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Original Research Article

An Observational Study of Correlation of Microalbuminuria with Target Organ Damage in Essential Hypertension

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Abstract:

Background: Hypertension is one of the most prevalent chronic conditions worldwide and a major contributor. It is a major modifiable risk factor for cardiovascular disease, stroke, heart failure, and renal impairment. The complications of hypertension are not confined to the cardiovascular system; target organ damage in the kidneys is of equal concern and is often silent until advanced stages. Microalbuminuria, defined as a urinary albumin excretion of 30–300 mg/24 hours, has been increasingly recognized as a sensitive and early indicator of renal involvement in hypertension. From a clinical perspective, detecting microalbuminuria provides an opportunity for early intervention**.**

Methodology: This is study was conducted in the Department of General Medicine. 100 patients who match the inclusion and exclusion criteria have been selected by random sampling method and included in the study. Patients who were diagnosed with essential hypertension (already known or newly diagnosed) were selected from outpatient clinic and wards of tertiary care teaching hospital after applying inclusion and exclusion criteria.

Results: Prevalence of microalbuminuria in this study was 33%. Distribution of microalbuminuria in different sex 35.2% males and 30.43% females had microalbuminuria. 54 patients were males and 46 patients were females out of 100 hypertensives. Microalbuminuria was present in 32.3% of non-smokers and 34.2% of smokers. 65 patients out of 100 were non-smokers and 35 patients were smokers. Out of 33 patients with microalbuminuria, 1 patient had normal fundus. 8 patients had grade 1 hypertensive retinopathy, 19 had grade 2 hypertensive retinopathy, 5 patients had grade 3 hypertensive retinopathy. This is statistically significant ($p<0.00001$). 22 people out of 35 patients with LVH on ECG had microalbuminuria. This is statistically significant ($p<0.00001$). 10 out of 56 patients with normal cardia on echocardiography had microalbuminuria and 23 out of 44 patients with LVH/cardiac dysfunction had microalbuminuria. This value is statistically significant.

Conclusion: Microalbuminuria was detected in 33% of patients with essential hypertension, indicating its role as an early marker of target organ damage. A strong and statistically significant association was found between microalbuminuria and hypertensive retinopathy (fundus changes), left ventricular hypertrophy (LVH), and cardiac dysfunction on 2D-ECHO, highlighting its correlation with cardiovascular morbidity.

Keywords: Microalbuminuria; Hypertension; Cardiac Dysfunction.

Introduction

Hypertension is one of the most prevalent chronic conditions worldwide and a major contributor to morbidity and mortality. Hypertension is one of the most important public health challenges globally, affecting nearly one third of the adult population. [1] It is a major modifiable risk factor for cardiovascular disease, stroke, heart failure, and renal impairment. The majority of patients are diagnosed with essential hypertension, a form without a clearly identifiable secondary cause, which contributes significantly to morbidity and mortality worldwide. [2] The complications of hypertension are not confined to the cardiovascular system; target organ damage in the kidneys is of equal concern and is often silent until advanced stages. Early markers that reflect renal injury and systemic vascular damage are therefore of critical value in the management of hypertensive patients. [3] Microalbuminuria, defined as a urinary albumin excretion of 30–300 mg/24 hours, has been increasingly recognized as a sensitive and early indicator of renal involvement in hypertension. Unlike overt proteinuria, which signifies established kidney disease, microalbuminuria appears at an earlier stage and often precedes clinically apparent renal dysfunction. [4] Its importance extends beyond the kidney, as numerous studies have shown that microalbuminuria is a marker of endothelial dysfunction and general-

ized vascular injury. The presence of microalbuminuria in hypertensive individuals has been linked to increased risk of cardiovascular morbidity, progression to end-stage renal disease, and overall mortality. [5]

The pathophysiological basis of microalbuminuria in essential hypertension is multifactorial. Hemodynamic stress due to elevated blood pressure leads to glomerular hyperfiltration and increased permeability of the glomerular basement membrane. [6] Additionally, structural and functional changes in the vascular endothelium contribute to the leakage of albumin into the urine. Coexisting metabolic abnormalities such as insulin resistance, obesity, and dyslipidemia further exacerbate the process. [7] This makes microalbuminuria not only a renal marker but also a reflection of systemic metabolic and vascular health. [8]

From a clinical perspective, detecting microalbuminuria provides an opportunity for early intervention. Antihypertensive agents, particularly those targeting the renin–angiotensin–aldosterone system (RAAS), have been shown to reduce albuminuria and improve long-term renal and cardiovascular outcomes. [9]

Thus, routine screening for microalbuminuria in hypertensive patients is increasingly advocated as part of comprehensive risk assessment. [10] Despite its recognized importance, the prevalence of microalbuminuria varies across different populations, influenced by factors such as genetic background, duration and severity of hypertension, control of blood pressure, and coexisting comorbidities like diabetes mellitus. [11]

In India and other developing countries, where the burden of hypertension is rapidly rising, studies investigating microalbuminuria are particularly relevant. Early identification of individuals at risk can help reduce the long-term consequences of uncontrolled hypertension in resource-limited settings. However, data on the prevalence and clinical correlates of microalbuminuria in essential hypertension remain limited and sometimes inconsistent. [12] The present study seeks to address this gap by evaluating the prevalence of microalbuminuria in patients with essential hypertension and examine its relationship with target organ involvement. By doing so, we aim to highlight the role of microalbuminuria as a prognostic marker and to emphasize the need for its routine assessment in the management of hypertensive individuals.

Objectives

1. To study the presence of microalbuminuria in subjects with essential hypertension

2. To assess the target organ involvement and it's correlation with microalbuminuria

Materials and Methods

This study was conducted in the Department of General Medicine. 100 patients who match the inclusion and exclusion criteria have been selected by random sampling method and included in the study. Data was collected using the pretested proforma. Patients who were diagnosed with essential hypertension (already known or newly diagnosed), selected from outpatient clinic and wards of tertiary care teaching hospital after applying inclusion and exclusion criteria.

Inclusion Criteria

1. Adults aged more than 40 years attending medical OPD and wards of tertiary care teaching hospital, diagnosed to have essential hypertension.
2. Patients diagnosed with essential hypertension and already on antihypertensive drugs.
3. As per JNC VII criteria, BP above 140/90mmHg is regarded as hypertension.

Exclusion Criteria

1. Proven cases of secondary hypertension
2. Diabetes Mellitus
3. Urinary tract infection
4. Established cases of kidney diseases
5. Macroproteinuria
6. Congestive cardiac failure
7. Pregnancy
8. Acute febrile illness

Method of Collection

1. For patients already diagnosed with hypertension and on antihypertensive treatment, diagnosis of hypertension was verified with previous records.
2. For newly detected hypertensives, diagnosis of hypertension was made based on BP recorded in the right arm by mercury sphygmomanometer. For each patient two readings were recorded. BP was measured with patient's back supported and relaxed for five minutes and right arm was kept at the heart level.

Fundoscopy: Based on fundoscopy findings by direct ophthalmoscope (visualised after dilating pupils with 1% Tropicamide eye drops) according to Keith Wagner classification

Following Investigations were done in all patients:

- RBS, FBS, PPBS, HBA1C
- RFT, Fasting lipid profile
- Urine routine and microscopy
- Electrocardiogram- to look for LVH
- 2 D ECHO- to look for LVH, systolic and diastolic dysfunction
- Chest X-ray- for cardiomegaly
- Ultrasound abdomen- to look for renal system abnormalities

- NCCT Brain- when indicated in stroke patient's other investigations when indicated.

Test for microalbuminuria

- Patients were told to avoid exercise prior to collection of urine sample.
- 5ml of early morning sample of first void midstream urine was collected.
- The urine samples were tested for microalbuminuria by immunoturbidimetric method.
- Principle- Turbidimetry measures the reduction in light transmission caused by particle formation, and it quantifies the residual light transmitted.
- Method- TURBILYTE-MA kit by Coral clinical systems, Goa was used to perform the test on semi-auto analyser. This is based on the principle of agglutination reaction. The test specimen is mixed with the activation buffer and the antihuman antibody solution and allowed to react. Presence of albumin in the test specimen forms an insoluble complex producing a turbidity, which is measured at wavelength 340nm. The resulting turbidity corresponds to the concentration of the albumin in the test specimen.
- Urine albumin values between 20mg/l and 300mg/l were considered as micro- albuminuria.

Statistical Method: Relationship between microalbuminuria and other variables was studied using Chi-square test. P value was calculated for all the relevant variables.

Results

Table 1: Sex distribution

Sex	Number of patients	Microalbuminuria	Percentage
Male	54	19	35.2
Female	46	14	30.43
Total	100	33	

In table 1, Distribution of microalbuminuria in different sex 35.2% males and 30.43% females had microalbuminuria. 54 patients were males and 46 patients were females out of 100 hypertensives.

Table 2: Age distribution

Age in years	Number of patients	Microalbuminuria	Percentage
40-49	34	6	17.65
50-59	20	8	40
60-69	28	10	35.8
70-79	16	7	43.8
≥80	2	2	100
Total	100	33	

In table 2, among 100 patients studied, 34% patients belonged to 40-49 years age group, 20% to 50-59 years group, 28% between 60-69 years, 16% between 70-79 years and 2% were 80years and above. Microalbuminuria was present in 17.65% of patients in 40-49 years age group, 40% in 50-59 years age group, 35.8% in 60-69 years age group, 43.8% in 70-79 years age group and 100% in 80 years and above age group.

Table 3: Smokers

Smoking	Number of patients	Microalbuminuria	Percentage
No	65	21	32.3
Yes	35	12	34.2
Total	100	33	

In table 3, Microalbuminuria was present in 32.3% of non-smokers and 34.2% of smokers. 65 patients out of 100 were non-smokers and 35 patients were smokers.

Table 4: Alcoholics

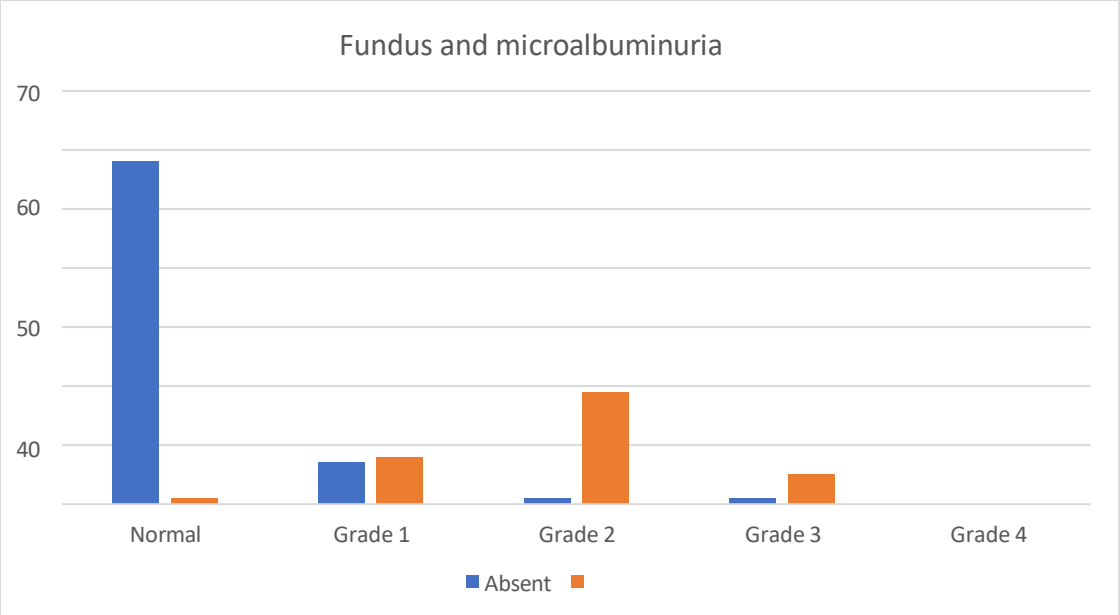
Alcohol	Number of patients	Microalbuminuria	Percentage
No	84	28	33.33
Yes	16	5	31.3
Total	100	33	

In table 4, Out of 100 hypertensives, 84 had no history of alcohol intake while 16 had history of alcohol intake. 33.33% of non-alcoholics had microalbuminuria and 31.3% of alcoholics had microalbuminuria.

Table 5: Fundus changes and microalbuminuria

Fundus	Microalbuminuria		Total
	Absent	Present	
Normal	58	1	59
Grade 1	7	8	15
Grade 2	1	19	20
Grade 3	1	5	6
Total	67	33	100

In table 5, Out of 33 patients with microalbuminuria, 1 patient had normal fundus. 8 patients had grade 1 hypertensive retinopathy, 19 had grade 2 hypertensive retinopathy, 5 patients had grade 3 hypertensive retinopathy. This is statistically significant (Chi square- 70.6028, P= <0.00001). 59 patients had normal fundus on examination, 15 patients had Grade 1, 20 had Grade 2 and 6 had Grade 3 hypertensive retinopathy respectively.



Graph 1: Fundus and microalbuminuria

Table 6: Lipid profile and microalbuminuria

Lipid profile	Microalbuminuria		Total
	Absent	Present	
Normal	29	9	38
Abnormal	38	24	62
Total	67	33	100

Chi square= 2.4057, P= 0.120894

In table 62 patients had abnormal lipid profile. Out of which 24 had microalbuminuria. While 9 out of 38 patients with normal lipid profile had microalbuminuria. This is not statistically significant.38 patients had normal lipid profile and 62 patients had abnormal lipid profile.

Table 7: LVH and microalbuminuria

LVH	Microalbuminuria		Total
	Absent	Present	
No	54	11	65
Yes	13	22	35
Total	67	33	100

Chi square=21.71, P= <0.00001

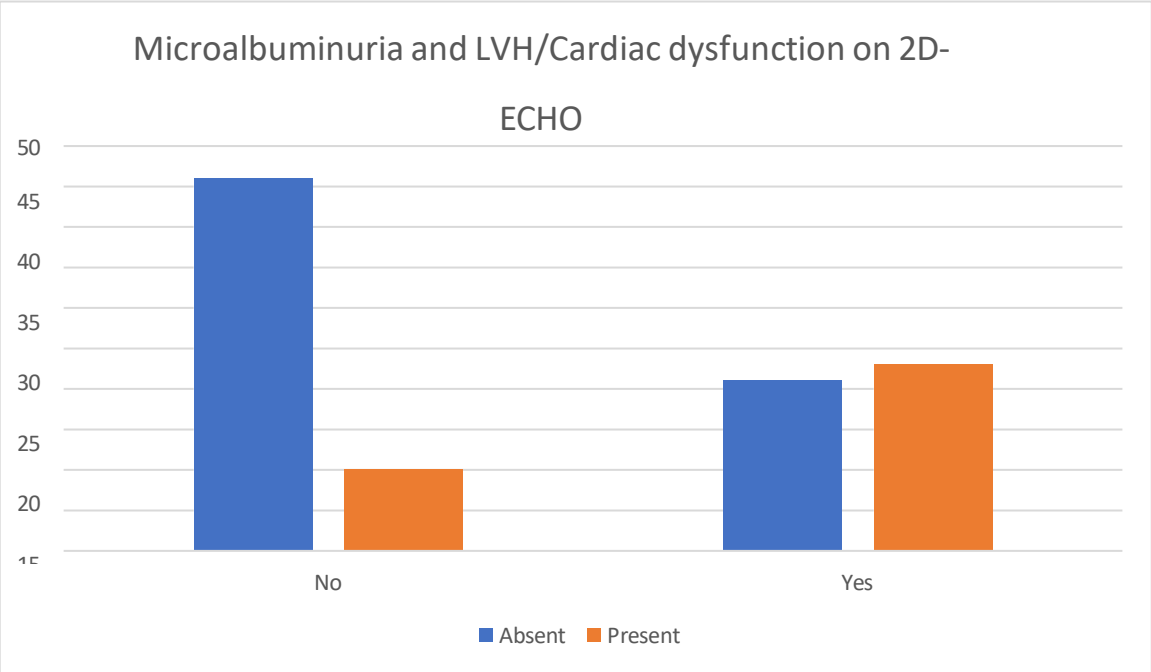
In table 7, 22 people out of 35 patients with LVH had microalbuminuria. This is statistically significant. 65 patients had no LVH while 35 patients had LVH.

Table 8: Microalbuminuria and LVH/cardiac dysfunction on 2D-ECHO

LVH/Cardiac dysfunction	Microalbuminuria		Total
	Absent	Present	
No	46	10	56
Yes	21	23	44
Total	67	33	100

Chi Square= 13.1996, P= 0.00028.

In table 8, 10 out of 56 patients with normal cardia have microalbuminuria and 23 out of 44 patients with LVH/cardiac dysfunction had microalbuminuria. This value is statistically significant. 44 out of 100 patients had LVH/Cardiac dysfunction on 2D-ECHO.



Graph 2: Microalbuminuria and LVH/Cardiac dysfunction on 2D-ECHO

Discussion

In this study, 35.2% males and 30.43% females had microalbuminuria. In a study by Bibek Paudel et al published in 2012, 46.7% male hypertensives and 58.7% female hypertensives were detected with microalbumin in urine. [13] In a study by Sabharwal et al, microalbuminuria in male and female hypertensives was 34% and 30.7% respectively [14] which is very much similar to the current study. Gopalraju Manickam Marudhaiveeran et al in their study found prevalence to be 55% in males and 45% in females. [15] In the MAGIC study on the prevalence and clinical correlates of microalbuminuria, Pontremoli et al observed that microalbuminuria was more common in males. [16]

In the current study, 32.3% non-smokers and 33.3% non-alcoholics had micro- albuminuria. While 34.2% smokers and 31.3% alcoholics had microalbuminuria. Sabharwal et al found that 20% non-smokers and non-alcoholics had microalbuminuria and 42% smokers and 35% alcoholics had microalbuminuria. [17] This study also looked into the relation between microalbuminuria and other risk factors for cardiovascular disease like unfavourable lipid profile. Out of 62 patients with abnormal lipid profile, 38 had no microalbuminuria and 24 had microalbuminuria [P= 0.12]. This is similar to study by Gopalraju Manickam Marudhaiveeran et al where microalbuminuria was found to have no relation with unfavorable lipid profile[p= 0.05]. [15] Similar to study by Bibek Poudel et al Miccroalbuminuria with Total Cholesterol [P=0.178] and Triglycerides [0.519]. This is not in agreement with previous studies. Bianchi et al in 1997 had observed that hypertensive patients with microalbuminuria manifest increased serum LDL level and greater LDL/HDL ratio when compared with patients without microalbuminuria and normotensives. [18] The present study showed a significant correlation between microalbuminuria and the presence and severity of retinopathy. ($p < 0.00001$). Beisen et al in 1997 has observed an increased prevalence of hypertensive retinopathy in a group with persistent microalbuminuria despite adequate treatment. ($P < 0.03$)21. In 2002 Cerasola

et al has observed a greater prevalence of retinopathy among those patients with micro albuminuria. [19] Kumar H et al and Hitha B et al also observed significant correlation between microalbuminuria and grades of retinopathy [P=0.002 and P <0.001] respectively. [20]

It was observed in this study that LVH was present more in subjects with microalbuminuria [P= <0.00001]. LVH was detected either by ECG, chest X-ray or 2D- ECHO. Tsioufis et al in their study in 2002 observed that 21% of the 249 had LVH. [21]

This aspect has been studied by W. Kristian et al in 2002 in LIFE study observed a higher prevalence of microalbuminuria 30% vs 9% in patients with concentric hypertrophy on ECHO (P < 0.0001). [22] Pontremoli et al in a study conducted in 279 patients in 2002 has observed that patients with microalbuminuria were 21 times more likely to have LVH (P < 0.01). Similary, in study by Gopalraju Manickam Marudhaiveeran et al [P=<0.005].

Patients with microalbuminuria also had more prevalence of LVH and cardiac dysfunction on 2D-ECHO [P=0.0028]. The association between microalbuminuria and LV geometry may be due to hemodynamic or non- hemodynamic reasons. It is suggested that increased levels of ANP secreted from hypertrophic ventricles can directly cause microalbuminuria. The fact that subjects with heart failure and elevated ANP levels exhibit microalbuminuria gives further support to this view. [23] One patient had previous history of stroke and another patient presented with CVA.

The data from this study support the positive correlation between Microalbuminuria and target organ damage.

Conclusion

Microalbuminuria was detected in 33% of patients with essential hypertension, indicating its role as an early marker of target organ damage. The prevalence of microalbuminuria increased with advancing age, reaching the highest levels in patients ≥80 years.

No significant differences were observed between sexes, smokers, and alcoholics. A strong and statistically significant association was found between microalbuminuria and hypertensive retinopathy (fundus changes), left ventricular hypertrophy (LVH), and cardiac dysfunction on 2D-ECHO, highlighting its correlation with cardiovascular morbidity.

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