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Prevalence and Risk Factors of Microvascular Complications in Patients with Type 2 Diabetes Mellitus Attending a Tertiary Care Centre

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Abstract

Background: Microvascular complications such as diabetic retinopathy, nephropathy, and neuropathy are major causes of morbidity in patients with type 2 diabetes mellitus (T2DM). Their early detection and identification of associated risk factors are crucial for preventing progression.

Objectives: To determine the prevalence and risk factors of microvascular complications among patients with T2DM attending a tertiary care center.

Methods: A cross-sectional observational study was conducted among 300 patients with T2DM attending a tertiary care hospital. Clinical, biochemical, and anthropometric parameters were recorded. Screening for diabetic retinopathy, nephropathy, and neuropathy was performed using standard methods. Associations between complications and risk factors were analyzed using logistic regression.

Results: The overall prevalence of any microvascular complication was 38.3%. Diabetic neuropathy (24.7%) was the most common, followed by nephropathy (21.3%) and retinopathy (18.0%). Increasing age (>50 years), duration of diabetes (>10 years), poor glycemic control (HbA1c ≥8%), hypertension, dyslipidemia, and obesity were independently associated with microvascular complications ($p<0.05$).

Conclusion: Microvascular complications were highly prevalent among T2DM patients attending tertiary care. Age, duration of diabetes, poor glycemic control, and comorbidities were major predictors. Regular screening and optimal metabolic control are essential to reduce disease burden.

Keywords: Type 2 diabetes mellitus, Microvascular complications, Retinopathy, Nephropathy, Neuropathy, Risk factors, Prevalence.

Introduction

Type 2 diabetes mellitus (T2DM) is one of the most important non-communicable diseases worldwide and represents a major global public health challenge. It accounts for approximately 90–95% of all diabetes cases

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and continues to increase in prevalence due to population ageing, urbanization, sedentary lifestyle, and dietary transitions[1]. The International Diabetes Federation estimates that hundreds of millions of adults are currently living with diabetes globally, with a substantial proportion residing in low- and middle-income countries such as India. The chronic and progressive nature of T2DM, along with its long-term complications, imposes a significant burden on individuals, healthcare systems, and national economies.

Persistent hyperglycemia in T2DM leads to structural and functional alterations in small blood vessels through mechanisms such as oxidative stress, advanced glycation end-product formation, and endothelial dysfunction. These pathological changes result in microvascular complications, primarily diabetic retinopathy, diabetic nephropathy, and diabetic neuropathy[2]. Diabetic retinopathy is a leading cause of preventable blindness among working-age adults, diabetic nephropathy is a major contributor to chronic kidney disease and end-stage renal failure, and diabetic neuropathy predisposes patients to foot ulcers and amputations. Collectively, these complications significantly impair quality of life, increase disability, and contribute to premature mortality among diabetic individuals.

Importantly, microvascular complications may develop early in the course of T2DM and are sometimes present at the time of diagnosis due to prolonged asymptomatic hyperglycemia. Epidemiological studies have reported that approximately 18–30% of individuals with T2DM already exhibit at least one microvascular complication at diagnosis[3]. In the Indian context, clinic-based studies have documented the prevalence of diabetic retinopathy and nephropathy to be around 23.7% and 19.7%, respectively, highlighting the substantial burden of microvascular disease in the country[4]. Variations in prevalence across regions are influenced by differences in healthcare access, screening practices, socioeconomic status, and genetic susceptibility.

The development and progression of microvascular complications are multifactorial. Several well-established risk factors have been identified, including increasing age, longer duration of diabetes, poor glycemic control, hypertension, dyslipidemia, and obesity[5]. Chronic exposure to elevated blood glucose remains the most critical determinant, as demonstrated by large prospective trials showing a strong association between glycated hemoglobin (HbA1c) levels and complication risk. Coexisting hypertension and dyslipidemia further accelerate vascular damage through hemodynamic stress and atherosclerotic changes, while obesity and insulin resistance contribute to systemic inflammation and endothelial injury. Lifestyle factors such as physical inactivity, unhealthy diet, and smoking also play contributory roles.

Identification of these risk factors in specific populations is essential for designing targeted prevention and management strategies. Early detection through routine screening, coupled with aggressive control of glycemia and cardiovascular risk factors, has been shown to delay onset and progression of microvascular complications. In developing countries, where diabetes prevalence is rapidly rising, hospital-based studies assessing the burden and determinants of complications are particularly valuable. Such evidence helps guide clinical practice, resource allocation, and public health policies aimed at reducing diabetes-related morbidity and improving long-term outcomes.

Aim:

To determine the prevalence and associated risk factors of microvascular complications among patients with T2DM attending a tertiary care center.

Materials and Methods

Study design and setting

Hospital-based cross-sectional observational study conducted at a tertiary care teaching hospital over 12 months.

Study population

Patients with diagnosed T2DM attending outpatient and inpatient departments.

Inclusion criteria

- Diagnosed T2DM (≥1 year)

- Age ≥30 years
- Willing to participate

Exclusion criteria

- Type 1 diabetes
- Gestational diabetes
- Severe systemic illness
- Incomplete data

Sample size

Based on expected prevalence of 30% microvascular complications, minimum sample size calculated as 280; total 300 patients were included.

Data collection

A structured proforma recorded:

- Demographic details
- Duration of diabetes
- BMI and blood pressure
- Lifestyle factors
- Laboratory parameters (HbA1c, lipid profile, creatinine)

Assessment of microvascular complications

- **Diabetic retinopathy:** Fundus examination by ophthalmologist
- **Diabetic nephropathy:** Microalbuminuria or eGFR <60 ml/min
- **Diabetic neuropathy:** Clinical examination and vibration perception test

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 25.0 (IBM Corp., Armonk, NY, USA). The prevalence of microvascular complications was calculated and expressed as percentages. Associations between categorical variables and microvascular complications were assessed using the Chi-square test. Variables showing significant association in univariate analysis were further evaluated by multivariate logistic regression to identify independent risk factors. A p-value of <0.05 was considered statistically significant.

Results

Baseline characteristics

The baseline characteristics of the study population showed that the mean age of the participants was 55.2 ± 10.8 years, with males comprising 56% of the sample. The mean duration of diabetes was 8.6 ± 6.1 years. Nearly half of the patients (48%) had poor glycemic control, defined as glycated hemoglobin (HbA1c) levels ≥8%, indicating a substantial burden of uncontrolled diabetes in the study group.

Prevalence of microvascular complications

The prevalence of microvascular complications among the study participants showed that diabetic neuropathy was the most common complication, affecting 24.7% of patients. This was followed by diabetic nephropathy in 21.3% and diabetic retinopathy in 18.0% of the study population. Overall, 38.3% of patients had at least one microvascular complication, indicating that more than one-third of individuals with type 2 diabetes mellitus in this tertiary care setting were affected by microvascular damage. These findings highlight a substantial burden of diabetes-related complications, with neuropathy emerging as the predominant manifestation in the study group (table 1). Neuropathy was the most common complication, consistent with previous epidemiological studies[6].

Table 1: Prevalence of Microvascular Complications among Patients with Type 2 Diabetes Mellitus

Complication	Prevalence (%)
Neuropathy	24.7
Nephropathy	21.3
Retinopathy	18.0
Any complication	38.3

The univariate analysis

Showed several factors to be significantly associated with the presence of microvascular complications among patients with type 2 diabetes mellitus. Patients aged more than 50 years had a higher likelihood of complications, suggesting the influence of advancing age on vascular damage. A longer duration of diabetes (>10 years) was also significantly associated, indicating the cumulative effect of prolonged hyperglycemia over time. Poor glycemic control, reflected by HbA1c levels ≥8%, emerged as an important determinant, highlighting the role of inadequate glucose regulation in the development of microvascular injury. In addition, comorbid hypertension and dyslipidemia were significantly linked to complications, possibly due to their additive effects on endothelial dysfunction and vascular stress. Overweight and obesity (BMI ≥25 kg/m²) were also associated with increased risk, suggesting the contribution of metabolic and inflammatory mechanisms. Overall, these findings indicate that both disease-related factors and cardiovascular risk factors play a crucial role in the occurrence of microvascular complications in patients with type 2 diabetes mellitus.

Multivariate logistic regression

Multivariate logistic regression analysis identified several independent predictors of microvascular complications among patients with type 2 diabetes mellitus. A duration of diabetes greater than 10 years was the strongest predictor, with affected patients having about three times higher odds of developing complications (OR = 3.1, $p < 0.001$), indicating the cumulative impact of prolonged disease exposure. Poor glycemic control (HbA1c ≥ 8%) was also a significant independent factor, increasing the risk nearly threefold (OR = 2.7, $p = 0.002$), which underscores the central role of chronic hyperglycemia in microvascular damage. Hypertension independently increased the odds of complications by more than two times (OR = 2.4, $p = 0.01$), suggesting the additive effect of elevated blood pressure on vascular injury. Additionally, age greater than 50 years was associated with a twofold higher likelihood of complications (OR = 2.0, $p = 0.03$), reflecting the influence of aging-related vascular changes. These findings demonstrate that longer disease duration, inadequate glycemic control, coexisting hypertension, and older age are key independent determinants of microvascular complications in patients with type 2 diabetes mellitus.

Independent predictors:

- Duration >10 years (OR 3.1, $p<0.001$)
- HbA1c ≥8% (OR 2.7, $p=0.002$)
- Hypertension (OR 2.4, $p=0.01$)
- Age >50 (OR 2.0, $p=0.03$)

Discussion

This study revealed that more than one-third (38.3%) of patients with type 2 diabetes mellitus attending a tertiary care center had at least one microvascular complication, indicating a substantial burden of diabetes-related morbidity in the studied population. Similar prevalence levels have been reported in clinic-based studies from different regions, suggesting that microvascular damage is common among patients receiving hospital care. Among the individual complications, diabetic neuropathy was the most frequent, which aligns with cohort studies showing peripheral nerve involvement as the earliest and most prevalent manifestation of microvascular injury in diabetes.

Advancing age and longer duration of diabetes emerged as strong predictors of complications, reflecting the cumulative effect of chronic hyperglycemia and progressive vascular deterioration over time. Patients with

poor glycemic control (HbA1c ≥8%) had a significantly higher risk, reinforcing the well-established role of sustained hyperglycemia in the development of retinal, renal, and neural damage. Hypertension also independently increased the likelihood of complications, likely due to additional hemodynamic stress and endothelial dysfunction that accelerate microvascular ischemia.

Overall, these findings emphasize that both metabolic factors (hyperglycemia, duration of disease) and cardiovascular comorbidities (hypertension) interact to promote microvascular injury in patients with type 2 diabetes. The results underscore the importance of comprehensive diabetes management, including strict glycemic control, blood pressure regulation, and routine screening for complications, particularly in older patients and those with long-standing diabetes.

Conclusion

The study concludes that microvascular complications are highly prevalent among patients with type 2 diabetes mellitus attending tertiary care centers, with neuropathy, nephropathy, and retinopathy being common manifestations. Increasing age, longer duration of diabetes, poor glycemic control, and hypertension were identified as major risk factors. These findings highlight the need for early detection through regular screening and aggressive management of modifiable risk factors to reduce diabetes-related morbidity and improve long-term outcomes in affected individuals.

Limitations

This study has certain limitations that should be considered while interpreting the findings. First, the hospital-based design may limit the generalizability of the results to the broader diabetic population, as patients attending tertiary care centers often have more severe or long-standing disease compared to community populations. Second, the cross-sectional nature of the study restricts the ability to establish causal relationships between risk factors and microvascular complications; it can only identify associations at a single point in time. Third, some complications, particularly neuropathy and nephropathy, were assessed using clinical and basic laboratory methods rather than advanced diagnostic techniques, which may have led to under- or over-estimation of their true prevalence.

Recommendations

Based on the study findings, several practical recommendations can be made. Regular annual screening for microvascular complications should be implemented for all patients with type 2 diabetes mellitus to ensure early detection and timely management. Strict control of blood glucose and blood pressure should be emphasized, as poor glycemic status and hypertension were major modifiable risk factors identified in the study. Lifestyle modification programs focusing on healthy diet, physical activity, weight management, and smoking cessation should be strengthened to address metabolic and cardiovascular risk factors. Additionally, large-scale community-based longitudinal studies are recommended to better understand the incidence, progression, and determinants of microvascular complications in the general population and to generate evidence that is more widely generalizable.

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Conflict of Interest: The authors declare that there is no conflict of interest.

Data Availability: All datasets generated or analyzed during this study are included in the manuscript.

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