

Relationship between Biochemical Variables, the Length of Time a Person Has Had Diabetes, and Dry Eye and Diabetic Retinopathy: A Retrospective Study

Binod Kumar¹, Suman Saurabh², Rupak Kumar Jha³

¹Assistant Professor and HOD, Department of Ophthalmology, JNKTMC Madhepura, Bihar, India

²Senior Resident, of Ophthalmology, JNKTMC Madhepura, Bihar, India

³Senior resident, Department of Ophthalmology, JNKTMC Madhepura, Bihar, India

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Corresponding Author: Dr. Suman Saurabh

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Abstract

Aim: The aim of the present study was to correlate the dry eye and diabetic retinopathy with duration of diabetes and blood urea and serum creatinine level.

Material & Methods: A retrospective study was conducted in the Department of Ophthalmology, JNKTMC Madhepura, Bihar, India from January 2023 to October 2023. A written consent was obtained from the patients before subjecting them for detailed clinical examination. 200 cases of only type 2 diabetes mellitus patients who reported to eye OPD through referral from diabetology OPD and ward, medicine OPD and ward for routine diabetes eye screening were examined.

Results: Among 200 patients studied, 132 patients were females and 68 patients were males. The patients diagnosed with diabetes less than 1 year duration were 6%. Majority of population were between 1 to 5 years duration i.e., 59%. 65% had no dry eye symptoms and 35% had dry eye symptoms. 25% of patients had FBS less than 110mg/dl. 75% had FBS more than 110mg/dl. 52 patients had PPBS less than 160 mg/dl. 148 patients had PPBS more than 160 mg/dl. 172 patients had urea level less than 40 mg /dl. 28 patients had urea level more than 40 mg. 180 patients had Creatinine level less than 1 mg/dl. 20 patients had Creatinine more than 1 mg/dl. 60 Schirmer test positive patients, 16 patients had 1 to 5 years of diabetes. 20 of them were 6 to 10 years of diabetes. 16 of them were 11 to 20 years of diabetes. The P value of above comparison was significant. 50 TBUT test positive patients, 8 of them were in 1 to 5 years duration of diabetes, 32 of the were in 6 to 10 years duration and 10 of them were in 11 to 20 years duration of diabetes.

Conclusion: There was statistically significant positive correlation between the dry eye and duration of diabetes and severity of retinopathy. Hence, all the diabetic patients should be evaluated and screened at the earliest for retinopathy changes and presence of ocular surface disorders and treated accordingly. Early treatment would prevent complications associated with ocular surface disorders and diabetic retinopathy. They should be emphasized upon on need for regular follow up and maintaining a good glycemic control.

Keywords: Dry eye, Diabetes, Diabetic retinopathy, Schirmer test

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Introduction

Diabetes mellitus causes 15-33% dry eye. According to 2016 WHO figures, 422 million persons worldwide had diabetes mellitus in 2014, up from 108 million in 1980. [1] 5% of diabetics have type 1 diabetes, whereas 95% have type 2. This is frequently linked to old age, obesity, inactivity, family history of type 2 diabetes, or gestational diabetes. Diabetes causes 2.6% of worldwide blindness. [2]

Diabetics with dry eye have been observed to have ocular surface issues that lead to superficial punctate keratitis, trophic ulceration, and chronic epithelial defect. [3] Diabetes duration and polyneuropathy severity enhance ocular sensitivity impairment. [4,5]

On in-vivo confocal microscopic images, severe polyneuropathy evaluated by MNSI score demonstrated lower corneal sensitivity and fewer long nerve fiber bundles in the sub-basal nerve plexus. Cornea is damaged early in polyneuropathy. Sub-basal nerve densities were markedly diminished in all polyneuropathy patients. Normal corneal sensitivity with no or mild-to-moderate neuropathy. Only severe neuropathy, diabetes with amputated limb, and prosthetic eye impact nerve density and corneal sensitivity, causing difficulties. [6]

Diabetic neuropathy was diagnosed using MNSI. Feldman et al. found that MNSI score predicts diabetic neuropathy with 80% sensitivity and 95%

specificity. MNSI score inversely affects corneal sensitivity. [7] Early diabetes causes corneal thickening, although neuropathy does not modify epithelial thickness. A thin epithelium caused by reduced neurotrophic impulses in severe neuropathy may cause recurrent corneal erosions. [8] Reduced basal tear production suggests peripheral neuropathy affects lacrimal gland function in long-term diabetics with problems. [9] Dry eye patients have hypoesthesia following mechanical, thermal, and chemical stimuli, perhaps due to corneal sensory innervation loss. [10]

The goal was to correlate dry eye and diabetic retinopathy with diabetes duration, blood urea, and serum creatinine levels, evaluate risk factors, and study prevalence.

Material & Methods

A retrospective study was conducted in the Department of Ophthalmology, JNKTMCH Madhepura, Bihar, India from January 2023 to October 2023. Prior to conducting a thorough clinical evaluation, the patients were required to provide written permission. A total of 200 cases consisting exclusively of patients with type 2 diabetes mellitus who were referred from the diabetology OPD and ward, medicine OPD and ward, and reported to the eye OPD for regular diabetes eye screening, were evaluated. These individuals were already receiving treatment with oral antidiabetic medications, insulin, or a combination of both.

Inclusion Criteria

- This research comprised individuals of all genders, aged between 35 and 85 years.
- All participants only had type 2 diabetes mellitus.

Exclusion Criteria

- Contact lens usage, long-term tricyclic antidepressants, beta blockers, and antihistaminics are linked to type 2 diabetes.
- Dry eye syndrome can also be caused by rheumatoid arthritis, HIV, recent ocular surgeries, lupus, Parkinson, ocular cicatricial pemphigoid, Steven Johnson syndrome, keratoconjunctivitis sicca, antipsychiatric drugs, beta-blockers, diuretics, antihistaminics, tricyclic antidepressants, post-LASIK surgery, meibomian gland dysfunction, pregnancy, vitamin A deficiency, corneal oedema, contact lens wearers, viral keratitis.
- We also omitted type 1 diabetes.

Methodology

Patients' age, sex, BMI, duration of diabetes, drug history (oral antidiabetic, insulin, or both), and other associated conditions (hypertension, chronic kidney disease, hyperlipidaemia) were obtained from medical records and direct patient interviews. Apart from poor eyesight, eye complaints included ocular irritation, gritty feeling, itching, redness, blurring, which improves with blinking, and burning. Visual acuity by Snellen chart distance and near vision, cycloplegic refraction, slit lamp examination, intraocular pressure by applanation tonometer, fundus by direct and indirect ophthalmoscope, angle of anterior chamber by Goldmann three mirror gonioscopy, tear breakup time, Schirmer's test I, corneal sensitivity test, and blood tests like fasting and postprandial blood sugar, Hb1AC, blood urea

Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences version 22. Significance was considered to be $P < 0.05$. Results were given with their 95% CIs. Data were presented as means \pm SD.

Results

Table 1: Demographic data

Gender	N%
Male	68 (34)
Female	132 (66)
Duration range	
Less than 1 year	12 (6)
1 to 5 years	118 (59)
6 to 10 years	52 (26)
11 to 20 years	18 (9)
Prevalence of dry eye symptoms	
Absent	130 (65)
Present	70 (35)

Among 200 patients studied, 132 patients were females and 68 patients were males. The patients diagnosed with diabetes less than 1 year duration were 6%. Majority of population were between 1 to 5 years duration i.e., 59%. 65% had no dry eye symptoms and 35% had dry eye symptoms.

Table 2: Fasting and post prandial blood sugar range

Fasting blood sugar	N%
FBS < 110	50 (25)
FBS > 110	150 (75)
Post prandial blood sugar	
Up to 160	52 (26)
Above 160	148 (74)

25% of patients had FBS less than 110mg/dl. 75% had FBS more than 110mg/dl. 52 patients had PPBS less than 160 mg/dl. 148 patients had PPBS more than 160 mg/dl.

Table 3: Blood Urea and Serum Creatinine Range

Blood Urea	N%
Upto 40 mg /dl	172 (86)
>40 mg /dl	28 (14)
Serum Creatinine	
Upto 1 mg /dl	180 (90)
>1 mg /dl	20 (10)

172 patients had urea level less than 40 mg /dl. 28 patients had urea level more than 40 mg. 180 patients had Creatinine level less than 1 mg/dl. 20 patients had Creatinine more than 1 mg/dl.

Table 4: Schirmer Test and Duration of Diabetes

Schirmer Test	Less than 1 year	1 to 5 years	6 to 10 years	11 to 20 years
Positive	0	16	20	16
Negative	10	104	30	4
Total	10	120	50	20

60 Schirmer test positive patients, 16 patients had 1 to 5 years of diabetes. 20 of them were 6 to 10 years of diabetes. 16 of them were 11 to 20 years of diabetes. The P value of above comparison was significant.

Table 5: TBUT and Duration Of Diabetes Mellitus

TBUT	Less than 1 year	1 to 5 years	6 to 10 years	11 to 20 years
Positive	0	8	32	10
Negative	10	112	18	10
Total	10	120	50	20

50 TBUT test positive patients, 8 of them were in 1 to 5 years duration of diabetes, 32 of the were in 6 to 10 years duration and 10 of them were in 11 to 20 years duration of diabetes.

Discussion

Dry eye is a condition characterized by a combination of factors affecting the tear film and the surface of the eye, leading to symptoms such as vision impairment, discomfort, instability of the tear film, higher osmolarity of the tear film, and inflammation of the eye surface. This definition was established by the Dry Eye Workshop (DEWS) in 2007. [11] Decreased corneal sensitivity contributes to the development of dry eye syndrome (DES) by lowering the frequency of blinking, reducing reflex-induced tear production, and increasing the loss of tears by evaporation. [12] Several ideas elucidate the connection between dry eye and diabetes. Hyperglycemia and microvascular injury to the neurons in the cornea might impede the feedback process that regulates tear secretion. When there is a disruption in the innervation of the ocular surface,

the lacrimal gland fails to release tears adequately. Hyperglycemia induces inflammatory changes, leading to a decrease in tear production. Dry eye not only leads to inflammation, but also results from it.

Out of the 200 patients examined, 132 were female and 68 were male. 6% of the patients had been diagnosed with diabetes for less than 1 year. The majority of the population, accounting for 59%, fell between the age range of 1 to 5 years. 65% of the participants did not have any symptoms of dry eye, whereas 35% of them reported having dry eye symptoms. According to research conducted by Manaviat et al, the prevalence of dry eye syndrome among individuals with diabetes was found to be 54.3%. A strong correlation was seen between dry eye syndrome and the length of time a person has had diabetes, and this correlation was more common in those with diabetic retinopathy. [13] According to research conducted by Pradeep et al, the occurrence of dry eye among individuals with type 2 diabetes was found to be 32%. The study also revealed that the prevalence of dry eye was higher in older age

groups and among those who had been diagnosed with diabetes mellitus for more than 10 years. [14] The diminished corneal sensitivity seen in diabetic patients is considered to be a manifestation of the widespread polyneuropathy that occurs in these individuals. [15] Corneal issues associated with diabetes, such as superficial punctate keratitis, chronic epithelial defects, and corneal endothelial damage, have been attributed to abnormalities in tear production, reduced corneal sensitivity, and inadequate adhesion between epithelial cells and their basement membrane. [16] There is a correlation between reduced corneal sensitivity and the severity of diabetes. Patients with this symptom have been shown to have more severe retinopathy and a longer duration of the condition. [17] Diminished corneal sensitivity is a contributing factor to dry eye. Additionally, it increases the susceptibility of patients to corneal injury, leading to a higher likelihood of developing trophic corneal ulcers. [18] Furthermore, it negatively impacts the healing process of corneal wounds. [19]

Conclusion

A positive link was found between dry eye and both the duration of diabetes and the severity of retinopathy. Therefore, it is essential to promptly assess and examine all diabetes patients for retinal alterations and the existence of ocular surface problems, and thereafter provide appropriate treatment. Timely intervention might avert consequences linked to ocular surface diseases and diabetic retinopathy. Emphasis should be placed on the need of frequent follow-up and maintaining optimal glycemic control.

References

1. Global report of diabetes. Geneva: World Health Organization 2016.
2. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002-2030. PLoS Med 2006;3(11):e442.
3. Management and therapy of dry eye disease: report of management and therapy subcommittee of the International Dry Eye Workshop. Ocul Surf 2007;5(2):163-178.
4. Moss SE, Klein R, Klein BE. Prevalence of and risk factors dry eye syndrome. Arch Ophthalmol 2000;118(9):1264-1268.
5. Moss SE, Klein R, Klein BEK. Incidence of dry eye in older population. Arch Ophthalmol 2004;122(3):369-373.
6. Schultz RO, Peters MA, Sobocinski K, et al. Diabetic corneal neuropathy. Trans Am Ophthalmol Soc 1983; 81:107-124.
7. Nielsen NV, Lund FS. Diabetic polyneuropathy. Corneal sensitivity, vibratory perception and Achilles tendon reflex in diabetics. Acta Neural Scand 1979;59(1):15-22
8. Ruben ST. Corneal sensation in insulin dependent and non-insulin dependent diabetics with proliferative retinopathy. Acta Ophthalmol 1994;72(5):576-580.
9. Ishida N, Rao GN, Cerro M, et al. Corneal nerve alterations in diabetes mellitus. Arch Ophthalmol 1984;102(9):1380-1384.
10. Martin XY, Safran AB. Corneal hypoesthesia. Surv Ophthalmol 1988;33(1):28-40.
11. International Dry Eye Workshop Subcommittee. The definition and classification of dry eye disease: report of the definition and classification subcommittee of the International Dry Eye Workshop (DEWS - 2007). Ocul Surf 2007; 5:75-92.
12. Achtsidis V, Eleftheriadou L, Kozanidou E, Voumvourakis K.I., Stamboulis E, Theodosiadis P.G., Tentolouris N. Dry Eye Syndrome in Subjects with Diabetes and Association with Neuropathy. Diabetes Care 2014;37(10):e210–e211.
13. Manaviat MR, Rashidi M, Afkhami-Ardekani M, Shoja MR. Prevalence of dry eye syndrome and diabetic retinopathy in type 2 diabetic patients. BMC ophthalmology. 2008 Dec; 8:1-5.
14. Pakalapati P, Sharmila AG, Nalinodbhavi B. Clinical association between Dry eye and diabetes mellitus. Indian Journal of Applied Research. 2015;5(6):474-8.
15. Fujishima H, Shimazaki J, Yagi Y, et al. Improvement of corneal sensation and tear dynamics in diabetic patients by oral aldose reductase inhibitor ONI-2235: a preliminary study. Cornea 1996;15(4):368-375.
16. Ramos-Remus C, Suarez-Almazor M, Russell AS. Low tear production in patients with diabetes mellitus is not due to Sjogren's syndrome. Clin Exp Rheumatol 1994;12(4): 37 5-380.
17. Schultz RO, Matsuda M, Yee RW, et al. Corneal endothelial changes in type I and type II diabetes mellitus. Am J Ophthalmol 1984; 98(4):401-410.
18. Schultz RO, Peters MA, Sobocinski K, et al. Diabetic keratopathy as a manifestation of peripheral neuropathy. Am J Ophthalmol 1983;96(3):368-371.
19. Schwartz DE. Corneal sensitivity in diabetics. Arch Ophthalmol 1974;91(3):174-178.