

Original Research Article

Prevalence and correlates of microvascular complications among patients with diabetes mellitus: a cross sectional study

Ashok Kumar¹, Ardaman Singh², Vikram S. Tanwar³, Nikhil Govil^{4*}

¹Consultant Cardiology, Paras Hospital, Gurugram, Haryana, India

²Department of General Medicine, Government Medical College, Patiala, Punjab, India

³Department of General Medicine, SHKM Government Medical College, Nalhar, Nuh, Haryana, India

⁴Department of General Medicine, Kalpana Chawla Government Medical College, Karnal, Haryana, India

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*Correspondence:

Dr. Nikhil Govil,

E-mail: govilnikhil37@gmail.com

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ABSTRACT

Background: Diabetes mellitus is a metabolic disorder of multiple etiology, characterized by chronic hyperglycemia and associated with various microvascular, macrovascular and nonvascular complications leading to increasing morbidity and mortality. Microvascular complications are diabetes specific and their relation with associated comorbidities studied worldwide. To estimate the prevalence of microvascular complications in diabetic patients and to find their relation with various comorbid conditions.

Methods: A total of hundred diagnosed patients of diabetes mellitus with age ranging from 18 to 75 years were enrolled in the study. Patients were assessed for the presence of microvascular complications and associated comorbidities. The effect of various comorbidities on frequency of microvascular complications was also determined. Data collected was statistically analyzed.

Results: In this study, the mean age of the study group was 55.77 ± 11.75 years. Mean age of onset of the disease was 48.89 ± 11.50 years. Mean duration of the disease in the study group was 6.86 ± 5.02 years. Diabetic retinopathy, neuropathy and nephropathy was found in 76%, 63% and 69% patients, respectively. Among patients with hypertension, 91.7%, 83.3%, and 81.7% cases were found to have retinopathy, neuropathy and nephropathy, respectively. The corresponding figures for those with comorbid IHD were 91.1%, 83.9% and 76.8% respectively whereas among patients with coexisting metabolic syndrome, 92.5%, 80.6%, and 79.1% were found to have retinopathy, neuropathy, and nephropathy, respectively.

Conclusions: The most frequent microvascular complication reported by this study was diabetic retinopathy. comorbid conditions like hypertension, ischemic heart disease, and metabolic syndrome were associated with higher prevalence of microvascular complications in diabetic patients.

Keywords: Hypertension, Ischemic heart disease, Microvascular complications, Metabolic syndrome

INTRODUCTION

Diabetes mellitus (DM) is the most prevalent metabolic disorder worldwide. The global burden of DM is enormous with an estimated 366 million people living with DM worldwide.¹ In India 62 million people are

affected by DM which is projected to rise to 101 million by 2030.^{1,2} It is one of the major risk factors accounting for premature mortality and morbidity due to its vast complications (i.e. non-vascular, macrovascular and microvascular complications). The microvascular complications (retinopathy, neuropathy, nephropathy) are diabetes-specific, which if undetected or left untreated

can have a devastating impact on quality of life and place a significant burden on health care costs.^{3,4} In addition, diabetic microvascular complications can reduce life expectancy. Macrovascular complications (stroke, peripheral vascular disease) are nonspecific to DM. Various risk factors and comorbid conditions including advanced age, smoking, obesity, dyslipidaemia, metabolic syndrome and hypertension have been found to coexist with DM. Effect of these comorbid conditions on diabetic complications have been studied worldwide but only few of them were related to microvascular complications (MVC). Therefore, authors did a cross-sectional observational study to estimate the prevalence of microvascular complications in patients with diabetes mellitus presenting to this hospital and to determine their correlation with various comorbid conditions as described above.

METHODS

It was a prospective, cross-sectional observational study conducted on hundred patients of Diabetes Mellitus who presented in the department of General Medicine of a public tertiary care hospital in North India. The diagnosis of Diabetes Mellitus was established as per American Diabetic Association (ADA); 2011 diagnostic criteria for DM.¹ Ethical approval for the study was sought from the Institutional Ethics Committee (IEC) and a written informed consent was obtained from the study participants before their enrolment in the study. A total of 50 male and 50 female patients were recruited after fulfilling the inclusion and exclusion criteria which were as follows:

Inclusion criteria

- Patients of diabetes mellitus having age between 18 to 75 years, after excluding the exclusion criteria.

Exclusion criteria

- Seriously ill patients
- Unconscious patients
- Serious psychiatric disorder
- Repeat admission
- Patients with bilateral cataracts were excluded for retinopathy
- Pregnant females or nursing mothers.

A detailed history of each patient was taken and complete clinical examination was done. Retinopathy was assessed by direct ophthalmoscopy, and defined as presence of at least one microaneurysm or haemorrhage or exudates in either of the eye.

Evidence of peripheral sensory neuropathy was obtained on the basis of at least one objective sign including absence of both ankle reflexes or, impairment of lower limb touch and pain sensation on any side with or without symptoms and by using Semmes- Weinstein filament.

Autonomic neuropathy was assessed by various methods including Cardiovascular response to Valsalva manoeuvre, heart rate response to deep breathing, postural variation of Blood Pressure. Gustatory sweating, erectile dysfunction, diabetic diarrhoea and urinary incontinence were recorded from history as an indicator for autonomic neuropathy.

Diabetic nephropathy was diagnosed by estimating 24-hour albuminuria of more than 30 mg per day after ruling out other causes.

Hypertension was defined as patients already taking antihypertensive drugs or having a blood pressure of more than 140/90 mmHg.

Patients with ischemic heart disease (IHD) were defined on the basis of history, electrocardiogram (ECG) and/or echocardiographic findings.

Metabolic Syndrome was defined according to National Cholesterol Education Program / Adult Treatment Panel III (NCEP/ATP III) criteria.⁵ Data collected were analysed statistically at the end of the study.

Statistical analysis

SPSS software version 14.0 for Windows (Chicago, Illinois, USA) was used. Descriptive statistics was computed in terms of Mean±S.D for continuous variables whereas frequency with percentages were calculated for categorical variables. The prevalence was used as a measure of the frequency of occurrence of the microvascular complications. The association between the microvascular complications and other comorbidities under study was analysed using the Pearson's Chi Square test. The p value (significance level) was taken as ≤ 0.05 .

RESULTS

A total of hundred patients with diabetes mellitus (50 male and 50 female) were evaluated. Mean age of the study group was 55.77 ± 11.75 years. Mean age of onset of the disease was 48.89 ± 11.50 years. Mean duration of the disease (i.e. DM) in the study group was 6.86 ± 5.02 years.

Table 1: Age wise distribution of various microvascular complications in the study group.

Age group in year	Retinopathy	Neuropathy	Nephropathy
<30	0	0	1
31-40	3	3	4
41-50	15	12	15
51-60	31	23	24
61-70	23	21	22
>70	4	4	3
Total	76	63	69

Table 2: Frequency of microvascular complications in the study group.

Number of MVCs in a patient	Number of patients
0	13
1	13
2	27
3	47
Total	100

MVCs= microvascular complications

Diabetic Retinopathy (DR) was the most frequent microvascular complication with a prevalence of 76% followed by nephropathy and neuropathy with a frequency of 69 and 63% respectively (Table 1). Most of these complications were detected in patients of age group 40 to 70 years. Among the study participants, 13% did not have any of the microvascular complications whereas 13%, 27% and 47% were found to have one, two and all three microvascular complications respectively (Table 2).

Table 3: Gender wise distribution of microvascular complications in the study group.

Gender	n	D Retinopathy		D Neuropathy		D Nephropathy	
		(+)	(-)	(+)	(-)	(+)	(-)
Male	50	34 (68%)	16 (32%)	35 (70%)	15 (30%)	33 (66%)	17 (34%)
Female	50	42 (84%)	8 (16%)	28 (56%)	22 (44%)	36 (72%)	14 (28%)
p value		0.061		0.147		0.517	

D Retinopathy- Diabetic retinopathy; D Neuropathy- Diabetic Neuropathy; D Nephropathy- Diabetic Nephropathy; n- number of patients; (+)= present; (-) = absent; p value <0.05 = significant

Table 4: Distributions of various microvascular complications among diabetic patients with hypertension.

HTN	n	D Retinopathy		D Neuropathy		D Nephropathy	
		(+)	(-)	(+)	(-)	(+)	(-)
Yes	60	55 (91.7%)	5 (8.3)	50 (83.3%)	10 (16.7%)	49 (81.7%)	11 (18.3%)
No	40	21 (52.5%)	19 (47.5%)	13 (32.5%)	27 (67.5%)	20 (50%)	20 (50%)
p value		0.00		0.00		0.001	

HTN- Hypertension; n- number of patients; D Retinopathy- Diabetic retinopathy; D Neuropathy- Diabetic Neuropathy; D Nephropathy- Diabetic Nephropathy; (+)= present; (-) = absent; p value <0.05 = significant

Table 5: Distributions of various microvascular complications among diabetic patients with IHD.

IHD	n	D Retinopathy		D Neuropathy		D Nephropathy	
		(+)	(-)	(+)	(-)	(+)	(-)
Yes	56	51 (91.1%)	5 (8.9%)	47 (83.9%)	9 (16.1%)	43 (76.8%)	13 (23.2%)
No	44	25 (56.8%)	19 (43.2%)	16 (36.4%)	28 (63.6%)	26 (59.1%)	18 (40.9%)
p value		0.00		0.000		0.04	

IHD- Ischemic heart disease; n- number of patients; D Retinopathy- Diabetic retinopathy; D Neuropathy- Diabetic Neuropathy; D Nephropathy- Diabetic Nephropathy; (+)= present; (-) = absent; p value <0.05 = significant

Table 6: Distributions of various microvascular complications among diabetic patients with metabolic syndrome.

MS	n	D Retinopathy		D Neuropathy		D Nephropathy	
		(+)	(-)	(+)	(-)	(+)	(-)
Yes	67	51 (91.1%)	5 (8.9%)	53 (80.6%)	14 (9.4%)	54 (80.6%)	13 (19.4%)
No	33	25 (56.8%)	19 (43.2%)	10 (45.5%)	23 (54.5%)	15 (45.5%)	18 (54.5%)
p value		0.000		0.000		0.000	

MS- metabolic syndrome; n- number of patients; D Retinopathy- Diabetic retinopathy; D Neuropathy- Diabetic Neuropathy; D Nephropathy- Diabetic Nephropathy; (+)= present; (-) = absent; p value <0.05 = significant

Females had a higher rate of retinopathy (84%) and nephropathy (72%) complications than males with corresponding figures being 68% and 66%; however, this gender difference was not statistically significant

(p=0.061 and p=0.517 respectively). On the contrary; Diabetic neuropathy had a male preponderance (70% in males versus 56% in females) though, again, this difference was not statistically significant (p=0.147).

Thus, there no significant association of gender with any of the microvascular complication of Diabetes Mellitus in the study (Table 3).

Among the study subjects, 60% had comorbid hypertension. Hypertension was significantly associated with the development of all three microvascular complications. Diabetic Retinopathy was detected in 91.7% of diabetic patients with comorbid Hypertension ($p < 0.01$). The prevalence of diabetic neuropathy and nephropathy increased to 83.3% and 81.7% from 69% and 63% respectively among diabetic patients with comorbid hypertension and this difference was statistically significant ($p < 0.01$ for each) (Table 4).

Presence of Ischemic Heart Disease (IHD) was another risk factor found to have significant association with all the three microvascular complications of Diabetes Mellitus. IHD was present in 56 % of the patients in this study. The figures for the prevalence of Diabetic retinopathy, neuropathy and nephropathy rose to 91.1%, 83.9%, and 76.8% respectively when patients had comorbid IHD and this difference was statistically significant ($p < 0.05$ for each) (Table 5).

Out of 67 diabetic patients who were detected to have metabolic syndrome (MS), DR was detected in 92.5%, neuropathy in 79.1% and nephropathy in 80.6% of them. Statistical assessment of these findings was suggestive of a significant contribution of MS for these microvascular complications ($p < 0.01$ for each) (Table 6).

DISCUSSION

Diabetes Mellitus is the commonest metabolic disorder and has a high prevalence in India. The prognosis of the diabetic patients largely depends on the complications seen in the natural course of illness.⁶ All types of diabetes mellitus are associated with the development of diabetic specific microvascular pathology in the retina, glomeruli and peripheral nerves. Diabetes is the leading cause of blindness in the people aged 24-74 years and is also the leading cause of end stage renal disease. Diabetes increases the risks of cardiovascular complications 2 to 6 times as compared to normal. This study was a cross-sectional study done to estimate the prevalence of various microvascular complications of diabetes mellitus and the influence of various comorbid conditions over these complications.

In this study Diabetic Retinopathy (DR) emerged as the most frequent microvascular complication with a prevalence of 76% followed by nephropathy and neuropathy with a frequency of 69 and 63% respectively (Table 1). Patients in this study had a relatively higher prevalence of microvascular complications compared to those quoted in previous studies. Idriss-Kanoun et al, in their study found that the prevalence of diabetic microangiopathies was significantly higher in diabetic population. DR was noted in 43.8%, neuropathy in 63.5%

and nephropathy in 25.3% of the cases.⁷ Corresponding figures in a study by Lepore et al were 41%, 23.6% cases and 24.4% respectively.⁸ Agrawal et al, found that DR was present in 28.9%, neuropathy in 30.1% and nephropathy in 32.5% of patients with diabetes mellitus.⁶ Hence, after comparing the observations amongst similar study models, it can be concluded that the prevalence of the microvascular complications of diabetes mellitus is quite high and it varies across the globe.

In this study authors observed that most of the complications were present in the age group ranging from 40 to 70 years (Table 1) which was similar to the result of the study done by Amari F.⁹

In this study authors found that patients of diabetes mellitus with associated hypertension had a high prevalence of microvascular complications (Table 4). UKPDS, Gall et al, Ebeling et al, Lepore et al, and Dyck et al, in their studies on patients with diabetes mellitus found similar results. On the contrary, Rema et al, found no significant contribution of hypertension as a risk factor in diabetic retinopathy.¹⁰⁻¹⁵

In the present study, overall prevalence of IHD in the study group was 56% of which 91.1% had DR, 83.9% had diabetic neuropathy and 76.8% of the cases had nephropathy (p value < 0.05) (Table 5). Ebeling et al, in a study found that IHD was associated with diabetic retinopathy in 3.9% of the cases (p value < 0.001) and 20% of the cases had nephropathy with p value < 0.001 .¹² As per study done by Agrawal et al, IHD was associated with microvascular complications in 19.2% of the patients with p value of < 0.01 .⁶

Similarly, Liu et al, found the higher prevalence of IHD (30.1%) among diabetics and a significant association between IHD and microvascular complications in DM ($p < 0.01$).¹⁶ Thus, it can be concluded that diabetic patients with ischemic heart disease (IHD) have a higher chance of developing microvascular complications.

Metabolic syndrome (MS) was found to have a causal relationship with MVCs in diabetic patients. Pedro et al, observed that MS was found in 92.5% of the cases of DR, 79.1% of the patients having diabetic neuropathy and 80.6% cases having diabetic nephropathy, indicating a statistically significant association of metabolic syndrome as a contributing factor for microvascular complications.¹⁷ Ahamed et al, observed that in patients with metabolic syndrome, 33.3% were found to have retinopathy (vs. 13.3% in control group); 38.7% had nephropathy (vs. 22.7% in the control group); 50.7% had neuropathy (vs. 26.7% in the control group).¹⁸ Thus, indicating that patients with MS have more prevalence of microvascular complications as compared to patients with only diabetes mellitus.

Similarly, authors found a high prevalence of MVCs in diabetic patients having MS (DR in 92.5% cases,

neuropathy in 80.6% cases, and nephropathy in 79.1% cases) (Table 6).

Limitations of this study it was a hospital-based study, the possibility of overestimation of microvascular complications compared to community-based studies cannot be denied. The study was also limited by a small sample size. Further, cause and effect relationship between microvascular complications and comorbid illnesses could not be established due to cross sectional design of the study. The authors further recommend cohort studies to confirm causal relationship between various risk factors and microvascular complications of diabetes.

CONCLUSION

Diabetic retinopathy was found to be the most common microvascular complication followed by diabetic nephropathy and neuropathy in that order. The presence of comorbid conditions like hypertension, ischemic heart disease, and Metabolic Syndrome were found to be associated with higher prevalence of microvascular complications.

The study highlights the need of aggressive screening for early detection of microvascular complications in diabetic patients; more so, if they have comorbid conditions like hypertension, ischaemic heart disease and metabolic syndrome.

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