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Assessment of Retinal Nerve Fibre Layer Thickness in Type 2 Diabetes Mellitus Patients Using Optical Coherence Tomography

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Abstract: ***Diabetes mellitus (DM) is chronic metabolic disorder which is globally prevalent and fast growing disorder, commonly leads to complications like neuropathy, nephropathy, retinopathy, keratopathy, cardiovascular diseases, and diabetic foot. Hyperglycemia affects both cornea and retina. As many studies have been conducted on OCT and it usefulness in Diagnosing Early Changes of Diabetic Retionpathy. This study aimed to do analysis of RNFL thickness in Type such that it leads to early diagnosis and treatment for the same. Method: The study was conducted on 200 patients which were equally divided into Group I consisting of 100 diabetic patients and Group II consisting of 100 non - diabetic patients in Department of Ophthalmology, Rama Medical College, Hospital and Research Centre, Hapur. In all study patients RNFL thickness using Nidek ® Retina Scan Duo RS - 330 (SD - OCT) was recorded. Conclusion: The results of this study revealed significant alterations in RNFL thickness, as measured by OCT, in diabetic patients compared to non - diabetic controls. These changes are likely associated with early - stage neuronal and vascular abnormalities in the diabetic retina.***

Keywords: Diabetes mellitus, diabetic retinopathy.

List of Abbreviations

DOA	Date of Admission
DOD	Date of Discharge
DM	Diabetes Mellitus
ETDRS	Early treatment diabetic retinopathy study
IRMA	Intraretinal microvascular abnormalities
IOP	Intraocular Pressure
NVD	Neovascularisation of disc
NVE	Neovascularisation Elsewhere
NPDR	Non Proliferative Diabetic Retinopathy
OCT	Optical Coherence Tomography
PDR	Proliferative Diabetic Retinopathy
RNFL	Retinal nerve fibre layer

1. Introduction

Diabetes Mellitus (DM) is a long - term metabolic disorder characterized by hyperglycemia, leading to potential damage to vital organs such as the heart, blood vessels, eyes, kidneys, and peripheral nerves. Type 2 Diabetes Mellitus (T2DM) represents approximately ninety percent of total diabetes cases globally. Overweight due to unhealthy eating habits and physically idleness is primary reason for T2DM. Around 8.5% adults around the world had diabetes during 2014 compared to 4.7% during 1980, and it is still rising rapidly in many countries including India. Diabetic retinopathy (DR) is among the most serious complications, which can lead to complete loss of vision among working - age group. Early detection and treatment of DR can prevent severe vision loss; however, the asymptomatic nature of the early stages of DR often leads to missed diagnoses until the disease progresses to more damaging stages.2 This delay underscores the importance of effective screening tools that can detect DR at an early stage.

The Retinal Nerve Fibre Layer (RNFL) is particularly susceptible to damage from diabetic microvascular alterations due to its high energy demands and blood supply dependency. Optical Coherence Tomography (OCT) has emerged as a vital tool in ophthalmology for imaging retinal structures with micrometre resolution, allowing for the precise measurement of RNFL thickness. Using low - intensity light, OCT produces high - definition, cross-sectional images of the retina, providing a detailed view of its structure that can highlight changes in the thickness of the RNFL, which are indicative of

Rationale of Study

Early neuronal damage even before visible signs of DR are present. The assessment of RNFL thickness using OCT can serve as an early biomarker for detecting diabetic changes in the retina.3 Research has shown that RNFL thinning is significantly associated with the duration and severity of diabetes, and it may occur prior to the onset of clinically identifiable diabetic retinopathy.

This suggests that OCT could play a crucial role in the early screening and diagnosis of DR by detecting subtle changes in RNFL thickness in diabetic patients without retinopathy. Despite the potential benefits of using OCT for early DR detection, there remains a substantial gap in the utilisation of this technology in routine diabetes care. Many studies have focused on populations with established diabetic retinopathy or those with long - standing diabetes. There is limited information on RNFL thickness in newly diagnosed T2DM patients who do not yet show signs of retinopathy.4 These patients, who are often asymptomatic, could greatly

benefit from early screening and subsequent intervention, potentially preventing the progression of DR. Additionally, comparing RNFL thickness between diabetic and non - diabetic individuals using OCT could provide further insights into the pathophysiological changes occurring in the retinas of diabetic patients. This comparison is crucial for establishing the specific retinal layer susceptibilities in diabetic patients, which could aid in formulating targeted preventive strategies.

This investigation endeavors to fill the existing voids in research by evaluating RNFL thickness in patients newly diagnosed with T2DM compared to non- diabetic individuals using OCT. By focusing on this particular patient population, the study seeks to underline the importance of early detection and regular monitoring of diabetic patients for signs of retinal neurodegeneration, which could precede and predict the development of DR. The discoveries made in this study may shed light on the early aspects of neurodegenerative processes in the diabetic retina, potentially leading to the development of novel diagnostic and therapeutic approaches for preventing diabetic retinopathy in its initial stages

2. Need for the Study

Globally, Type 2 Diabetes Mellitus (T2DM) is one of the most common chronic conditions, posing significant health challenges, affecting millions of people. A significant complication arising from T2DM is diabetic retinopathy (DR), with the potential to cause permanent and irreversible blindness if not detected and treated early. Currently, diabetic retinopathy is diagnosed primarily through direct observation of the retina when noticeable vascular changes occur, which often represents later stages of the disease where interventions are less effective in preventing vision loss.6 Advancements in diagnostic technologies such as Optical Coherence Tomography (OCT) have opened new pathways for earlier detection of diabetic changes in the retina. OCT provides high - resolution images that can identify subtle changes in the retinal structure, particularly the retinal nerve fiber layer (RNFL) thickness, which is critical for assessing early diabetic eye changes before the onset of visible retinopathy. Despite the capabilities of OCT, its application in the routine screening of diabetes - related ocular changes, especially in newly diagnosed or early – stage T2DM patients, remains underutilised. Most existing studies and screening protocols focus on patients with established diabetes or those already showing signs of diabetic retinopathy. This gap highlights a critical need for research focused on early detection, aiming to intervene before irreversible damage occurs.7The ability to detect retinal changes in the early stages of diabetes can transform patient management strategies, emphasizing preventive care rather than reactive treatment. Furthermore, current research often overlooks the comparison of RNFL thickness between diabetic patients without retinopathy and healthy individuals. Such comparative studies are essential to understand more deeply how diabetes affects the retina, potentially leading to early markers that can be used in routine diabetes management and screening protocols. Understanding these differences is crucial not only for detecting DR at an earlier stage but also for implementing early intervention strategies that could halt or slow the progression of the disease. This study addresses these needs by evaluating RNFL thickness using OCT in newly diagnosed T2DM patients compared to non – diabetic controls.8 This approach aims to establish the effectiveness of OCT as a screening tool in the early stages of diabetes, thereby facilitating earlier and more accurate diagnosis of retinal changes. The outcomes of this study could lead to significant shifts in clinical practice, integrating OCT into standard diabetes care protocols, thereby enhancing the quality of life and visual outcomes for diabetic patients.

3. Materials and Methods

Study Design: Prospective observational non randomized study.

Study Area: The study is conducted in the OPD of Department of Ophthalmology Rama Medical College Hospital and Research Centre, Hapur, U. P. - 245304.

Study Period: 18 months (April 2023 to October 2024)

Study Population: All Type 2 Diabetes Mellitus patients attending the OPD of Department of Ophthalmology at Rama Medical College and Hospital.

Sample size estimation: Sample size is calculated using Cochran's formula.
n=Z2pq/e2
n is sample size;
Z is normal deviant at 95% confidence interval;
p is prevalence;
q=1 - p; e is margin of error=5%.

So, an approximate sample size of 200 was taken.

Materials and Methods
The patients were enrolled according to the following inclusion and exclusion criteria:

Inclusion criteria:

Group 1
All the cases of newly detected Type 2 diabetes mellitus (Duration of DM < 7 years)
Age > 40 years
PP>200 mg/dl, FBS >126 mg/dl, HbA1c >6.5%

Group 2
Age > 40 years
PP < 200 mg/dl, FBS < 126 mg/dl, HbA1c < 5.9 %

Exclusion criteria:

Group 1
- Known case of diabetic retinopathy
- Age < 40 years
- Duration of DM > 7 years
- Patients who underwent recent ocular surgery (1 month)
- Long term steroid users

Materials and Methods

- High myopia
- Media opacities such as cataract
- IOP > 21 mmHg, other causes for secondary glaucoma
- Post glaucoma surgery

Group 2

- Age < 40 years
- Patients who underwent recent ocular surgery (1month)
- Long term steroid users
- High myopia
- Media opacities such as cataract
- IOP>21mmHg, other causes for secondary glaucoma

The present cross - sectional study was carried out on 100 patients in Rama Medical College Hospital & Research Centre, Hapur. Total 100 patients (50 suffering from DM II, 50 non - diabetics) of either gender attending the Ophthalmology Out - Patient Department, Rama Medical College Hospital & Research Centre, Hapur, was enrolled in this Prospective Observational non randomized study. The study has been approved by the Institutional Ethics Committee of our Institute. A detailed history was recorded in each case. A detailed history was recorded in each case.

4. Method of Study

Each subject will provide written, informed permission in their native tongue before the study begins. A piloted proforma will be used to gather data from the patients, therefore fulfilling the study's goals through in – person interviews with the patients. Patients who meet the inclusion criteria will be the only ones enrolled in the research after being screened out based on the data supplied. A thorough clinical history will be gathered of the patient when they are chosen for the research. Foveal thickness will be recorded using Nidek® Retina Scan Duo RS - 330.

5. Data Entry and Statistical Analysis

After being coded and converted into variables, the gathered data was input into Microsoft Excel. SPSS - PC 20 version was used to analyze and statistically assess the data.

P - values below 0.05 are regarded as statistically significant.

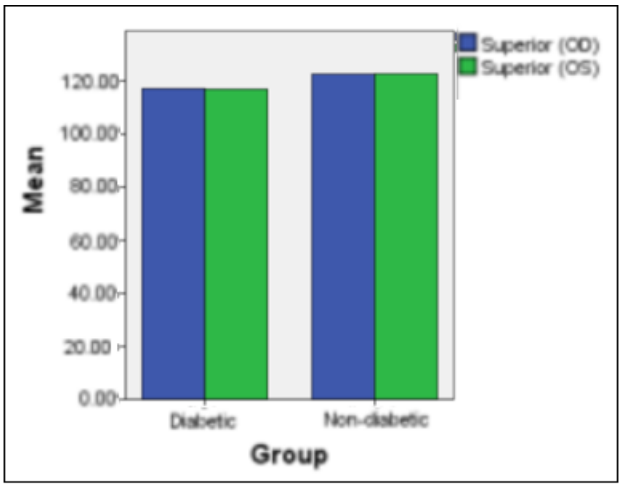

Figure 4.11: Comparison of OCT- Superior RNFL

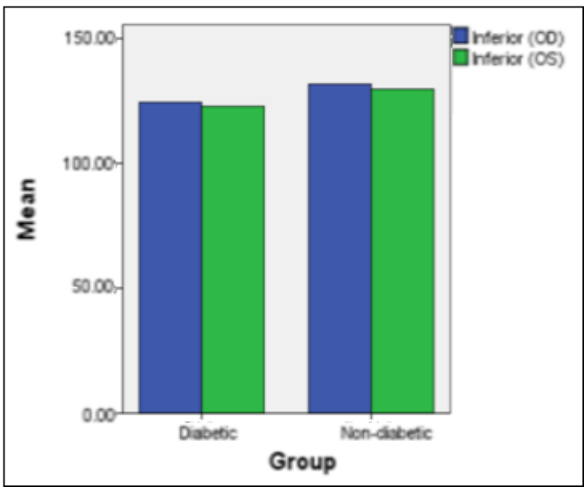

Figure 4.12: Comparison of OCT- Inferior RNFL

The work included history and detailed ocular examination of all patients:

- Visual Acuity (UCVA, BCVA) using Snellen's Chart
- Slit - lamp examination to rule out pre - existing ocular pathology
- Pupillary dilation with eye drops Tropicamide 1%
- Fundus examination using indirect ophthalmoscopy with +20D lens and slitlamp biomicroscopy using +90D lens
- Optical Coherence Tomography using Macula Map scan on Nidek Retina Scan Duo RS - 330 (Spectral - domain OCT) OCT
- FBS/RBS/HbA1c

4. Conclusion

The present study was conducted on patients attending the Ophthalmology OPD of Rama Medical college Hospital and Research centre, Hapur over a period of one and a half years from April 2023 to October 2024 and a total number of 200 patients was taken to study the changes of retinal nerve fibre layer thickness in Type 2 Diabetes Mellitus patients without Diabetic Retinopathy measurements were done by by 3D - OCT [Optical coherence tomography], evaluate the correlation of Diabetic group and controls with the variables included in the study, such as Retinal nerve

fiber layer thickness to OCT characteristics of RNFL in patients with Diabetes mellitus without Diabetic Retinopathy was determined. The RNFL thickness is decreased amongst diabetics as compared to non diabetics. This maybe due to vascular and neural changes in retina.

References

[1] Budenz DL, Anderson DR, Varma R, Schuman J, Cantor L, Savell J et al. Determinants of normal retinal nerve fiber layer thickness measured by stratus OCT. Ophthalmology 2007; 114 (6): 1046 - 1052.
[2] Salvi L, Plateroti P, Balducci S. Abnormalities of retinal ganglion cell complex at optical coherence tomography in patients with type 2diabetes: a sign of diabetic polyneuropathy, not retinopathy," Journal of Diabetes and its complications 2016; 30 (3): 469 - 76.
[3] Santos AR, Ribeiro L, Bandello F. Functional and structural findings of neuro degeneration in early stage diabetic retinopathy: crosssectional analyses of baseline data of EUROCONDOR project," Diabetes 2017; 66 (9): 2503 - 510.
[4] Shahidi AM, Sampson GP, Pritchard N. Retinal nerve fibre layer thinning associated with diabetic peripheral neuropathy, Diabetic Medicine 2012; 29 (7): 106 - 11.
[5] Simo R, Hernandez C. Neurodegeneration in the diabetic eye: new insights and therapeutic perspectives," Trends in Endocrinology & Metabolism 2014; 25 (1): 23 - 33.
[6] Sugimoto M, Saosh M, Ido M, Wakitani Y, Takahashi C, Uji Y. Detection of early diabetic change with optical coherence tomography in type 2 diabetes mellitus without retinopathy. Ophthalmologica 2005; 219 (6): 379 - 85.