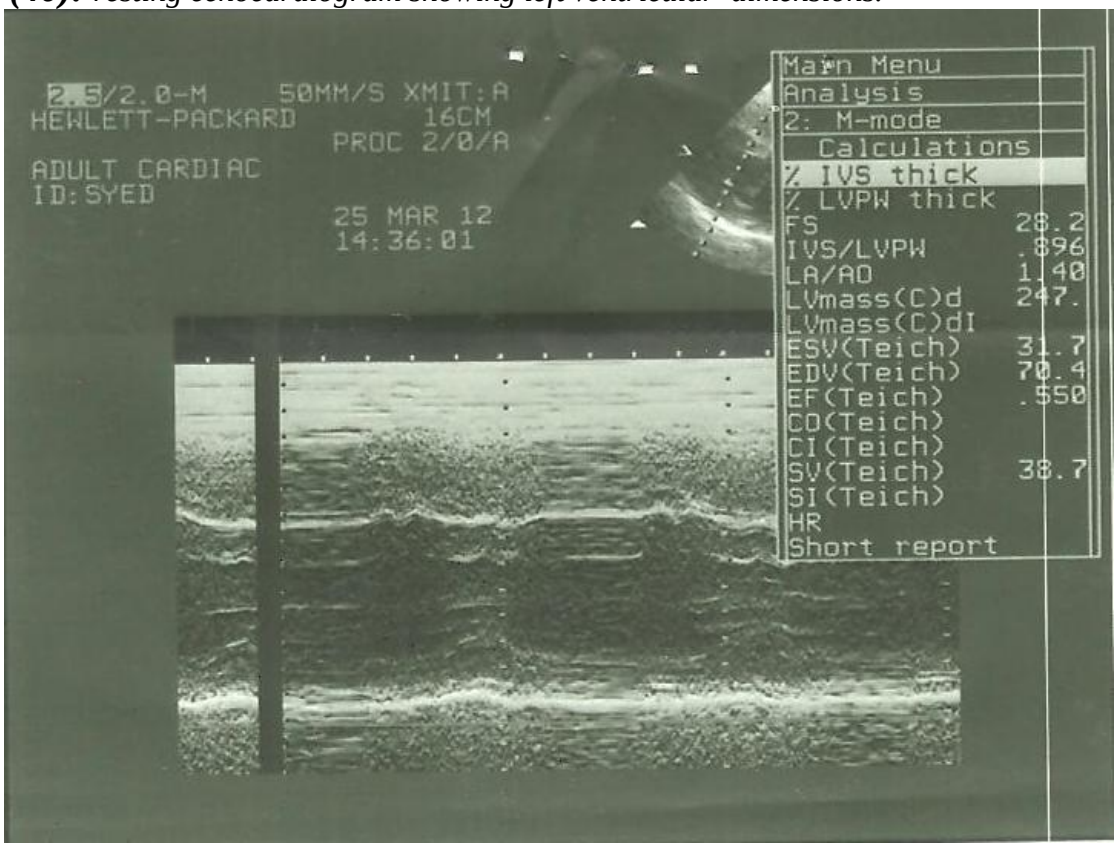

Figure (41): *showing the same patient with echocardiographic LVH(L.V mass 247 g and L.V mass index=141 g/m2)*

Figure (42): *showing 12 lead ECG of the same patient showing normal p wave duration, P-terminal force in lead V1 >40ms.mm*