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Original Research Article

PREVALENCE AND CLINICAL CORRELATES OF MICROALBUMINURIA IN HYPERTENSIVE PATIENTS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Hypertension is a major risk factor for kidney damage, and microalbuminuria (MA) is considered an early marker of renal involvement in hypertensive individuals. This study aimed to investigate the prevalence of MA among patients with primary hypertension and explore its associations with demographic and clinical variables, including treatment adherence, lipid profiles, and target organ damage.

Material and Methods: This cross-sectional cohort study was conducted over one year, from November 2023 October 2024, involving 100 patients with primary hypertension attending a Hypertension Clinic. Participants underwent a thorough clinical evaluation, including blood pressure measurement, lipid profiling, optic fundus examination, electrocardiography, and assessment of microalbuminuria using turbidimetric immunoassay. Data were analyzed using SPSS software, and correlations between MA and various risk factors were determined using chi-square tests and multivariate regression analyses.

Results: The study found that 35% of hypertensive patients had microalbuminuria. The condition was more prevalent in individuals aged 41-60 years and those with hypertension of over 10 years' duration. Irregular treatment adherence was strongly associated with a higher prevalence of MA (57.14%). Additionally, elevated total cholesterol and low HDL cholesterol were significantly linked to MA, with 46.88% of patients with high cholesterol levels showing microalbuminuria. MA was also significantly associated with target organ damage, particularly left ventricular hypertrophy, retinopathy, and stroke.

Conclusion: Microalbuminuria is prevalent in hypertensive patients and is associated with age, duration of hypertension, treatment adherence, lipid abnormalities, and target organ damage. These findings underscore the importance of early detection and consistent management of hypertension to prevent renal and cardiovascular complications. Regular monitoring for microalbuminuria in hypertensive patients may help identify those at risk for more severe complications.

Key Words: Hypertension, Microalbuminuria, Target organ damage, Lipid profile, Kidney function, Treatment adherence.

INTRODUCTION

Microalbuminuria, defined as the urinary excretion of albumin ranging between 30 to 300 mg/day, serves as an early and sensitive marker of endothelial dysfunction and systemic vascular injury. This phenomenon is increasingly recognized in patients with primary hypertension, a condition characterized by persistently elevated arterial blood pressure without a secondary identifiable cause. Evidence suggests that microalbuminuria not only reflects glomerular hyper-filtration but also indicates widespread vascular compromise, which may predispose individuals to accelerated target organ damage (TOD) in the heart, kidneys, and brain.[1,2]

Despite being subclinical, microalbuminuria correlates strongly with adverse cardiovascular outcomes, chronic kidney disease (CKD) progression, and cerebrovascular events, underscoring its importance in the stratification of hypertensive patients.[3,4]

The pathophysiological mechanisms linking microalbuminuria to TOD in primary hypertension are multifactorial. Endothelial dysfunction, oxidative stress, and low-grade inflammation have been implicated as key contributors. Additionally, impaired renal autoregulation due to sustained hypertension exacerbates glomerular permeability, leading to albuminuria. This renal leakage mirrors systemic vascular injury and heralds TOD, including left ventricular hypertrophy (LVH), hypertensive nephropathy, and micro-vascular cerebral damage.[5,6] Importantly, microalbuminuria's predictive value transcends its renal origin, serving as a surrogate marker for diffuse vascular injury and atherosclerosis.[7]

Given its clinical significance, the detection of microalbuminuria has garnered attention as an integral component of hypertensive patient evaluation. The advent of standardized, high-sensitivity assays has facilitated early detection, enabling timely therapeutic interventions. Management strategies targeting blood pressure reduction, renin-angiotensin-aldosterone system (RAAS) inhibition, and glycemic control have demonstrated efficacy in mitigating microalbuminuria and delaying TOD.[8,9] Furthermore, emerging evidence highlights the utility of microalbuminuria as a dynamic marker for monitoring therapeutic response and long-term prognosis in hypertensive populations.[10]

Thus, microalbuminuria represents a pivotal biomarker in the continuum of hypertensive disease. Its association with endothelial dysfunction and systemic vascular injury provides critical insights into the pathogenesis and progression of TOD. Incorporating microalbuminuria assessment into routine clinical practice may augment risk stratification and improve outcomes for patients with primary hypertension.

MATERIALS AND METHODS

This cross-sectional cohort study was conducted over a period of one year, from November 2023, to October 2024 at Department of General Medicine, NRI Medical College & General Hospital. The study included 100 participants, comprising of patients with primary hypertension who attended the Hypertension Clinic and those admitted to the medical wards with hypertension-related complications. Ethical clearance was obtained prior to the study's initiation, and written informed consent was secured from all participants. Patients aged between 18–70 years with primary hypertension, defined according to the JNC VII guidelines as a blood pressure ≥140/90 mmHg, were included. The exclusion criteria encompassed patients with secondary hypertension, diabetes mellitus, established kidney diseases, urinary tract infections, macroproteinuria, pregnancy, congestive cardiac failure, acute febrile illnesses, recent strenuous exercise, and a history of NSAID intake.

The study group consisted of 100 patients with primary hypertension. Detailed history-taking and physical examinations were conducted for all participants, with specific focus on neurological, cardiovascular, and fundoscopic evaluations. Blood pressure was measured using a standardized, calibrated sphygmomanometer, adhering to the JNC VII guidelines. Optic fundus examinations were performed using a direct ophthalmoscope to assess hypertensive retinopathy. Routine hematological and biochemical investigations were conducted, alongside specific tests such as fasting lipid profile, which was analyzed following a 12-hour fasting period per ATP-3 guidelines of the National Cholesterol Education Program. Electrocardiography was performed to assess left ventricular hypertrophy using the Sokolow-Lyon index, and chest radiography was utilized to evaluate the cardiothoracic ratio. For patients presenting with stroke, brain computed tomography confirmed middle cerebral artery (MCA) territory infarctions. Microalbuminuria was assessed using a turbidimetric immunoassay on randomly voided urine samples, with testing in women conducted during the non-menstrual phase. The FIMEMOO25 kit (Erba Mannheim) was used, with values between 25–400 mg/L considered positive. Data analysis was performed using SPSS software, employing descriptive statistics, chi-square tests, and multivariate regression analyses to explore the correlation between microalbuminuria and target organ damage, with statistical significance set at $p < 0.05$.

RESULTS

The present study aimed to investigate the prevalence and associations of microalbuminuria (MA) among hypertensive patients, revealing notable patterns across various demographic and clinical variables. A total of 35% of the cohort exhibited microalbuminuria, with the condition showing a marked increase with advancing age. Specifically, 39.1% of patients aged 41-50 and 41.93% of those between 51-60 years had MA, indicating a progressive relationship between age and the risk of microalbuminuria. The highest prevalence (58.33%) was observed in individuals with hypertension of over 10 years' duration, highlighting the increasing risk of kidney damage with longer exposure to elevated blood pressure. Notably, poor treatment adherence was strongly associated with MA, as 57.14% of patients with irregular treatment regimens exhibited

microalbuminuria, compared to only 15.4% in those with regular treatment. These findings emphasize the critical role of consistent management in mitigating complications such as renal involvement.

Lipid profile also emerged as a significant factor. Higher total cholesterol levels (≥240 mg/dL) were associated with an increased prevalence of MA (46.88%), supporting the established link between dyslipidemia and kidney damage in hypertensive individuals. In contrast, the association between triglycerides and MA was less pronounced (P = 0.102). Furthermore, lower HDL cholesterol levels (<40 mg/dL) were strongly correlated with MA, with 48.38% of patients in this category showing evidence of microalbuminuria, underscoring the potential protective effect of higher HDL levels against kidney injury. [Table 1]

Target organ damage was a major determinant of microalbuminuria. Left ventricular hypertrophy (LVH), retinopathy, and stroke all showed significant associations with MA, with odds ratios of 9.1, 6.7, and undefined, respectively. These findings suggest that MA could serve as an early marker for systemic complications in hypertensive patients. The high prevalence of MA among those with stroke (100%) further reinforces the need for comprehensive monitoring of renal function in hypertensive individuals with target organ damage. [Table 2]

Table 1: Baseline characteristics

Characteristic		No. of individuals (n = 100)	No. of individuals with microalbuminuria (n = 35)	P value
Age (in years)	< 40	12%	2 (16.67%)	0.007
	41-50	23%	9 (39.1%)	
	51-60	31%	13 (41.93%)	
	> 60	34%	12 (35.29%)	
Gender	Males	64 %	22 (34.37%)	0.0615
	Females	36%	13(36.11%)	
Duration of hypertension	New (<1 year)	20%	4 (20%)	< 0.0001
	1-5 years	40%	13 (32.5)	
	6-10 years	28%	11 (39.28%)	
	>10 years	12%	7 (58.33%)	
Stage of hypertension	Stage 1 (Systolic < 140 mmHg)	40%	10 (25%)	0.021
	Stage 2 (Systolic ≥ 140 mmHg)	60%	25 (41.7%)	
Treatment adherence	Regular	65	10 (15.4%)	<0.0001
	Irregular	35	20 (57.14%)	

Table 2: correlation between lipid profile and microalbuminuria

Lipid profile				P value
Total cholesterol	< 240 mg/dL	68	20 (29.411%)	0.019
	≥ 240 mg/dL	32	15 (46.875%)	
Triglycerides	< 200 mg/dL	85	30 (35.29%)	0.102
	≥ 200 mg/dL	15	5 (33.3%)	
HDL cholesterol	< 40 mg/dL	31	15 (48.38%)	0.008
	≥ 40 mg/dL	69	20 (28.98%)	

Table 3: Correlation between target organ damage and microalbuminuria

Target Organ Damage	No. of Patients (N)	No. with MA (n)	P Value	OR (95% CI)
LVH	39	25 (64%)	< 0.001	9.1 (4.2-19.1)
Retinopathy	25	17 (68%)	< 0.001	6.7 (3.0-15.0)
Stroke	5	5 (100%)	<0.001	-
No target organ damage	31	0	-	-

DISCUSSION

This study was undertaken to investigate the prevalence and clinical correlates of microalbuminuria (MA) in patients with primary hypertension, focusing on its associations with age, duration of hypertension, lipid profile, treatment adherence, and target organ damage. Microalbuminuria is an early marker of kidney damage, and its detection in hypertensive patients may provide valuable insights into the risk of developing chronic kidney disease and other systemic complications. Given the high prevalence of hypertension and its associated morbidity, identifying factors that predict kidney involvement is crucial for improving patient outcomes.

The present findings are consistent with those of previous studies, which have demonstrated a higher prevalence of microalbuminuria among older patients with a longer duration of hypertension. For instance, studies by Niafar et al,[11] and Singh et al,[12] found that microalbuminuria prevalence increases with age, with those over 50 years of age being at greater risk. Our study also observed a higher prevalence (58.33%) of MA in patients with more than 10 years of hypertension, which correlates with the results of a study by Sharma et al,[13] who similarly noted that long-term

hypertension significantly increases the likelihood of renal involvement.

Additionally, the association between poor treatment adherence and microalbuminuria is corroborated by findings in the literature, including those by Tanaka et al,[14] who demonstrated that irregular antihypertensive therapy leads to poorer renal outcomes. The high prevalence of MA among individuals with irregular treatment (57.14%) in our study is consistent with the notion that non-adherence accelerates kidney damage in hypertensive patients.

The correlation between lipid profile and microalbuminuria also aligns with existing research. Higher total cholesterol and lower HDL cholesterol levels were strongly associated with the presence of MA in our cohort, supporting findings by Zhang et al,[15] and Sadeghi et al,[16] who reported that dyslipidemia is a significant risk factor for kidney damage in hypertensive individuals. In contrast, triglycerides did not show a significant relationship with MA in our study, which is consistent with some reports in the literature, such as that by Miller et al,[17] who also found the triglyceride-MA association to be weak.

Finally, the significant associations between target organ damage and microalbuminuria in our study further highlight the utility of MA as a marker for systemic complications, particularly in patients with left ventricular hypertrophy, retinopathy, and stroke. These findings are consistent with those of Al-Mutairi et al,[18] and Yano et al,[19] who emphasized the predictive role of microalbuminuria for target organ damage in hypertensive patients.

CONCLUSION

In this study, 35% of hypertensive patients exhibited microalbuminuria (MA), with a higher prevalence associated with advancing age, longer duration of hypertension, and poor treatment adherence. The findings highlight the critical role of regular antihypertensive treatment in preventing kidney damage. Additionally, elevated cholesterol and low HDL levels were strongly linked to MA, underlining the importance of managing lipid profiles in hypertensive individuals. Target organ damage, such as left ventricular hypertrophy, retinopathy, and stroke, was significantly associated with MA, suggesting that MA could serve as an early marker for systemic complications in hypertensive patients.

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Conflicts of Interest: The authors declare no conflicts of interest related to this study.

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