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Retinal nerve fiber layer thickness in diabetes mellitus versus normal population using optical coherence tomography

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ABSTRACT

Background: Diabetes mellitus is a micro vascular disorder that is on a rapid increase in number of diagnosed and undiagnosed cases, and it is estimated that approximately 191 million people may be suffering from this disorder by year 2030. It affects major vital organ and organ systems of the body, and is frequently accompanied with neuropathy, nephropathy, cardiovascular disorders and retinopathy. The quality of life of diabetic patients is significantly impacted by diabetic neuropathy. **Aims and Objectives:** To investigate the difference in peripapillary retinal nerve fibre layer (RNFL) thickness between normal population and Type-II diabetic patients without diabetic retinopathy using optical coherence tomography. **Materials and Methods:** Between May 2021 and May 2022, this case control research was conducted at Skims MCH Bemina SRINAGAR. Out of 400 eyes, 200 eyes belonged to healthy people and 200 eyes to Type II diabetics who did not have diabetic retinopathy. Age and gender were the same for both groups. **Results:** Mean age of study population was 47.05 ± 5.47 years. Mean peripapillary RNFL thickness was 126.98 ± 10.07 µm in Group-A (normal persons), and 120.77 ± 5.41 µm in Group-B (Type-II diabetes). Between the two groups, there was a statistically significant difference in mean RNFL thickness as well as RNFL thicknesses in each quadrant (P = 0.001). **Conclusion:** The diagnosis of any disease based on RNFL thinning must take into consideration the fact that diabetic patients have thin RNFL in comparison to normal persons.

Key words: Diabetic neuropathy; Optical coherence tomography; Retinal nerve fibre layer thickness

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INTRODUCTION

In the ophthalmic outpatient department, diabetes mellitus (DM) is a micro vascular disorder that is frequently seen. Its epidemiology shows a rapid increase in number of diagnosed and undiagnosed cases, and it is estimated that approximately 191 million people may be suffering from this disorder by year 2030.[1] The condition affects major vital organ and organ systems of the body, and is frequently accompanied with neuropathy, nephropathy, cardiovascular disorders and retinopathy. The quality of life of diabetic patients is significantly impacted by diabetic neuropathy. The hunt for a pharmacological cure for this incapacitating illness, diabetic neuropathy, is currently underway. Assessment of retinal nerve fiber layer (RNFL) thickness has been in clinical practice for early detection of glaucoma.[2] Since glaucoma is a form of optic neuropathy, researchers have found variation in retinal nerve fibre layer (RNFL) thickness in patients suffering from various neuropathies like migraine, Alzheimer's disease, multiple sclerosis, obstructive sleep apnea and neurofibromatosis.[3] Various studies have shown the difference in RNFL thickness in diabetic patients, as compared to normal age matched population.[4] Diabetic neuropathy is supposed to affect neurons, and thus, measurement of RNFL thickness in patients with DM can be utilized to diagnose patients

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with, or at risk for development of diabetic neuropathy. The purpose of study was to investigate the difference in peripapillary RNFL thickness between normal population and Type-II diabetic patients without diabetic retinopathy using spectral domain optical coherence tomography (SD OCT).

Aims and objectives

To compare peripapillary retinal nerve fiber layer thickness between normal population and patients with diabetes using OCT.

MATERIALS AND METHODS

This case control study was carried out at SKIMS MCH Hospital Bemina Srinagar from May 2021 to May 2022, after approval from the institutional ethical committee, and taking written informed consents from patients. A total of 400 eyes of 200 patients were analyzed. Patients from either gender, aged 40–60 years, either normal individuals, or with diagnosis of DM on basis of fasting blood sugar levels, post prandial blood sugars and hemoglobin A1C, but no fundoscopic evidence of diabetic retinopathy were included. Patients with glaucoma, diabetic retinopathy, high axial myopia, tilted disc, family history of glaucoma, inherited optic neuropathies, ocular trauma, ocular surgery, chronic topical steroids users, hypermetropia, and prior laser photocoagulation were excluded. Demographic data of study population was acquired. All patients underwent detailed ophthalmic examination with measurement of best corrected visual acuity, anterior and posterior segment examination, measurement of intraocular pressure, fundus examination with non-contact fundus viewing lens. All examination was done by single ophthalmologist to exclude bias. Patients were separated in two groups. Group-A was control group, with normal individuals, Group-B was identified Type-II DM patients, with satisfactory glycemic control, but without evidence of diabetic retinopathy. Axial length was measured using partial laser interferometry.

For data analysis, the average of three measurements were collected. After dilating one eye with 0.1% topical Tropicamide eye drops, measurements of the peripapillary RNFL were made using the ZEISS CIRRUS HD OCT equipment. All four quadrants' mean and overall peripapillary RNFL thicknesses were measured. The researcher completed the pre-designed proforma by signing off on the subject's demographic information, the results of the eye exam, and the RNFL thickness of the peripapillary region. The patient's record's confidentiality was upheld.

For statistical analysis, the windows version of 20.0 Statistical Package for Social Sciences was utilised. The data were described using descriptive statistics, such as mean and standard deviation for quantitative values (age, axial length, RNFL thickness), frequencies, and percentages for qualitative factors (gender, laterality of eyes). The independent t'-test was used to compare quantitative data and the chi square test was used to evaluate qualitative factors between two groups. Statistical significance was set at a P=0.005.

RESULTS

200 subjects fulfilling inclusion criteria participated in this study. Mean age of study population was 47.05±5.45 (Range: 40–50 years). 108 (54%) subjects were males, while 92 (46%) were females. Mean axial length was 22.99±0.66 mm (Range: 22.2–24.5 mm). Demographic data of study population and of both groups is given in Table 1. There was no statistically significant difference in both groups in terms of age, gender, and axial length (P=0.197, 0.553 and 0.298 respectively). Mean of peripapillary RNFL thickness, along with mean peripapillary RNFL thickness of superior, inferior, nasal and temporal quadrants of study population and both groups are given in Table 2. The difference in mean RNFL thickness, as well as RNFL thickness of all four quadrants was statistically significant between both groups (P<0.001).

DISCUSSION

We assessed the RNFL thickness in diabetes patients and controls, maintaining the age range of the two groups the same (40–60 years), and eliminating axial lengths at the extremes.[6] Several variables impact RNFL measurement, the most important factors being axial length, gender, and age. There was no distinction between the two groups in terms of axial length, age, gender, ocular laterality.[5] Thus, the two groups were comparable in these factors and the variation in RNFL measurement is due to the neurodegenerative impact of alone DM. According to research by Altman and colleagues it was seen that diabetic retinopathy was due to combination of two factors.[6] Microvascular abnormalities in addition to DM's neurodegenerative effects on retinal ganglion cells. Another study supported this, pointing out that the primary cause of the diabetic neurodegenerative effect on ganglion cells and RNFL thickness is DM, and that the secondary cause is blood retinal barrier damage, which leads to damage to retinal ganglions due to edema and an increase in extracellular fluid levels.[7] We contrasted the RNFL thickness between healthy controls and diabetics without retinopathy. There were two objectives. One was to determine whether diabetic retinopathy develops before the neurodegenerative effects of DM. Second, it was thought that diabetic retinopathy interferes with various SD OCT measurements of retinal regions, and that findings

Table 1: Demographic data (n=200)

Characteristics	Study population	Controls	Cases	P-value
Age (years) mean±SD	47.05±5.45	46.72±5.60	47.38±5.32	0.197
Males	108 (54%)	55 (50.9%)	53 (49%)	0.553
Females	92 (46%)	43 (46.7%)	49 (53.2%)	
Axial length (mm) mean±SD	22.99±0.66	22.97±0.73	23±0.59	0.298

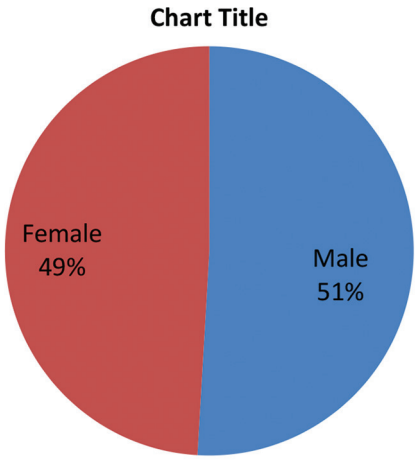
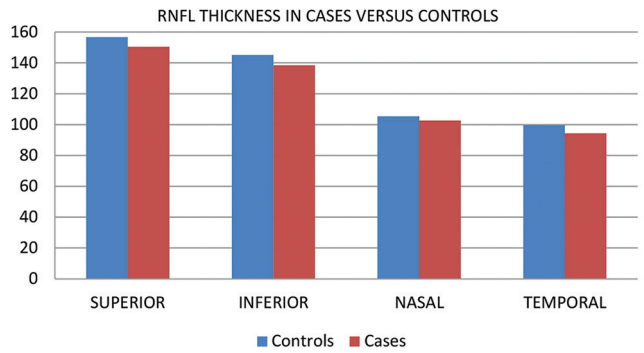


Table 2: Group wise distribution of peripapillary RNFL thickness (n=200)

Quadrant	Study population	Controls	Cases	P-value
Superior	153.57±6.64	156.72±6.23	150.43±5.47	0.0001
Inferior	141.84±8.70	145.22±8.32	138.47±7.74	0.0001
Nasal	104.04±5.14	105.38±4.73	102.70±5.21	0.0001
Temporal	97.03±8.41	99.67±8.32	94.39±7.17	0.0001

RNFL: Retinal nerve fibre layer



might be impacted by changes in thickness brought on by edoema, haemorrhages, and cotton wool spots. In a related investigation, Sohn EH and colleagues found that, in comparison to an age-matched control group, individuals with DM but no diabetic retinopathy exhibited thin ganglion cell layers and RNFL.[8] Additionally, they discovered that the thinning occurred over a 4 year period and was unrelated to age, gender, or glycosylated haemoglobin levels. Similar differences in RNFL thickness were discovered in a different investigation that involved Type I diabetic individuals without retinopathy.Another study indicated that RNFL and ganglion cell thickness were significantly lower in Type-I diabetic children without retinopathy than in healthy children.[9] Thus, there is proof that diabetes has a neurodegenerative effect on ganglion cells before the vascular component of diabetic retinopathy develops. Not many research has produced different findings. Researchers found that the RNFL was only thinner in the superonasal and superotemporal quadrants of Type-II diabetes patients with diabetic retinopathy as compared to healthy controls. They support the idea that neurodegeneration is a precursor to diabetes and may coexist with diabetic retinopathy, but they argue that there still has to be an explanation for why two quadrants only thinned preferentially. In a related study, patients with Type-1 diabetes who did not have retinopathy had their RNFL thickness measured using scanning laser polarimetry, and it was found that the superior quadrant had shrunk in comparison to the normative data base. These two studies have demonstrated that in Type-1 diabetic patients, the superior quadrants exhibit RNFL thinning regardless of the presence of retinopathy. Our results contrast from those of Srinivasan S and colleagues' studies, which discovered that RNFL thickness and ganglion cell thickness of the cell layer in healthy people, and diabetes, whether they had retinopathy or not, were not differs statistically in any region. Neuronal degeneration is a symptom of diabetes was discovered to be same in terms of RNFL thickness between groups that have retinopathy or don't, and between the control group.[10] The thickness of the RNFL in diabetic individuals with and without retinopathy was not compared. In research to examine the thickness of the RNFL in healthy persons, diabetics with and without retinopathy, it was found that the RNFL became progressively thinner as the retinopathy worsened. Therefore, it is assumed that the neurodegeneration of ganglion cells is progressing at a similar rate to the vascular progression of diabetic retinopathy, resulting in further RNFL thinning. In different research, it was discovered that the length of diabetes had an inverse relationship with RNFL thickness, and that as retinopathy progressed and the diabetes length increased, the RNFL became thinner.[11]

Limitations of the study

Our study has limitations of not including the patients with diabetic retinopathy and including diabetic patients with good glycemic control .

CONCLUSION

RNFL thickness is decreased in patients with DM as compared to age matched controls. This thinning is attributed to neuro-degeneratory effect of DM which occurs prior to development of retinopathy irrespective of age, glycaemic control or duration of diabetes.

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Authors Contribution:
EWK- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis and manuscript preparation; **QAS-** Concept, design, clinical protocol, manuscript preparation, editing, manuscript revision, article submission, statistical analysis and interpretation; **IAL-** Review manuscript and coordination.

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