

COMPARISON OF DIFFERENT CLINICAL AND METABOLIC PARAMETERS AMONG TYPE 2 DIABETIC PATIENTS WITH AND WITHOUT RETINOPATHY IN PRIMARY HEALTH CLINICS IN MEDAN CITY, NORTH SUMATERA, INDONESIA

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Abstract

Background: The global prevalence of type 2 diabetes mellitus is increasing steadily and diabetic retinopathy is one of the microvascular complications of diabetes mellitus. This research aims to compare different clinical and metabolic parameters among type 2 diabetic patients with and without diabetic retinopathy.

Methods: This cross-sectional study was done at various primary health care centers in Medan city and the surrounding areas in North Sumatera from May to July 2020. Collected medical data included blood pressure, body mass index, duration of disease, family history and medical treatment. Laboratory data included blood glucose, glycated hemoglobin (HbA1c) and lipid profile. Diabetic retinopathy was detected by fundoscopic examination by an ophthalmologist.

Results: Total patients were 88 and 26 had retinopathy. There was significant difference between the average blood pressure, blood glucose and HbA1C values among patients with type 2 diabetes mellitus with and without retinopathy ($p < 0.005$). But, there was no significant difference between the average body mass index (BMI), abdominal circumference and lipid profile.

Conclusion: Study showed that type 2 diabetic patients with retinopathy had increased blood glucose levels and HbA1c than patients without retinopathy.

Key words: Type 2 diabetes mellitus, blood sugar levels, HbA1c, retinopathy.

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Introduction

Diabetic retinopathy is a major microvascular complication of diabetes¹ and the prevalence of retinopathy increases with the duration of diabetes. More than 60% of patients with type 2 diabetes and almost all patients with type 1 diabetes have some degree of retinopathy after 20 years of diabetes.³ Dyslipidemia is a complex disorder that involves both central, as well as organ-specific mechanisms.⁴⁻⁶ These include abnormal levels of lipids in the plasma that arise from a disproportion in metabolism, release and/or uptake by the adipose tissue as well as inefficient

lipid removal from blood circulation. In addition to central regulation, most cells in the body have tissue-specific control of lipid uptake, remodeling and elimination.⁷⁻⁹ Moreover, insulin resistance has been shown to promote dyslipidemia by elevating low density lipoprotein (LDL) cholesterol, total cholesterol, free fatty acids and triglycerides as well as decreasing high density lipoprotein (HDL) cholesterol and inhibiting reverse cholesterol transport genes.^{10,11} This study was designed to compare different clinical and metabolic parameters among type 2 diabetic patients with retinopathy and without retinopathy.

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Methods

This cross-sectional study was done in Medan city and Primary Health Care Centers in Binjai and Stabat city, North Sumatera, Indonesia from May to July 2020. Collected medical data included blood pressure, body mass index, duration of disease, family history and medical treatment. Laboratory data included blood glucose, glycated hemoglobin (HbA1c) and lipid profile.

Eighty eight patients with type 2 diabetes mellitus were recruited, including 26 patients with retinopathy. Diabetic retinopathy was detected by the funduscopic examination by ophthalmologists and patients with known diabetics taking oral hypoglycaemic agents or managed with diet or using insulin for the glycaemic control were included in the study.

Permission from the institutional review committee was obtained. Patients were informed with the detail of the study and written consent was obtained from the patients before they participated in the study.

We measured height and weight with the subjects standing in light clothes. Body mass index (BMI) was calculated as the weight in kilograms divided by square of the height in meters (kg/m^2). Blood pressure values were taken as the mean of two measurements after the subjects had been seated for at least five minutes. Subjects fasted overnight to provide a blood specimen. Blood samples were collected (using syringe) and transferred to Paramitha Clinical Laboratory immediately to be conducted fasting blood

sugar, hemoglobin glycosylate and lipid profile. The examination of blood sugar levels were done by using hexokinase methods, hemoglobin glycosylate using HPLC methods, lipid profile using direct CHOD PAP and GPO PAP.

Statistical Analysis

SPSS version 24.0 (SPSS Inc., Chicago, Illinois) statistical software was used for statistical analysis. All the variables in this sample of the study were tested by Shapiro–Wilk, the normal distribution variables ($p > 0.005$) were tested by parametric correlation test, but the abnormal distribution variables ($p < 0.005$) were tested by non-parametric test.

Results

Total patients were 88; 26 had retinopathy (males, 9) (age range, 45 – 79 years) and 62 did not have retinopathy (males, 17) (age range, 35 – 78 years) and the average age was not different ($p > 0.005$) between two groups. Mean BMI and abdominal circumference of patients with and without retinopathy was not different but there was significant difference in blood pressure (Table I).

Regarding metabolic parameters, mean fasting blood glucose (retinopathy group, 320.81 mg/dL vs non-retinopathy group, 212.66 mg/dL) and HbA1c (retinopathy group 9.92% vs non-retinopathy group 8.25%) were poor in patients with retinopathy than patients without retinopathy but lipid profile was not significantly different between two groups (Table II).

Table I
Characteristic of the samples (N = 88)

	N	Mean	Median	P-value	
Age (years)	Diabetic Retinopathy	26	57.73	58 (45 -79)	P=0.669
	Non-Diabetic Retinopathy	62	56.82	55 (35-78)	
BMI (kg/m^2)	Diabetic Retinopathy	26	24.60	23.80(17.63-46.44)	P=0.91
	Non-Diabetic Retinopathy	62	26.85	25.5(18.21-46.44)	
Abdominal circumference (cm)	Diabetic Retinopathy	26	91.12	90 (68-121)	P=0.716
	Non-Diabetic Retinopathy	62	90.13	89 (64-121)	
Systole (mmHg)	Diabetic Retinopathy	26	153	160 (120-193)	P=0.036
	Non-Diabetic Retinopathy	62	142.71	142 (98-203)	
Diastole (mmHg)	Diabetic Retinopathy	26	89.15	89 (71-110)	P=0.115
	Non-Diabetic Retinopathy	62	85.26	85 (60-112)	

Table II
Metabolic parameters of patients with (n = 26) and without (n = 62) diabetic retinopathy

		N	Mean	Median	Std. Deviation	Std. Deviation	P-value
Cholesterol (mg/dL)	Diabetic Retinopathy	26	221.73	227 (146-321)	48.720	48.720	P=0.222
	Non-Diabetic Retinopathy	62	208.42	210.50 (111-277)	38.284	38.284	
HbA1c (%)	Diabetic Retinopathy	26	9.92	9.85 (4.7-19.5)	3.8121	3.8121	P=0.044
	Non-Diabetic Retinopathy	62	8.25	.8 (5-13.4)	2.2477	2.2477	
BSL (mg/dL)	Diabetic Retinopathy	26	320.81	326 (73-610)	158.003	158.003	P=0.003
	Non-Diabetic Retinopathy	62	212.66	180.5 (80-492)	106.745	106.745	
Triglycerides (mg/dL)	Diabetic Retinopathy	26	246.04	206 (87-662)	129.073	129.073	P=0.144
	Non-Diabetic Retinopathy	62	204.39	188 (49-408)	91.502	91.502	
LDL (mg/dL)	Diabetic Retinopathy	26	124.23	121 (65-213)	38.732	38.732	P=0.730
	Non-Diabetic Retinopathy	62	121.27	124 (50-181)	30.161	30.161	
HDL (mg/dL)	Diabetic Retinopathy	26	46.88	45 (24-77)	14.146	14.146	P=0.812
	Non-Diabetic Retinopathy	62	47.61	46 (29-77)	9.780	9.780	

Discussion

In this study, we have compared different parameters of type 2 diabetic patients with retinopathy and without retinopathy. This research showed that there was no significant difference in BMI and waist circumference in two groups. Many epidemiologic studies have explored the association of diabetic retinopathy with BMI or anthropometric parameters, but the conclusions have been contradictory. Recent studies conducted in Asian populations have reported an inverse association between BMI and the risk of retinopathy, suggesting a protective role.¹² Research by Lu J et al showed that overweight patients had lower diabetic retinopathy prevalence than normal-weight individuals, which may be attributable to better a cell function in overweight patients.¹³ And research by Hwang et.al showed that an independent association of body fat with diabetic retinopathy and provides evidence that sex differences in body fat composition may affect the prevalence and progression of diabetic retinopathy.¹⁴

Dysfunction of blood vessel endothelial cells is an important factor in the pathogenesis of vascular complications in diabetes mellitus, where vascular dysfunction is mainly caused by elevated blood sugar levels that occur chronically. With the onset of hyperglycemia, it directly changes endothelial function or affects endothelial cells functioning indirectly by affecting the growth factor pathways, cytokines and vasoactive agents.¹⁵ Hyperglycemia was considered to play an important role in the pathogenesis of retinal microvascular damage too. Multiple metabolic pathways have been implicated in hyperglycemia-

induced vascular damage including the polyol pathway, advanced glycation end products (AGEs) accumulation, the protein kinase C (PKC) pathway and the hexosamine pathway.¹⁶ The earliest responses of the retinal blood vessels to hyperglycemia are dilatation of blood vessels and blood flow changes. These changes are considered to be metabolic autoregulation to increase retinal metabolism in diabetic subjects.¹⁷ Our study showed that there was a significant difference in average blood sugar levels in diabetic retinopathy than those without retinopathy. There was a difference in average HbA1c also. This study is similar to the research by Ebru, who found that a significant correlation between the mean blood glucose, HbA1c, and total cholesterol, and then in his research there was no significant association between serum lipids and the severity of diabetic retinopathy.¹⁸ Our research at both of the groups' samples showed the mean HbA1c value > 6.5 %, it means that both of the groups were uncontrolled type 2 diabetes mellitus category. We know that HbA1c was the best available biochemical parameter to assess the long-term metabolic control in patients with diabetes. HbA1c levels are closely associated with the response to treatment and the risk of developing complications and hence it provides the evidence-based marker with which we can assess the chances of developing diabetic complications. It provides information about the overall control of glucose in the previous 6-8 weeks.¹⁹ Research by Sadhana Sewak concluded that the value of HbA1c showed an increasing trend as the severity of diabetic retinopathy increases.²⁰ The good glycemic control of diabetes with a target HbA1c of 7.0%. The

other research concluded that a threshold of the risk for incident retinopathy at a 6.5% HbA1c level. Regular ophthalmic screening for diabetic retinopathy changes will reduce morbidity due to diabetic retinopathy and then they recommend maintaining HbA1c levels below 7.5% which may reduce the risk of development and progression of diabetic retinopathy.²¹ Research by Lokesh showed as the HbA1c level increases the severity of the diabetic retinopathy also increases. And also, patients who had microalbuminuria and longer the duration of diabetes higher the chances of microvascular complications. Hence HbA1c can be used as a useful tool to assess the long-term control of diabetes mellitus and hence the development of diabetic retinopathy.²²

Our study showed that there were no difference average cholesterol, triglycerides, LDL, and HDL levels among retinopathy group and non-retinopathy group but both of the groups showed that an increasing the cholesterol and triglycerides levels were compared normal value. The other research found that did not find obvious differences in TG, TC, and HDL-C levels between patients with diabetic retinopathy and without diabetic retinopathy. However, a little higher levels of LDL-C with borderline statistical significance were observed in patients with diabetic retinopathy. In addition, whether any association existed between serum lipids and retinopathy progression was unknown, but the fenofibrate treatment should be recommended since it could prevent the diabetic retinopathy progression through lipid-modulating independent pathways. In the future, more prospective large-scale studies would be needed to further investigate the association between serum lipids and diabetic retinopathy. As well, the mechanisms of fenofibrate involved in the control of diabetic retinopathy progression needed further investigation.²³

Patients with diabetic dyslipidemia were shown to have a higher frequency of acquiring retinal irregularities.²⁴ However, unlike macrovascular complications, where the direct correlation between pathology and circulating lipid levels is well established²⁵ the role of circulating lipids in microvascular complications is still controversial. Indeed, Wisconsin Epidemiologic Study of Diabetic Retinopathy found no association between total cholesterol or HDL and incidence of diabetic retinopathy or macular edema, while there was a modest association between higher levels of HDL and decreased prevalence of proliferative diabetic retinopathy.²⁶

Conclusion

In our conclusion, we found that load pressure, blood sugar levels, and HbA1c levels were higher in type 2

diabetic patients who had diabetic retinopathy than those who did not have diabetic retinopathy. These factors should be addressed for reduction of slowing diabetic complications including retinopathy.

Conflict of Interests: There are no conflicts of interest.

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