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Association of Epicardial Adiposity and Albuminuria in Patient with Essential Hypertension

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ABSTRACT

Aim: The aim of the present study was to find an association of epicardial adiposity and albuminuria patients with essential hypertension.

Methods: The Observational study was conducted in the Department of Medicine, SGRDIMSR, Vallah, Sri Amritsar from April 2021 to July 2022. In this study, 100 patients aged 18-60 years having essential hypertension were enrolled. Patients were divided into 2 groups depending upon UACR i.e albuminuria(>30mg/dl) and albuminuria(<30mg/dl) coming to medicine opd or getting admitted in SGRDIMSR fulfilling the inclusion criteria after giving written and informed consent.

Results: Out of 100 patients, majority of the patients (64%) belonged to 51-60 age group followed by 41-50 years (15%), 31-40 years (13%), and 21-30 years (8%) age group. Mean age of the patients was 49.96±11.35 years. 51% were males and 49% were females. 46% of patients had BMI 23-24.9 followed by >25 (32%), 18.5-22.9 (19%), and <18.5 (3%). Mean BMI of the patients was 24.54±3.27. Stage I hypertension was present in 66% of the patients, while stage II was present in 34% of patients. Left Ventricular Hypertrophy (LVH) was present in 84% of patients and absent in 16% of patients. 78% patients had serum albumin levels 3.5-5.5 mg/dl and 22% patients had serum albumin levels <3.5 mg/dl. Mean albumin levels were 4.0130±0.54747 mg/dl.

Conclusion: From this study it can be concluded that epicardial adipose tissue thickness and albuminuria was significantly associated with Hypertension. The relation of UACR levels with left ventricular hypertrophy and LVMI was found statistically significant. Similarly, the relation of epicardial adipose tissue thickness and serum albumin levels were significantly associated.

Keywords: Epicardial adipose tissue, Essential hypertension, Albuminuria

1. INTRODUCTION

Hypertension, a "silent killer" is increasingly diagnosed in its quiescent phase, to prevent cardiovascular diseases, which maintains its dignity as being the most common cause of mortality worldwide.1 Epicardial adipose tissue (EAT) and albuminuria have emerged as newer risk factors to identify high risk hypertensive people. Epicardial fat, a type of visceral fat, is present between the epicardial surface and the visceral surface of the pericardium

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covering the heart base, apex, the atrioventricular sulci, the interventricular sulci and the entire surface of the right ventricle.2,3 It provides free fatty acids (FFA) to meet the myocardial energy demand, protects the myocardium from cardiotoxic effect of FFA by scavenging them, protects heart from hypothermia, provides mechanical protection to the coronary circulation.4-6 and secretes adiponectin and other adipokines, which have been found to be anti-atherogenic and anti-inflammatory.7,8 EAT has also been found to play a pivotal role in the pathogenesis of atherosclerosis by secreting adipokines, which triggers systemic inflammation and oxidative stress, are thought to influence the underlying atherosclerotic plaque development via paracrine and vasocrine actions.9 Role of epicardial fat has been found in atrial fibrillation, hypertension, increased left ventricular mass (LVM), left ventricular mass index (LVMI) and decreased ejection fraction.10-12

Albuminuria has been found to be related to increased all-cause mortality.13 Hypertensive individuals with microalbuminuria have greater incidence of cardiovascular events than patients with normal urinary albumin excretion.13,14 A recent concept is that microalbuminuria is a marker of extensive endothelial dysfunction or generalised vasculopathy, which may accelerate atherogenesis.14 Microalbuminuria (urinary albumin excretion of 30-300 mg/24 h) represents a sign of renal and cardiovascular damage. It is a well-known predictor for several metabolic and non-metabolic clinical conditions in patients with essential hypertension. Microalbuminuria is known to be related to obesity. Studies suggest that both subcutaneous and visceral adipose tissues are associated with microalbuminuria.15,16

Essential hypertension (EH) is one of the most important modifiable risk factors for coronary heart disease, stroke, congestive heart failure, end-stage renal disease, and peripheral vascular disease. Uncontrolled EH may lead to the detriment of the cardiovascular system, brain, and kidneys. EH is associated with a variety of non-modifiable and modifiable risk factors.34 Obesity is one of those hypertension risk factors that can be modified. Reduction of adipose tissue depots is one way of alleviating hypertension and lowering the likelihood of subsequent major adverse cardiac events.10,17

The aim of the present study was to find an association of epicardial adiposity and albuminuria patients with essential hypertension.

2. MATERIALS AND METHODS

The Observational study was conducted in the Department of Medicine, SGRDIMSR, Vallah, Sri Amritsar from April 2021 to July 2022. In this study, 100 patients aged 18-60 years having essential hypertension were enrolled. Patients were divided into 2 groups depending upon UACR i.e albuminuria(>30mg/dl) and albuminuria(<30mg/dl) coming to medicine opd or getting admitted in SGRDIMSR fulfilling the inclusion criteria after giving written and informed consent.

INCLUSION CRITERIA

- Patients in the age group of 18-60 years with hypertension as per the JNC 8 criteria were included in the study
- Patients were taken as hypertensive when blood pressure is 150/90 mm Hg or higher in adults of 60 years or 140/90 mm Hg or higher in patients younger than 60 years.

EXCLUSION CRITERIA

- Chronic kidney disease
- Diabetes mellitus

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- Previous stroke
- Valvular heart disease
- Secondary hypertension
- UTI

3. METHODOLOGY

A detailed history was taken from patient of breathlessness, cough, expectoration, chest pain and palpitations, swelling over feet, syncope and previous history of CVA. A thorough physical and systemic examination including fundus examination was done to look for any complications of hypertension. All patients included in the study was undergo routine blood investigations such ashemogram, fasting plasma glucose, renal function tests, serum electrolytes, lipid profile, LFT, urine routine, UACR, USG whole abdomen, electrocardiogram and 2D echocardiography. Microalbuminuria was assessed from UACR which was measured on a random spot, single void urine specimen.

Echocardiography was done in all the cases. End diastolic measurements of interventricular septal thickness (IVS), LV internal diameter and posterior wall thickness (PWT) in accordance with the American Society of Echocardiography recommendations were taken using M-mode. Left ventricular Mass Index was measured on Philips 2 DEcho Machine using the Devereux and Reichek "cube" formula: Left ventricular mass = 0.80 x 1.04 [(IVSd x LVEDDd x PWTd) 3-(LVEDDd) 3] +0.6 where IVSd is interventricular septal thickness LVEDD is left ventricular end diastolic diameter and PWT is posterior wall thickness. Normal values for women: 43-95g/m2 Normal values for men: 49-115 g/m2.

EPICARDIAL FAT THICKNESS MEASUREMENT EAT

Thickness was measured on the free wall of right ventricle from the parasternal long axis views. Epicardial fat was identified as echo free space in the pericardial layers on the2d echocardiography and its thickness was measured perpendicularly on the free wall of the right ventricle at end diastole for the 3 cardiac cycles.

Statistical Method: The data thus collected was statistically analyzed and valid conclusion was drawn.

4. RESULTS

Table 1: Patient details

		Number	Percent
Age (In Years)	21-30	8	8.0
	31-40	13	13.0
	41-50	15	15.0
	51-60	64	64.0
Mean±SD	49.96±11.35		
Gender	**Female**	49	49.0
	Male	51	51.0
BMI	<18.5	3	3.0
	18.5-22.9	19	19.0
	23-24.9	46	46.0
	>25	32	32.0
Mean±SD	24.54±3.27		
Stage of HTN (mmHg)	I	66	66.0

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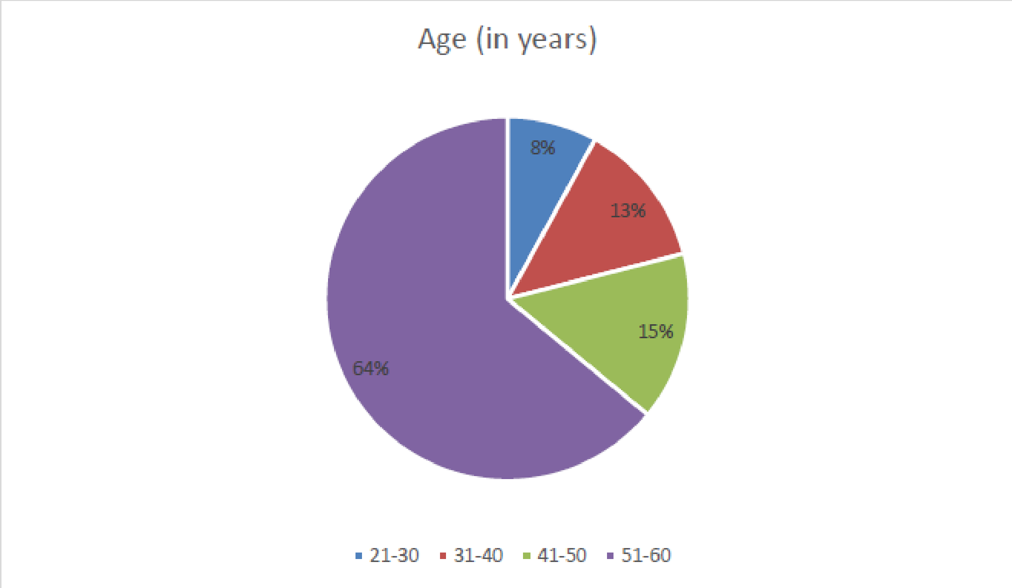
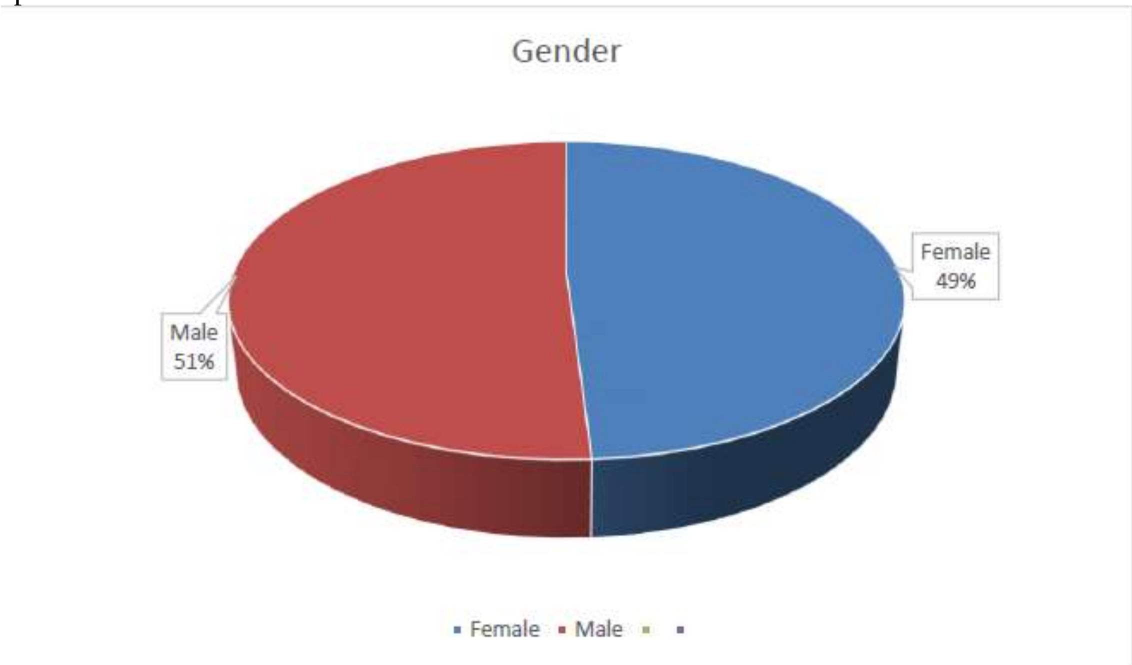
	II	34	34.0
LVH	Absent	16	16.0
	Present	84	84.0
S. Albumin (mg/dl)	<3.5	22	22.0
	3.5-5.5	78	78.0
Mean±SD	4.0130±0.54747		

Graph 1: **AGE DISTRIBUTION OF THE STUDY POPULATION**



Graph 2: **GENDER DISTRIBUTION OF STUDY POPULATION**



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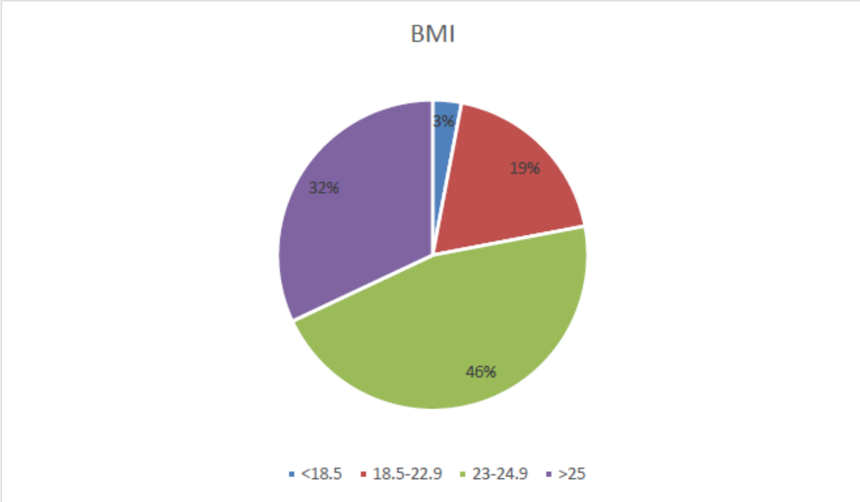
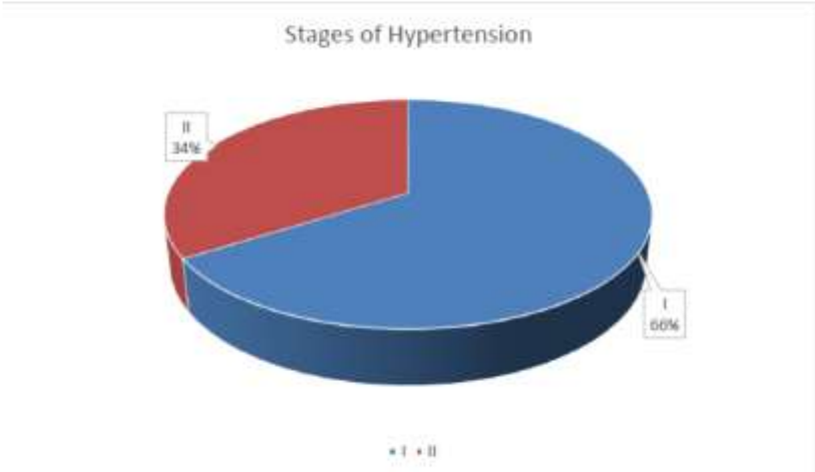
Graph 3: **DISTRIBUTION OF PATIENTS ACCORDING TO BODY MASS INDEX (BMI)**



Graph 4: **DISTRIBUTION ACCORDING TO STAGE OF HYPERTENSION IN STUDY POPULATION**



Graph 7: **DISTRIBUTION ACCORDING TO LEFT VENTRICULAR HYPERTROPHY (LVH) IN STUDY POPULATION**

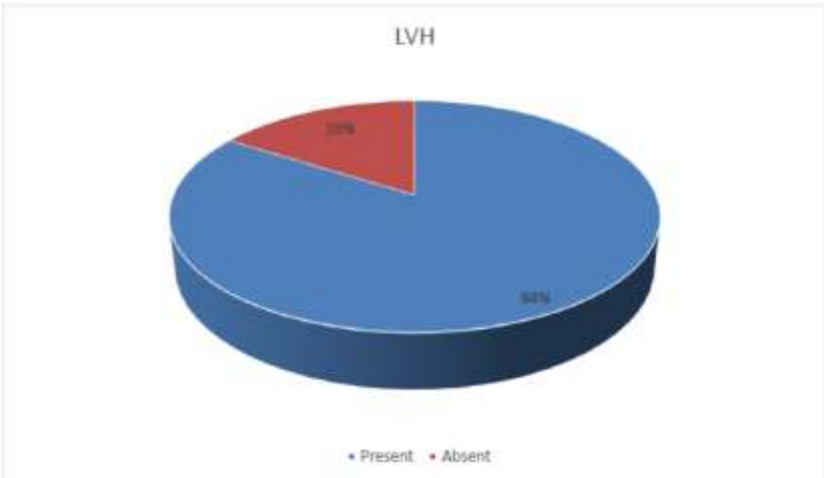


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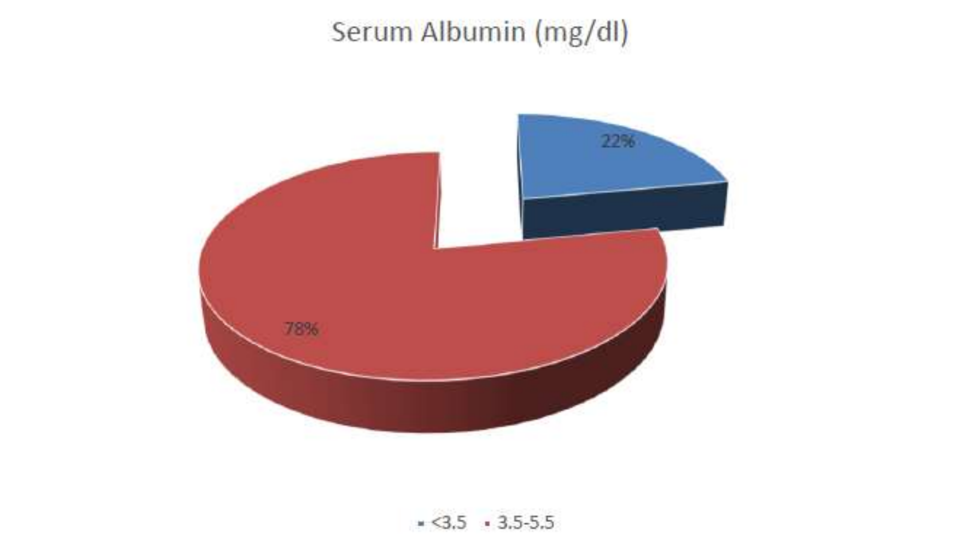
Table 9: **DISTRIBUTION ACCORDING TO S. ALBUMIN IN STUDY POPULATION**



Out of 100 patients, majority of the patients (64%) belonged to 51-60 age group followed by 41-50 years (15%), 31-40 years (13%), and 21-30 years (8%) age group. Mean age of the patients was 49.96±11.35 years. 51% were males and 49% were females. 46% of patients had BMI 23-24.9 followed by >25 (32%), 18.5-22.9 (19%), and <18.5 (3%). Mean BMI of the patients was 24.54±3.27. Stage I hypertension was present in 66% of the patients, while stage II was present in 34% of patients. Left Ventricular Hypertrophy (LVH) was present in 84% of patients and absent in 16% of patients. 78% patients had serum albumin levels 3.5-5.5 mg/dl and 22% patients had serum albumin levels <3.5 mg/dl. Mean albumin levels were 4.0130±0.54747 mg/dl.

Table 2: Distribution of patients according to serum cholesterol levels, serum triglyceride levels, serum HDL levels

		Number	Percent
Total Cholesterol (mg/dl)	<201(Normal)	81	81.0
	201-250	15	15.0
	>250	4	4.0
Mean±SD	164.4730±65.8793		
Triglyceride (mg/dl)	<151	69	69.0
	151-200	19	19.0
	201-250	3	3.0
	>250	9	9.0
Mean±SD	138.5420±94.16421		
HDL (mg/dl)	<41	36	36.0
	41-60	52	52.0
	>60	12	12.0
Mean±SD	44.4300±14.34795		
UACR (mg/gm)	<30	25	25.0
	>30	75	75.0
Mean±SD	119.5790±103.12208		

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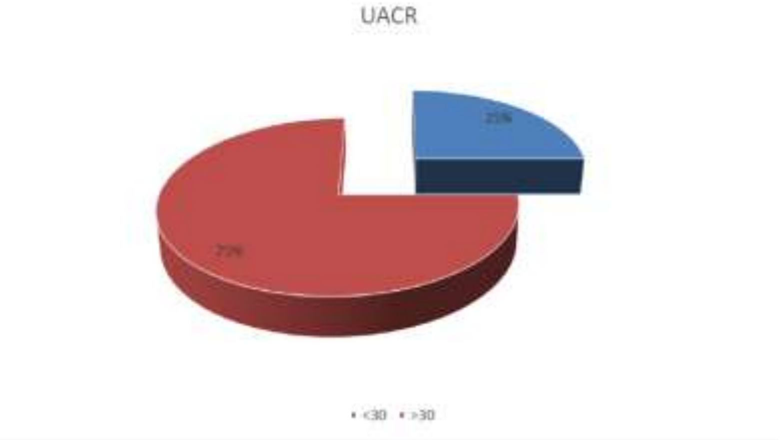
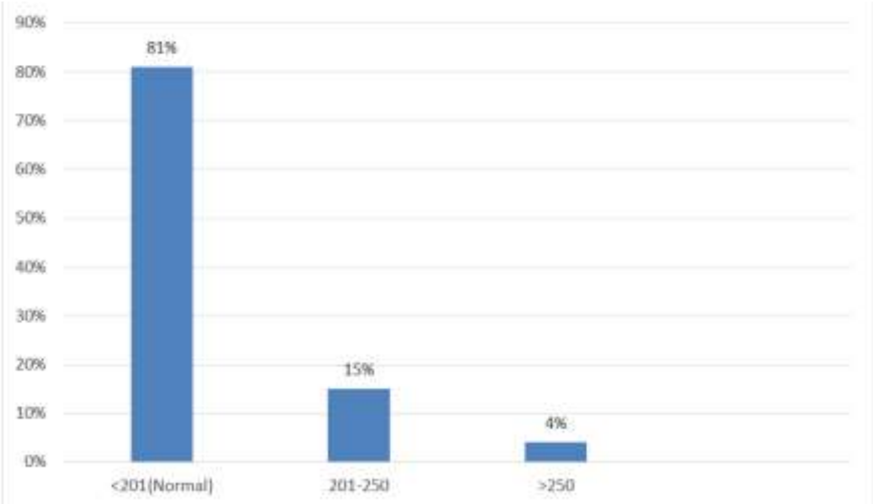
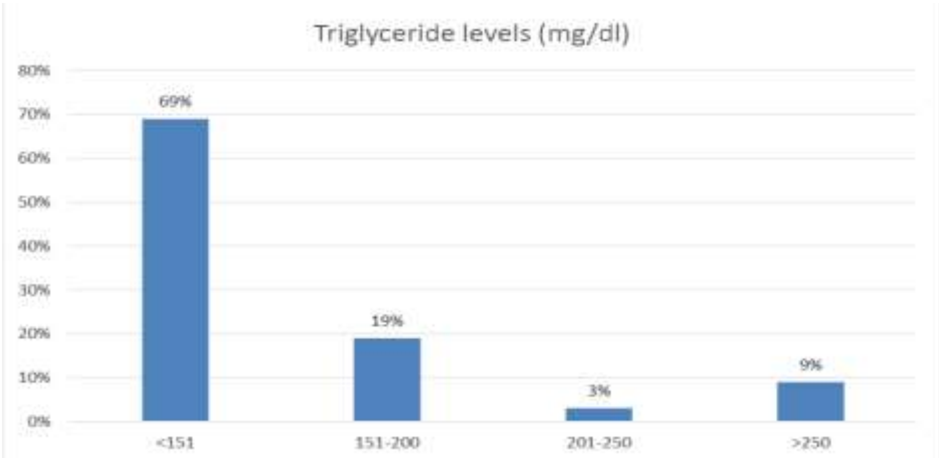
Graph 10: **DISTRIBUTION ACCORDING TO UACR IN STUDY POPULATION**



Graph 11: **DISTRIBUTION OF PATIENTS ACCORDING TO SERUM CHOLESTEROL LEVELS**



Graph 12: **DISTRIBUTION OF PATIENTS ACCORDING TO SERUM TRIGLYCERIDE LEVELS**



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81% of patients had total cholesterol 250 mg/dl. Mean total cholesterol values were 164.4730±65.8793 mg/dl. 69% patients had triglyceride levels 250 mg/dl), and 3% (201-250 mg/dl). Mean triglyceride levels were 138.5420±94.16421 mg/dl. 52% had serum HDL levels 41-60 mg/dl, 36% had serum HDL levels 60 mg/dl serum HDL levels. Mean HDL levels were 44.4300±14.34795 mg/dl. 75% of patients had UACR >30 mg/gm, while only 25% patients had UACR

Table 3: Distribution of UACR according to clinic-demographic details

		UACR(mg/gm)		Total
		<30	>30	
Age (In years)	21-30	3	5	8
		37.5%	62.5%	100.0%
	31-40	4	9	13
		30.8%	69.2%	100.0%
	41-50	5	10	15
		33.3%	66.7%	100.0%
	51-60	13	51	64
		20.3%	79.7%	100.0%
p-value		0.531 (NS)		
Gender	Female	12	37	49
		24.5%	75.5%	100.0%
	Male	13	38	51
		25.5%	74.5%	100.0%
p-value		0.393 (NS)		
LVH	ABSEN T	10	6	16
		62.5%	37.5%	100.0%
	PRESE NT	15	69	84
		17.9%	82.1%	100.0%
Total		25	75	100
		25.0%	75.0%	100.0%
p-value		0.001 (Sig.)		

Parameter	UACR(mg/gm)	N	Mean	Std. Deviation	p-value
LVMI(g/m2)	<30	25	93.2064	24.86307	0.001 (Sig.)
	<30	75	134.8993	48.79550	

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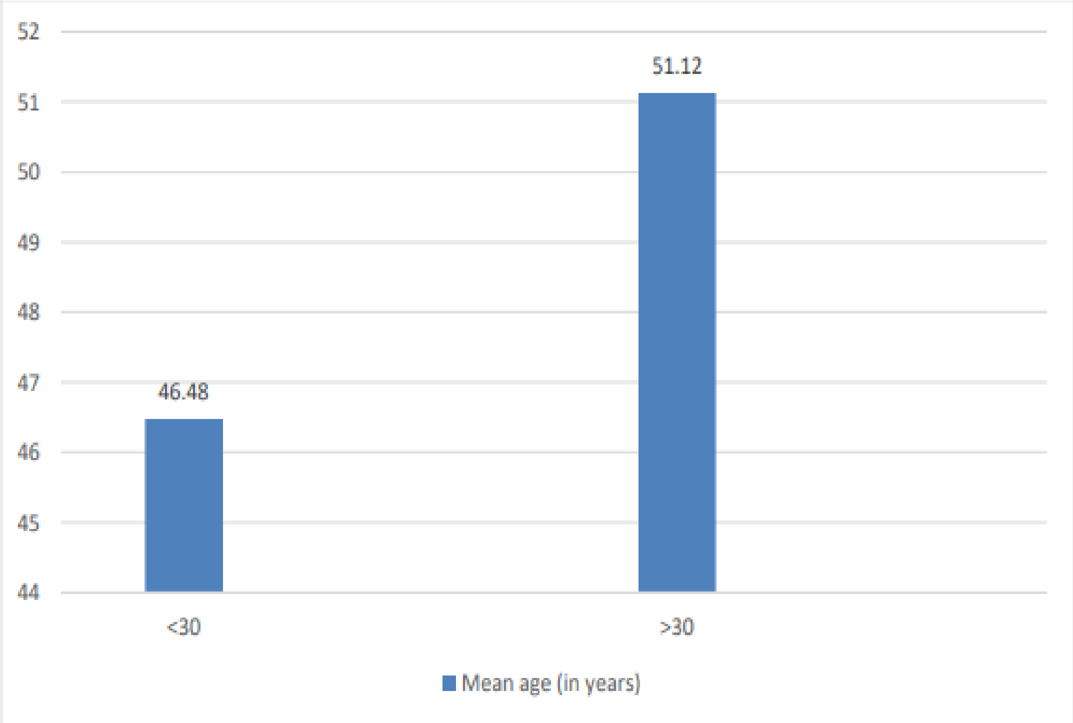
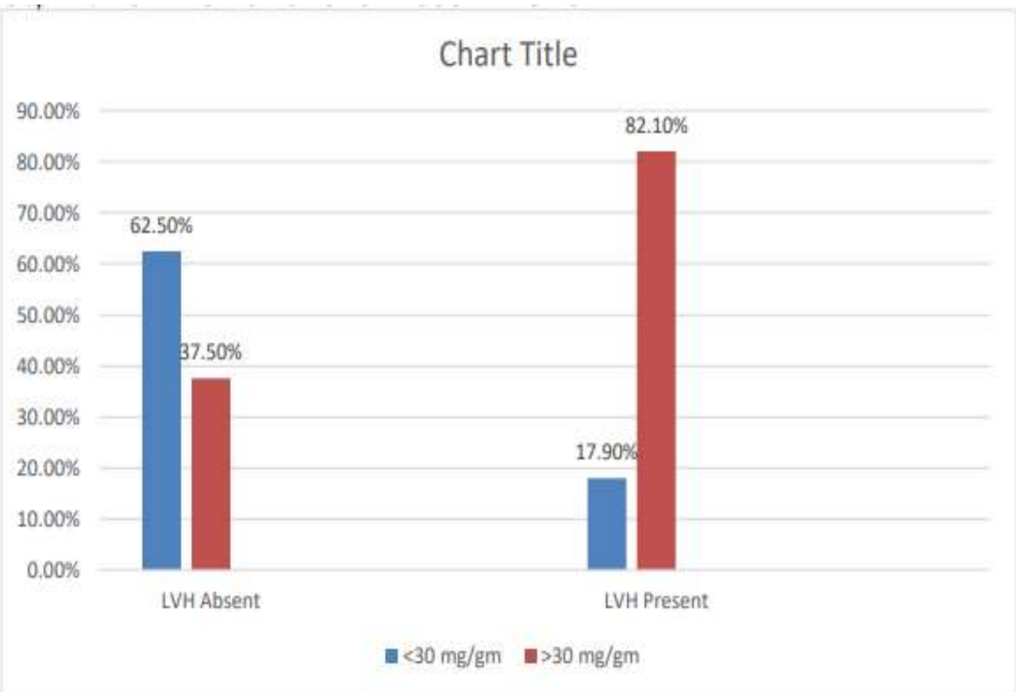
Graph 13: MEAN VALUE OF AGE ACCORDING TO UACR



Graph 14: DISTRIBUTION OF UACR ACCORDING TO LVH



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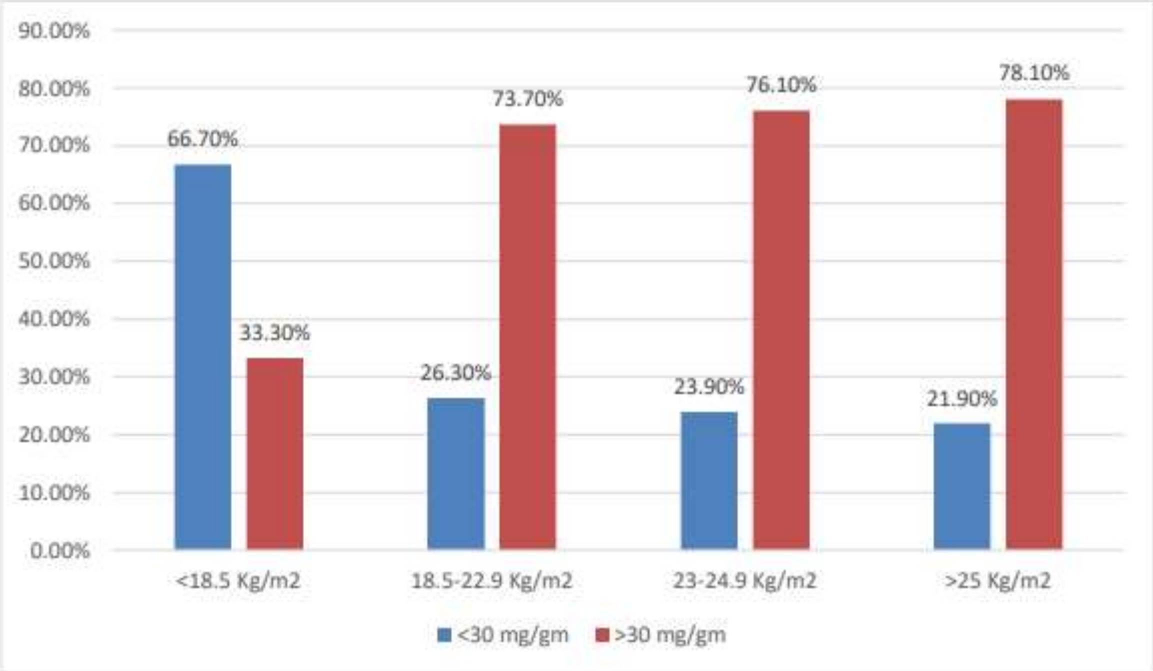
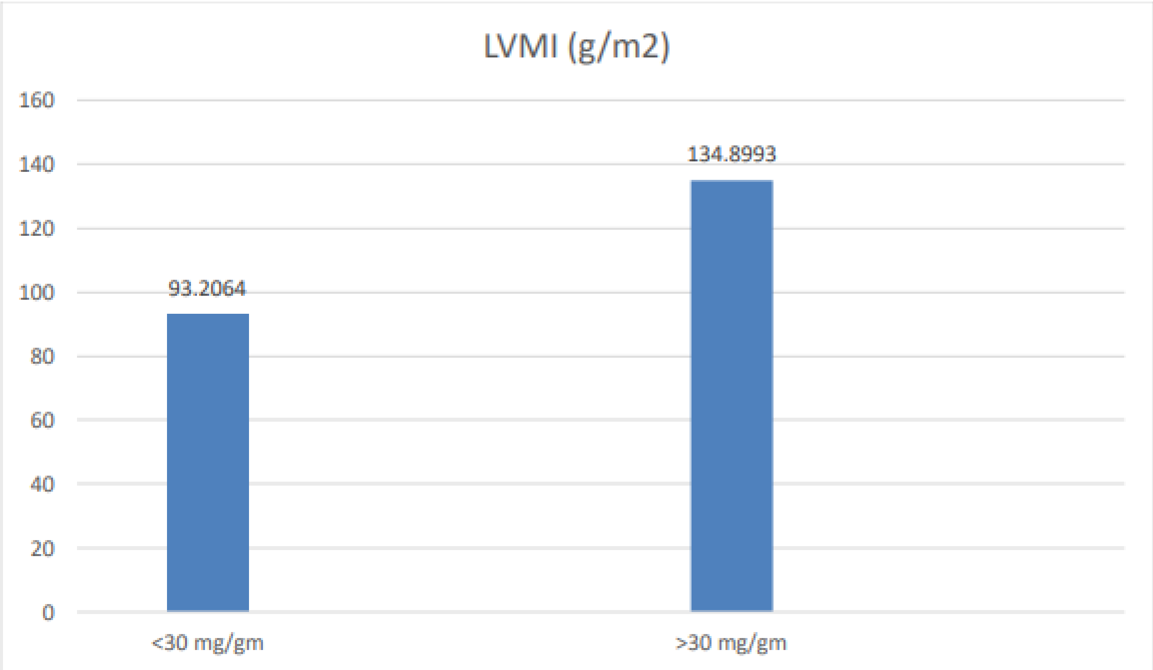
Graph 15: DISTRIBUTION OF UACR ACCORDING TO BMI



Graph 16: MEAN VALUE OF LVMI ACCORDING TO UACR



In every age-group, Majority of the patients had UACR >30 mg/gm. In age group of 21-30 years, 62.5% had >30 mg/gm and 37.5% had <30 mg/gm. In age group of 31-40 years, 69.2% had >30 mg/gm and 30.8% had <30 mg/gm. In age group of 41-50 years, 66.7% had >30 mg/gm and 33.3% had <30 mg/gm. In age group of 51-60 years, 79.7% had >30 mg/gm and 20.3% had <30 mg/gm. In females, 75.5% had UACR >30 mg/gm, while 24.5 % had <30 mg/gm. Similarly in males, 74.5% had UACR>30 mg/gm and 25.5% had <30 mg/gm. The values were not statistically significant. In patients with BMI <18.5 Kg/m2, 66.7% had UACR

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<30 mg/gm and 33.3% had >30 mg/gm. In patients with BMI 18.5-22.9 Kg/m2, 26.3% had UACR <30 mg/gm and 73.7% had >30 mg/gm. In patients with BMI 23-24.9 Kg/m2, 23.9% had UACR <30 mg/gm and 76.1% had >30 mg/gm. In patients with BMI >25 Kg/m2, 21.9% had UACR <30 mg/gm and 78.1% had >30 mg/gm. The difference was not significant. Out of 16 patients with left ventricular hypertrophy absent, 62.5% had UACR <30 mg/gm and 37.5% had >30 mg/gm. Out of 84 patients with left ventricular hypertrophy present, 17.9% had UACR <30 mg/gm and 82.1% had >30 mg/gm.

Table 4: Distribution of EAT according to clinic-demographic details

		EAT(RVFT)		Total
		3-12 mm	>12 mm	
Gender	Female	45	4	49
		91.8%	8.2%	100.0%
	Male	47	4	51
		92.2%	7.8%	100.0%
	p-value	0.953 (NS)		
BMI (kg/m2)	<18.5	3	0	3
		100.0%	0.0%	100.0%
	18.5-22.9	19	0	19
		100.0%	0.0%	100.0%
	23-24.9	42	4	46
		91.3%	8.7%	100.0%
	>25	28	4	32
		87.5%	12.5%	100.0%
p-value		0.420 (NS)		
LVH	ABSENT	13	3	16
		81.2%	18.8%	100.0%
	PRESENT	79	5	84
		94.0%	6.0%	100.0%
p-value		0.084 (NS)		
S. Albumin(mg/dl)	<3.5	17	5	22
		77.3%	22.7%	100.0%
	3.5-5.5	75	3	78
		96.2%	3.8%	100.0%
p-value	0.004 (Sig.)			
TG (mg/dl)	<151	64	5	69
		92.8%	7.2%	100.0%
	151-200	18	1	3
		94.7%	5.3%	100.0%
	201-250	2	1	3
		66.7%	33.3%	100.0%
	>250	8	1	9
		88.9%	11.1%	100.0%
p-value		0.395 (NS)		

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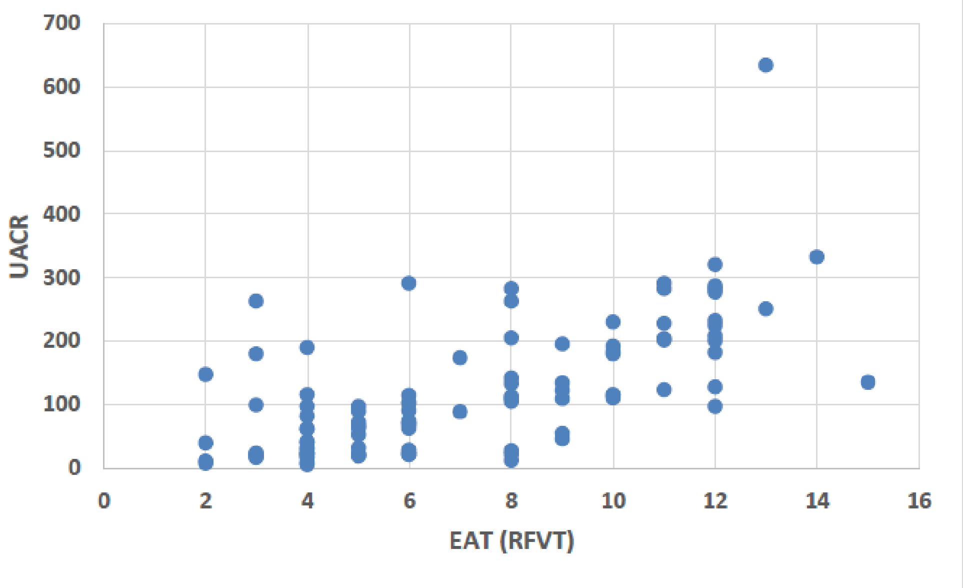
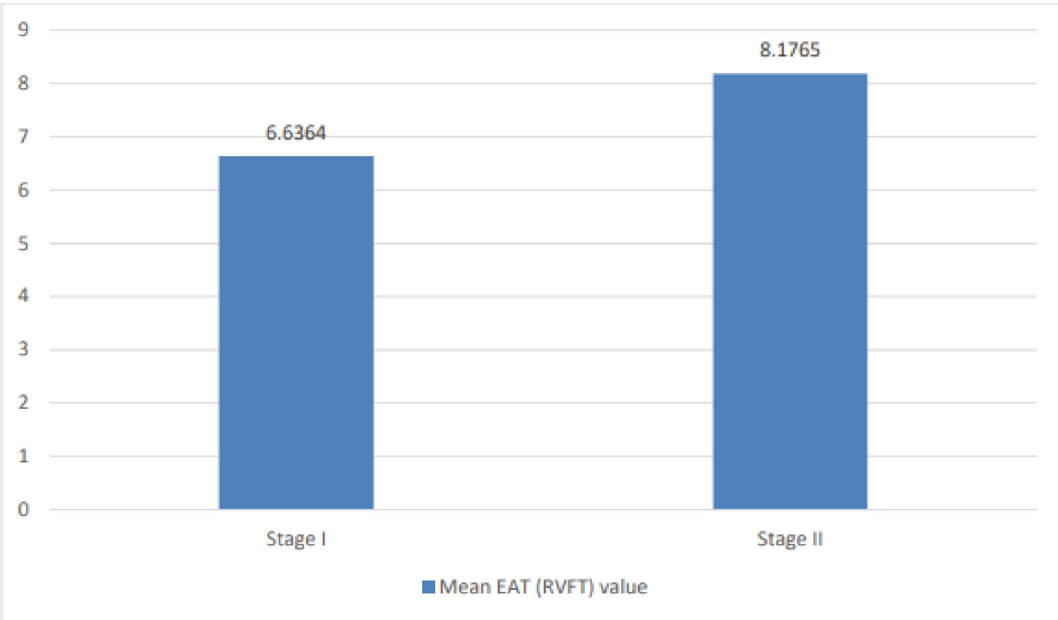
		EAT(RVFT)
UACR	Pearson Correlation	0.657**
	Sig. (2-tailed)	0.001 (Sig.)

	Stage	N	Mean	Std. Deviation	p-value
EAT (RVFT)	1	66	6.6364	3.37245	0.026 (Sig.)
	2	34	8.1765	2.90736	

Graph 17: **PEARSON CORRELATION COEFFICIENT BETWEEN UACR AND EAT (RVFT)**



Graph 18: **DISTRIBUTION OF MEAN VALUE OF EAT(RVFT) ACCORDING TO STAGES OF HTN**



In females, 91.8% had EAT (RVFT) 3-12 mm and 8.2% had >12 mm. In males, 92.2% had 3-12 mm and 7.8% had >12 mm. 100% patients with BMI 12 mm. Out of patients with BMI >25 Kg/m2, 87.5% had 3-12 mm and 12.5% had >12 mm. The diff was non-significant. Out of patients with LVH absent, 81.2% had 3-12 mm and 18.8% ad >12 mm. Out of patients with LVH present, 94% had 3-12 mm and 6% had >12 mm. In patients with serum albumin levels 12 mm. In patients with serum albumin levels 3.5-5.5 mg/dl, 96.2% had EAT value 3-12 mm and 3.8% had >12 mm. Majority of the patients in each group of Serum triglyceride levels had 3-12 mm of EAT (RVFT). In females, 91.8% had EAT (RVFT) 3-12 mm and 8.2% had >12 mm. In males, 92.2% had 3-12 mm and 7.8% had >12 mm. 100% patients with BMI 12 mm. Out of patients with BMI >25 Kg/m2, 87.5% had 3-12 mm and 12.5% had >12 mm. The diff was non-significant. Out of patients with LVH absent, 81.2% had 3-12 mm and 18.8% ad >12 mm. Out of patients with LVH present, 94% had 3-12 mm and 6% had >12 mm. In patients with serum albumin levels 12 mm. In patients with serum albumin levels 3.5-5.5 mg/dl, 96.2% had EAT value 3-12 mm and 3.8% had >12 mm. Majority of the patients in each group of Serum triglyceride levels had 3-12 mm of EAT (RVFT).

5. DISCUSSION

Hypertension (HT) is one of the most common diseases that cause morbidity and mortality over time.18-20 It is mostly insidious. Therefore, end-organ damage has developed in many patients at the time of diagnosis, and in many of these patients, more than one end-organ damages are accompanying.18,19 EAT has also been found to play a pivotal role in the pathogenesis of atherosclerosis by secreting adipokines, which triggers systemic inflammation and oxidative 6.6364 8.1765 0 1 2 3 4 5 6 7 8 9 Stage I Stage II Mean EAT (RVFT) value stress, are thought to influence the underlying atherosclerotic plaque development via paracrine and vasocrine actions.21,22 Albuminuria is a well-known predictor for several metabolic and nonmetabolic clinical conditions in patients with essential hypertension.23,24 In patients with heart failure (HF), there is increased prevalence of albuminuria, and higher urine albumin-to-creatinine ratio (UACR) is associated with greater overall cardiovascular mortality and more frequent hospitalization for HF.25,26 The patients in our research ranged in age from 21 to 60 years old, with a mean age of 49.96±11.35 years. This was consistent with the findings of Arnold Forlemu et al27, who found that the average age of the participants was 52.65±3.42 years. However, due to different demographic characteristics, the mean age fluctuated among research, and no consistent pattern was seen in the studies done. In our study, 49 females (49%) and 51 men (51%), with a F:M ratio of 0.96, were included. A similar pattern of sex distribution was seen in research done by Arnold Forlemu et al27, in which 52.9% of the patients were females and 47.05% were men, with a M: F ratio of 0.9. The gender distribution of the patients occurred by chance and was not predetermined in any of the investigations, including ours. The patients' mean BMI was 24.54±3.27 kg/m2, which was equivalent to the research of Josep Redon et al28, in which the mean BMI was 27.7±3.7 kg/m2. This can be explained by the many ethnic and racial characteristics that influence population anthropometric parameters.

In the current study, 75% of patients exhibited microalbuminuria (UACR >30 mg/gm), but only 25% had UACR 12 mm EAT. However, greater left ventricular mass revealed by echocardiography has been linked to higher EAT thickness, according to Iacobellis G et al.33 We discovered that 87.9% of patients with HTN stage I had an EAT (RVFT) value of 3-12 mm and 12.1% had a value greater than 12 mm. In patients with stage II HTN, the EAT value ranged from 3 to 12 mm, and the difference was statistically significant. Many recent

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investigations have indicated that EAT thickness is related with HT, and that this association is more prominent, particularly in HT patients with LVH.34,35
LVH is a strong independent predictor of cardiovascular morbidity and mortality in hypertensive patients. In present study, out of patients with LVH present, 94% had 3-12 mm and 6% had >12 mm. But according to Iacobellis G et al., high left ventricular mass detected in the echocardiography has been associated with increased EAT thickness. According to Eroğlu S et al.64, EAT thickness could be increased in hypertension as an adaptation to incremental needs of the hypertrophied LV.

Pearson correlation coefficient between EAT (RVFT) and LVMI was significant.

In the current study, 96.2% of individuals with normal blood albumin levels (3.5-5.5 mg/dl) had normal epicardial adipose tissue thickness, whereas only 3.8% had > 12 mm thickness. 22.7% of individuals with blood albumin levels less than 3.5 mg/dl had EAT thickness more than 12 mm. As a result, serum albumin levels may be linked to increasing epicardial adipose tissue thickness. The mean LVMI value in patients with EAT values 3-12 mm was 122.9177±33.46015 and 142.3975±130.35589 in patients with EAT values >12 mm, although the difference was not statistically significant. In our study, the mean BMI values in both groups were similar, and there was no significant link between EAT thickness and BMI. In our study, there were no significant relationships between EAT thickness and blood pressure or lipid profiles.
The first drawback of our study is that we only had a limited number of participants. Our study has the restriction that there was only one urine sample utilized to measure the UACR. This is the second drawback of our investigation. It would have been easier to reproduce the results if you had used the average UACR from all three urine samples. In addition, we did not do ambulatory blood pressure measurement in this trial; as a result, we were unable to entirely rule out the potential that any of the patients in the study had what is known as "white-coat hypertension."

6. CONCLUSION

From this study it can be concluded that epicardial adipose tissue thickness and albuminuria was significantly associated with Hypertension. The relation of UACR levels with left ventricular hypertrophy and LVMI was found statistically significant. Similarly, the relation of epicardial adipose tissue thickness and serum albumin levels were significantly associated. In conclusion, we think that adipose tissue thickness measurements are the simple, effective and feasible method to predict target organ damage, especially in patients with LVH, and maybe a useful tool to monitor the follow-up of hypertensive patients. We recommend performing a detailed renal evaluation to predict the development of kidney damage in every hypertensive patient with more epicardial adipose tissue thickness and left ventricular hypertrophy.

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