

Diabetic Retinopathy: Does 12 Weeks of Intensive Lifestyle Intervention Cause Any Improvement?

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ABSTRACT

Introduction: Diabetic retinopathy (DR) is a microvascular disorder occurring due to the long-term effects of diabetes mellitus and is the most common cause of severe vision loss in adults. Diabetic retinopathy may lead to vision-threatening damage to the retina, eventually leading to blindness.

Aim: To study the effect of 12 weeks of intensive lifestyle intervention program on diabetic retinopathy using OCT and VEP.

Setting and design: Quasi-experimental study conducted in the Department of Physiology in collaboration with the Department of Ophthalmology at AIIMS, Nagpur.

Materials and methods: 75 patients of type 2 diabetes mellitus with a duration of >5 years were recruited as per the inclusion and exclusion criteria. After taking clinical history and anthropometry parameters, visual evoked potential and optical coherence tomography were done. Then, a 1.5-hour lifestyle intervention session was conducted. Followed by follow-up visits on 15th, 30th, and 45th days, done with biweekly follow-up in between through telephonic/ WhatsApp group.

Results: Modification in dietary pattern, regular exercise, healthy sleep schedule, and stress management showed a reduction in latencies and no major changes in amplitudes, but overall mild improvement was observed in PRVEP and FVEP. Also, in the retinal nerve fiber layer, mild changes along with a reduction in the severity of thickening of the retinal nerve fiber layer (RNFL) of both eyes were seen, but no major changes in central macula thickness were observed.

Conclusion: Lifestyle modifications play a crucial role in the improvement of diabetic retinopathy.

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MATERIALS AND METHODS

This was a quasi-experimental study (pre- and post-comparison without control) of 1-year duration conducted in the Department of Physiology (Lifestyle Intervention Clinic) in collaboration with the Department of Ophthalmology at All India Institute of Medical Sciences (AIIMS), Nagpur. Seventy-five patients with type 2 diabetes mellitus of >5 years' duration were recruited under the following criteria.

Inclusion Criteria

- Age between 18 and 60 years of either gender.
- Known case of type 2 diabetes mellitus of >5 years duration.
- HbA1c between 6.5 and 9.9%.
- The patient should be on a stable dose of oral antidiabetic medications during the study period.
- Nonhypertensive, nonsmoker, nonalcoholic.

Exclusion Criteria

- Recently diagnosed with diabetes mellitus.
- HbA1C >10%.
- Pregnant and lactating women.
- Presence of associated psychiatric illness.
- Undergone recent surgery.
- Patients taking steroids.
- Failure to give informed consent.

In the lifestyle intervention clinic, participants meeting the inclusion criteria—diagnosed with type 2 diabetes mellitus were enrolled after obtaining informed consent. Clinical history and anthropometric measurements were documented, followed by baseline assessments using VEP to assess visual pathway function and OCT to evaluate retinal structural changes. A structured 1.5-hour lifestyle intervention session was

INTRODUCTION

India is known as the diabetic capital of the world, and there is a growing incidence of DM in the age group between 20 and 70 years. The reason for the rising prevalence of diabetes and other noncommunicable diseases is due to various factors such as rapid urbanization, sedentary lifestyles, unhealthy diet, and stress. In India, the prevalence of diabetes mellitus is 9.3% among individuals aged 18–69 years.¹ Diabetes mellitus is a chronic, metabolic disease characterized by elevated levels of blood glucose, which leads to serious damage to the heart, blood vessels, eyes, kidneys, and nerves.² One of the microvascular complications of diabetes is diabetic retinopathy, that damage the blood vessels in the tissue of the retina. In our study, visual evoked potential (VEP) gives important diagnostic information regarding the neural functional integrity of the visual system. It is done by light flash VEP or pattern VEP stimulus, which can be used to see the damage in the visual pathway, which includes retina, optic nerve, optic chiasm, optic radiations, and occipital cortex.

Optical coherence tomography (OCT)—a noninvasive imaging method that uses reflected light to create pictures of the retina, which helps in the early

diagnosis of DR by providing anatomical information about retinal nerve fiber layers, macula foveal dip, and thickness of macula, which tells us about disease progression.³ Lifestyle medicine is a medical specialty that uses lifestyle interventions as a primary modality to treat chronic conditions, including cardiovascular diseases, type 2 DM, and obesity. Lifestyle medicine clinicians are certified professionals trained to apply evidence-based, prescriptive lifestyle changes to treat and reverse chronic conditions. Applying the pillars of lifestyle medicine, which are a whole-food plant-based diet, physical activity, restorative sleep, stress management, and positive social connection, provides effective modes of prevention for these chronic diseases.⁴ Standard treatment protocols are insufficient to manage long-standing DM and its complications. Incorporating lifestyle modifications along with standard treatment protocol increases the chances of better control over blood glucose and reduces the effects of hyperglycemia on other organ systems, causing improvement in diabetes and its complications. Hence, this study was undertaken to assess the effect of 12 weeks of a structured lifestyle intervention program on diabetic retinopathy using OCT and VEP.

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Table 1: Visual evoked potential (Pattern)

| VEP (Pattern) | Latencies (ms) | | Amplitudes (mV) | | Normal | | Abnormal | |
|---------------|----------------|-----------------|-----------------|-------------|-----------|------------|-----------|------------|
| | Pre-I | Post-I | Pre-I | Post-I | Pre-I (%) | Post-I (%) | Pre-I (%) | Post-I (%) |
| Right eye | 113.19 ± 33.75 | 114.25 ± 35.27 | 6.14 ± 4.24 | 5.88 ± 3.24 | 21 (28) | 22 (29) | 54 (72) | 53 (71) |
| Left eye | 114.15 ± 34.14 | 112.64 ± 35.56* | 5.33 ± 3.23 | 5.21 ± 2.65 | 20 (27) | 20 (27) | 55 (73) | 55 (73) |

Pre-I, preintervention; post-I, postintervention; *statistically significant (< 0.05)

Table 2: Visual evoked potential (Flash)

| VEP(Pattern) | Latencies(ms) | | Amplitudes (mV) | | Normal | | Abnormal | |
|--------------|----------------|-----------------|-----------------|--------------|-----------|------------|-----------|------------|
| | Pre-I | Post-I | Pre-I | Post-I | Pre-I (%) | Post-I (%) | Pre-I (%) | Post-I (%) |
| Right eye | 123 ± 32.18 | 123.51 ± 28.52 | 7.17 ± 3.61 | 7.69 ± 3.77* | 45 (60) | 47 (63) | 30 (40) | 28 (37) |
| Left eye | 123.07 ± 36.84 | 119.59 ± 33.89* | 7.34 ± 3.55 | 6.99 ± 3.66* | 47 (63) | 44 (59) | 28 (37) | 31 (41) |

Pre-I, preintervention; post-I, postintervention; *statistically significant (<0.05)

Table 3: Optical coherence tomography: retinal nerve fiber layer

| Variables | Right eye (RNFL) | | Left eye (RNFL) | |
|------------|---------------------|----------------------|---------------------|----------------------|
| | Preintervention (%) | Postintervention (%) | Preintervention (%) | Postintervention (%) |
| Normal | 49 (65.33) | 54 (72) | 53 (70.67) | 57 (76.00) |
| Thinning | 13 (17.33) | 16 (21.33) | 10 (13.33) | 8 (10.67) |
| Thickening | 13 (17.33) | 5 (6.67) | 10 (13.33) | 8 (10.67) |
| Cataract | 0 (0.00) | 0 (0.00) | 2 (2.67) | 2 (2.67) |

Table 4: Optical coherence tomography (OCT): Central macula thickness (µm)

| Variables | Preintervention Mdn (IQR) | Postintervention Mdn (IQR) | Mean difference |
|-----------|---------------------------|----------------------------|-----------------|
| Right eye | 262 (36) | 261 (30)* | 1.5 |
| Left eye | 261 (33) | 261 (33.5) | 1.5 |

*Statistically significant (<0.05)

then conducted, emphasizing evidence-based modifications in dietary habits, physical activity, sleep hygiene, stress management, and social connectivity. Follow-up assessments were conducted on Days 15, 30, and 45, with additional biweekly check-ins via telephone or WhatsApp to reinforce adherence, address concerns, and monitor ongoing progress throughout the intervention period.

Statistical Analysis

The collected data was entered into a Microsoft excel spreadsheet. Jamovi 2.3.28 was used for data analysis. Depending on the normality tests, parametric and nonparametric paired *t*-test applied, that is student's *t*-test and the Wilcoxon signed-rank test, respectively for comparing pre(baseline) and postintervention parameters. *p*-value <0.05 will be considered as statistically significant.

RESULTS

The results are presented in Tables 1 to 4.

DISCUSSION

Diabetic retinopathy (DR) is a devastating complication and can lead to blindness due

to microangiopathy and optic neuropathy because of metabolic abnormalities and intraneural blood flow disorders. T2DM leads to microvascular alterations in the retinal capillary network, microaneurysms, intraretinal microvascular abnormalities, and neovascularization.⁵ Applying the pillars of lifestyle medicine—a whole-food plant-based diet, regular physical activity, restorative sleep pattern, stress management, and having positive social connections—provides effective prevention for these conditions.³ In our study, assessment of diabetic retinopathy was done by fundus examination and OCT, whereas for visual pathway impairment, assessment was done by VEP. The study by Sala-Vila et al. and Aro et al. reported that dietary involvement of long-chain ω-3 polyunsaturated fatty acid (LCω3PUFA), lifestyle changes with involvement of exercise and healthy diet, is associated with a reduced incidence of severe DR in individuals with type 2 diabetes and can lead to a significant reduction of retinal microaneurysm and macular edema.⁶ Dietary changes, such as including nitrates, a dietary source found in dark leafy greens (represents 80% of nitrate intake), are converted to nitric oxide once ingested. Nitric oxide has a protective

action against DR as it causes vasodilation and increased blood flow to the eye vessels. Omega-3 fatty acids in the diet also improve systemic microcirculation and ocular blood flow, which leads to improved ocular health. Another study by She et al. reported that oxidative stress causes optic nerve injury, so the fruits and vegetables with high antioxidants act as neuroprotection from oxidative stress, affecting the cell and tissue morphology and its functions, leading to cell death, which has an important role in the pathogenesis of retinal diseases.⁷ The study by Soleimani et al. and Pan et al. each reported that 5,000 steps daily or two and a half hours of nonsedentary life reduced the visual field progression significantly by 10%.⁸ Every additional 10 minutes of evening activity per day leads to a slowing of the rate of ganglion cell-inner plexiform layer thinning.⁹ And exercise also improves blood flow throughout the body, including the eyes, which helps in delivering nutrients for collagen production. Stress reduction techniques like yoga and meditation have a positive impact on eye health because of high stress, hormones such as cortisol and adrenaline that cause insulin resistance, which can raise your blood sugar and increase the risk of diabetic retinopathy.¹⁰

So, relaxation techniques, such as meditation, yoga, deep breathing, and mindfulness, along with positive social connection with family and friends and good sleep can help individuals to relax the body and manage their pain in a better way.

However, other advantages were incidentally noted. Dosage of medications was reduced with a decrease in economic burden related to treatment for diabetes. Patients experienced more positivity and a good mood to do day-to-day activities. Through this study, in many patients who were asymptomatic of complications, early detection of complications was possible so that further precautions could be taken, which reduced the risk of complications of diabetes, along with a positive impact and better quality of life¹¹ experienced by patients.

One of the primary limitations of our study is the relatively short duration of the intervention, which lasted only 12 weeks. Although mild improvements in PRVEP and FVEP latencies and RNFL thickening were observed, the limited timeframe may not have been sufficient to capture more substantial or long-term changes in visual function or retinal structure. Additionally, no significant changes were noted in the central

macular thickness, suggesting that longer follow-up periods may be necessary to detect meaningful structural improvements. Lastly, variability in participant adherence, despite regular follow-up via telephonic and WhatsApp-based check-ins, may have influenced the consistency of intervention effects.

Overall, we concluded that in a sample size of 75 patients, diet and lifestyle modification (regular physical exercise, restorative sleep pattern, stress management, and positive social connection) ought to be included in the first line of the management of diabetes. Reduction in the dosage of medications with early detection of complications was possible, reducing the financial burden on the patients. But for more significant changes to be observed, follow-up of more than 12 weeks is required.

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