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Original Research Article

Prevalence of dry eye and tear film changes in diabetic population: experience at our tertiary care centre

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ABSTRACT

Background: Abnormalities in tear secretion, alteration of epithelial barrier and autonomic neuropathy lead to tear film and ocular surface changes in diabetes, thus causing dry eye. Aim was the evaluation of tear film and ocular surface of diabetic patients and to assess the prevalence of dry eye in diabetic patients presenting to our department.
Methods: It was prospective, observational study. Visual acuity was tested for all the patients and slit lamp evaluation was done followed by staining methods to evaluate dry eye. The parameters included ocular symptoms, Schirmer test, tear meniscus height, tear film breakup time, corneal staining with fluorescein, conjunctival staining, presence of strands/filaments and presence of diabetic retinopathy.
Results: A total of 200 diabetic patients were assessed. Forty percent had the duration of diabetes mellitus ranging between 6-10 years. Majority of patients were having grittiness (54%). Around 32% of the study participants are having dry eye. On Schirmer test majority (43%) were having 6-10 mm. 69% of the study participants were having more than 1 mm of tear meniscus height. Majority (69%) of the study participants had more than 10 sec tear film breakup time. 18% of the study participants were having positive conjunctival staining and 18% of the study participants were having positive corneal staining. 13% of the study participants are having filaments/strands.
Conclusions: The incidence of dry eye was seen to increase with increasing duration of diabetes and increasing age. Careful elicitation of history followed by proper evaluation to diagnose dry eye is emphasized.

Keywords: Diabetes, Dry eye, Tear film

INTRODUCTION

Diabetes mellitus is a major health problem causing significant morbidity and mortality. Nearly 70 million Indians are living with diabetes according to World Health Organization (WHO) reports. It is a leading cause of ocular morbidity. Ocular morbidity associated with diabetes is progressive but is preventable with early diagnosis and treatment. It is a major cause of avoidable blindness in both the developed and developing countries. Ocular complications of diabetes mellitus include diabetic retinopathy, cataract, papillopathy, glaucoma, and ocular surface disease.[1] Ocular surface problems especially dry eye has recently drawn attention in diabetic patients. Diabetes and dry eye appear to have a significant impact on the quality of life of patients in several studies.

Dry eye syndrome (DES), is a multifactorial disorder due to inflammation of the ocular surface and lacrimal gland, neurotrophic deficiency and meibomian gland dysfunction. Dry eye patients present with symptoms like grittiness, foreign body sensation, burning sensation, photophobia, redness and blurred vision.[2] The ocular

surface comprises of the cornea, conjunctiva, the lacrimal gland, meibomian gland, lids, with the sensory and motor nerves that connect them. Quantitative and qualitative abnormalities in tear secretion, alteration of epithelial barrier leading to poor adhesion of regenerating epithelial cells[6]and autonomic neuropathy causing decreased corneal sensitivity leading to tear film and ocular surface changes in diabetes, thus causing dry eye.[3-7] Because of the micro vasculopathy and autonomic neuropathy in longstanding diabetics dry eye symptoms are less predominant but clinical signs of dry eye are present, as suggested by Nielsen et al.[8] There is no gold standard diagnostic test for dry eye disease hence a combination of signs and symptoms is commonly used as the basis for diagnosis. Several studies have been conducted to study dry eye, its risk factors, tear film parameters, ocular surface irregularities, prevalence and the various methods to diagnose dry eye but the results remain inconclusive and variable.[9] Hence research in an Indian population warrants further studies. Many hospital-based studies have documented the significant relationship between diabetes and dry eye.[10,11] Examination of diabetic patients for dry eye should be an integral part of assessment of diabetic eye disease along with evaluation of diabetic retinopathy.

This study was aimed at evaluating the tear film and ocular surface of diabetic patients and to assess the prevalence of dry eye in diabetic patients presenting to our department. We also aimed to assess dry eye sign and symptoms.

METHODS

It was a prospective, observational study conducted in ophthalmology department of SKIMS medical college and hospital from September 2021 to September 2022. Sample size was 200 patients. Patients with age less than 40 years, patients on systemic medication for disorders that can alter tear film and ocular surfaces such as hypertension, thyroid disorders, those using topical medications/ocular drug abuse, contact lens wearers, pregnant women, patients with history of ocular surgery in past 3 months, patients with abnormalities in eyelids, cornea, conjunctiva or patients who were not willing/not given informed consent for the study were excluded from the study.

Visual acuity was tested for all the patients and preliminary slit lamp evaluation was done followed by staining methods to evaluate dry eye. The following are the test parameters, their gradings and the basis on which patients were diagnosed to have dry eye or not.

Ocular symptoms

Grittiness, foreign body sensation, burning, irritation, stinging, watering, photophobia, diminution of vision, blurring of vision, redness and dryness. Presence of symptoms were graded as: less than 2 symptoms: grade 1; more than 2 symptoms: grade 2.

Schirmer test without anesthesia

0 to 5 mm- grade 1; 6 to 10 mm- grade 2; 11 to 15 mm- grade 3; more than 15 mm- grade 4

Tear meniscus height (TMH)

Less than 1 mm- grade 1; more than 1 mm- grade 2.

TBUT- tear film breakup time

Graded as follows: less than 10 seconds- grade 1; more than 10 seconds- grade 2.

Corneal staining with fluorescein

Graded as follows: Grade 0- absent; Grade 1- minimal; Grade 2- mild; Grade 3- moderate; Grade 4- marked; Grade 5- severe. Score of 3 or more is abnormal as was considered as corneal staining positive.

Conjunctival staining

It was graded using the Oxford system of grading for cornea and conjunctiva: grade 0- absent; grade 1- minimal; grade 2- mild; grade 3- moderate; grade 4- marked; grade 5- severe. Score of 3 or more is abnormal.

Presence of strands/filaments

Presence of strands/filaments was noted as positive or negative by viewing with the slit lamp after fluorescein staining: strands/filaments present- grade 1; strands/ filaments absent- grade 2.

Presence of diabetic retinopathy

Dilatation and fundus examination with 90 D lens in slit lamp with confirmation on indirect ophthalmoscopy was done to diagnose diabetic retinopathy. Based on the findings it was graded as: presence of diabetic retinopathy- grade 1; absence of diabetic retinopathy- grade 2. When 3 or more tests were positive the patient was diagnosed to have dry eye.

The data was recorded on pre-structured proforma for study. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS version 12.0, Chicago IL). Chi square test was used to compare discrete variables. Significance was considered to be $p<0.05$.

RESULTS

A total of 200 diabetic patients were assessed. Forty three percent patients were 40-50 years of age, followed by 31.50% in the age group of 51-60 years, 14% in 61-70

years and 11.50% more than 71 years. Male preponderance was observed, with 56% patients being males (Figure 1).

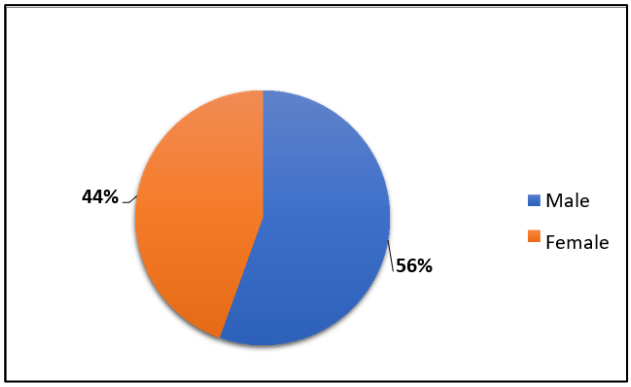

Figure 1: Gender distribution of patients.

Table 1: Association of dry eye with demographic profile among diabetic patients (N=200).

	Dry eye present (n=64)	Dry eye absent (n=136)	P value
Age			
40-50	15 (23.4%)	71 (52.2%)	<0.001
51-60	19 (29.7%)	44 (32.4%)	
61-70	13 (20.3%)	15 (11%)	
≥71	17 (26.6%)	6 (4.4%)	
Gender			
Male	39 (60.9%)	72 (52.9%)	0.360
Female	25 (39.1%)	64 (47.1%)	
Type of occupation			
Farmer	22 (34.4%)	30 (22.1%)	0.165
Industry/factory/ labourers	24 (37.5%)	48 (35.3%)	
Office/computer/job business	1 (1.6%)	6 (4.4%)	
Home maker/student	17 (26.7%)	52 (38.2%)	
Duration of diabetes			
0-5 years	9 (14.1%)	54 (39.7%)	<0.001
6-10 years	24 (37.5%)	56 (41.2%)	
11-15 years	13 (20.3%)	12 (8.8%)	
16-20 years	10 (15.6%)	11 (8.1%)	
>20 years	8 (12.5%)	3 (2.2%)	
Diabetic retinopathy			
Present	49 (76.6%)	71 (52.2%)	
Absent	15 (23.4%)	65 (47.8%)	<0.001

Distribution of patients as per occupation is shown in (Table 1). Forty percent had the duration of diabetes mellitus ranging between 6-10 years followed by 31.5% of the subjects ranging between 0-5 years. 40% of the individuals were suffering from diabetic retinopathy (Table 2). Among 200 patients, majority of them were having grittiness (54%) followed by irritation (43%), watering (34%), dryness (27%), blurring of vision (16.5%), photophobia (15%) and redness (13.5%). Around 32% of the study participants are having dry eye in our study. Distribution of patients according to their types of ocular symptoms with and without dry eye in shown in (Figure 2).

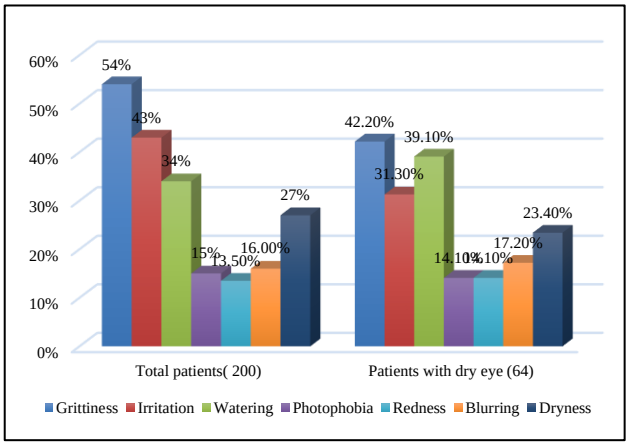

Figure 2: Combined graph showing distribution of patients according to their types of ocular symptoms with and without dry eye.

Table 2: Association of dry eye with tear film and ocular surface tests among diabetic patients (N=200).

	Dry eye present (n=64)	Dry eye absent (n=136)	P value
Ocular symptoms			
≤2 symptoms	5 (7.8%)	68 (50%)	<0.001
≥2 symptoms	59 (92.2%)	68 (50%)	
Schirmer test			
0-5 mm	26 (40.6%)	0 (0)	<0.001
6-10 mm	32 (50%)	54 (39.7%)	
11-15 mm	6 (9.4%)	46 (33.8%)	
>15 mm	0 (0)	36 (26.5%)	
Tear meniscus height			
<1 mm	59 (92.2%)	4 (2.9%)	<0.001
>1 mm	5 (7.8%)	132 (97.1%)	
Tear film breakup time			
<10 sec	58 (90.6%)	4 (2.9%)	<0.001
>10 sec	6 (9.4%)	132 (97.1%)	
Conjunctival staining			
Positive	32 (50%)	5 (3.7%)	<0.001
Negative	32 (50%)	131 (96.3%)	
Corneal staining			
Positive	29 (45.3%)	7 (5.1%)	<0.001
Negative	35 (54.7%)	129 (94.9%)	
Presence of filaments/strands			
Present	23 (35.9%)	4 (2.9%)	<0.001
Absent	41 (64.1%)	132 (97.1%)	

On Schirmer test majority (43%) were having 6-10 mm, followed by 26% of them having 11-15 mm, 18% of them were having more than 15 mm and remaining 13%

with 0-5 mm. Majority (69%) of the study participants were having more than 1 mm of tear meniscus height. Majority (69%) of the study participants had more than 10 seconds tear film breakup time. Around 18% of the study participants were having positive conjunctival staining and around 18% of the study participants were having positive corneal staining. Around 13% of the study participants are having filaments/strands. Tear film and ocular surface tests among our study population with their association with dry eye is shown in (Table 2).

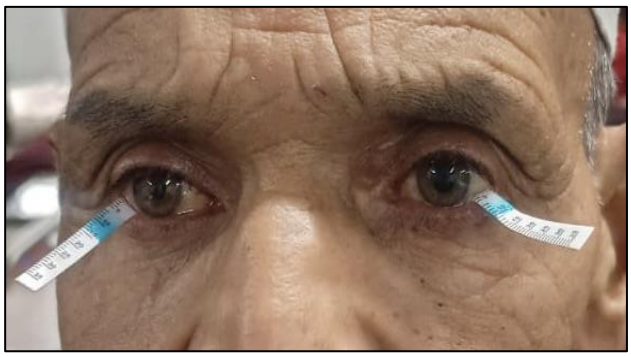

Figure 3: Schirmer test.

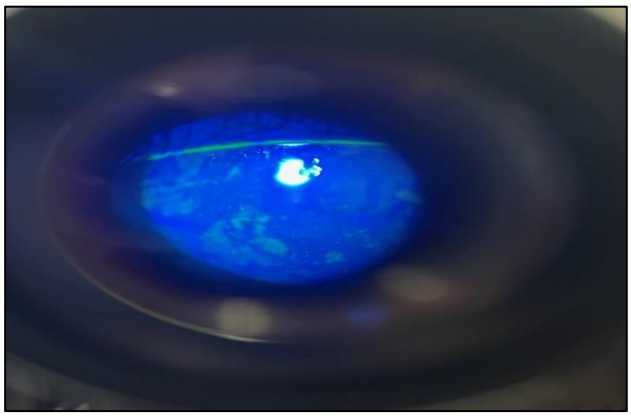

Figure 4: Corneal staining.

DISCUSSION

Our study was undertaken to estimate prevalence of dry eye in diabetic patients by using their symptoms and subjective analysis of tear film and ocular surface parameters in clinical tests. Dry eye in diabetes is due to various mechanisms. Abnormal enzymatic activity of aldose reductase causes lacrimal gland and tear film dysfunction. Chronic hyperglycaemia causes effects on the lacrimal functional unit comprising of the cornea, conjunctiva, lacrimal gland, meibomian gland, lids, and the sensory and motor nerves that connect them resulting in corneal and conjunctival epithelial damage. A total of 200 participants, all diabetic patients (new and old) were included in this study. Past studies suggest that dry eye has a wide prevalence range from 17 % to 69%.[12-15] The variation in prevalence is mainly from the different methods used to evaluate dry eye, variation in inclusion and exclusion criteria, and the parameters with varying cut offs employed in the different studies. Though there is high variation in its prevalence, association of dry eye with diabetes mellitus is well correlated in most of the studies. In our study 64 patients (32%) had dry eye. Maximum number of patients in the study were in 40 to 50 years (43%) of age followed by 51 to 60 years (31.5%). 111 patients were males (55.5%) and 89 were females (44.5%). Duration of diabetes plays a major role in development of dry eye and majority of them in our study (40%) had the duration of diabetes mellitus ranging between 6-10 years followed by 31.5% of the subjects who were in 0-5 years age group. This was a statistically significant association in individuals diagnosed with dry eye. This result was in agreement with the study conducted by Waris et al in which diabetes mellitus duration more than 6 years was statistically more associated with dry eye.[16]

Our study showed that tear film parameters like Schirmer test, TBUT, tear meniscus height, corneal and conjunctival staining were affected significantly in the diabetic patients.

Symptom assessment is the first and very important step in the diagnosis of dry eye, dry eye is believed to be a ‘symptom based’ disease. In the present study, around 63.5% of them had more than two symptoms and 36.5% had less than two symptoms. The commonest complaint that the subjects with dry eye complained of was grittiness and it was significantly associated with dry eye ($p<0.001$). Itching, burning and dryness of the eyes, which were also commonly reported symptoms in these subjects, were also each significantly associated with dry eye. It is important to rule out tear film abnormalities with inclination to rule out dry eye if a diabetic patient presents with symptoms of grittiness, itching, irritation, watering, dryness, blurring of vision, photophobia and redness. Our study showed the prevalence of ocular surface disorder to increase with increasing age with a peak prevalence in the 50 to 60 years (29.7%) group. It may be because this group of participants are occupationally active with more exposure to environmental stress factors like sunlight and UV radiation for prolonged hours. A meta-analysis conducted by Barabino also showed that dry eye disease is a debilitating disease occurring in all ages, with increased frequency in older subjects.[17] Our study in contrary to other previous studies as it showed a higher prevalence of dry eye in male diabetics (39%) than female diabetics (25%). This may be due to the higher number of male patients reporting to the hospital for treatment than female patients who neglect symptoms until later stages owing to inability to spare time to visit a hospital or seek medical attention considering work and family commitments. Workers from industry factory and labourers showed a higher prevalence (22%), probably due to long working hours, inadequate eye protection during work hours and raised temperature in the work environment. a population-based study by Bazeer et al

showed that raft and related trades workers, e.g. building workers and metal and machinery workers, showed the highest risk of dry eye (OR=1.12, 95% CI =1.02-1.24, p=0.01).[18] Patients with diabetic retinopathy had significant worse scores on tear film tests and ocular surface analysis compared to patients without retinopathy. Among 200 patients 120 patients (60%) were found to have some form of diabetic retinopathy. The prevalence in retinopathic patients being 46% than non-retinopathy patients 15% with a significant p value. Diabetic patients presenting with more than 2 ocular symptoms had a higher prevalence, (92.2%) of occurrence of dry eye than in patients who had less than 2 symptoms with dry eye (7.8%) and this was significant with a p value <0.001.

Diagnosis of tear film and ocular surface disorder in patients with diabetes is made with Schirmer, TBUT, TMH and staining methods. Schirmer test interpretation showed patients with 0 to 5mm wetting with severe form of dry eye seen in 26 patients to have 40.6% prevalence compared to patients with 6 to 10 mm wetting of Schirmer s strip with moderate dry eye 32 patients with 50% prevalence of dry eye. Less wetting had more significance with a p value <0.001.

Our study showed TBUT<10 seconds in 58 patients (90.6%) compared to 6 patients (9.4%) with more than 10 seconds showing that TBUT was significantly lower in patients with dry eye with p value <0.001. Some studies have shown results similar to ours in TBUT values and significance. Tear meniscus height of less than 1mm was seen in 32% patients among 200 patients. Fifty-nine patients (92.2%) of these patients had dry eye which was significant. Fluorescein staining of cornea is positive when defects in corneal epithelium on the corneal surface are present, seen in moderate to severe dry eye. Corneal staining was positive in 29 patients (45.3%) of dry eye subjects compared to stain negative in 35 patients (54.7%) which was significant in our study. Conjunctival stain positive was seen in 32 patients 50% of patients diagnosed to have dry eye and the remaining 50 % had stain negative which was significant with p value <0.001. Presence of filaments /strands was present in 23 patients (35.9%) with dry eye which was significant. Similar results were seen in study conducted by Kesarwani et al who showed significantly reduced Schirmer, TBUT measurements and positive corneal staining scores.[9]

There are some limitations of study. Correlation of dry eye with other modalities of evaluation of tear film and ocular surface such as tear osmolarity and conjunctival impression cytology have proven to be better markers in studies, but was beyond the scope of this study. Patients with pre-existing corneal and conjunctival pathology were excluded from our study which may reflect on under estimating the prevalence of dry eye. Another limitation of the study was lack of glycemic parameters and correlation with severity of diabetic retinopathy.

CONCLUSION

Long term diabetes predisposes to changes in tear film causing ocular surface irregularities which leads to dry eye. Dry eye is common in diabetic patients and the same was proved in our study. The progression of dry eye is multifactorial. If untreated it causes serious ocular complications thereby early detection and management is essential. Early identification of symptoms, signs and timely evaluation by the treating ophthalmologist, must be given priority in the analysis for dry eye in diabetic patients.

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