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Original Research Article

A study of micro vascular complications and associated risk factors in newly diagnosed patients of type 2 diabetes mellitus

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ABSTRACT

Background: Diabetes and its complications are one of the leading causes of death and disability worldwide. The aim of the study is to elucidate the prevalence and associated risk factors of microvascular complication among diabetes mellitus type 2 population of Ajmer, Rajasthan India.
Methods: This is the study of 464 newly detected type 2 diabetic people screened for their biochemical parameters, attending outpatient department comprising of 256 male and 208 female. The presence of complications was evaluated by relevant investigations.
Results: Microvascular complication namely retinopathy was diagnosed in 344 (74%) of type 2 diabetic patients, neuropathy in 200 (43%), nephropathy in 138 (30%). Linear regression analysis concluded that age, body mass index, duration, family history, stress, glycated haemoglobin (HbA1C), triglyceride and total cholesterol were significantly associated with these vascular complications. Prevalence of microvascular complications increases with age, duration, body mass index (BMI), hereditary and poor glycemic control.
Conclusions: Retinopathy and neuropathy were the most prevalent microvascular complication in type 2 diabetic population.

Keywords: Diabetes mellitus type 2, Microvascular complication, Chronic complication, Retinopathy, Neuropathy, Nephropathy

INTRODUCTION

Diabetes mellitus type 2 is the most common non communicable chronic metabolic disorder caused by the relative insufficiency of insulin secretion and insulin action. If it is not properly treated or left untreated it is characterized by chronic hyperglycaemia and disordered carbohydrate, lipid and protein metabolism and is associated with the development of specific microvascular complications and of non-specific macrovascular disease.[1] Microvascular complication includes the disease of eye, kidney and variety of clinical neuropathies. People with diabetes are at higher risk of developing a number of complications than people without diabetes.

The global prevalence and economic cost of diabetes and its complications are abnormally increasing and become a real problem of developed and developing countries like India and this is projected to increase substantially over the next 2 decades. According to the diabetes atlas, seventh edition 2015 published by the IDF. The total number of people with diabetes in India currently around 69.2 million is expected to rise to 123.5 million by 2040.[2] Diabetes complications can affect many parts of body, manifesting in different ways in different people. Moreover, at least one complication is present in large

proportion of people with diabetes at the time of diagnosis.[2] Around 20% to 25% of type 2 diabetic people already have retinopathy at the time of diagnosis.[3] Diabetes is likely to be underreported as a cause of death simply because diabetes leads to many complications that ultimately cause death.

Poorly managed diabetes leads to serious complications, reduced quality of life and early death. Diabetes complications can be prevented or delayed by maintaining blood glucose, blood pressure and cholesterol levels as close to normal. Therefore to determine the prevalence of complications among diabetes urban Indian population and also study the influence of various modifiable and non- modifiable risk factor on complication

The aim of the present study is to describe the prevalence and associated risk factors of micro vascular complication among diabetic population of Ajmer Rajasthan India. Diabetes and its complication both are the major health challenge for small city of Ajmer.

METHODS

This is the study of newly detected 464 diabetes type 2 patients comprising of 256 male and 208 female screened for their biochemical parameters, attending outpatient (OPD) especially consultations of Department of Biochemistry, JLN Medical college, and Saxena Diabetes Care Centre Ajmer. They are agreed to sign a written consent of all related aspect and outcomes.

A questionnaire was phrased for obtaining the information about socio demographic status, age, past history, family history, stress and complications. The presence of complications was evaluated by relevant investigations. Retinopathy was diagnosed by symptom of blurred vision and detailed fundus examination. Nepheropathy was by elevated level of creatinine and blood urea. Neuropathy and peripheral vascular disease was diagnosed by history of numbness, tingling and burning sensations and confirmed by vibration test with biothesiometer and examination of peripheral pulses of feet or ankle brachial pressure index.

The biochemical marker studies included blood glucose, HBAIC, cholesterol and triglycerides. Anthropometric measurements, height, weight (BMI) of each participant was recorded. Body mass index is defined as the individuals body weight divided by the square height (kg/m^2).

Inclusion criteria

Newly diagnosed type 2 diabetes patients more than 10 years of age were included in the study. Blood glucose levels of diabetes mellitus was confirmed by classification and diagnosis criteria lay by WHO (1999). According to WHO criteria of diagnosis are FPG ≥110 mg/dl as no caloric intake for at least 8 hours; 2 hrs post plasma glucose (PPG) ≥200 mg/dl as after intake caloric intake; random plasma glucose ≥200 mg/dl and with classic symptoms of hyperglycemia or hypoglycemic crisis; glycosylated hemoglobin (HbA1C) ≥6.5% are diabetic.[4] All these tests were conducted using randox kit from USA.

Exclusion criteria

Exclusion criteria were type 1 diabetes mellitus patients were excluded; pregnant women; highly depressed patients; very severe illness before diagnosis of diabetes; patients who refused to be part of study.

Period of study

This study was conducted 3 years during July 2014 to July 2017.

Analysis of data

Entire data was entered in excel spreadsheet by masking personal identity of each respondent. Mean and percentage were calculated for each suitable studied variable. Linear regression analysis is used to establish the association between diabetes complication and risk factor. SPSS version 21 software is used for statistical analysis.

RESULTS

In this study total no. of type 2 DM patients studied were 464 shown in Table 2. Microvascular complication namely retinopathy was diagnosed in 344 (74%) of DM type 2 patients, neuropathy in 200 (43%), nephropathy in 138 (30%) (Figure 1).

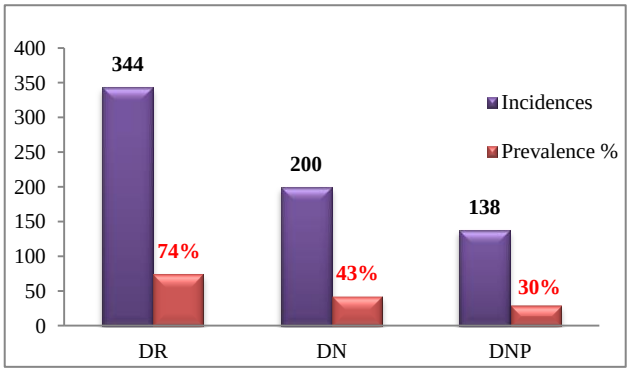

Figure 1: Showing the incidences and prevalence of micro vascular complications in type 2 diabetes mellitus.

Table 1 indicates a significant association with all complications with age. P value <0.05 showed a significant association with all complications with age. In Table 2 patients of DM type 2 were divided into seven age groups according to their age in years 11 to 20 is the lowest and 71 to 80 years is the highest group. Maximum

patients were suffering from retinopathy 104 (72%), neuropathy 64 (62%), nephropathy 46 (32%). The prevalence of DR (92%) and DN (54%) was found to maximum in age group of 71 to 80 years; DN (62%) was in age groups 61 to 70 years**.** As in the table 1, the age was correlating, the linear regression we found a $p<0.05$ that showed a significant association with all complications.

Table 1: Showing the correlation of modifiable and non- modifiable factor with diabetic complications.

Risk factors	Pearson correlation	Diabetic retinopathy (DR)	Diabetic neuropathy (DN)	Diabetic nephropathy (DNP)	ANOVA	
Age-group	Std. coefficients Beta	-0.168	-0.179	-0.251	F	Sig.
	(Sig) P value	0.000	0.000	0.000	10.330	0.000[b]
BMI	Std. coefficients Beta	-0.079	0.053	0.060		
	(Sig) P value	0.045	0.129	0.098	2.612	0.012[b]
Duration	Std. coefficients Beta	-0.115	-0.074	0.082		
	(Sig) P value	0.007	0.055	0.039	2.993	0.004[b]
Family history	Std. coefficients Beta	-0.100	-0.071	-0.091		
	(Sig) P value	0.016	0.062	0.025	2.473	0.017[b]
Stress	Std. coefficients Beta	0.004	0.010	0.025		
	(Sig) P value	0.463	0.417	0.296	3.543	0.001[b]
HbA1C	Std. coefficients Beta	0.160	-0.052	-0.026		
	(Sig) P value	0.000	0.131	0.285	5.008	0.000[b]
Triglyceride (TG)	Std. coefficients Beta	0.059	-0.128	0.019		
	(Sig) P value	0.102	0.003	0.338	4.151	0.000[b]
Total cholesterol	Std. coefficients Beta	-0.059	0.016	0.077		
	(Sig) P value	0.103	0.362	0.049	4.862	0.000[b]

b=Predictors: (Constant), Foot problem, Neuropathy (neuron problem), Retinopathy (eye problem).

Table 2: Describes the prevalence and incidences of diabetic complications in non-modifiable factors.

		Total	Diabetic retinopathy (DR)	Diabetic neuropathy (DN)	Diabetic nephropathy (DNP)
		Incidences (prevalence %)	Incidences (prevalence %)	Incidences (prevalence %)	Incidences (prevalence %)
Age group	11-20 yrs	8 (2)	4 (50)	3 (38)	0 (0)
	21-30 Yrs	16 (3)	12 (75)	5 (31)	0 (0)
	31-40 yrs	40 (9)	24 (60)	12 (30)	8 (20)
	41-50 yrs	100 (22)	68 (68)	36 (36)	20 (20)
	51-60 yrs	144 (31)	104 (72)	52 (36)	46 (32)
	61-70 yrs	104 (22)	84 (81)	64 (62)	36 (35)
	71-80 yrs	52 (11)	48 (92)	28 (54)	28 (54)
	Total	464 (100)	344 (74)	200 (43)	138 (30)
Duration of diabetes	11 month	88 (19)	54 (61)	35 (40)	35 (40)
	1-5 yrs	229 (49)	167 (73)	97 (42)	64 (28)
	6-10 yrs	88 (19)	70 (80)	39 (44)	25 (28)
	11-15 yrs	37 (8)	35 (95)	16 (43)	9 (24)
	16-20 yrs	17 (4)	13 (76)	8 (47)	4 (24)
	21-25 yrs	4 (1)	4 (100)	4 (100)	0 (0)
	26-30 yrs	1 (0)	1 (100)	1 (100)	1 (100)
	Total	464 (100)	344 (74)	200 (43)	138 (30)
BMI of diabetic patients	<18.5	24 (5)	16 (67)	12 (50)	4 (17)
	18.5-24.99	144 (31)	100 (69)	60 (42)	44 (31)
	25-29.99	160 (34)	128 (80)	80 (50)	50 (31)
	30-34.99	76 (16)	56 (74)	24 (32)	36 (47)
	35-39.99	40 (9)	28 (70)	16 (40)	4 (10)
	>40	20 (4)	16 (80)	8 (40)	0 (0)
	Total	464 (100)	344 (74)	200 (43)	138 (30)

Continued.

		Total	Diabetic retinopathy (DR)	Diabetic neuropathy (DN)	Diabetic nephropathy (DNP)
		Incidences (prevalence %)	Incidences (prevalence %)	Incidences (prevalence %)	Incidences (prevalence %)
Family history	None	220 (47)	156 (71)	80 (36)	62 (28)
	Mother	96 (21)	76 (79)	48 (50)	24 (25)
	Father	60 (13)	44 (73)	32 (53)	16 (27)
	Both parent	20 (4)	8 (40)	12 (60)	8 (40)
	Parents and sibling	44 (9)	40 (91)	16 (36)	20 (45)
	Siblings	24 (5)	20 (83)	12 (50)	8 (33)
	Total	464 (100)	344 (74)	200 (43)	138 (30)

Table 3: Describes the prevalence and incidences of diabetic complications in modifiable factors.

	Description	Total	Diabetic retinopathy (DR)	Diabetic neuropathy (DN)	Diabetic nephropathy (DNP)
		Incidences (prevalence %)	Incidences (prevalence %)	Incidences (prevalence %)	Incidences (prevalence %)
Situation of stress	Death of close relative	16 (3)	12 (75)	8 (50)	4 (25)
	Anxiety persisting	40 (9)	36 (90)	12 (30)	8 (20)
	Health	192 (41)	140 (73)	84 (44)	69 (36)
	Financial problem	20 (4)	16 (80)	12 (60)	0 (0)
	Property	4 (1)	4 (100)	4 (100)	0 (0)
	Education and career	24 (5)	12 (50)	8 (33)	8 (33)
	Children marriage	12 (3)	8 (67)	8 (67)	8 (67)
	Work load	20 (4)	16 (80)	8 (40)	4 (20)
	Death of relative, anxiety and health	52 (11)	32 (62)	24 (46)	17 (33)
	Property and financial	52 (11)	40 (77)	16 (31)	12 (23)
	Education, child marriage and work load	32 (7)	28 (88)	16 (50)	8 (25)
	Total	464 (100)	344 (74)	200 (43)	138 (30)
Triglyceride (TG)	(Optimal)	28 (6)	24 (86)	12 (43)	8 (29)
	(Normal)	124 (27)	88 (71)	36 (29)	40 (32)
	(High)	312 (67)	232 (74)	152 (49)	90 (29)
	Total	464 (100)	344 (74)	200 (43)	138 (30)
Hemoglobin glucose HbA1C	(Non diabetic)	12 (3)	8 (67)	4 (33)	8 (67)
	(Good control)	112 (24)	92 (82)	53 (47)	29 (26)
	(Fair control)	172 (37)	128 (74)	60 (35)	44 (26)
	(Poor control)	147 (32)	99 (67)	71 (48)	53 (36)
	(Very poor)	21 (5)	17 (81)	12 (57)	4 (19)
	Total	464 (100)	344 (74)	200 (43)	138 (30)
Total cholesterol	(Normal)	32 (7)	20 (63)	12 (38)	16 (50)
	(Optimal)	144 (31)	100 (69)	68 (47)	40 (28)
	(High)	288 (62)	224 (78)	120 (42)	82 (28)
	Total	464 (100)	344 (74)	200 (43)	138 (30)

Table 1 showed that BMI was significantly ($p<0.05$) associated with retinopathy ($p=0.045$). Maximum patients of retinopathy are 128 out of 464. 80 of neuropathy and 50 of nephropathy was found in the overweight categories whose BMI were in between 25-29.99 kg/cm^2. The maximum prevalence of retinopathy was found 80% in overweight categories of BMI, neuropathy and nephropathy were 50% and 47% respectively (Table 2).

Regression analysis showed that duration of diabetes is significantly affecting the microvascular complication ($p=0.007$, 0.05, 0.03 respectively) Table 1. Highest

incidences of vascular complication lie in the group of 1 to 5 years of duration of diabetes. Prevalence of vascular complication increased with duration. After 11 to 15 years of suffering 95% patients were suffering from retinopathy and after 16 to 20 years of suffering, prevalence of neuropathy was 47% (Table 2).

In our study hereditary factor was significantly associated with retinopathy (p=0.01) and nephropathy (p=0.02) Table 1. Maximum incidences of vascular complications are found in categories those do not have any family history of diabetes. But prevalence of micro complication was found significantly higher in patients whose both parents and sibling are suffering from diabetes that is retinopathy; neuropathy and nephropathy were 83%, 60% and 45% respectively (Table 2).

Non modifiable risk factor

Various situation of stress that is mention in the table 1 were not significantly influence the micro vascular complication. Neuropathy (p=0.003) was significantly associated with triglycerides. A total 312 diabetes type 2 patients out of 464 were having triglyceride level above the normal range. Prevalence of retinopathy, neuropathy and nephropathy was 72%, 49% and 29% respectively due to higher range of triglycerides (Table 3).

Retinopathy (p=0.00) was significantly associated with HbA1C showed in Table 1. Out of 464 diabetes patients 172 have fair control, 142 have poor and 21 were having very poor control on blood sugar. The prevalence of retinopathy was found maximum 82% in poor (6.6-8.0%) and very poor (12.6-15%) control of HBA1C. Nephropathy (p=0.04) were significantly associated with high cholesterol level (Table 3).

DISCUSSION

Diabetic retinopathy (DR) and risk factors

The results of our study demonstrated a positive association of age, duration of diabetes, family history of diabetes, BMI, poor diabetes control HBAIC and with retinopathy and not associated with stress and dyslipidemia. Our results collaborated with the results of Heidari and Rassoulinejad et al who reported dyslipidemia, smoking and hypertension were not associated with DR.[5] Song et al reported increased age, higher prevalence of obesity, hypertension, and dyslipidemia are significantly causing risk factors for diabetic retinopathy.[6] Ocular complications occur at higher BMI levels than other complications in both genders were reported by Gray and Picone et al.[7] Obesity imposes diabetic patients to more severe DR due to inflammatory process. Both obesity and inflammation play a role in the development of endothelial impairment involved in diabetic retinopathy. Ramachandran and Snehalatha et al reported after studying the population of south India that retinopathy was diagnosed in 23.7% (background retinopathy in 20.0% and proliferative in 3.7%) and also showed that age had a significant association with retinopathy.[8] Rema and Ponnaiya et al, studied duration of diabetes, glycosylated haemoglobin, type of treatment, systolic and diastolic blood pressures and serum creatinine, showed a positive association with retinopathy but body mass index (BMI) showed an inverse association.[9]

Diabetic neuropathy (DN)

Our result showed that DPN is significantly associated with age, duration and higher level of triglycerides and not with BMI, family history, stress, HBA1C and cholesterol level that supports the findings of Gill, Yadav et al, which showed that DPN was independently associated with age and duration of diabetes but not with body mass index, plasma glucose, or HbA1c.[10] Mohan et al, found neuropathy was the most common complication that increased with age and poor glycemic control.[11] Song, reported neuropathy became significantly higher in T2DM after 20 years duration.[6] Distal symmetrical polyneuropathy shows a constant rise with duration reported by Orchard and Dorman et al.[12] Ramachandran and Snehalatha et al showed that age and higher HbA1 had a significant association with neuropathy but hypertension was not associated with the complications of neuropathy.[8]

Nephropathy (DNP)

Our finding partially associated with the finding of Svensson and Tyrberg et al who reported older age and higher BMI at diagnosis of diabetes were the risk markers for development of diabetic nephropathy.[13] In addition, poor glycaemic control but systolic blood pressure was not a risk marker for later development of diabetic nephropathy. Ramachandran and Snehalatha et al, showed that age and higher HbA1C is a significantly associated with nephropathy.[6] In our result, duration and family history of diabetes also influenced neuropathy.

CONCLUSION

Advancement in age was found to be a main culprit of micro vascular complication. Duration of diabetes and BMI was directly proportional to these complications. Family history of diabetes were also influence the micro vascular complications, prevalence was found significantly higher in patients whose both parents and sibling are suffering from diabetes. Retinopathy and neuropathy were the most prevalent microvascular complication in type 2 diabetic population of Ajmer city. Screening with some simple test such as ECG, fundoscopy, biothesiometer and biochemical tests namely, lipid, protein and fat profile for all cases of diabetes is essential to identify the complications at an early age. These complications were delayed or controlled by biochemical parameters within normal range. No such studies in the past have been done in this

region, through which comparisons could be made. Further studies are required to justify the conclusion of risk and complications in Ajmer Rajasthan (India).

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