Section: Miscellaneous

Original Research Article

TYPE AND SEVERITY OF DIABETIC RETINOPATHY IN DIABETIC FOOT PATIENTS

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Abstract

Background: To study the presence, type & severity of diabetic retinopathy in diabetic foot patients and to evaluate the clinical features and visual parameters among diabetic foot patients with diabetic retinopathy. **Materials and Methods:** A hospital based cross sectional study was conducted among 180 subjects in the age group of 25 to 70 years who were diagnosed to have type II diabetes mellitus for more than 5 years and having an established diabetic foot. Study was conducted at Government Medical College, Kozhikode from January 2019 to January 2020. **Result:** Out of 180 subjects with diabetic foot, 65.5% were having diabetic retinopathy and 34.4% were not having diabetic retinopathy. An increased presence of retinopathy in patients with an increased grade of diabetic foot was found statistically significant by the Chi-square test ($P < 0.001$). In patients with grade 1 diabetic foot,40% were having diabetic retinopathy (36% NPDR and 4% PDR) and patients with grade 3 diabetic foot,66.2% were having diabetic retinopathy(58.1% NPDR and 8.1% PDR).While in patients with grade 5 diabetic foot,86.4% patients were having diabetic retinopathy(50% NPDR and 36.4% PDR). A positive correlation was found by Kendall's tau-b test, between the increasing severity of diabetic foot and severity of the stage of retinopathy ($\tau b = 0.433$, $P < 0.01$). **Conclusion:** Our study found an increased presence and severity of diabetic retinopathy in patients with higher grades of diabetic foot. Presence of maculopathy was also observed to be more among patients with severe grades of diabetic foot. Mean BCVA was poor among patients with diabetic retinopathy when compared to patients without diabetic retinopathy. Patients with diabetic retinopathy showed lower hemoglobin value than patients without diabetic retinopathy.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycemia which develops as a consequence of defects in insulin secretion, insulin action, or both.[1] Type 1 diabetes is characterized by the presence of beta cell auto antibodies leading to insulin deficiency. In Type 2 diabetes mellitus, peripheral insulin resistance and dysfunctional insulin secretion by pancreatic beta cells is implicated in the pathogenesis.[2] According to World Health Organization, DM will be the seventh-leading cause of death worldwide in 2030.[3]

Diabetic retinopathy is the most common microvascular complication in diabetes and ultimately it may lead to blindness.[4] After about 20 years, nearly 99 percent of patients of type 1 and about 60 percent of type 2 diabetes mellitus develops diabetic retinopathy.[5] The most common cause of vision loss in patients having diabetic retinopathy is macular edema (DME).

Diabetic Retinopathy Study (DRS) was the first landmark clinical trial for diabetic retinopathy and it showed a significant reduction in the rates of severe vision loss in eyes treated with pan retinal photocoagulation compared to untreated control eyes.[6]

In this study we are planning to study the type and severity of diabetic retinopathy in diabetic foot patients.

MATERIALS AND METHODS

This cross sectional study was done in Department of ophthalmology outpatient, inpatient department of General Surgery and Diabetic foot clinic under the department of General medicine, Government

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Medical College, Kozhikode. From January 2019 to January 2020.

Inclusion Criteria

Patients with age of 25 to 70 yrs with Type 2 diabetes mellitus for >5 yrs and is having diabetic foot.

Exclusion Criteria

Patients with Type 1 DM

Patients with gestational diabetes

Patients having other retinal vascular diseases

Patients who is not giving consent for the study

Sample Size: According to a study conducted by Thoiba karam et al in south India and published in IJO in 2018, prevalence of diabetic retinopathy in diabetic foot patients found to be 67.5%.

According to the formula =4

d2

p=prevalence, 67.5% q=100-p=32.5 d=10% of p=7

So sample size is calculated as 180

Study Variables

Demographic variables like age and gender were studied.

Lab investigations were done including fasting blood sugar (FBS), post prandial blood sugar (PPBS), glycosylated hemoglobin (HbA1C), renal function test (RFT), fasting lipid profile (FLP), hemoglobin (Hb), and urine for microalbumin.

Ophthalmological evaluation including visual acuity using snellens chart, anterior segment evaluation using slitlamp biomicroscopy, fundus evaluation using a +90D lens, direct ophthalmoscope and indirect ophthalmoscope were done in these patients and diabetic retinopathy classified according to ETDRS classification.

Method of Data Collection

This was a cross-sectional study conducted from January 2019 to January 2020 after obtaining Institutional ethical committee clearance. Subjects in the age group of 25 to 70 years, diagnosed with type II diabetes mellitus for more than 5yrs and having established diabetic foot was enrolled into the study. The study was explained and written informed consent was obtained from the patients before their enrollment. Patients who were not ready to give consent were not included. Subjects with Type I DM, gestational diabetes, other retinal vascular disorders were also not included in the study.

Diagnostic criteria for diabetes mellitus was WHO criteria, according to which FBS≥126mg/dl,2hour PPBS≥200mg/dl, HbA1c≥6.5%; or a RBS≥200mg/dl in the presence of signs and symptoms are diagnosed as having diabetes mellitus. We selected patients who were already diagnosed to have Type II diabetes mellitus for more than 5 years.

The participants then underwent a detailed ophthalmological evaluation including visual acuity, anterior segment evaluation using slit-lamp biomicroscopy and fundus evaluation using a + 90 D lens, direct and an indirect ophthalmoscope. Visual acuity was assessed using Snellen visual acuity chart and converted into log MAR equivalent. In patients with unequal diabetic retinopathy between eyes, the retinopathy of greater severity was considered. Diabetic retinopathy was classified according to ETDRS classification. For making the analysis easy, diabetic retinopathy patients were classified into three groups; No DR, NPDR and PDR.

RESULTS

In total, 180 participants were enrolled in this study according to inclusion and exclusion criteria. Study was conducted for a duration of 1 year. Among the study population, 132 (73.3%) were males and 48(26.7%) were females. Majority of patients (38.3%) belonged to age group 55-64yrs. The mean age was 54.63 ± 7.97 years. Mean duration of DM was 16.03 ± 7.24yrs. Mean BCVA in our study was logMAR 0.633 ± 0.614.

Table 1: Demographical data and BCVA among total population.

	MEAN	SD	MAXIMUM	MINIMUM
Age in years	54.63	7.97	69	38
Duration of DM in years	16.03	7.24	30	6
BCVA (LogMAR)	0.633	0.614	3	0

Table 2: Distribution of comorbidities and complications among total population

Comorbidity	N	Percentage
Hypertension	92	51.1
Dyslipidemia	48	26.7
Coronary artery disease	18	10.0
Cerebro vascular accidents	6	3.3
Chronic kidney disease	30	16.7
Peripheral occlusive vascular disease*	66	59.5
Microalbuminuria	60	33.3

**Presence of Peripheral occlusive vascular disease was studied only among 111 patients as previous arterial Doppler study was present only in those patients. Most common comorbidity among the study population was hypertension.

Most of the patients were taking OHA alone for controlling diabetes mellitus.20% of the population was using both OHA and insulin for DM control.

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Table 3: Biochemical and hematological parameters among total study population

	MEAN	SD	MAXIMUM	MINIMUM
FBS(mg/dl)	132.09	25.09	200	86
PPBS(mg/dl)	117.58	33.52	299	112
HbA1C(%)	8.05	2.24	14.5	5
Hemoglobin(g/dl)	11.69	1.80	14.6	6.3

Glycemic status of the study population was assessed using the values of FBS, PPBS and HbA1c.Mean value of FBS, PPBS and HbA1c was 132.09 ± 25.09 mg/dl, 17.58 ± 33.52 mg/dl and 8.05 ± 2.24 % respectively. Mean hemoglobin was 11.69 ± 1.80 g/dl.

Table 4: Demographical data and BCVA among patients with and without diabetic retinopathy

	Retinopathy		NO RETINOPATHY		
	MEAN	SD	MEAN	SD	P VALUE
Age in years	56.83	7.71	50.44	6.72	<0.001**
Duration of DM in years	18.64	6.50	11.08	5.91	<0.001**
BCVA(LogMAR)	0.863	0.619	0.195	0.271	<0.001**

**P VALUE SIGNIFICANT

Mean age and duration of DM was found high among patient with diabetic retinopathy than patients without diabetic retinopathy. Mean BCVA was poor among patients with diabetic retinopathy when compared to patients without diabetic retinopathy. These observations were statistically significant.

Table 5: Distribution of comorbidities and complications among patients with and without diabetic retinopathy

	Retinopathy		No retinopathy		P value
Comorbidity	N	Percentage	N	Percentage	
Hypertension	74	62.7	18	29	<0.001**
Dyslipidemia	33	28	15	24.2	0.723
Coronary artery disease	17	14.4	1	1.6	0.007**
Cerebrovascular accidents	6	5.1	0	0	0.095
Chronic kidney disease	26	22	4	6.5	0.010**
Peripheral occlusive vascular disease	45	61.6	21	55.3	0.546
Microalbuminuria	56	47.5	4	6.5	<0.001**

**P value significant

Presence of hypertension, CKD, CAD and microalbuminuria was found more among patients having diabetic retinopathy than patients without diabetic retinopathy (P VALUE<0.05).Dyslipidemia and CVA was more among patients with retinopathy, but it was not statistically significant. POVD could be studied only in 111 patients due to unavailability of arterial Doppler study report in the rest of the subjects. POVD was also found to be more among patients with retinopathy than patients without retinopathy but this observation was not statistically significant.

Table 6: Biochemical and hematological parameters among patients with and without diabetic retinopathy

	NO diabetic retinopathy		Diabetic retinopathy		
	MEAN	SD	MEAN	SD	P value
FBS(mg/dl)	119.53	16.86	138.69	26.22	<0.001**
PPBS(mg/dl)	157.82	21.62	187.96	34.05	<0.001**
HbA1C(%)	6.97	1.26	8.62	2.43	<0.001**
Hemoglobin(g/dl)	12.40	1.79	11.31	1.70	<0.001**

**P value significant

Mean FBS, PPBS and HbA1c were found high among patients having diabetic retinopathy than patients without diabetic retinopathy. Mean hemoglobin was low among patients with diabetic retinopathy than patients without retinopathy. All these observations were found statistically significant.

Table 7: Relation between type of diabetic retinopathy and duration of diabetes mellitus

		Duration of DM				P value
	5-10YRS	11-15YRS	16-20YRS	21-25YRS	>25YRS	
No DR	35 68.6%	12 40.0%	10 24.4%	5 13.2%	0 .0%	<0.001**
NPDR	15 29.4%	17 56.7%	23 56.1%	22 57.9%	10 50.0%	
PDR	1 2.0%	1 3.3%	8 19.5%	11 28.9%	10 50.0%	

Among patients with duration of diabetes mellitus more than 25 years, 100% of them have diabetic retinopathy (50% NPDR and 50% PDR). While those with 5–10 years of diabetes, only 31.4% have diabetic retinopathy. Prevalence of diabetic retinopathy increases significantly when the duration of diabetes mellitus increases. Proliferative diabetic retinopathy is also more common in patients with longer duration of DM than patients with shorter duration. These observations were significant.

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Table 8: Demographical data and BCVA based on type of diabetic retinopathy

	No DR		NPDR		PDR		
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**P value**
Age in years	50.44	6.72	56.67	7.90	57.29	7.28	<0.001**
Duration of DM in years	11.08	5.91	17.51	6.53	21.81	5.29	<0.001**
BCVA(LogMAR)	0.195	0.270	0.660	0.440	1.432	0.697	0<.001**

**P value significant

When compared the mean values of age and duration of DM between NPDR and PDR, it was found that mean value was higher in patients with PDR than NPDR ($p<0.05$).Mean BCVA among patients without diabetic retinopathy, NPDR and PDR was logMAR 0.195 ± 0.270, 0.660 ± 0.440 and 1.432 ± 0.697 respectively (P value <0.05).

Table 9: Comorbidities and complications based on type of diabetic retinopathy

		No DR		NPDR		PDR	P value
Comorbidity	**N**	**Percentage**	**N**	**Percentage**	**N**	**Percentage**	
Hypertension	18	29	59	67.8	15	48.4	<0.001**
Dyslipidemia	15	24.2	26	29.9	7	22.6	0.631
Coronary artery disease	1	1.6	13	14.9	4	12.9	0.024**
Cerebrovascualr accidents	0	0	5	5.7	1	3.2	0.156
Chronic kidney disease	4	6.5	17	19.5	9	29	0.014**
Peripheral occlusive vascular disease	21	55.3	33	58.9	12	70.6	0.561
Microalbuminuria	4	6.5	42	48.3	14	45.2	<0.001**

** P value significant

Hypertension, CAD and microalbuminuria were present more among patient with NPDR than PDR.CKD was more among patients with PDR. These observations were statistically significant.

Table 10: Biochemical and hematological parameters based on type of diabetic retinopathy

	No DR		NPDR		PDR		
	MEAN	**SD**	**MEAN**	**SD**	**MEAN**	**SD**	**P value**
FBS(mg/dl)	119.53	16.86	131.80	22.80	158.03	25.85	<0.001**
PPBS(mg/dl)	157.82	21.62	181.15	33.14	207.06	29.36	<0.001**
HbA1C(%)	6.97	1.26	8.09	2.15	10.10	2.58	<0.001**
Hb(g/dl)	12.40	1.79	11.31	1.80	11.33	1.42	<0.001**

**P value significant

FBS, PPBS and HbA1c were high among patients with proliferative diabetic retinopathy than with non-proliferative diabetic retinopathy. Hemoglobin value was low among patients with diabetic retinopathy than patients without diabetic retinopathy but it showed not much difference between patients with NPDR and PDR (P value <0.05).

Table 11: Biochemical and hematological parameters based on severity of NPDR

	VERY MILD		MILD		MODERATE		SEVERE		VERY SEVERE		
	MEAN	**SD**	**MEAN**	**SD**	**MEAN**	**SD**	**MEAN**	**SD**	**MEAN**	**SD**	**P value**
FBS(mg/dl)	103.70	11.30	142.03	22.67	130.17	19.26	133.92	21.32	133.17	21.54	<0.001**
PPBS(mg/dl)	135.50	19.67	190.17	29.81	176.60	24.45	205.50	32.44	187.67	34.62	<0.001**
HbA1C(%)	6.37	0.54	7.27	1.03	8.16	2.14	10.60	2.51	9.62	2.15	<0.001**
Hb(g/dl)	11.51	2.18	11.66	1.89	11.40	1.31	9.90	2.15	11.55	1.06	0.064

** P value significant

Patients with all grades of NPDR showed poor glycemic control. Mean hemoglobin was less than normal among patients with NPDR. But it didn't show any relation with severity of NPDR.

Table 12: Biochemical and hematological parameters based on severity of PDR

	Mild - moderate		High risk		ADED		
	MEAN	**SD**	**MEAN**	**SD**	**MEAN**	**SD**	**P value**
FBS(mg/dl)	152.19	31.74	168.36	16.23	153	12.62	0.263
PPBS(mg/dl)	203.31	29.40	217	33.01	194.75	5.06	0.340
HbA1C(%)	10.44	2.51	10.50	2.79	7.65	0.44	0.125
Hb(g/dl)	11.71	1.11	11.30	1.56	9.83	1.46	.053

Mean FBS, PPBS and HbA1c was higher than normal value in patients with PDR, but there was no significant relation between these values and severity of PDR. Hemoglobin value was low among patients with severe grades of PDR but it was not statistically significant.

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Table 13: Demographical parameters and BCVA in patients with and without maculopathy

	No maculopathy		Maculopathy		
	Mean	**SD**	**Mean**	**SD**	**P value**
Age	53.87	7.794	57.28	8.121	0.017**
Duration of DM in years	14.80	6.994	20.35	6.467	<0.001**
BCVA(LogMAR)	0.497	0.5158	1.108	0.6959	<0.001**

**P value significant

Age and duration of diabetes mellitus was high among patients with maculopathy than patients without maculopathy (p value<0.05).

Table 14: Biochemical and hematological parameters in patients with and without maculopathy

	No maculopathy		Maculopathy		
	MEAN	**SD**	**MEAN**	**SD**	**P value**
FBS(mg/dl)	128.26	24.04	145.50	24.38	<0.001**
PPBS(mg/dl)	170.99	29.82	200.65	35.84	<0.001**
HbA1C(%)	7.76	2.11	9.08	2.39	0.001**
Hb(g/dl)	11.82	1.76	11.22	1.91	0.060

**P value significant

Mean FBS, PPBS and HbA1c values were high among patients with maculopathy than without maculopathy (P <0.05). Hb value showed no significant relation between patients with and without maculopathy.

Table 15: Biochemical and hematological parameters in patients with different grades of diabetic foot

	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		
	MEAN	**SD**	**MEAN**	**SD**	**MEAN**	**SD**	**MEAN**	**SD**	**MEAN**	**SD**	**P value**
FBS(mg/dl)	117.04	25.40	128.17	23.23	127.95	22.09	143.51	23.31	149.14	23.77	<0.001**
PPBS(mg/dl)	155	34.55	166.31	26.52	170.65	24.35	198.97	32.59	207.18	30.82	<0.001**
HbA1C(%)	7.04	2.22	7.29	1.25	7.77	2.00	9.37	2.50	9.14	2.44	<0.001**
Hb(g/dl)	12.86	1.60	12.35	1.57	11.66	1.80	10.88	1.63	10.64	1.51	<0.001**

**P value significant

Mean FBS, PPBS and HbA1c values were high among patients with higher grades of diabetic foot. Hemoglobin value was low among patients with higher grades of diabetic foot. These observations were statistically significant.

Factor Analysis:

Table 16: Relation between presence of diabetic retinopathy and diabetic foot grading

	Diabetic foot grading					P value
	Grade 1	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**	
Diabetic Retinopathy	10 (40%)	13 (36.1)	41 (66.1)	35 (100)	19 (86.4%)	<0.001**
No diabetic Retinopathy	15 (60)	23 (63.9%)	21 (33.9)	0 (0%)	3 (13.6%)	

**P value significant

Presence of diabetic retinopathy was found high among patients with high grade diabetic foot and it was statistically significant.

Table 17: Relation between type of diabetic retinopathy and diabetic foot grading

	Diabetic foot grading					P value
	Grade 1	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**	
NO DR	15 60.0%	23 63.9%	21 33.9%	0 .0%	3 13.6%	<0.001**
NPDR	9 36.0%	10 27.8%	36 58.1%	21 60.0%	11 50.0%	
PDR	1 4.0%	3 8.3%	5 8.1%	14 40.0%	8 36.4%	

**P value significant

In patients with grade 1 diabetic foot, 40% were having diabetic retinopathy(36% NPDR and 4% PDR) and patients with grade 3 diabetic foot, 66.2% were having diabetic retinopathy (58.1% NPDR and 8.1% PDR).While in patients with grade 5 diabetic foot, 86.4% patients were having diabetic retinopathy (50% NPDR and 36.4% PDR).

Presence of diabetic retinopathy was found high among patients with high grade diabetic foot and it was statistically significant (p<0.05). A positive correlation was found by Kendall's tau-b test, between the increasing severity of diabetic foot and severity of the stage of retinopathy ($\tau b = 0.433$ P = 0.00).

Table 18: Relation between severity of NPDR and diabetic foot grading

	Diabetic foot grading					P value
	Grade 1	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**	
Very mild NPDR	3 (30.0%)	1 (10.0%)	4 (40.0%)	2 (20.0%)	0 (.0%)	<0.001**
Mild NPDR	2 (6.9%)	4 (13.8%)	18 (62.1%)	0 (.0%)	5 (17.2%)	
Moderate NPDR	3 (10.0%)	4 (13.3%)	13 (43.3%)	7 (23.3%)	3 (10.0%)	
Severe NPDR	0 (.0%)	0 (.0%)	0 (.0%)	10 (83.3%)	2 (16.7%)	

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Very severe NPDR	1 (16.7%)	1 (16.7%)	1 (16.7%)	3 (33.3%)	1 (16.7%)	

**P value significant

Severity of NPDR was more among patients with more severe grade of diabetic foot. Positive correlation obtained by Kendall's tua b test (p=0.002, τb=0.277)

Table 19: Relation between severity of PDR and diabetic foot grading

	Diabetic foot grading					P value
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	
Mild- moderate PDR	0 .0%	2 12.5%	3 18.8%	5 31.3%	6 37.5%	0.557
High risk PDR	1 9.1%	1 9.1%	2 18.2%	6 54.5%	1 9.1%	
ADED	0 .0%	0 .0%	0 .0%	3 75.0%	1 25.0%	

Severity of PDR and severity of diabetic foot didn't show any association.

Table 20: Relation between presence of maculopathy and diabetic foot grading

	Diabetic foot grading					P value
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	
Maculopathy	1 2.5%	4 10.0%	8 20.0%	19 47.5%	8 20.0%	<0.001**
No maculopathy	24 17.1%	32 22.9%	54 38.6%	16 11.4%	14 10.0%	

** P value significant

Presence of maculopathy was more among patients with severe grades of diabetic foot (P value <0.05).

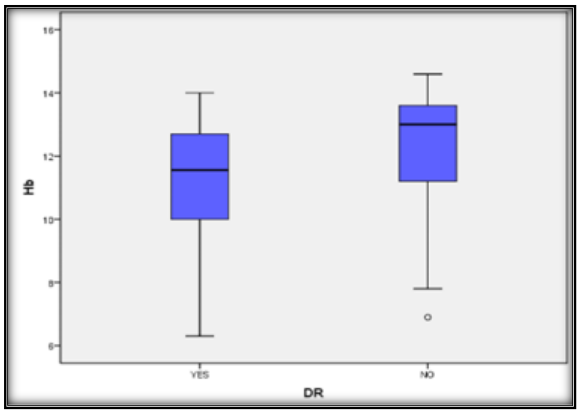

Figure 1: Hemoglobin distribution among patients with and without diabetic retinopathy

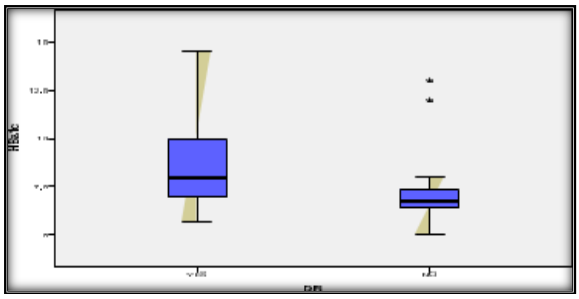

Figure 2: HbA1c value distribution among patients with and without diabetic retinopathy

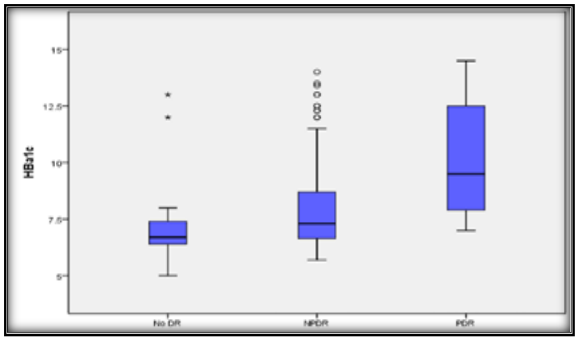

Figure 3: Relation between HbA1c value distribution and type of diabetic retinopathy

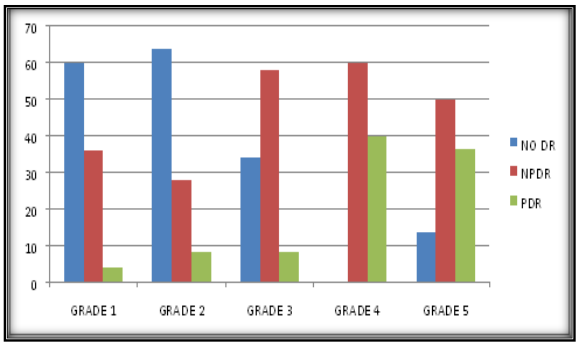

Figure 4: Relation between type of diabetic retinopathy and diabetic foot grading

DISCUSSION

This study was conducted in a tertiary care centre in north Kerala among patients with Type II diabetes mellitus.180 participants with diabetic foot were enrolled according to inclusion and exclusion criteria and studied the retinopathy status among them. Study was conducted for duration of 1 year.

Among the study population, 132 (73.3%) were males and 48(26.7%) were females. Majority of patients (38.3%) belonged to age group 55-64yrs. The mean age among total population was 54.63 ± 7.97 years. Mean duration of DM was 16.03 ± 7.24 years. Mean BCVA in our study was logMAR 0.633 ± 0.614. Most of the patients were taking OHA alone for controlling diabetes mellitus.20% of the population was using both OHA and insulin for glycemic control.

Patients with DR have more age and longer duration of DM than patient without DR (P value<0.05). It was found to be consistent with previous studies.[7] Prevalence of diabetic retinopathy was significantly associated with duration of diabetes mellitus. Long duration of exposure to hyperglycemic state leads to more chance of developing micro and macrovascular complications. Among patients with duration of diabetes mellitus more than 25 years, 100% of them

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have diabetic retinopathy. While those with 5–10 years of diabetes, only 31.4% have diabetic retinopathy. When compared the mean values of age and duration of DM between NPDR and PDR, it was found that mean value was higher in patients with PDR than NPDR ($p<0.05$). This shows that severity of retinopathy also increases with increase in age and duration of diabetes mellitus.

Mean BCVA was poor among patients with diabetic retinopathy when compared to patients without diabetic retinopathy. Mean BCVA among patients without diabetic retinopathy, NPDR and PDR was log MAR 0.195 ± 0.270, 0.660 ± 0.440 and 1.432 ± 0.697 respectively (P value <0.05). Patients with proliferative diabetic retinopathy was having poorer vision compared to patients with non-proliferative diabetic retinopathy.

Among 180 participants, 118(65.5%) have diabetic retinopathy of which 87(48.3%) patients having NPDR and 31(17.2%) patients having PDR. 62(34.4%) patients were not having diabetic retinopathy. Most of the patients were having NPDR. This may be due to the fact that, being in a tertiary care centre, patients having an established complication like diabetic foot will be screened for other complications of diabetes also. This may prevent patients with diabetic retinopathy to go into proliferative stages. Karam T et al,[8] in their cross sectional study in patients with diabetic foot from a tertiary care centre in south India, found that, diabetic retinopathy was seen in 67.58% of patients, with 17.88% of retinopathy being proliferative. This was found against the results obtained by Hwang DJ et al,[9] who conducted a retrospective review among patients with and without diabetic foot in a south Korean hospital. It was observed that most of their diabetic foot patients to have retinopathy (90%), nearly half of which was proliferative (55%). This disparity may be due to difference in the ethnicity.

Presence of diabetic retinopathy was found high among patients with high grade diabetic foot and it was statistically significant also. In patients with grade 1 diabetic foot,40% were having diabetic retinopathy(36% NPDR and 4% PDR) and patients with grade 3 diabetic foot, 66.2% were having diabetic retinopathy (58.1% NPDR and 8.1% PDR).While in patients with grade 5 diabetic foot, 86.4% patients were having diabetic retinopathy (50% NPDR and 36.4% PDR).A positive correlation was found by Kendall's tau-b test, between the increasing severity of diabetic foot and severity of the stage of retinopathy ($\tau b = 0.433$ $P = 0.00$).Among patients having NPDR, the severity of NPDR was also more among patients with more severe grade of diabetic foot. Positive correlation obtained by Kendall's tua b test ($p=0.002$, $\tau b=0.277$). Severity of PDR and severity of DF didn't showed any association in the present study. Prevalence of maculopathy was only 22.2% among total study population. Presence of maculopathy was also more among patients with severe grade of diabetic foot.(P VALUE <0.05) Diabetic retinopathy and diabetic foot have a common pathogenic mechanism, which is characterized by oxidative stress and endothelial dysfunction.[9] The presence of non healing diabetic ulcers indicates the elevated levels of systemic inflammatory mediators, advanced glycation end products, and macrophages. These when present in the retina, will cause a cascade of events resulting in progression of diabetic retinopathy. This may be the reason for the higher prevalence and severity diabetic retinopathy in severe grades of diabetic foot patients. So patients having diabetic foot should be screened for diabetic retinopathy to prevent them from blindness and to improve their quality of life.

Most common comorbidity among population was hypertension. Presence of POVD was studied only among 111 patients and among that 59.5% had POVD. Presence of hypertension, CKD, CAD and microalbuminuria was found more among patients having DR than patients without DR (P VALUE<0.05). Dyslipidemia and CVA was more among patients with DR, but it was not statistically significant. Even though POVD was studied only in 111 patients, it was found more among patients with DR. But this observation was not statistically significant. Many previous studies showed similar findings with most common comorbidity being hypertension.[10,11]

Mean FBS, PPBS and HbA1c were found high among patients having DR than patients without DR and it was high among patients with proliferative DR than with non proliferative DR.

Mean Hb was low among patients having DR when compared to patients without DR (P value<0.05). This was found consistent with study by Rasoulinejad SA et al.[12] Anemia causes tissue hypoxia and can cause oxidative stress which has a critical role in the etiology of diabetic retinopathy. But in this study, hemoglobin value showed not much difference between patients with NPDR and PDR and it also showed no significant relation between patients with and without maculopathy. Hemoglobin value was comparatively low among patients with higher grades of diabetic foot.

CONCLUSION

Increased presence of diabetic retinopathy was found in patients with higher grades of diabetic foot. Severity of diabetic retinopathy was greater in patients with severe grades of diabetic foot. Higher the age and duration of diabetes mellitus, greater the prevalence and severity of diabetic retinopathy.

Mean best corrected visual acuity (BCVA) was poor among patients with diabetic retinopathy when compared to patients without diabetic retinopathy. Most common comorbidity associated with the study population was hypertension. Hypertension, chronic kidney disease, coronary artery disease and microalbuminuria was found more among patients having diabetic retinopathy than patients without diabetic retinopathy. Patients with proliferative

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diabetic retinopathy have higher values of FBS, PPBS, and HbA1c than patients with non-proliferative diabetic retinopathy.

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