ORIGINAL RESEARCH

Assessment of tear film changes in type II diabetes mellitus with and without diabetic retinopathy

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ABSTRACT
Background: One typical sign of dry eye syndrome (keratoconjunctivitis sicca) is inflammation of the ocular surface and lacrimal glands. The present study was conducted to assess tear film changes in type II diabetes mellitus with and without diabetic retinopathy.
Materials & Methods:180 diagnosed with type II diabetes mellitus underwent routine ophthalmic checkup including best corrected visual Acuity (BCVA), slit lamp examination, tonometry and fundus examination. Posterior segment evaluation was done by indirect ophthalmoscopy and grading of DR was done according to Early Treatment in Diabetic Retinopathy Study (ETDRS). Grading of dry eyes was based on OSDI questionnaire and was confirmed by TBUT and Schirmer I and II test.
Results: Out of 180 eyes, diabetic retinopathy was present in 89 and no DR in 91. Out of DR, dry eyes grading was normal in 28, mild in 14, moderate in 21 and severe in 26 patients. Out of no DR, dry eyes grading was normal in 50, mild in 18, moderate in 9 and severe in 14 patients. The difference was significant ($P< 0.05$). TBUT revealed normal in 35, 34 mild0 moderate and 20 severe DR and 23 normal, 52 mild- moderate and 16 severe no DR patients. The difference was significant ($P< 0.05$).
Conclusion: Patients with DR have reduced tear film amount. All diabetes patients should have regular dry eye screenings so that appropriate care can be provided.
Keywords: dry eye syndrome, diabetic retinopathy, TBUT

INTRODUCTION

One typical sign of dry eye syndrome (keratoconjunctivitis sicca) is inflammation of the ocular surface and lacrimal glands. Dry eye symptoms could indicate a systemic condition, therefore early detection could help spot a potentially fatal issue.[1] Furthermore, those with dry eye are more vulnerable to potentially blinding infections like bacterial keratitis and are more likely to have problems following common procedures like laser refractive surgery. Dry eye can develop as a result of a number of environmental variables, including contact lens wear, dry climates, inflammatory disorders like vascular and allergy, hormonal imbalances like those experienced by perimenopausal women and patients receiving hormone replacement therapy, and cigarette smoke.[2]

Ocular surface damage from tear film disorders brought on by tear evaporation or lack results in pain for the eyes.[3] Since ancient times, cataract and retinopathy have been recognized as ocular consequences of diabetes. Its link to dry eyes and issues with the ocular surface has recently come to light. The main characteristic of diabetic ocular surface illness is tear film abnormalities, which results from subnormal ocular surface and poor tear quality and function.[4] The global prevalence of DED, which ranges from 5% to 35%, is significantly

impacted by people's lifestyle, geographic location, and climate. In Indian diabetic patients, the prevalence of DR is at 21.27%.[5]
Numerous pathophysiological mechanisms, such as hyperglycemia, the buildup of advanced glycated end products, oxidative stress, and the activation of inflammatory mediators, have been hypothesized to explain DED in diabetics. Aqueous deficient dry eye in diabetics is caused by "autonomic neuropathy," which affects the nerves that regulate the lacrimal gland.[6,7]

AIM & OBJECTIVES

The present study was conducted to assess tear film changes in type II diabetes mellitus with and without diabetic retinopathy.

MATERIALS & METHODS

Study Design

This was an **observational cross-sectional study** conducted to assess tear film changes in patients with Type II Diabetes Mellitus (T2DM), both with and without Diabetic Retinopathy (DR).

Study Population

Sample Size: 180 patients diagnosed with T2DM.
Age Range: 40 to 80 years.
Gender: Both males and females were included.
Consent: All participants provided written informed consent.

Study Setting and Duration

Location: Department of Ophthalmology, Vardhman Mahavir Medical College & Safdarjung Hospital, New Delhi, India.
Study Period: January 2019 to April 2021(Two years and four months).

Ethical Considerations

Approval: Obtained from the Institutional Ethics Committee.
Guidelines Followed: Conducted in accordance with the Declaration of Helsinki.

Inclusion Criteria

- Patients aged between 40 and 80 years.
- Diagnosed with Type II Diabetes Mellitus.
- Provided informed consent to participate in the study.

Exclusion Criteria

- Pre-existing tear film dysfunction or ocular surface disorders.
- History of glaucoma or uveitis.
- History of rheumatoid arthritis or other connective tissue disorders.

Use of topical or systemic medications known to cause dry eye.

Methodology

1. **Data Collection**:

Recorded demographic details: name, age, gender, and duration of diabetes.

Ophthalmic Examination:

1. **Best Corrected Visual Acuity (BCVA).**
   - Slit-lamp examination.
   - Tonometry.
   - Fundus examination.
   - Posterior segment evaluation using indirect ophthalmoscopy.

2. **Grading of Diabetic Retinopathy (DR)**:

Based on the Early Treatment Diabetic Retinopathy Study (ETDRS) classification.

3. **Assessment of Dry Eye Disease (DED)**:

Subjective Evaluation:

Ocular Surface Disease Index (OSDI) questionnaire, comprising 12 questions divided into three sections:
Symptoms related to visual disturbance.
Symptoms affecting visual function.
Symptoms influenced by environmental factors.
Scoring:

- 0–12: Normal.
- 13–22: Mild DED.
- 23–32: Moderate DED.
- 33–100: Severe DED.

Objective Tests:

Schirmer's Test I:

Measures both reflex and basal tear secretion without anesthesia.
Procedure: Whatman filter paper No. 41 placed at the junction of the medial 2/3rd and lateral 1/3rd of the lower eyelid; eyes closed.
Evaluation after 5 minutes; <10 mm wetting considered abnormal.

Schirmer's Test II:

Measures basal tear secretion with topical anesthesia (0.5% proparacaine).
Same procedure as Schirmer's Test I; <10 mm wetting considered abnormal.

Tear Film Break-Up Time (TBUT):

Fluorescein strip moistened with saline applied to the ocular surface.
Patient blinks several times; under cobalt blue light, the time until the first dry spot appears is measured.
Interpretation:

- 10 seconds: Normal.
- 5–10 seconds: Mild to moderate dry eye.
- <5 seconds: Severe dry eye.

4. **Laboratory Investigations**:

HbA1c levels assessed along with routine diabetic investigations.

Outcome Measures

- Prevalence and severity of Dry Eye Disease (DED) in T2DM patients with and without Diabetic Retinopathy (DR).
- Correlation between DED severity and DR status.
- Association of DED with HbA1c levels and duration of diabetes.

Statistical Analysis

Software Used: Statistical Package for the Social Sciences (SPSS) version 22.0.

Data Analysis:

Quantitative data: Analyzed using parametric tests.

Qualitative data: Analyzed using non-parametric tests.

Significance Level: p-value < 0.05 considered statistically significant

RESULTS

Table 1: OSDI and dry eye

Parameters	OSDI				Total	P value
	Normal	Mild	Moderate	Severe		
DR	28	14	21	26	89	0.04
No DR	50	18	9	14	91	
Total	78	32	30	40	180	

Table 1 shows that out of 180 eyes, diabetic retinopathy was present in 89 and no DR in 91. Out of DR, dry eyes grading was normal in 28, mild in 14, moderate in 21 and severe in 26 patients. Out of no DR, dry eyes grading was normal in 50, mild in 18, moderate in 9 and severe in 14 patients. The difference was significant (P< 0.05).

Table 2: Tear film breaks up time and dry eye

Parameters	TBUT			Total	P value
	Normal	Mild- moderate	Severe		
DR	35	34	20	89	0.04
No DR	23	52	16	91	
Total	58	86	36	180	

Graph I. Tear film break up time and dry eye

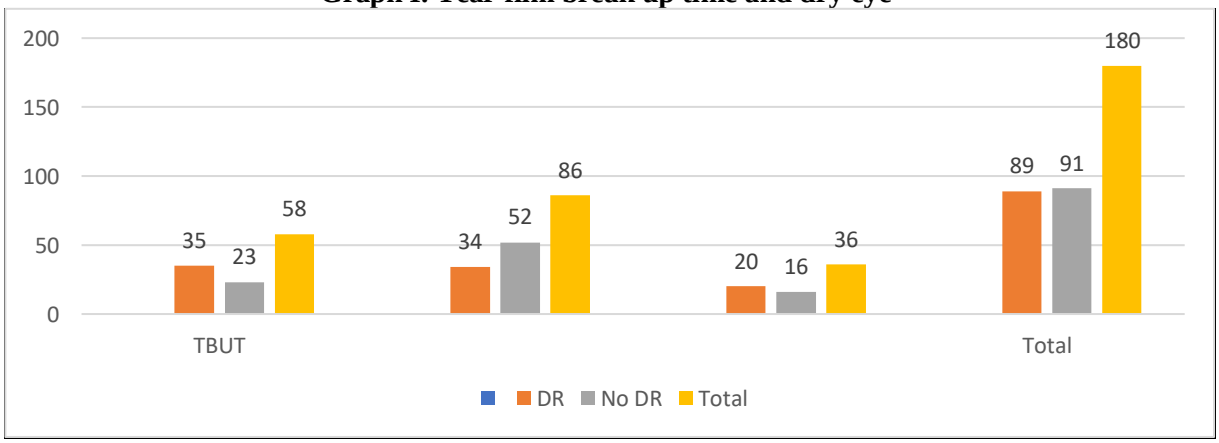

Table 2, graph I shows that TBUT revealed normal in 35, 34 mild0 moderate and 20 severe DR and 23 normal, 52 mild- moderate and 16 severe no DR patients. The difference was significant (P< 0.05).

DISCUSSION

Diabetes is one of the most common leading causes of blindness in 20–74- years old persons. Cataract and retinopathy are well-known as ocular complications of diabetes.[8] Recently, problems involving the ocular surface, dry eyes in particular, have been reported in diabetic patients.[9,10] These patients suffer from a variety of corneal complications including superficial punctuate keratopathy, trophic ulceration, and persistent epithelial defect. Dry eye is an important contributor to these problems. Dry eye syndrome has many causes. One of the most common reasons for dryness is aging process.[11]

The mechanism responsible for dry eyes is unclear but autonomic dysfunction may be responsible. Aldose reductase, the first enzyme of the sorbitol pathway, may also be involved. The oral administration of aldose reductase inhibitors has been shown to improve the tear dynamics significantly.[12]The present study was conducted to assess tear film changes in type II diabetes mellitus with and without diabetic retinopathy.

We found that out of 180 eyes, diabetic retinopathy was present in 89 and no DR in 91. Out of DR, dry eyes grading was normal in 28, mild in 14, moderate in 21 and severe in 26 patients. Out of no DR, dry eyes grading was normal in 50, mild in 18, moderate in 9 and severe in 14 patients. Sethia et al[13] estimated the prevalence of dry eye in 103 type II diabetic patients and tear film changes with Diabetic Retinopathy (DR). Out of which 43 patients had DR and 60 patients had no DR. Dry eye evaluation was done using Ocular Surface Disease Indexing (OSDI) questionnaire and was confirmed objectively using Schirmer's I and II test and Tear film Break Up Time (TBUT). 68 among 103 diabetics patients had DED with the prevalence of 66% based on OSDI scoring. Out of the 43 patients with DR and 60 without DR, DED was encountered in 38 and 30 patients, respectively. DED status was not influenced by gender, age and duration of diabetes. An increase in DED was seen with higher HbA1c (Glycated Haemoglobin) values but was not significant. DED in DR group yielded a significant association with OSDI (p=0.002), Schirmer's I and II (p=0.001) and TBUT (p=0.046).

We found that TBUT revealed normal in 35, 34 mild0 moderate and 20 severe DR and 23 normal, 52 mild- moderate and 16 severe no DR patients. Manviat et al.[14] assessed the prevalence of dry eye syndrome and diabetic retinopathy (DR) in type 2 diabetic patients and their contributing factors. 199 type 2 diabetic patients were assessed by questionnaire about other diseases and drugs. Dry eye syndrome was assessed with Tear break up time tests and Schirmer. All the subjects underwent indirect ophthalmoscopy and retinal color photography. DR was graded according to early treatment diabetic retinopathy (ETDRS) criteria. Of 199 subjects, 108 patients (54.3%) suffer from dry eye syndrome. Although dry eye syndrome was more common in older and female patients, this association was not significant. But there was significantly association between dry eye syndrome and duration of diabetes (P = 0.01). Dry eye syndrome was more frequent in diabetic patients with DR (P = 0.02). DR was found in 140 patients (70.35%), which included 34 patients (17.1%) with mild non proliferative DR (NPDR), 34 patients (17.1%) with moderate NPDR, 22 patients (11.1%) with severe NPDR and 25 patients (25.1%) with proliferative DR (PDR). There was significant relation between age, sex and duration of diabetes and DR.

LIMITATIONS OF THE STUDY

1. **Cross-Sectional Design**: The study's design captures data at a single point in time, limiting the ability to establish causal relationships between diabetes, DR progression, and dry eye disease (DED).
2. **Single-Centre Study**: Conducted at a tertiary care hospital in Vadodara, Gujarat, the findings may not be generalizable to broader populations due to regional and demographic variations.
3. **Exclusion of Certain Patient Groups**: Patients with pre-existing ocular surface disorders, glaucoma, uveitis, rheumatic arthritis, and those on medications causing dry eye were excluded. This may have led to an underestimation of DED prevalence among the diabetic population.
4. **Lack of Glycemic Control Data**: While HbA1c levels were measured, the study did not analyze the correlation between glycemic control and the severity of DED or DR. Previous research indicates that poor glycemic control is associated with worse tear function
5. The shortcoming of the study is small sample size.

CONCLUSION

Authors found that patients with DR have reduced tear film amount. All diabetes patients should have regular dry eye screenings so that appropriate care can be provided. The study concludes that the prevalence and severity of Dry Eye Disease (DED) are significantly higher in patients with Diabetic Retinopathy (DR) compared to those without DR. This was evidenced by statistically significant differences in Ocular Surface Disease Index (OSDI) scores, Schirmer's I and II test results, and Tear Film Break-Up Time (TBUT) measurements between the two groups. These findings suggest that DR adversely affects both the quality and quantity of the tear film, potentially due to mechanisms such as oxidative stress, inflammation, and diabetic neuropathy leading to corneal nerve damage.

Although an increase in DED incidence was observed with higher HbA1c levels, this correlation was not statistically significant. Given these insights, the study recommends routine screening for dry eye symptoms in all diabetic patients, particularly those with DR, to facilitate early diagnosis and management of DED.

REFERENCES

1. McCarty CA, Bansal AK, Livingston PM, Stanislavsky YL, Taylor HR. The epidemiology of dry eye in Melbourne, Australia. Ophthalmology. 1998;105(6):1114-19.
2. Lin PY, Tsai SY, Cheng CY, Liu JH, Chou P, Hsu WM. Prevalence of dry eye among an elderly Chinese population in Taiwan: The Shihpai Eye Study. Ophthalmology. 2003;110(6):1096-101.
3. Gadkari S, Maskati QB, Nayak BK. Prevalence of diabetic retinopathy in India: The All India Ophthalmological Society Diabetic Retinopathy Eye Screening Study 2014. Indian J Ophthalmol. 2016;64(1):38-44.
4. Moss SE, Klein R, Klein BE. Prevalence of and risk factors for dry eye syndrome. Arch Ophthalmol. 2000;118(9):1264-68.
5. Schein OD, Tielsch JM, Munõz B, Bandeen-Roche K, West S. Relation between signs and symptoms of dry eye in the elderly. A population-based perspective. Ophthalmology. 1997;104(9):1395-401.
6. Kesarwani D, Rizvi SWA, Khan AA, Amitava AK, Vasenwala SM, Siddiqui Z. Tear film and ocular surface dysfunction in diabetes mellitus in an Indian population. Indian J Ophthalmol. 2017;65(4):301-04.
7. Ghasemi H, Gharebaghi R, Heidary F. Diabetes as a possible predisposer for blepharitis. Can J Ophthalmol. 2008;43(4):485.
8. Yazdani-Ibn-Taz MK, Han MM, Jonuscheit S, Collier A, Nally JE, Hagan S. Patient-reported severity of dry eye and quality of life in diabetes. Clin Ophthalmol. 2019;13:217-24.
9. Li HY, Pang GX, Xu ZZ. Tear film function of patients with type 2 diabetes. Zhongguo Yi Xue Ke Xue Yuan Xue Bao. 2004;26(6):682-86.
10. Zou X, Lu L, Xu Y, Zhu J, He J, Zhang B, et al. Prevalence and clinical characteristics of dry eye disease in community-based type 2 diabetic patients: The Beixinjing eye study. BMC Ophthalmol. 2018;18(1):117.
11. Schiffman RM, Christianson MD, Jacobsen G, Hirsch JD, Reis BL. Reliability and validity of the ocular surface disease index. Arch Ophthalmol. 2000;118(5):615-21.
12. Klein R, Klein BE, Linton KL, De Mets DL. The Beaver Dam Eye Study: Visual acuity. Ophthalmology. 1991;98(8):1310-15.
13. Sethia R, Patel J, Pothuri NA, Shah S, Mehta J, Vora J. Tear Film Changes in Type II Diabetes Mellitus with and without Diabetic Retinopathy. Journal of Clinical & Diagnostic Research. 2021 Feb 1;15(2).
14. Manaviat MR, Rashidi M, Afkhami-Ardekani M, Shoja MR. Prevalence of dry eye syndrome and diabetic retinopathy in type 2 diabetic patients. BMC Ophthalmol. 2008;8:10.