



Original Research Article

Comparative evaluation of the severity of diabetic macular oedema in patients with and without metabolic syndrome

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ABSTRACT

Introduction: Diabetic retinopathy may be the most common microvascular complication of diabetes. Retinopathy develops in one of every four diabetics which is major cause of visual impairment. In addition to the micro and macrovascular complications of DM, the potential association between Metabolic syndrome and DR has been also investigated but with inconclusive results

Aims & Objective: Comparative evaluation of the severity of diabetic macular oedema in patients with and without metabolic syndrome and the association between Diabetic macular oedema with biochemical parameters (HbA1c, blood sugar, Serum triglycerides, HDL, LDL, VLDL) and Physical parameter (BMI and Waist Circumference).

Materials and Methods: Hospital-based prospective observational Study involved 80 patients of diabetic macular oedema carried out over a period of 18 months from January 2018 to June 2019. Based on criteria of metabolic syndrome they were divided into two groups: 1) with metabolic syndrome 2) without metabolic syndrome. Socio demographic profile, macular thickness, biochemical parameters and physical parameters were recorded.

Results: Out of 80 patients, 57 (71.2%) were male and 23 (28.8%) were female. Mean age of the patients in metabolic syndrome group was 53.68 ± 4.7 years while mean age of the patients without metabolic syndrome was 56.07 ± 10.14 years. Macular thickness was significantly high in both eyes in subjects with metabolic syndrome compare to without metabolic syndrome. Macular thickness of both eye was found to be positively correlated with HbA1C level (for right eye $r = 0.50$; for left eye $r = 0.27$) and mean arterial blood pressure eyes ($r = 0.41$ for right eye & $r = 0.38$ for left eyes). In our study apart from VLDL and HDL no correlation was seen with other individual cholesterol parameters like Total Cholesterol, LDL and triglycerides.

Conclusion: In conclusion, Metabolic syndrome and few of its components (BMI, MAP) were significantly associated with an increased risk of macular thickness. However, considering the limitations existed, further studies would be urgently necessary.

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1. Introduction

Diabetes is a chronic disease, which occurs when the pancreas does not produce enough insulin, or when the body cannot effectively use the insulin it produces. This leads to an increased concentration of glucose in the blood (hyperglycaemia).¹ Diabetes mellitus (DM) may be caused by insulin resistance, insulin deficiency, or by

a combination of both. Pancreatectomy, pancreatitis, alcoholic chronic pancreatitis, hemochromatosis, cystic fibrosis, mitochondrial DNA mutations, or by drugs/toxins may lead to insulin deficiency. Insulin deficiency may lead to type 1 diabetes mellitus (T1DM) which may be autoimmune or idiopathic in nature and is present in 9% cases of insulin deficiency. Insulin resistance may also be caused by autoimmune diseases, lipatrophy, or endocrinopathies including glucagonoma, pheochromocytoma, acromegaly, Cushing's syndrome, and

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thyroid disease. Type 1 DM is primarily caused by genetic factors, environmental factors, and disorder of the immune regulatory mechanism. A combination of all these three factors causes autoimmune disease.² The combination of both (insulin deficiency and insulin resistance) may lead to gestational diabetes or to Type 2 DM. Type 2 DM may be caused by genetic and environmental factors (diet and exercise) and is present in 85% patients with insulin deficiency and insulin resistance. Incidence of Diabetes mellitus is increasing and will be emerging as a major public health problem in India.³ The prevalence of diabetics across the world has been suggested to rise from 171 million in 2000 to 366 million in 2030⁴ and the greatest rise is suggested to occur in India which will be very close to 195% from 18 million in 1995 to 54 million in 2025. Diabetes is a growing challenge in India with estimated 8.7% diabetic population in the age group of 20 and 70 years. The rising prevalence of diabetes and other non-communicable diseases is driven by a combination of factors - rapid urbanization, sedentary lifestyles, unhealthy diets, tobacco use, and increasing life expectancy.⁵

Diabetic macular edema (DME) is defined as retinal thickening (associated with the typical lesions such as microaneurysms, retinal edema and hard exudates) within 1 disc diameter from the foveal centre (1 disc diameter = 1500 μm); it can either be focal or diffuse in distribution. Clinically significant macular edema (CSME) is a form of DME that was precisely defined by the ETDRS,⁶ as any of the following criteria being met: 1) Any retinal thickening within 500 μm of the centre of the macula. 2) The presence of hard exudates at or within 500 μm of the centre of the macula, if associated with thickening of the adjacent retina (not residual hard exudates remaining after the disappearance of retinal thickening of macular oedema). 3) A zone, or zones, of retinal thickening 1 disc area or larger, any part of which is within 1 disc diameter (1 disc = 1500 μm) of the centre of the macula.

Currently, OCT is the most important test in evaluation and management of diabetic macular edema. OCT can determine whether diabetic macular edema is centre-involving or non centre-involving, which has become an important distinction in the era of anti-VEGF therapy.^{7,8}

Metabolic syndrome (MetS), defined as a constellation of metabolic abnormalities with obesity, glucose intolerance, hypertension, elevated triglyceride (TG), and low level of high density lipoprotein cholesterol (HDL), is a risk factor for cardiovascular complications of the type 2 DM.⁹

2. Materials and Methods

The study was a hospital based prospective study conducted in department of Ophthalmology in Jawaharlal Nehru Medical College and Associated Group of Hospitals, Ajmer, Rajasthan India.

The study population comprised of cases of diabetic macular oedema who fulfilled the inclusion criteria.

2.1. Inclusion criteria

1. All outdoor and indoor cases with Diabetes Macular Oedema with and without metabolic syndrome.

Following investigations were done-

1. Biochemistry investigation – Blood sugar [FBS, PP], Blood urea, HbA1c, Lipid Profile [Triglyceride, HDL, LDL, VLDL]
2. BMI and WC (waist circumference)
3. Fundus examination by direct and indirect ophthalmoscope
4. Optical Coherence Tomography- Retinal thickness and volume.
5. FFA was repeated if/whenever required.

3. Results

In our study total 80 patients were studied in which 38 patients were with metabolic syndrome and 42 were without metabolic syndrome.

Patients with metabolic syndrome had significantly higher value of BMI, Fasting Blood Sugar, Postprandial Blood Sugar, Total Cholesterol, LDL cholesterol and triglycerides compare to diabetic patients without metabolic syndrome ($p < 0.01$). S. creatinine and HbA1C value were not found to be significantly different between both group.

Macular thickness was significantly high in both eyes in those study subjects in which metabolic syndrome was present compare to those in which metabolic syndrome was absent.

In present study macular thickness of both eyes was found to be positively correlated with HbA1C level (for right eye $r = 0.50$; for left eye $r = 0.27$). In our study apart from VLDL and HDL no correlation was seen with other individual cholesterol parameters like Total Cholesterol, LDL and triglycerides. Macular thickness was positively correlated with VLDL in right eye ($r = 0.29$) and negatively correlated with HDL in left eye ($r = -0.36$). Mean arterial blood pressure was also found to be significantly correlated with macular thickness of both eyes ($r = 0.41$ for right eye & $r = 0.38$ for left eyes). Waist circumference was also found to be significantly correlated with macular thickness of left eye ($p < 0.01$).

4. Discussion

Although metabolic syndrome is clearly a risk factor for macrovascular disease, its association with microvascular disease such as diabetic retinopathy is unclear.¹⁰

The present study was a Hospital based prospective observational study conducted on 80 diabetic patients with

Table 1: Comparison of different parameters between both groups

Parameters	Metabolic syndrome				P value
	Yes (n=38)		No (n=42)		
	Mean	SD	Mean	SD	
BMI (kg/m ²)	27.54	3.02	23.01	2.45	<0.01
Waist circumference (cm)	97.2	6.58	85.7	7.11	<0.01
Fasting Blood sugar (mg/dl)	146.94	24.30	129.72	14.53	<0.01
PPBS (mg/dl)	212.17	36.55	191.86	23.16	<0.01
Total Cholesterol (mg/dl)	209.25	27.01	189.35	14.28	<0.01
HDL(mg/dl)	40.86	9.07	43.43	4.51	0.02
LDL(mg/dl)	142.70	23.21	118.80	29.82	<0.01
VLDL(mg/dl)	30.12	10.98	26.95	4.85	0.57
TG (mg/dl)	190.68	44.38	154.69	28.89	<0.01
S. creatinine (mg/dl)	1.01	0.16	1.00	0.07	0.09
HbA1C	7.56	1.37	7.16	0.79	0.17

Table 2: Comparison of macular thickness between both groups

Macular thickness (μm)	Metabolic syndrome				P value
	Yes (n=38)		No (n=42)		
	Mean	SD	Mean	SD	
Right eye	351.95	117.47	286.38	106.88	<0.01
Left eye	401.03	146.63	309.14	98.38	<0.001

Table 3: Correlation of macular thickness with different parameters

OCT	BMI	WC	FBS	PPBS	T. Cholesterol	HDL	LDL	VLDL	TG	HbA1C	MAP
Right eye R value	.20	0.18	.23	.164	-.141	-.071	.073	.259	.042	.503	0.41
Right eye P value	0.06	0.11	.03*	.147	.213	.530	.522	.020*	.709	<0.01	<.001
Left eye R value	.48	.46	.293	.201	.001	-.361	.058	.158	.018	.270	.38
Left eye P value	<0.01	<0.01	<0.01	.075	.996	<0.01	.608	.160	.873	.042*	<0.01

diabetic macular oedema, taking treatment and care from JLN Medical College and Associated Group of Hospitals, Ajmer, Rajasthan. Patients with and without metabolic syndrome were compared to see the differences in macular thickness. The study also aimed to find out the correlation of macular thickness with biochemical parameters and physical parameters.

In present study, macular thickness was significantly high in both eyes in those study subjects in which metabolic syndrome was present compare to those in which metabolic syndrome was absent.

In our study apart from VLDL and HDL no correlation was seen with other individual cholesterol parameters like Total Cholesterol, LDL and triglycerides. Macular thickness was positively correlated with VLDL ($r=0.29$) and negatively correlated with HDL ($r = -0.36$). The lack of association of serum lipids with macular thickness in this study is compatible with previous data from the Multi-ethnic Study of Atherosclerosis(MESA), which show no association between serum lipids, including total-C, LDL-

C, and HDL-C and DR,¹¹ and the Australian Diabetes, Obesity, and Lifestyle Study (AusDiab).¹²

In our study mean arterial blood pressure was found to be significantly correlated with macular thickness of both eyes ($r = 0.41$ for right eye & $r=0.38$ for left eyes). Similar to our study Goodling KM et al¹³ also reported that mean arterial pressure was independently associated with macular thickness in the inner quadrants, and with all the outer quadrants except for the nasal quadrant.

In present study macular thickness of both eyes was found to be positively correlated with HbA1C level (for right eye $r = 0.50$; for left eye $r =0.27$). Two plausible mechanisms that might explain this positive correlation between chronic HbA1c level and macular thickness and volume are, firstly, that abnormal amounts of fluid may accumulate as a result of the osmotic hydration of retinal tissue during longstanding hyperglycaemia, and secondly, that macular haemodynamics may be subject to change as a result of microvascular damage and autoregulation dysfunction.

Similar to our study Yeung L et al¹⁴ also showed that chronic HbA1c levels over the previous year positively correlated with macular thickness and volume in diabetic patients. Peng Yi-Ji et al¹⁵ also found that higher levels of HbA1c were associated with greater CMT and volume in eyes without macular oedema, which was consistent with our study.

In our study BMI was found to be significantly correlated with macular thickness of left eyes ($r=0.48$; $p<0.01$) but did not found any correlation with right eyes ($r=0.20$; $p=0.06$). Similar results were obtained for correlation between macular thickness and waist circumference as significant correlation was observed between macular thickness of left eye and waist circumference while waist circumference was not correlated with macular thickness of right eye. Similar to our study, Wong KCM et al¹⁶ also found significant correlation between BMI and macular thickness ($r=0.22$; $p<0.05$) while in contrast to our study Gupta P et al¹⁷ did not found the same. Goodling KM et al¹³ did not reported any correlation between macular thickness and waist circumference.

5. Conclusion

The mean HbA1c was 7.38% (range, 5.2%-10.1%) which was significantly higher than the normal upper limits of testing laboratory value (6%). The mean HDL, LDL and TG levels were 42.21 ± 7.12 mg/dl, 130.15 ± 29.29 mg/dl, and 171.78 ± 41.02 mg/dl respectively.

Patients with metabolic syndrome had significantly higher value of BMI, Fasting Blood Sugar, Postprandial Blood Sugar, Total Cholesterol, LDL cholesterol and triglycerides compare to diabetic patients without metabolic syndrome ($p<0.01$). S. creatinine and HbA1C value were not found to be significantly different between both group.

Macular thickness was significantly high in both eyes in those study subjects in which metabolic syndrome was present compare to those in which metabolic syndrome was absent.

On right eye visual acuity examination, most of the diabetic patients in metabolic syndrome group had 6/9P to 6/9 visual acuity (26.3%) followed by FC1.5-6M (26.2%) while in patients without metabolic syndrome maximum subjects had 6/12P-6/12 visual acuity (30.9%) followed by 6/36P-6/36 (28.6%).

On left eye visual acuity examination, most of the diabetic patients in metabolic syndrome group had FC1.5M visual acuity (39.5%) followed by 6/36P-6/36 (21.0%) while in patients without metabolic syndrome maximum subjects had 6/60 visual acuity (28.6%) followed by 6/24P-6/24 (23.8%).

In present study macular thickness of both eye was found to be positively correlated with HbA1C level (for right eye $r = 0.50$; for left eye $r = 0.27$). In our study apart from VLDL and HDL no correlation was seen with other

individual cholesterol parameters like Total Cholesterol, LDL and triglycerides. Macular thickness was positively correlated with VLDL in right eye ($r=0.29$) and negatively correlated with HDL in left eye ($r = -0.36$). Mean arterial blood pressure was also found to be significantly correlated with macular thickness of both eyes ($r = 0.41$ for right eye & $r=0.38$ for left eyes).

6. Source of Funding

None.

7. Conflict of Interest

None.

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