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Original Research Article

A Comparative Study of Retinal Nerve Fiber Layer Thickness among Diabetes and Non-Diabetics

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Abstract:

Purpose: This prospective observational study compares patients with Type II diabetes mellitus (DM) to age-matched non-diabetics (healthy controls) in order to map the differences in retinal nerve fiber layer thickness.

Methods: This study included 160 eyes divided in to two groups. Group A- included 80 eyes with Type II diabetics, Group B - included 80 eyes of non-diabetics (Healthy controls). Using the optical coherence tomography scanning, RNFL thickness was measured in each of the four quadrants.

Results: For the entire optic disc as well as each quadrant, diabetics RNFL thickness was lower than that of non-diabetics.This difference was statistically significant in all 4 quadrants (P=0.007).

Conclusion: We draw the conclusion that, in comparison to persons without diabetes, RNFL thickness is lower in diabetic patients. It is necessary to take diabetic retinal thinning into account before thinking about retinal thinning due to other neurodegenerative conditions.

Keywords: Diabetes mellitus, Diabetic retinopathy, Retinal nerve fibre layer, Optical coherence tomography.

Introduction

In the ophthalmic outpatient department, diabetes mellitus (DM) is a micro-vascular condition that is frequently seen. [1] The World Health Organization predicts that 300 million individuals globally will develop diabetes mellitus (DM) by 2025, with type 2 DM accounting for 270–285 million (90–95%) of cases [2]. By 2040, the nation is predicted to be the eighth most populous in the world when it comes to DM cases. [3] Diabetic retinopathy (DR) is the primary cause of visual impairment and one of the most common consequences resulting from diabetes mellitus [4]

The pathophysiology of Diabetic retinopathy has been explained by a number of theories, the most widely recognized of which is the micro-vascular theory. [5] Nevertheless, an increasing amount of data indicates unequivocally that neuronal tissue loss happens well in advance of the commencement of micro-vascular alterations, causing the retinal nerve fiber layer to become thinner (RNFL). [6]

In clinical practice, measuring the retinal nerve fiber layer's (RNFL) thickness has been used to identify glaucoma early. [7] Researchers have discovered variations in RNFL thickness in individuals with a variety of neuropathies, including obstructive sleep apnea, migraine, neurofibromatosis, multiple sclerosis, and Alzheimer's disease. [8-12] Patients with diabetes who do not have glaucoma or any other optic nerve illness may experience RNFL thinning. Numerous observations, including diminished RNFL visibility, elevated optic disc pallor, and unaltered neuro-retinal rim size, imply a possible link between DM and non-glaucomatous optic nerve atrophy. [13]

Material and Methods:

This Prospective observational study conducted for a period of 8 months from (NOV 2023 to MAY 2024). A total of 160 patients' eyes were examined. Of these, 80 belonged to diabetics and 80 to non-diabetics. Patients from either gender, aged above 40 years, with diabetes diagnosed based on ADA criteria (The 2022 American Diabetes Association Diagnostic Criteria for Prediabetes and Diabetes.) (Table 1) with fasting blood sugar levels, HBA1C , Random plasma glucose levels , 2 hours plasma glucose levels with duration of diabetes more than 10 years but none of the fundoscopic indicators of diabetic retinopathy were included.Patients with glaucoma, high axial myopia , tilted disc , family history of glaucoma, any systemic diseases other than diabetes , Any other retinal pathology, including diabetic retinopathy and who are on IOP-lowering medications/chronic oral/topical steroids, any history of ocular Trauma, ocular surgeries, previous Laser Photocoagulations, extremes of axial length and other Ocular Pathology were

excluded. The study population's demographic information was obtained. A comprehensive ophthalmic examination was performed on all patients, including an assessment of their best corrected visual acuity, an inspection of their anterior and posterior segments, an intraocular pressure measurement, axial length measurements, and a fundus examination using a non-contact fundus viewing lens.

To eliminate bias, a single examiner performed all examinations. Patients were categorized in two groups. Group-A - Type-II DM patients Group-B was Non-diabetics, without signs of diabetic retinopathy and with adequate glycemic control by Convenient sampling who gave informed consent and fulfilled the criteria for inclusion and exclusion. The study was conducted at Department of Ophthalmology, Alluri Sita Rama Raju Academy of Medical Sciences, Eluru, and Andhra Pradesh.

The initiation of the study was preceded by obtaining permission from higher authorities and clearance from the Institutional Ethics Committee and taking written informed consents from patients.For data analysis, an average of three readings were taken.Peripapillary RNFL measurements were taken using Parameters from EDTRS Macular program using Optical coherence tomography (TOPCON-3D OCT-1 MAESTRO 2) after dilating both eyes with 0.1% topical Tropicamide eye drops.The four quadrants' mean peripapillary RNFL thickness was measured. The researcher filled in the pre-made proforma by verifying the subject's demographics, the results of the ocular examination, and the RNFL thickness of the peripapillary area. The patient record's confidentiality was respected.

Table 1: The 2022 American Diabetes Association Diagnostic Criteria for Prediabetes and Diabetes.

Test	Prediabetes	Diabetes2	Comments
A1C	A1C 5.7-6.4%	> 6.5%	A1C should be measured in a NGSP-certified laboratory. The purpose of the NGSP is to standardize HbA1c test results to those of the Diabetes Control and Complications Trial (DCCT) and United Kingdom Prospective Diabetes Study (UKPDS) which established the direct relationships between Alc levels and outcome risks in patients with diabetes.
Fasting plasma glucose (FPG)	100-125 mg/dL (5.6-6.9 mmol/L)	> 126 mg/dL (7.0 mmol/L)	No caloric intake for at least 8 hours
2-h plasma glucose during OGTT	140-199 mg/dL (7.8-11.1 mmol/L)	> 200 mg/dL (11.1 mmol/L)	Using glucose load of 75 g anhydrous glucose dissolved in water
Random plasma glucose		> 200 mg/dL (11.1 mmol/L)	Random glucose: Any time of the day without regard to time since last meal Symptoms: Polyuria, polydipsia, unexplained weight loss

Statistical Analysis: The data were entered in Microsoft Excel and analysed using SPSS (statistical package for social sciences) software version 22 for windows were used in the statistical analysis. Independent t-tests were used to compare the means between the diabetic and non - diabetic groups. $P < 0.05$ was set as the significant level.

Results

160 eyes of Patients met the requirements for inclusion criteria were examined.In the present study, the thickness of RNFL was analysed by comparing subjects of diabetics and non-diabetics.The study population's mean peripapillary RNFL thickness as well as the means of the superior, inferior, nasal, and temporal quadrants for both groups is given in Table 2 and Table 3. For the entire optic disc as well as each quadrant, diabetics RNFL thickness was lower than that of non-diabetics. The difference in the thickness of RNFL was statistically significant in all 4 quadrants ($P = 0.007$)

Table 2:

Group -RNFL Thickness	N	Minimum (micrometre)	Maximum (micrometre)
Diabetics -Superior	80	43	168
Diabetics -Inferior	80	81	180
Diabetics -Nasal	80	43	112
Diabetics -Temporal	80	30	103
Non -Diabetics -Superior	80	114	140
Non -Diabetics -Inferior	80	109	171
Non -Diabetics -Nasal	80	62	102
Non -Diabetics -Temporal	80	60	98

Table 3:

					t-value		95%	CI
Quadrants	**Group**	**N**	**Mean**	**Std. Deviation**		**p-value**	**Lower**	**Upper**
	Diabetic	80	115.19	23.084	-5.786		-20.623	-10.127
Superior	Non-Diabetic	80	130.56	5.657		.000		
	Diabetic	80	126.43	21.279	-8.741		-32.871	-20.754
Inferior	Non-Diabetic	80	153.24	17.321		.000		
	Diabetic	80	82.66	14.750	-3.033		-9.040	-1.910
Nasal	Non-Diabetic	80	88.14	6.568		.003		
	Diabetic	80	69.29	13.546	-2.731		-9.004	-1.446
Temporal	Non-Diabetic	80	74.51	10.454		.007		

Discussion

By age matching and excluding extreme axial lengths, we evaluated the thickness of the RNFL in both diabetic patients and non-diabetic patients. The neurodegenerative effect of DM alone can be responsible for the discrepancy in RNFL measurement.

Neuro-degeneration is an early step in the etiology of DR that is well supported by evidence, and it may be connected to the emergence of micro-vascular anomalies. One of the main characteristics of diabetes-related neurodegenerative alterations is the death of several types of neurons, such as ganglion, amacrine, horizontal, Muller, and photoreceptor cells. Reduced thickness of the RNFL and inner retinal layers is the structural result of this apoptotic death.

In our study, RNFL was the thinnest in all quadrants in diabetics Patients compared to non-diabetics, which was similar to the results seen in a study conducted by Mohammad Asim Mehboob, Zulfiqar Ali Amin and Qamar Ul Islam [14], On comparing RNFL thickness in diabetics to that of normal population, When diagnosing any condition based on RNFL thinning, it is important to consider that diabetic patients have thinner RNFL than normal people. Diabetes causes an increasing loss of astrocytes and ganglion cells, which could account for the decrease in RNFL thickness. This could be due to the direct toxicity of hyperglycemia or Muller cell malfunction, which causes neuronal cell death and gradual axonal degeneration.

Other study by Kapoor, Rohan,; Kaur, Gurvinder; Batra, Nitin [15] assessed the Retinal nerve fiber layer (RNFL) thickness in patients with type 2 diabetes mellitus (DM) and assessed the correlation of RNFL thickness with duration of DM and HbA1c levels, determined that in comparison to non-diabetic people, RNFL thickness is lower in diabetic patients Regardless of the length of their diabetes or their HbA1c levels, this may help diabetic patients receive an early diagnosis of diabetic retinopathy.

Other study by Aparna Bhaskaran, Mahesh Babu, N A Sudhakar, Krishna Prasad Kudlu, B C Shashidhara Compare and examine the changes in the thickness of the peripapillary retinal nerve fiber layer (RNFL) between individuals without diabetes and those with diabetes who are at various stages of the Diabetic retinopathy (DR) concluded that in diabetic retinopathy, peripapillary RNFL thickness was thinner than in normal controls, and the thinner portion become more severe as the DR progressed. [16]

The current study had certain drawbacks of just including diabetic patients with under control blood sugar levels and excluding those with diabetic retinopathy more reliable outcomes with stronger clinical implications will be obtained by measuring the thickness of the ganglion cell layer and including individuals with retinopathy and uncontrolled blood sugar profiles.

Conclusion

We draw the conclusion that, in comparison to age-matched controls, RNFL thickness is lower in DM patients. Diabetes mellitus-related neurodegeneration is shown by the thinning of the RNFL thickness. The findings of this study support the notion that neurodegeneration is a precursor to diabetic retinopathy.

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