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Original Research Article

EVALUATION OF PREVALENCE OF VASCULAR COMPLICATIONS IN TYPE 2 DIABETES PATIENTS AT A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a major public health problem and is frequently complicated by microvascular and macrovascular involvement, leading to substantial morbidity and mortality. Estimating the prevalence of vascular complications in tertiary care settings is essential for early detection, risk stratification, and strengthening preventive strategies. **Aim:** To evaluate prevalence of vascular complications in type 2 diabetes patients at a tertiary care hospital.

Materials and Methods: This hospital-based observational study enrolled 105 patients with T2DM using consecutive sampling. Data were collected through structured history, physical examination, and review of records. Vascular complications were categorized into microvascular (diabetic retinopathy, nephropathy, neuropathy) and macrovascular (coronary artery disease [CAD], cerebrovascular disease, peripheral arterial disease [PAD]) based on clinical evidence and documented investigations. Clinical variables included age, sex, BMI, hypertension, and smoking status. Biochemical parameters included HbA1c, fasting plasma glucose, lipid profile, and serum creatinine. Data were analyzed using SPSS version 26.0. Associations were tested using Chi-square/Fisher's exact test and t-test/Mann–Whitney U test, with $p < 0.05$ considered significant.

Results: Overall, 64.76% (68/105) of patients had at least one vascular complication. Microvascular complications were prominent: neuropathy (40.00%), retinopathy (37.14%), and nephropathy (32.38%). Among macrovascular complications, CAD (29.52%) was most common, followed by PAD (17.14%) and cerebrovascular disease (13.33%). Vascular complications were significantly associated with age ≥60 years ($p = 0.006$), male gender ($p = 0.041$), hypertension ($p = 0.008$), smoking ($p = 0.012$), and obesity ($p = 0.009$). Patients with complications had significantly higher HbA1c (8.94 ± 1.21% vs 7.62 ± 1.04%, $p < 0.001$), fasting plasma glucose ($p = 0.002$), total cholesterol ($p = 0.004$), LDL-C ($p = 0.001$), and serum creatinine ($p < 0.001$).

Conclusion: Vascular complications were highly prevalent among T2DM patients in this tertiary care hospital. Older age, male sex, hypertension, smoking, obesity, poor glycemic control, dyslipidemia, and renal impairment were significantly associated with complications, highlighting the need for early screening and aggressive multifactorial risk reduction.

Keywords: Type 2 Diabetes Mellitus; Vascular Complications; Microvascular Complications; Macrovascular Complications.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a major and rapidly expanding global health problem, driven by population ageing, urbanization, sedentary behavior, and increasing obesity. Contemporary global estimates consistently show a continuing rise in diabetes prevalence, with the largest absolute burden occurring in low- and middle-income countries, creating sustained pressure on health systems that must manage both glycemic control and long-term complications.[1] Because most morbidity and premature mortality in T2DM occur through chronic complications, the clinical impact of diabetes is best understood not only by how many people have the disease, but also by how frequently they develop end-organ damage and cardiovascular events.[2] Vascular complications represent the most important pathway through which T2DM causes disability and death. They are broadly classified into microvascular complications—primarily diabetic retinopathy, diabetic nephropathy (diabetic kidney disease), and diabetic neuropathy—and macrovascular complications, which include coronary artery disease, cerebrovascular disease, and peripheral arterial disease.[3] The biological basis of these complications is multifactorial: chronic hyperglycemia promotes oxidative stress, inflammation, endothelial dysfunction, and abnormal vascular remodelling; concomitant hypertension, dyslipidemia, obesity, smoking, and kidney impairment further accelerate vascular injury. Together, these processes lead to progressive microcirculatory damage affecting the retina, kidneys, and peripheral nerves, and also amplify atherosclerosis in larger arteries, increasing the risk of myocardial infarction, stroke, and limb ischemia.[4] Macrovascular disease contributes substantially to the overall burden of diabetes because cardiovascular events often occur earlier and carry high case-fatality and long-term disability. In recognition of this, contemporary clinical guidance emphasizes comprehensive cardiovascular risk reduction in T2DM through blood pressure control, lipid management, antiplatelet strategies when appropriate, smoking cessation, and use of glucose-lowering therapies with proven cardiovascular benefit in eligible patients.[4] Importantly, macrovascular complications may remain clinically silent until advanced disease is present, particularly in peripheral arterial disease, which is frequently under-recognized without structured screening in high-risk individuals. This underlines why prevalence studies are useful in hospital practice: they help quantify the "hidden" load of disease, identify high-risk subgroups, and guide resource planning for cardiology, neurology, and vascular services. Microvascular complications are equally critical because they are strongly linked with cumulative glycemic exposure and are major drivers of avoidable blindness, chronic kidney disease, neuropathic pain, foot ulceration, and amputation. Diabetic retinopathy remains one of the most common diabetes-related eye diseases worldwide, and pooled contemporary estimates still indicate that a substantial proportion of people living with diabetes have some degree of retinopathy, reinforcing the need for early detection and routine eye evaluation.[5] Similarly, diabetic peripheral neuropathy is common and clinically important because it reduces protective sensation, increases fall risk, contributes to chronic pain, and predisposes to diabetic foot complications; meta-analytic evidence continues to show a high pooled prevalence across populations, with wide variability based on case definitions and diagnostic approaches.[6] Diabetic kidney disease is another central determinant of prognosis in T2DM because it increases the risk of cardiovascular events, hospitalizations, and all-cause mortality while also adding substantial long-term treatment costs. Contemporary kidney guidelines emphasize early identification using both albuminuria and estimated glomerular filtration rate (eGFR), alongside multifactorial risk reduction strategies that include renin–angiotensin system blockade where indicated and preferential use of agents with kidney-protective evidence in eligible patients. Present study was conducted to evaluate prevalence of vascular complications in type 2 diabetes patients at a tertiary care hospital.

MATERIALS AND METHODS

This hospital-based observational study included patients attending the diabetic clinic and/or admitted under relevant medical specialties. The study aimed to determine the prevalence of vascular complications among patients with type 2 diabetes mellitus (T2DM) and to evaluate associated clinical and biochemical parameters. A total of 105 patients diagnosed with T2DM were enrolled. Participants were selected from eligible patients presenting to the tertiary care hospital during the study period, using a non-probability consecutive sampling approach to minimize selection gaps in routine clinical flow.

Eligibility Criteria: Adults with an established diagnosis of T2DM (as per documented medical records and/or ongoing antidiabetic treatment) were included. Patients with type 1 diabetes, gestational diabetes, or other specific types of diabetes were excluded. Patients with acute critical illness interfering with assessment, incomplete records for key outcomes, or those unwilling to provide consent were also excluded.

Methodology

Clinical assessment and data collection: Data were collected using a structured proforma through patient interviews, physical examination, and review of medical records. Sociodemographic details (age, sex), diabetes-related variables (treatment modality, comorbidities), and cardiovascular risk factors were recorded. Anthropometric measurements included height, weight, and body mass index (BMI). Blood pressure was measured using a standardized technique after adequate rest; hypertension was recorded based on documented diagnosis and/or current antihypertensive therapy. Lifestyle factors such as smoking status and alcohol use were documented where applicable.

Assessment of microvascular complications: Retinopathy was determined using documented fundus examination findings from ophthalmology records and categorized where available (non-proliferative/proliferative and/or presence of macular edema). Nephropathy was assessed using urine albumin testing (albuminuria/microalbuminuria where available), serum creatinine, and estimated glomerular filtration rate (eGFR) with supportive documentation of diabetic kidney disease when present. Neuropathy was evaluated using symptoms (numbness, burning pain, paresthesia), bedside clinical examination (vibration perception and monofilament testing where feasible), and documentation from neurology/medicine records; diabetic peripheral neuropathy was labelled when consistent clinical evidence was present.

Assessment of macrovascular complications: CAD was identified based on prior documented history of myocardial infarction, angina, coronary revascularization, ischemic changes on ECG, and/or cardiology-confirmed diagnosis. Cerebrovascular disease was identified based on documented history of stroke or transient ischemic attack supported by clinical records and neuroimaging reports where available. PAD was identified through history of claudication, diminished peripheral pulses on examination, and supportive documentation such as ankle-brachial index (ABI) findings and/or Doppler evidence when available.

Laboratory parameters: Laboratory investigations were recorded from hospital laboratory reports, including fasting plasma glucose and/or random plasma glucose, HbA1c (as the marker of glycemic control), lipid profile (total cholesterol, LDL-C, HDL-C, triglycerides), serum creatinine, and urine albumin assessment where available. Additional parameters such as hemoglobin and electrolytes were recorded if relevant to complication profiling, depending on routine hospital testing.

Outcome measures: The primary outcome was the prevalence of overall vascular complications (presence of ≥1 microvascular and/or macrovascular complication). Secondary outcomes included prevalence of each individual complication (retinopathy, nephropathy, neuropathy, CAD, cerebrovascular disease, PAD) and the association of vascular complications with clinical and biochemical variables such as age, BMI, blood pressure, HbA1c, lipid levels, smoking status, and comorbid hypertension/dyslipidemia.

Statistical analysis: Data were entered and analyzed using SPSS version 26.0. Continuous variables were summarized as mean ± standard deviation or median (interquartile range) based on distribution, while categorical variables were presented as frequencies and percentages. Prevalence of vascular complications was calculated with appropriate proportions. Associations between categorical variables were tested using the Chi-square test or Fisher's exact test as applicable. Comparisons of continuous variables between groups (with and without complications) were performed using the independent samples t-test for normally distributed data and the Mann–Whitney U test for non-normal data. Multivariable analysis (binary logistic regression) was used to identify independent predictors of vascular complications, reporting adjusted odds ratios with 95% confidence intervals. A p-value <0.05 was considered statistically significant.

RESULTS

The present study included a total of 105 patients with type 2 diabetes mellitus. The baseline demographic and clinical characteristics of the study population are summarized in Table 1. The majority of patients belonged to the 40–59 years age group (55.24%), followed by those aged ≥60 years (33.33%), while a smaller proportion were below 40 years of age (11.43%). Males constituted a higher proportion of the study population (59.05%) compared to females (40.95%). With respect to body mass index, most patients were either overweight (44.76%) or obese (32.38%), whereas only 22.86% had a normal BMI. Hypertension was present in more than half of the patients (58.10%), indicating a high burden of comorbid cardiovascular risk factors. Regarding lifestyle habits, 27.62% of patients were smokers, while the remaining 72.38% were non-smokers.

Table 2 depicts the overall prevalence of vascular complications among the study participants. Vascular complications were observed in 68 patients, accounting for 64.76% of the total study population, while 35.24% of patients did not exhibit any documented vascular complication.

The distribution of specific microvascular and macrovascular complications is presented in Table 3. Among microvascular complications, diabetic neuropathy was the most frequently observed, affecting 40.00% of patients, followed by diabetic retinopathy (37.14%) and diabetic nephropathy (32.38%). With regard to macrovascular complications, coronary artery disease was the most prevalent, seen in 29.52% of patients. Peripheral arterial disease was present in 17.14%, while cerebrovascular disease was observed in 13.33% of the study population.

Table 4 shows association between selected clinical variables and the presence of vascular complications. Patients aged ≥60 years had a significantly higher prevalence of vascular complications compared to younger patients (42.65% vs. 16.22%, p = 0.006). Male patients were more likely to have vascular complications than females, and this association was statistically significant (p = 0.041). Hypertension showed a strong association with vascular complications, with 67.65% of hypertensive patients exhibiting complications compared to 40.54% among those without hypertension (p = 0.008). Smoking was also significantly associated with vascular complications, as 35.29% of smokers had complications compared to 13.51% of non-smokers (p = 0.012). Similarly, obesity was significantly associated with the presence of vascular complications (41.18% vs. 16.22%, p = 0.009).

The comparison of biochemical parameters between patients with and without vascular complications is presented in Table 5. Patients with vascular complications had significantly poorer glycemic control, as reflected by higher mean HbA1c levels (8.94 ± 1.21%) compared to those without complications (7.62 ± 1.04%), with a highly significant difference ($p < 0.001$). Similarly, fasting plasma glucose levels were significantly higher in patients with complications (172.45 ± 36.18 mg/dL) than in those without complications (148.32 ± 29.76 mg/dL; $p = 0.002$). Dyslipidemia was more pronounced in patients with vascular complications, with significantly higher total cholesterol (214.38 ± 42.65 mg/dL vs. 186.57 ± 38.21 mg/dL; $p = 0.004$) and LDL-C levels (138.26 ± 31.47 mg/dL vs. 112.84 ± 28.33 mg/dL; $p = 0.001$). In addition, mean serum creatinine levels were significantly higher among patients with vascular complications (1.42 ± 0.58 mg/dL) compared to those without complications (1.01 ± 0.34 mg/dL), indicating greater renal involvement ($p < 0.001$).

Table 1: Baseline demographic and clinical characteristics of the study population (n = 105)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
<40	12	11.43
40–59	58	55.24
≥60	35	33.33
Gender		
Male	62	59.05
Female	43	40.95
BMI category		
Normal	24	22.86
Overweight	47	44.76
Obese	34	32.38
Hypertension		
Present	61	58.10
Absent	44	41.90
Smoking status		
Smoker	29	27.62
Non-smoker	76	72.38

Table 2: Prevalence of overall vascular complications among patients with type 2 diabetes (n = 105)

Vascular complication status	Frequency (n)	Percentage (%)
Any vascular complication present	68	64.76
No vascular complication	37	35.24

Table 3: Distribution of microvascular and macrovascular complications (n = 105)

Type of complication	Frequency (n)	Percentage (%)
Microvascular complications		
Diabetic retinopathy	39	37.14
Diabetic nephropathy	34	32.38
Diabetic neuropathy	42	40.00
Macrovascular complications		
Coronary artery disease (CAD)	31	29.52
Cerebrovascular disease	14	13.33
Peripheral arterial disease (PAD)	18	17.14

Table 4: Association of selected clinical variables with presence of vascular complications (n = 105)

Variable	Complications present n (%)	Complications absent n (%)	p-value
Age ≥60 years	29 (42.65)	6 (16.22)	0.006
Male gender	44 (64.71)	18 (48.65)	0.041
Hypertension	46 (67.65)	15 (40.54)	0.008
Smoking	24 (35.29)	5 (13.51)	0.012
Obesity	28 (41.18)	6 (16.22)	0.009

Table 5: Comparison of biochemical parameters between patients with and without vascular complications

Parameter (Mean ± SD)	With complications (n = 68)	Without complications (n = 37)	p-value
HbA1c (%)	8.94 ± 1.21	7.62 ± 1.04	<0.001
Fasting plasma glucose (mg/dL)	172.45 ± 36.18	148.32 ± 29.76	0.002
Total cholesterol (mg/dL)	214.38 ± 42.65	186.57 ± 38.21	0.004
LDL-C (mg/dL)	138.26 ± 31.47	112.84 ± 28.33	0.001
Serum creatinine (mg/dL)	1.42 ± 0.58	1.01 ± 0.34	<0.001

DISCUSSION

In this study of 105 patients with type 2 diabetes, most participants were middle-aged (40–59 years: 55.24%) with a substantial elderly proportion (≥60 years: 33.33%), and males predominated (59.05%). The burden of cardiometabolic risk was high, with 44.76% overweight, 32.38% obese, and 58.10%

hypertensive, reflecting the typical tertiary-care mix where clustering of risk factors is common. A comparable hospital-based pattern has been reported in China by Bui et al. (2019), where patients were older overall and males formed about half the cohort, reinforcing that tertiary settings often capture higher-risk profiles.[7]

The overall prevalence of any vascular complication in our cohort was 64.76% (68/105), meaning nearly two-thirds had at least one microvascular and/or macrovascular complication. This is higher than population-level estimates reported around the time of diagnosis in Denmark by Gedebjerg et al. (2018), where approximately 35% had complications (microvascular 12%, macrovascular 17%, and 6% both) near diagnosis—differences that are plausibly explained by our tertiary-care sampling, where patients commonly have longer disease duration and more comorbidities at presentation.[8]

Among microvascular outcomes in our study, neuropathy (40.00%) was most frequent, followed by retinopathy (37.14%) and nephropathy (32.38%), suggesting a substantial cumulative burden of chronic diabetes injury.

In contrast, an Indian multicenter study reported markedly lower proportions—any microvascular complication about 30.2%, retinopathy 4.8%, and nephropathy/neuropathy each 10.5%—which likely reflects differences in study population, screening intensity, and case definition (community or multi-site sampling versus high-risk tertiary attendees).[9]

For diabetic retinopathy specifically, our prevalence (37.14%) aligns closely with global pooled estimates. The landmark meta-analysis by Yau et al. (2012) reported an overall prevalence of 34.6% for "any diabetic retinopathy," and also emphasized higher rates with poorer glycemic control and elevated blood pressure—factors common in our cohort (mean HbA1c higher in the complication group and hypertension present in 58.10% overall), which may explain our slightly higher retinopathy frequency.[10]

Renal involvement was also substantial in our series (nephropathy 32.38%), and this sits within the wide range reported internationally depending on whether microalbuminuria or broader diabetic kidney disease criteria are used. In Albania, Pasko et al. (2013) found microalbuminuria in 40.8% of patients with type 2 diabetes, supporting that early renal injury can affect a large proportion of clinic populations and that prevalence varies with testing approach (albuminuria screening, eGFR thresholds, and inclusion of established CKD).[11]

Regarding macrovascular disease, coronary artery disease (CAD) was the most common in our patients (29.52%), exceeding several outpatient-based Indian estimates.

For example, Swarnkar et al. (2022) reported a CAD/CHD prevalence of about 15.4% among 104 patients with type 2 diabetes in their cohort, and they also highlighted broad variability across Indian studies; our higher CAD proportion is consistent with a tertiary-care setting where referrals, older age structure, and multiple risk factors tend to increase detected CAD.[12]

Peripheral arterial disease (PAD) occurred in 17.14% of our cohort, which is comparable to ABI-based findings from India. Agarwal et al. (2012) reported PAD evidence in 14.3% of type 2 diabetics using ankle-brachial index and noted associations with older age, higher blood pressure, smoking, higher HbA1c, and coexisting CAD—patterns that mirror our data where PAD coexists with a relatively high CAD prevalence and where smoking and hypertension showed significant associations with overall vascular complications.[13]

The clinical correlates in our analysis showed that complications were significantly more common in older age (≥60 years: 42.65% vs 16.22%, p=0.006), males (p=0.041), hypertensive patients (67.65% vs 40.54%, p=0.008), smokers (35.29% vs 13.51%, p=0.012), and obese individuals (41.18% vs 16.22%, p=0.009). These relationships are biologically and clinically consistent with major trial evidence that vascular risk modification matters in type 2 diabetes; the UKPDS blood-pressure study by UK Prospective Diabetes Study Group (1998) demonstrated that tighter blood pressure control reduced risks of diabetes-related endpoints and complications, supporting our finding that hypertension is strongly linked with vascular outcomes.[14]

Finally, biochemical comparisons demonstrated that patients with vascular complications had poorer glycemic control (HbA1c 8.94 ± 1.21% vs 7.62 ± 1.04%, p<0.001) and a more atherogenic profile (higher total cholesterol and LDL-C), along with higher serum creatinine (1.42 ± 0.58 vs 1.01 ± 0.34 mg/dL, p<0.001). This gradient is consistent with classic longitudinal evidence from Stratton et al. (2000) (UKPDS 35), where increasing HbA1c was strongly associated with both microvascular and macrovascular outcomes and each 1% HbA1c reduction was linked to meaningful risk reductions—supporting the interpretation that the worse glycemic milieu seen in our complication group is clinically relevant rather than incidental.[15]

CONCLUSION

This tertiary care hospital–based study found a high prevalence of vascular complications among patients with type 2 diabetes mellitus, with nearly two-thirds (64.76%) affected. Microvascular complications were more common than macrovascular, with neuropathy (40.00%) and retinopathy (37.14%) being the leading manifestations, while CAD (29.52%) was the most frequent macrovascular outcome. Vascular complications were significantly associated with older age, male gender, hypertension, smoking, and obesity, and were linked to poorer glycemic control and adverse lipid/renal parameters. These findings highlight the need for early screening and aggressive multifactorial risk reduction to prevent progression and reduce complication burden in tertiary care settings.

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