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A Study of Comparison of Left Ventricular Mass in Hypertensive Patients with Diabetes Mellitus And Without Diabetes

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Abstract
Objectives*: The aim of the study was to compare the left ventricular mass in hypertensive patients with diabetes mellitus and without diabetes mellitus and to compare these two groups with controls in kilpauk medical college hospital,Chennai.*
Materials And Methods: *A total number of 150 subjects (50 Hypertensive cases + 50 Cases of both hypertension and diabetes + 50 controls) are investigated by following measures.Proper history and past medical history and demographic details were collected.General examination, vitals monitoring includes blood pressure and pulse rate ,Body Mass Index,Fasting and Post Prandial Blood Sugar ,Complete hemogram,Blood Urea, Serum Creatinine and Serum Electrolytes Urine analysis,Serum Total Cholesterol, Serum Triglyceride levels., Electro cardio graphy,Chest X-Ray,2-Dimensional Echocardiography were analysed.*
Results: *In our study, we studied 150 subjects (50-HT only, 50- HT+DM, 50- Controlswithout HT and DM) and they were compared with LV mass. The minimum age of the cases and controls was 36 years and maximum age was 85 years. There is significant statistical correlation between age group and left ventricular mass in hypertension with diabetes group with the p value of 0.039. But in control group and cases with hypertension only group, the p value was > 0.05 and it was not statistically significant. There is significant statistical correlation between female (p=0.042) cases with diabetes and hypertension and severity of abnormal left ventricular mass, than males (p=0.286).*
Conclusion: *There is increased left ventricular mass in females with hypertension and diabetes mellitus when compared to females with hypertension alone.There is no significant difference in the left ventricular mass in males in between the two (HT, HT+DM) groups.But the mean left ventricular mass was increased in both males and females of diabetes and hypertension group when compared to hypertension only group. . In our study, advancing age group is associated with increased left ventricular mass in cases of both hypertension and diabetes group.*

I. Introduction

Hypertension is a major risk factor for stroke, cardiovascular diseases and aortic dissection and hypertension is associated with significant morbidity and mortality. The development of echocardiography has offered new approaches regarding the pathophysiology and clinical implications that affect the hypertensive patients. Even though the ECG can identify the findings suggestive of left ventricular hypertrophy, the sensitivity is very less. The sensitivity of the criteria using ECG for LVH was 7% to 35% in moderate hypertrophy and 10% to 50% in severe hypertrophy. So echocardiography is preferred for assessment of left ventricular hypertrophy. In echocardiography, M-mode technique is the gold standard test. Diabetes mellitus also predisposes to cardiovascular diseases. In diabetes mellitus hyperinsulinemia (insulin resistance), high HbA1c and dysautonomia contributes to increased left ventricular mass. Compared to non-diabetic individuals, diabetic individuals have raised morbidity and mortality from cardiovascular disease.

II. Aim of the study

- To compare the left ventricular mass in hypertensive patients with diabetes mellitus and without diabetes mellitus.
- To compare these two groups with controls.

III. Background

3.1Selection of subjects:

The selected patients should be on regular treatment not on cardiac remodelling drugs like angiotensin converting enzyme inhibitors and aldosterone antagonists.

3.2inclusion Criteria:

- All patients > 35 yrs of age with hypertension of duration > 5yrs on regular treatment.
- Patients >35yrs of age with hypertension and diabetes mellitus >5yrs duration on regular treatment.

- Healthy controls of >35yrs of age.

3.3exclusion Criteria:
- Coronary Artery Disease
- Valvular Heart Disease
- Chronic Kidney Disease of non diabetic origin
- Obesity
- Cardiomyopathies

IV. Materials And Methods

Setting: Kilpauk Medical College.
Study design: Prospective Cross sectional study
Period of study: 6 months from March 2016 to August 2016.
Sample size: 150 subjects (50 Hypertensive cases + 50 Cases of both hypertension and diabetes + 50 controls).

4.1Both cases and controls are investigated by following measures:
- Proper history and past medical history and demographic details were collected.
- General examination , Vitals monitoring includes blood pressure and pulse rate
- Body Mass Index
- Fasting and Post Prandial Blood Sugar
- Complete hemogram
- Blood Urea, Serum Creatinine and Serum Electrolytes Urine analysis
- Serum Total Cholesterol, Serum Triglyceride levels.
- Electrocardiography
- Chest X-Ray
- 2-Dimensional Echocardiography

4.2Echocardiography:

By using transthoracic 2-Dimensional echocardiographic method, the following left ventricular dimensions are measured by M-mode technique using the parasternal long axis view just above/at the tip of the papillary muscle level.
- Left ventricular internal diameter at end diastole (LVID-D)
- Interventricular septal thickness at end diastole (IVST-D)
- Posterior wall thickness at end diastole (PWT-D)

  Apart from this measurements, left systolic functions, diastolic functions and ejection fractions also measured.

Left ventricular mass was calculated by penn convention method.
LV mass = $1.04[(\text{LVID-D}+\text{IVST-D}+\text{PWT-D})^3 - (\text{LVID-D})^3]$-13.6gm.

4.3Statistical Analysis:

Mean values of all parameters in groups were calculated by independent sample t-test. To compare the distributions of dichotomous data viz., age, gender, body mass index, smoking, alcoholism, duration of hypertension and diabetes mellitus and left ventricular mass, Chi-square test was used. ANOVA test was used for comparing mean LV mass in between three groups. Association of LV mass between hypertension group and group of both hypertension and diabetes mellitus was assessed by logistic regression model.

All statistical analysis were performed using SPSS (Software Package used for Statistical Analysis) package. A p- value of less than 0.05 was considered to be statistically significant.

V. Observation Analysis

Age wise distribution of cases (hypertensive groups and groups of both hypertension and diabetes) and controls

			Group		
			Control	HT	HT + DM
Age in years	36-45	Count	13	8	7
		% within Group	26.0%	16.0%	14.0%
	46-55	Count	28	16	12
		% within Group	56.0%	32.0%	24.0%
	Above 55	Count	9	26	31
		% within Group	18.0%	52.0%	62.0%

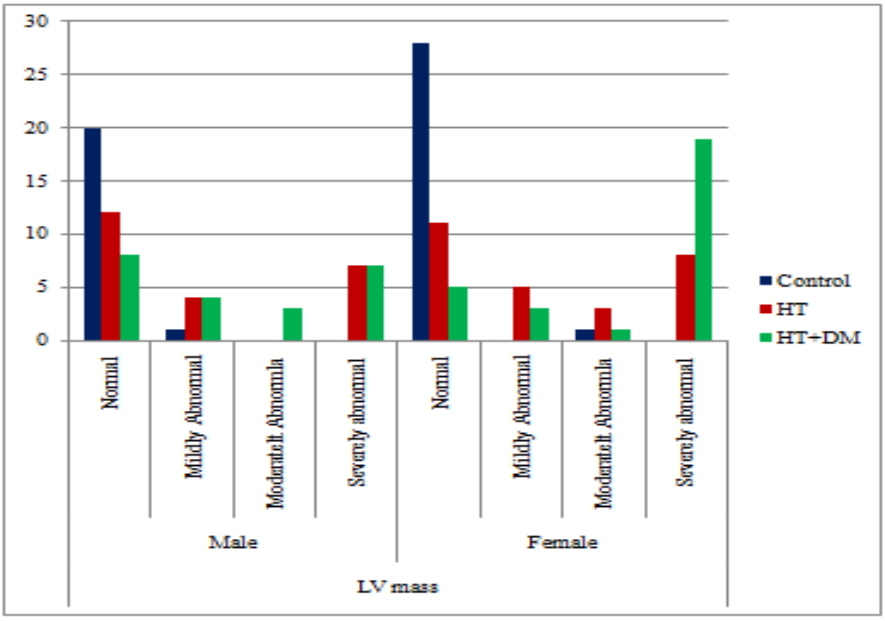
Age wise distribution of left ventricular mass in three groups:

Group			Age in years			p value
			36-45	46-55	Above 55	
Control	LV mass	Normal	13	27	8	0.248
		Mild	0	0	1	
		Moderate	0	1	0	
HT	LV mass	Normal	5	9	9	0.543
		Mild	0	3	6	
		Moderate	0	1	2	
		Severe	3	3	9	
HT +DM	LV mass	Normal	5	4	4	0.039
		Mild	0	2	5	
		Moderate	0	2	2	
		Severe	2	4	20	

Sex wise distribution of cases in of cases (Hypertensive groups and groups of both Hypertension and Diabetes) and controls:

			Group		
			Control	HT	HT + DM
Sex	Male	Count	21	23	22
		% within Group	42.0%	46.0%	44.0%
	Female	Count	29	27	28
		% within Group	58.0%	54.0%	56.0%

Sex wise distribution of left ventricular mass in three groups



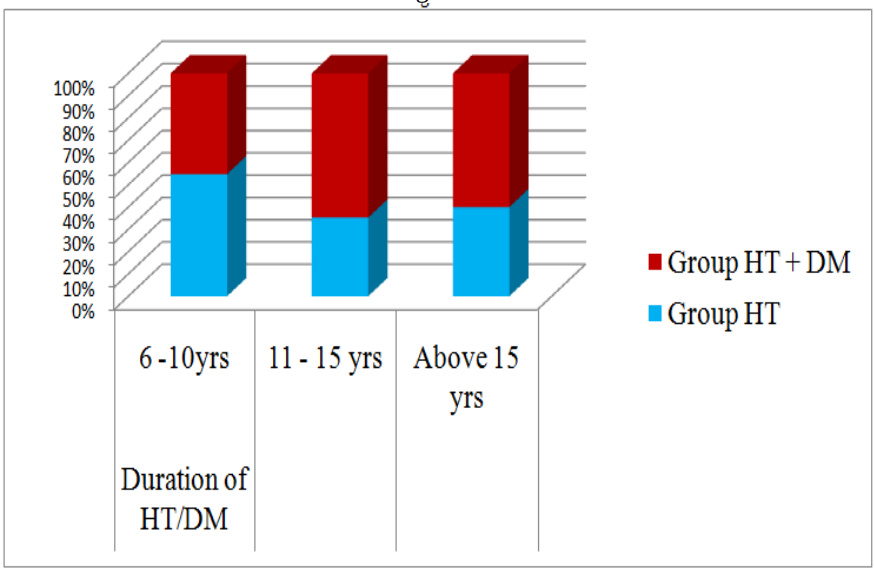
BMI wise distribution of cases and controls in three groups:

			Group		
			Control	HT	HT + DM
BMI	Normal	Count	31	27	24
		% within Group	62.0%	54.0%	48.0%
	Overweight	Count	19	23	26
		% within Group	38.0%	46.0%	52.0%

BMI wise distribution of left ventricular mass in three groups:

Group			BMI		p value
			Normal	Overweight	
Control	LV mass	Normal	30	18	0.325
		Mild	1	0	
		Moderate	0	1	
		Severe	0	0	
HT	LV mass	Normal	14	9	0.084
		Mild	2	7	
		Moderate	3	0	
		Severe	8	7	
HT+ DM	LV mass	Normal	7	6	0.624
		Mild	3	4	
		Moderate	3	1	
		Severe	11	15	

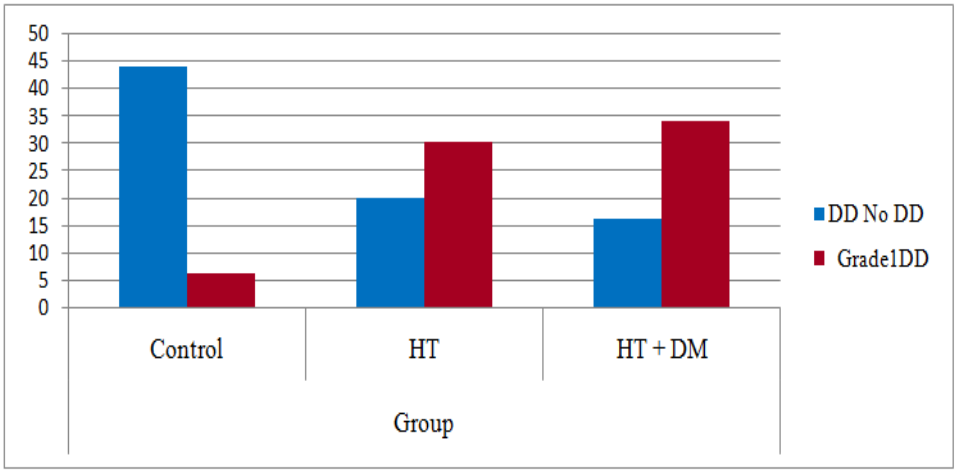
Distribution of cases according to the Duration of HT/HT+DM:



Distribution of LV mass according to the duration of HT/HT+DM:

Group			Duration of HT/DM			p value
			6-10yrs	11-15yrs	Above 15yrs	
HT	LV mass	Normal	17	2	4	0.378
		Mild	8	1	0	
		Moderate	2	1	0	
		Severe	13	2	0	
HT + DM	LV mass	Normal	9	3	1	0.446
		Mild	4	1	2	
		Moderate	1	2	1	
		Severe	19	5	2	

Mean LV mass according to the duration of HT in HT only group:



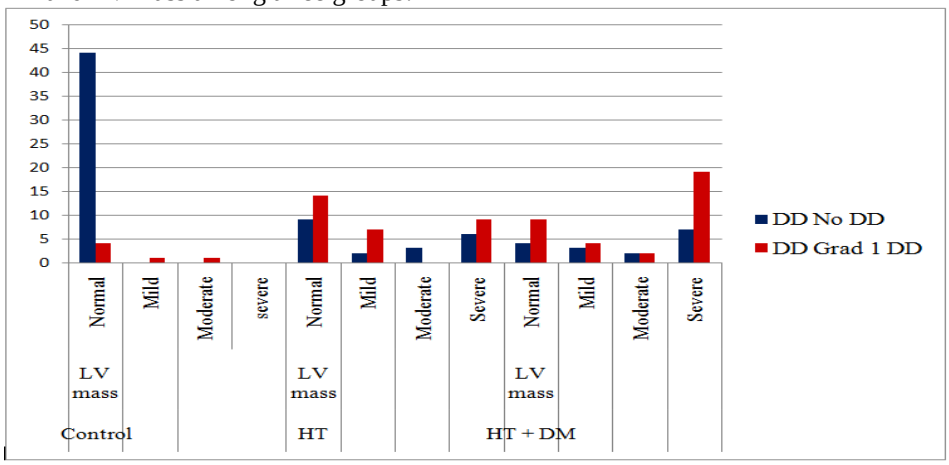
Mean LV mass according to the duration of HT/DM in Both HT and DM group:

		LV mass			
		Mean	SD	Minimum	Maximum
Duration of HT/DM	6-10	214.52	66.05	88.47	379.37
	11-15	204.29	62.82	102.48	296.70
	Above 15	229.42	68.84	152.47	330.65

Distribution of DD among three groups:

			Group		
			Control	HT	HT + DM
DD	No DD	Count	44	20	16
		% within Group	88%	40.0%	32.0%
	Grade1DD	Count	6	30	34
		% within Group	12%	60.0%	68.0%

Correlation DD and LV mass among three groups:



Distribution of smoking among three groups:

			Group		
			Control	HT	HT + DM
Smoking	Yes	Count	6	9	6
		% within Group	12.0%	18.0%	12.0%
	No	Count	44	41	44
		% within Group	88.0%	82.0%	88.0%

Correlation of smoking and LV mass among three groups:

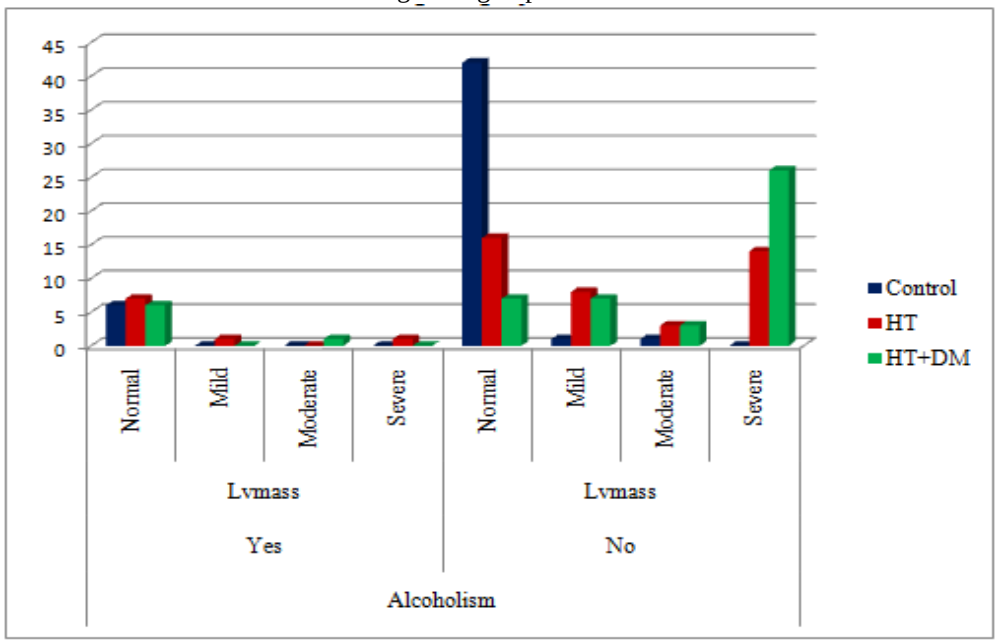
				Control	HT	HT+DM
Smoking	Yes	LV mass	Normal	6	6	3
			Mild	0	2	0
			Moderate	0	0	1

			Severe	0	1	2
	No	LV mass	Normal	42	17	10
			Mild	1	7	7
			Moderate	1	3	3
			Severe	0	14	24

Distribution of Alcoholism among three groups:

			Group		
			Control	HT	HT + DM
Alcoholism	Yes	Count	6	9	7
		% within Group	12%	18.0%	14.0%
	No	Count	44	41	43
		% within Group	88%	82.0%	86.0%

Correlation of Alcoholism and LV mass among three groups:



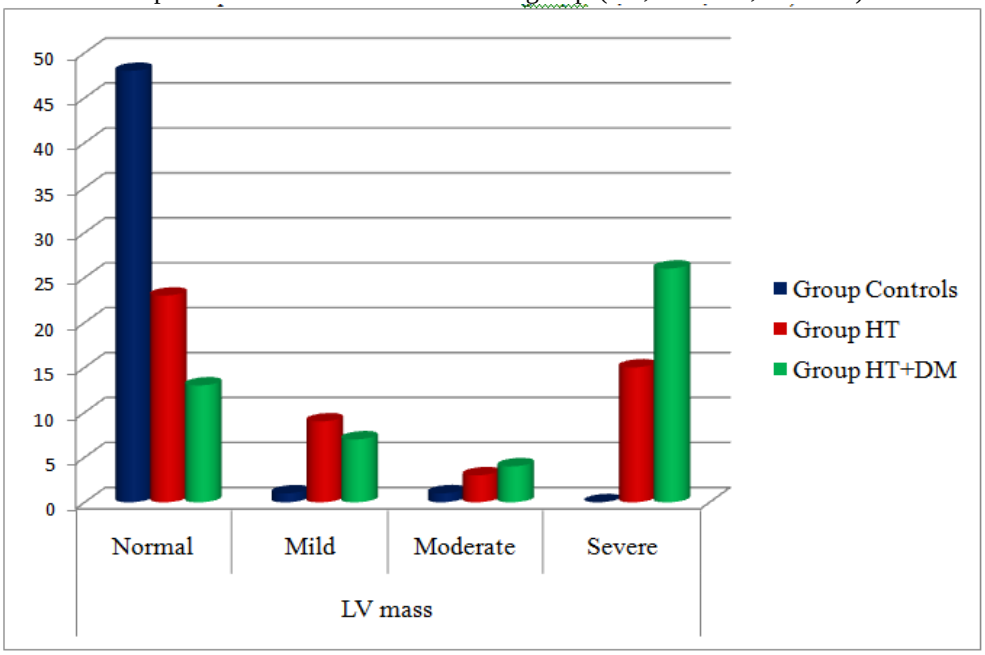
Comparison of LV mass between three groups (HT, HT+DM):

			Group			
			Controls	HT	HT+DM	Total
LV mass						
	Normal	Count	48	23	13	84
		% within LV mass	57.1%	27.4%	15.5%	100.0%
		% within Group	96.0%	46.0%	26.0%	56.0%
	Mild	Count	1	9	7	17
		% within LV mass	5.9%	52.9%	41.2%	100.0%
		% within Group	2.0%	18.0%	14.0%	11.3%
	Moderate	Count	1	3	4	8
		% within LV mass	12.5%	37.5%	50.0%	100.0%
		% within Group	2.0%	6.0%	8.0%	5.3%
	Severe	Count	0	15	26	41
		% within LV mass	.0%	36.6%	63.4%	100.0%
		% within group .0%	.0%	30%	52%	27.3%
Total		Count	50	50	50	150
		% within LV mass	33.3%	33.3%	33.3%	100.0%
		% within Group	100.0%	100.0%	100.0%	100.0%

Statistical comparison (Chi- Square Test) of LV mass in three groups:

	Value	Df	p value
Pearson Chi-Square	56.009(a)	6	.000
Likelihood Ratio	68.787	6	.000
Linear-by-Linear Association	47.189	1	.000
N of Valid Cases	150		

Comparison of LV mass between three groups(HT, HT+DM, Controls)::



Comparison of LV mass between two groups (HT, HT+DM

			Group		Total
			HT	HT + DM	
LV mass	Normal	Count	23	13	36
		% within LV mass	63.9%	36.1%	100.0%
		% within Group	46.0%	26.0%	36.0%
	Mild	Count	9	7	16
		% within LV mass	56.3%	43.8%	100.0%
		% within Group	18.0%	14.0%	16.0%
	Moderate	Count	3	4	7
		% within LV mass	42.9%	57.1%	100.0%
		% within Group	6.0%	8.0%	7.0%
	Severe	Count	15	26	41
		% within LV mass	36.6%	63.4%	100.0%
		% within Group	30.0%	52.0%	41.0%
Total		Count	50	50	100
		% within LV mass	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

Comparison LV mass between two groups (HT, HT+DM) in relation with Gender:

Sex				Group	
				HT	HT + DM
Male	LV mass	Normal	Count	12	8
			% within Group	52.2%	36.4%
		Mild	Count	4	4
			% within Group	17.4%	18.2%
		Moderate	Count	0	3
			% within Group	.0%	13.6%
		Severe	Count	7	7

			% within Group	30.4%	31.8%
Female	LV mass	Normal	Count	11	5
			% within Group	40.7%	17.9%
		Mild	Count	5	3
			% within Group	18.5%	10.7%
		Moderate	Count	3	1
			% within Group	11.1%	3.6%
		Severe	Count	8	19
			% within Group	29.6%	67.9%

Chi-Square test for Comparison LV mass between two groups (HT, HT+DM) in relation with Gender:

Sex		Value	Df	p value
Male	Pearson Chi-Square	3.780(a)	3	.286
	Likelihood Ratio	4.942	3	.176
	Linear-by-Linear Association	.673	1	.412
	N of Valid Cases	45		
Female	Pearson Chi-Square	8.216(b)	3	.042
	Likelihood Ratio	8.454	3	.038
	Linear-by-Linear Association	6.521	1	.011
	N of Valid Cases	55		

Comparing the mean LV mass in between two groups (HT, HT+DM):

	Group	N	Mean	Std. Deviation	Std. Error Mean
LV mass	HT	50	188.7868	62.57260	8.84910
	HT + DM	50	214.0584	64.71982	9.15276

Chi-Square Test for Comparison the mean LV mass in between two groups (HT, HT+DM):

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	p value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
LV mass	Equal variances assumed	.014	.908	-1.985	98	.050	-25.2716	12.73105	-50.53596	-.00724
	Equal variances not assumed			-1.985	97.889	.050	-25.2716	12.73105	-50.53632	-.00688

Comparison of mean LV mass for males in between two groups (HT, HT+DM) (T-Test):

	Group	N	Mean	Std. Deviation	Std. Error Mean
LV mass	HT	23	211.2470	72.98173	15.21774
	H T+ DM	22	224.2382	70.07182	14.93936

Chi-Square Test for Comparison of mean LV mass for males in between two groups (HT, HT+DM):

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	p value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
LV mass	Equal variances assumed	.155	.696	-.609	43	.546	-12.9912	21.34493	-56.03738	30.05493
	Equal variances not assumed			-.609	42.999	.546	-12.9912	21.32520	-55.99762	30.01517

Comparison of mean LV mass for females in between two groups (HT, HT+DM) (T-Test):

	Group	N	Mean	Std. Deviation	Std. Error Mean
LV mass	HT	27	169.6541	45.22834	8.70420
	HT + DM	28	206.0600	60.26539	11.38909

Chi-Square Test for Comparison of mean LV mass for females in between two groups (HT, HT+DM):

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	p value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
LV mass	Equal variances assumed	2.682	.107	-2.527	53	.015	-36.4059	14.40876	-65.30623	-7.50562
	Equal variances not assumed			-2.540	50.028	.014	-36.4059	14.33438	-65.19697	-7.61488

V. Discussion

In our study, we studied 150 subjects (50-HT only, 50- HT+DM, 50-Controlswithout HT and DM) and they were compared with LV mass. The minimum age of the cases and controls was 36 years and maximum age was 85 years. There is significant statistical correlation between age group and left ventricular mass in hypertension with diabetes group with the p value of 0.039. But in control group and cases with hypertension only group, the p value was > 0.05 and it was not statistically significant. There is significant statistical correlation between female (p=0.042) cases with diabetes and hypertension and severity of abnormal left ventricular mass, than males (p=0.286). There is no significant statistical correlation between body mass index, diastolic dysfunction, smoking and alcoholism with left ventricular mass.There is no significant statistical correlation between duration of hypertension and diabetes with LV mass (P>0.05) But there is increase in mean LV mass in hypertension and diabetes group. While comparing LV mass between these three groups (HT, HT+DM, Control) there is significant statistical correlation (p =0.001) between three groups. But while comparing the two groups (HT, HT+DM), the difference of LV mass according to the severity of abnormal LV mass was not statistically significant. So we did subgroup analysis between male and female cases separately in these groups. There is significant statistical correlation (p=0.042) of LV mass between hypertensive and both hypertensive and diabetic group females. But there is no significant statistical correlation of LV mass in males in these two groups.

Then we took mean LV mass and compared between the two (HT, HT+DM) groups. While comparing mean left ventricular mass between these two (HT, HT+DM) groups, there is no significant statistical correlation (p=0.05) between LV mass and these groups. After that subgroup analysis done between these two groups (HT, HT+DM) according to the gender which showed that the mean left ventricular mass for males in hypertension group was 211.25gm and in hypertension and diabetics group it was 224.24gm. This explains that mean left ventricular mass was increasing in the second group (HT+DM) but not correlated statistically (p=0.546). For females mean left ventricular mass for hypertension group was 169.65 and for hypertension and diabetic group was 206.06. This explains that there is significant statistical (p=0.015) correlation of increased LV mass in diabetes and hypertension group.

In The Framingham study , they studied 2623 diabetic subjects out of which 1514 were women with mean age of 53 years without cardiac disease and they found that women more left ventricular mass compared to men with p value of < 0.001 for women and p=0.054 for men. They explained that the increased activation of serine/threonine protein kinase which is an inhibitor of apoptosis and also the oestrogen receptors in cardiomyocytes in females are the responsibility of increased LV mass in females.

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VII. Conclusion

The study shows that there is increased left ventricular mass in females with hypertension and diabetes mellitus when compared to females with hypertension alone.There is no significant difference in the left ventricular mass in males in between the two (HT, HT+DM) groups.But the mean left ventricular mass was increased in both males and females of diabetes and hypertension group when compared to hypertension only group. The increased duration of hypertension and diabetes is associated with increased mean left ventricular mass in cases of both hypertension and diabetes group. In our study, advancing age group is associated with increased left ventricular mass in cases of both hypertension and diabetes group.

Hence, increased left ventricular mass is the important cause for increased cardiovascular morbidity and mortality, the females with diabetes and hypertension should be managed aggressively for reduction of left ventricular mass.

Limitations Of The Study

1. Echocardiography has observer variation.
2. The duration of undiagnosed diabetes mellitus and hypertension in the patient who presented towards and taken into the study is not taken into consideration.

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