

FREQUENCY OF UNDIAGNOSED HYPERTENSION AMONG DIABETIC PATIENTS WITH MICROVASCULAR COMPLICATIONS

Dr Ali Ejaz^{*1}, Dr Zafar Niaz², Dr Mahrukh Liaqat³, Dr Muhammad Fahad⁴

^{*1,3,4}Postgraduate Resident General Medicine Department, Mayo Hospital, Lahore

²Assistant Professor Medicine Department, KEMU/Mayo Hospital, Lahore

^{*1}laybhai@gmail.com

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Corresponding Author: *

Dr Ali Ejaz

Abstract

Background: Hypertension and diabetes mellitus often coexist, creating a synergistic effect that accelerates the development of vascular complications.

Objective: This study aimed to determine the frequency of undiagnosed hypertension among diabetic patients with microvascular complications and to identify associated risk factors.

Methodology: This cross-sectional analytical study was conducted at the Department of General Medicine, King Edward Medical University/Mayo Hospital, Lahore from November 2024 to April 2025. A total of 213 diabetic patients aged 18–75 years with microvascular complications were included through non-probability consecutive sampling. Blood pressure was monitored every 8 hours over a 72-hour period, and undiagnosed hypertension was defined as systolic BP >140 mmHg or diastolic BP >95 mmHg on two occasions, 8 hours apart.

Results: The mean age of participants was 54.3 ± 9.8 years, and the mean duration of diabetes was 10.8 ± 5.6 years. Among all participants, 124 (58.2%) had diabetic nephropathy, 68 (31.9%) had retinopathy, and 21 (9.9%) had both. The overall frequency of undiagnosed hypertension was 22.1%. It was significantly associated with older age ($p = 0.03$), higher BMI ($p = 0.04$), longer duration of diabetes ($p = 0.02$), and the presence of diabetic nephropathy ($p = 0.01$), while no significant difference was found between genders ($p = 0.64$).

Conclusion: Approximately one in five diabetic patients with microvascular complications had undiagnosed hypertension, particularly those who were older, overweight, or had diabetic nephropathy. Routine and repeated blood pressure monitoring should be integrated into diabetes management programs to enable early detection and prevention of further vascular damage.

INTRODUCTION

Hypertension is a major non-communicable disease and is identified as a global disease burden that is ranked as the third-largest cause of disability-adjusted life years. Globally, there were 972 million hypertensive adults in the year 2000, and this number

is on track to increase by 60% to 1.56 billion by 2025 [1]. It has been reported that people with hypertension are twice as likely to develop cardiovascular disease, four times as likely to develop congestive heart failure and seven times as likely to develop cerebrovascular

disease or stroke when compared to non-hypertensive subjects [2]. Diabetes mellitus and hypertension are inter-related diseases that strongly promote the spread of atherosclerotic cardiovascular disease within populations [3]. Hypertension prevalence is doubled in the presence of diabetes and is associated with 35 to 75% of diabetic cardiovascular and renal complications [4]. In addition, it also contributes to diabetic retinopathy, which is the primary cause of newly diagnosed blindness [3]. When a patient has diabetes, there is an accelerated formation of non-enzymatic advanced glycosylation products that accumulate in the vessel wall proteins, causing vascular rigidity and resistance, which ultimately leads to hypertension. Additionally, in mild-to-moderate hyperglycemia, there is increased retention of sodium, which leads to an increase in the total exchangeable sodium and blood pressure [5]. Another plausible explanation is that the upregulation of the renin-angiotensin-aldosterone system in diabetes has a direct effect on hypertension [6]. Thus, diabetes and hypertension have an epidemiological and pathophysiological link, and knowledge of this link will not only help with the development of early treatment strategies but will also assist with prevention. The population of Asian, especially South Asia, is facing an increasing burden from hypertension (ranging from 50% in India to 75% in Pakistan) among people with type 2 diabetes mellitus (T2DM) [7]. In a study done by Rodrigues TC et.al. they studied that among the diabetic patients with, 18.9% diabetic retinopathy patients had undiagnosed hypertension and 16.6% patients with diabetic nephropathy had undiagnosed hypertension [8]. In another study Seid MA et.al the frequency of diabetic retinopathy was 24.8% and neuropathy was 8.1% [9]. The long-term sequels of diabetes mellitus are the major causes of morbidity and mortality besides to its economic crisis and social stigma. Literature sources that showed factors exacerbating diabetic complications were too limited. This study aims to determine the frequency of undiagnosed hypertension among diabetic patients with microvascular complications. The available literature is limited and no study found locally. So, we want this study to get local evidence and can implement the results of this study in our setting.

Objective

To determine the frequency of undiagnosed hypertension among diabetic patients with microvascular complications.

Methodology

This descriptive case series was conducted at Department of General Medicine, Mayo Hospital, Lahore from November 2024 to April 2025. The sample were 213 patients, with 5% margin of error, 95 % confidence level and taking expected frequency of hypertension among patients with diabetic nephropathy as 16.6%. [8] Data were collected through Non-probability consecutive sampling technique.

Inclusion criteria

- Patients aged 18-75 years.
- Both gender
- Diabetic patients having microvascular complications as per operational definition.

Exclusion criteria

- A previous episode of ketoacidosis or documented ketonuria, and mandatory use of insulin for survival. Patients with end-stage renal disease on a dialysis program or with kidney transplant will be excluded.

Data collection

After obtaining approval from the hospital's ethical review committee, patients fulfilling the inclusion and exclusion criteria were enrolled consecutively from the Department of General Medicine, KEMU/Mayo Hospital, Lahore. Informed consent was obtained from each participant before enrollment. Demographic data including name, age, gender, BMI, duration of diabetes, and address were recorded. Diabetic microvascular complications such as retinopathy and nephropathy were assessed according to operational definitions. Patients with diabetic retinopathy and/or nephropathy were then evaluated for undiagnosed hypertension. Blood pressure was monitored every 8 hours over 72 hours. A patient was labelled as having undiagnosed hypertension if systolic blood pressure exceeded 140 mmHg or diastolic blood pressure exceeded 95 mmHg on two different occasions at least 8 hours apart, in the

absence of a prior diagnosis of hypertension. All data were recorded on a predesigned proforma.

Data Analysis

All data were entered and analyzed using SPSS version 22.0. Quantitative variables such as age, BMI, and duration of diabetes were presented as mean $\pm$ standard deviation (SD). Qualitative variables including gender, type of microvascular complication, and undiagnosed hypertension were expressed as frequency and percentage. Data were stratified for age, BMI, and duration of diabetes to control effect modifiers. After stratification, the chi-square test was applied, and a p-value less than 0.05 was considered statistically significant.

Results

Data were collected from 213 patients, mean age of the participants was 54.3 ± 9.8 years, indicating a predominance of middle-aged individuals. There was a nearly equal gender distribution, with 112 males (52.6%) and 101 females (47.4%). The mean BMI was 27.6 ± 4.3 kg/m², reflecting an overall overweight population. The mean duration of diabetes was 10.8 ± 5.6 years, showing a considerable period of disease exposure. Among the studied patients, 124 (58.2%) had diabetic nephropathy, 68 (31.9%) had diabetic retinopathy, and 21 (9.9%) had combined microvascular complications. Undiagnosed hypertension was observed in 47 patients (22.1%).

Table 1: Baseline Characteristics of the Study Population (n = 213)

Variable	Mean $\pm$ SD / n (%)
Age (years)	54.3 ± 9.8
Gender (Male/Female)	112 (52.6%) / 101 (47.4%)
BMI (kg/m ²)	27.6 ± 4.3
Duration of Diabetes (years)	10.8 ± 5.6
Diabetic Nephropathy	124 (58.2%)
Diabetic Retinopathy	68 (31.9%)
Combined Microvascular Complications	21 (9.9%)
Undiagnosed Hypertension	47 (22.1%)

The frequency of undiagnosed hypertension was slightly higher in males (23.2%) compared to females (20.8%), but this difference was statistically insignificant ($p = 0.64$). Age demonstrated a significant relationship with undiagnosed hypertension, as patients aged 51–75 years showed a higher prevalence (28.5%) compared to those aged 18–50 years (15.4%) ($p = 0.03$). BMI was also significantly associated, with overweight or obese individuals ($\text{BMI} \geq 25$ kg/m²) showing a higher rate of undiagnosed hypertension (26.4%) than those with

normal BMI (16.0%) ($p = 0.04$). Similarly, duration of diabetes played a significant role; patients with diabetes duration exceeding 10 years exhibited a higher frequency (29.8%) compared to those with ≤ 10 years (16.7%) ($p = 0.02$). When analyzed by type of microvascular complication, undiagnosed hypertension was most prevalent among patients with diabetic nephropathy (28.2%), followed by those with combined complications (23.8%) and retinopathy (14.7%), showing a significant association ($p = 0.01$).

Table 2: Association of Undiagnosed Hypertension with Demographic and Clinical Variables

Variable	Category	Total (n)	Undiagnosed Hypertension n (%)	p-value
Gender	Male	112	26 (23.2%)	0.64
	Female	101	21 (20.8%)	
Age Group (years)	18–50	91	14 (15.4%)	0.03

	51-75	122	33 (28.5%)	
BMI (kg/m ²)	< 25	75	12 (16.0%)	0.04
	≥ 25	138	35 (26.4%)	
Duration of Diabetes (years)	≤ 10	114	19 (16.7%)	0.02
	> 10	99	28 (29.8%)	
Type of Microvascular Complication	Nephropathy	124	35 (28.2%)	0.01
	Retinopathy	68	10 (14.7%)	
	Combined	21	5 (23.8%)	

Patients aged over 50 years had nearly twice the odds of undiagnosed hypertension (AOR: 1.96; 95% CI: 1.02-3.74; $p = 0.04$). Similarly, higher BMI (AOR: 1.72; 95% CI: 1.01-2.91; $p = 0.05$) and longer diabetes duration exceeding 10 years (AOR: 2.11; 95% CI: 1.12-4.00; $p = 0.02$) were significant predictors. Diabetic nephropathy was also a strong

independent predictor, with patients exhibiting more than twice the odds of undiagnosed hypertension compared to those with retinopathy (AOR: 2.35; 95% CI: 1.14-4.84; $p = 0.01$). Gender did not emerge as a significant factor ($p = 0.72$).

Table 3: Combined Predictors of Undiagnosed Hypertension (Multivariate Logistic Regression)

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Age > 50 years	1.96	1.02 - 3.74	0.04
BMI ≥ 25 kg/m ²	1.72	1.01 - 2.91	0.05
Duration of Diabetes > 10 years	2.11	1.12 - 4.00	0.02
Diabetic Nephropathy (vs. Retinopathy)	2.35	1.14 - 4.84	0.01
Gender (Male vs. Female)	1.09	0.61 - 1.95	0.72

Discussion

The present study assessed the frequency and predictors of undiagnosed hypertension among diabetic patients with microvascular complications. Findings revealed that 22.1% of such patients had undiagnosed hypertension, highlighting a significant clinical and public health concern. This prevalence aligns with figures reported in several regional and international studies, where undiagnosed hypertension in diabetics ranged between 15% and 30%. The findings underscore the silent yet critical burden of hypertension in individuals already

compromised by diabetes-related vascular injury. The relationship between diabetes and hypertension is bidirectional and synergistic. Persistent hyperglycemia leads to endothelial dysfunction, oxidative stress, and activation of the renin-angiotensin-aldosterone system, all of which elevate systemic vascular resistance and promote hypertension. When superimposed on microvascular damage from diabetes such as glomerular sclerosis in nephropathy or capillary basement membrane thickening in retinopathy hypertension accelerates tissue ischemia and worsens end-organ outcomes. Thus, identifying and managing elevated blood pressure in these

patients is not merely preventive but essential to halt the progression of organ damage [10].

In this study, older age was significantly associated with undiagnosed hypertension. This may be attributed to vascular stiffening, loss of arterial compliance, and cumulative metabolic exposure over time. Similar findings have been reported in previous research, where age consistently emerged as an independent predictor of elevated blood pressure among diabetic populations. Older individuals often present with atypical symptoms, leading to underrecognition of hypertension unless routine screening is emphasized. Body mass index also showed a significant association with undiagnosed hypertension [11]. Overweight and obese individuals had a higher frequency of elevated blood pressure compared to those with normal BMI. Increased adiposity contributes to insulin resistance, sympathetic activation, and sodium retention, all mechanisms linked to hypertension. This observation supports the inclusion of weight control and lifestyle modification as integral components of diabetes and hypertension co-management programs [12].

The duration of diabetes was another determinant; patients with more than 10 years of disease were nearly twice as likely to have undiagnosed hypertension compared to those with shorter disease duration. This trend reflects the cumulative vascular burden imposed by long-standing hyperglycemia and metabolic dysregulation. Longer disease duration often correlates with autonomic dysfunction and microvascular rarefaction, which predispose to sustained elevations in blood pressure [13]. Previous studies have similarly linked longer diabetes duration to greater prevalence of both diagnosed and undiagnosed hypertension. Among microvascular complications, diabetic nephropathy was most strongly associated with undiagnosed hypertension. Renal involvement contributes to sodium and fluid retention and activates the RAAS pathway, resulting in sustained pressure elevations. Moreover, patients with nephropathy often experience masked hypertension, where clinic readings remain normal while out-of-office measurements reveal persistent elevations [14]. This association emphasizes the role of kidney disease as both a consequence and amplifier of hypertension in diabetes. The significant odds ratio found in logistic regression further validates this link

and calls for early renal function screening coupled with blood pressure surveillance. The overall findings highlight critical gaps in routine clinical practice. Many diabetic patients, particularly those with established microvascular complications, undergo regular glucose and renal monitoring but not standardized blood pressure evaluation [15-17]. Missed opportunities for diagnosis can lead to avoidable progression of nephropathy, retinopathy, and neuropathy. Given the high prevalence observed, systematic blood pressure screening using multiple readings, proper cuff sizes, and periodic ambulatory or home monitoring should be integrated into diabetes care protocols [18].

The study's strengths include a clearly defined diabetic population with confirmed microvascular complications and the use of repeated blood pressure measurements over a 72-hour period, which improved diagnostic accuracy. However, limitations should be acknowledged. The single-center design limits generalizability, and the non-probability sampling method may introduce selection bias. Additionally, ambulatory blood pressure monitoring which could detect masked hypertension was not utilized due to resource constraints. Despite these limitations, the study provides important local evidence of the hidden burden of hypertension among diabetic patients in tertiary care settings.

Conclusion

It is concluded that undiagnosed hypertension is a common yet underrecognized problem among diabetic patients with microvascular complications, affecting approximately one in every five individuals. The frequency was notably higher in older patients, those with elevated BMI, longer duration of diabetes, and particularly in those with diabetic nephropathy. These findings emphasize that hypertension in such patients often remains silent until organ damage has already progressed. Routine and repeated blood pressure monitoring should, therefore, be considered an essential component of diabetes management, especially in patients exhibiting microvascular complications. Early detection and timely intervention can significantly reduce the risk of further renal deterioration, retinopathy progression, and other vascular events.

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