Original Article

Dry Eye Syndrome among Patients with Type II Diabetes Mellitus in a Tertiary Care Centre in South India

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ABSTRACT

Introduction: One of the leading causes of dry eye syndrome (DES) is found to be diabetes mellitus (DM). The current study was conducted to detect possible tear film anomalies among diabetic individuals attributable to dry eye. The study aimed to assess the proportion of dry eye syndrome among patients with Type 2 diabetes mellitus.

Materials and methods: Two hundred patients with Type 2 diabetes mellitus who came to the Ophthalmology OPD from October 2018 to November 2020 in the 29-60 years age group were included in the study. Patient data, diabetic history, dry eye symptoms, blood sugar values and tests to measure tear volume and tear film instability were carried out among patients and dry eyes were graded.

Results: The proportion of patients with dry eye symptoms among Type 2 diabetes mellitus were 61%. Mild dry eye syndrome was observed in 27%, moderate dry eye syndrome in 59% and severe dry eye syndrome in 14%. A statistically significant difference ($p<0.05$) was noted between the severity of dry eye syndrome and dry eye test parameters. A strong positive correlation ($r = 0.923$) was noted between severity of dry eye syndrome and Standardised Patient Evaluation of Eye Dryness (SPEED) score which was statistically significant ($p < 0.001$).

Conclusion: In our study, there was higher prevalence of dry eyes in patients who had Type 2 diabetes Mellitus which might be attributed to reduced tear secretion in diabetes mellitus patients caused by autonomic dysfunction in these patients. We recommend that dry eye evaluation should be an integral part of ocular examination in diabetic patients for early detection and treatment so that further complications can be prevented, which may lead to severe visual impairment.

Key words: Diabetes mellitus, Dry eye syndrome, Schirmer's test, Tear break up time, Tear meniscus height.

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INTRODUCTION

India is labelled "The diabetic capital of the world" by WHO as the country leads the world in diabetic population. It is estimated that 65.1 million people in India are diagnosed with diabetes (Zhang et al., 2016).

Diabetes mellitus (DM) has been found to be one among the leading causes of Dry Eye Syndrome (DES), which is a disorder of the tear film due to reduced tear production or excessive tear evaporation (Zhang et al., 2016). Type 2 diabetic patients have a greater tendency to develop tear dysfunction as compared to Type 1 and maturity onset diabetes of young (MODY) (Zou et al., 2018). Moreover, poor glycemic control can cause worsening of dry eye symptoms (Zhang et al., 2016).

Damages to the interpalpebral ocular surface and symptoms of ocular discomfort are commonly seen due to dry eyes in diabetic patients (Zhang et al., 2016). Prolonged increased blood sugar levels, peripheral neuropathy due to DM, reduced insulin levels, systemic hyperosmotic disturbances and microvasculopathy are considered as the risk factors for diabetes associated DES (Zhang et al., 2016). Severe DES may lead to impairment of vision, scarring of cornea as well as corneal ulcers, leading to secondary bacterial infections. The combined effect of corneal infection and diabetes worsens corneal lesions, which will irreversibly change the ocular surface which in turn causes visual impairment (Zhang et al., 2016). The current study was done to assess the tear film stability and the amount of production of tear in diabetic patients so as to detect possible anomalies of tear film attributable to dry eye.

MATERIALS AND METHODS

Cross-sectional study was done from October 2018 to November 2020 after obtaining approval by the Institutional review board (IRB) and ethical committee which constituted members outside the institution as per ICMR guidelines required for any study conducted in the institution. Type 2 DM patients in the age group of 20-60 years who visited the Out Patient Department of Ophthalmology for diabetic retinopathy evaluation and who gave informed consent for the study were included. Patients were selected irrespective of duration of diabetes, glycemic control, symptomatic / asymptomatic or dry eyes. Patients who were prone for dry eye disease due to other diseases like Sjogren's syndrome, Rheumatoid arthritis, SLE, Parkinson's disease, Type 1 diabetic patients, MODY, Vitamin A deficiency, history of previous ocular surgeries, meibomian gland dysfunction, contact lens use, medications like tricyclic antidepressants, OCPs, steroids, diuretics, pregnant women and those patients who were already taking treatment for dry eyes were excluded from the study.

Sample size was calculated using the formula $n = 4PQ/d^2$ where P is the Proportion of DES among Type 2 DM patients, Q is 100 - P, and d is the clinically expected variation. Following approval from the institutional ethics committee, patient data including age, sex, detailed diabetic history including onset, duration and control of diabetes, symptoms of dry eye, fasting (FBS) and postprandial (PPBS) blood glucose values

and glycated haemoglobin (HbA1c) were recorded.

The diagnostic methodology included tests to quantify patient symptoms, volume of tear and stability of tear film. To quantify patient symptoms, a Standardised Patient Evaluation of Eye Dryness (SPEED) questionnaire designed by Korb and Blackie was used as this questionnaire was observed to be repeatable and unidimensional (Ngo et al., 2013). Severity of DES was graded by the symptoms as per the SPEED score as 0-4 for mild, 5-7 for moderate and 8+ for severe dry eyes.

To measure tear volume**,** Schirmer's test and tear meniscus height was performed. Schirmer's test was performed under natural light with anaesthesia (Schirmer's I) and without anaesthesia (Schirmer's II). Schirmer's I measures baseline secretion whereas both basal and reflex secretion is measured by Schirmer's II. Schirmer's test is measured based on wetting of the Whatman filter paper 41strip (5 x 35 mm) by hooking the folded notch at the junction of middle one third and the temporal one third of the lower lid margin for a period of 5 minutes [48]. Less than 10 mm of wetting of Whatman filter paper without topical anaesthesia or less than 6 mm of wetting with anaesthesia after 5 minutes is considered abnormal (Rheinstorm S D., 1999). A value of >10 mm was considered normal, value of 5-10 mm as mild to moderate dry eye, value of < 5 mm as severe dry eye and value of < 2 mm as very severe dry eye (DEWS workshop., 2007). Tear Meniscus Height (TMH) was assessed by inspecting tear meniscus between the lower eyelid and the globe. Normally, it is 1 mm in height and convex in contour. According to the DEWS workshop, a tear meniscus of ≤ 0.25 mm is considered as abnormal, but for ease of measurement, we considered ≤ 0.3 mm as abnormal. TMH was recorded as normal or low under a thin beam of slit lamp biomicroscope.

Tear Break Up Time (TBUT) was done to measure the tear film stability. TBUT was done by staining the tears with fluorescein strips to enhance the visibility of tear film. Without anaesthesia, a dry fluorescein strip is touched to the inferior fornix of the eye with the patient looking up. The cornea is scanned under low slit lamp magnification using blue cobalt filtered light. The patient is instructed to blink once or twice and then stare straight ahead without blinking and TBUT is measured as the time interval between the last blink and the appearance of the first dry spot as small black spots in the precorneal tear film. A value of 10 seconds was considered normal, 5-10 seconds as mild to moderate, < 5 seconds as severe and if the value is immediate as very severe (DEWS workshop., 2007). According to Dry Eye Workshop (DEWS workshop., 2007), DES is graded as mild (Grade 1), moderate (Grade 2), severe (Grade 3) and severe and disabling (Grade 4).

Dry eye was diagnosed as having one or more symptoms along with one or more positive clinical findings based on slit lamp examination and one or more positive clinical tests of TBUT ≤ 10 seconds, Schirmer's test 2 score < 5 mm and Tear Meniscus Height (TMH) < 0.25 mm (DEWS workshop., 2007). The observed data were coded, tabulated as well as analysed using IBM SPSS Version 20.

RESULTS

Two hundred patients with Type 2 DM were included in the study ranging from 29 to 60 years of age. The proportion of patients with Dry Eye Syndrome (DES) among Type 2 DM was 61% (n = 122) and without DES was 39% (n=78).

Out of 122 patients with DES, 64 (52.5%) patients were males and 58 (47.5%) were females. Among 78 patients without DES, 53 (68%) patients were males and 25 (32%) were females. The differences were found to be significant statistically ($p = 0.03$: Chi square test $\chi^2 = 4.70$).

Among 122 patients with DES, it was observed that 33 patients had mild DES, of which 19 (15.57%) were males and 14 (11.47%) were females. 72 patients had moderate DES, which included 36 (29.51%) males and 36 (29.51%) females. 17 had severe DES, including 9 (7.38%) males and 8 (6.56%) females. It was observed that there was no significant difference between males and females statistically ($p < 0.77$) (Chi-square test $\chi^2 = 0.52$).

It was also observed that 83 (68%) DES patients were 51 to 60 years of age and 31 (25.4%) in the age group of 41-50 years. 4 (3.3%) patients each were in the age group of 20-30 years as well as in 31-40 years. The differences between the age groups were statistically significant ($p < 0.001$) (Chi-square test $\chi^2 = 41.598$).

According to the severity of DES, 33 (27.04%) patients had mild DES, 72 (59.01%) had moderate DES and 17 (13.95%) had severe DES as shown in Figure 1.

21 (64%) patients with mild DES and 33 (52%) patients with moderate DES had Schirmer's Test 1 values > 10mm and 12 (71%) patients with severe DES had values ranging from 6-10mm and this difference was significant statistically ($p < 0.001$). Also, there was a statistically significant difference between the severity of DES with Schirmer's Test 2 values ($p = 0.03$), TBUT ($p < 0.001$) and Tear Meniscus Height (TMH) ($p = 0.01$).

A correlation analysis was performed between severity of DES and SPEED score. It was found that there was a strong positive correlation which was statistically significant (R: 0.923, $p < 0.001$). Among 122 patients having DES, 51 of them (41.8%) reported grittiness, 39 (31.9%) reported burning sensation, 26 (21.3%) had irritation and 12 (9.8%) of them had eye fatigue. None of the patients complained about dryness, scratchiness, watering or soreness of eye. The symptoms were significantly associated with DES patients ($p < 0.05$). Distribution of symptoms among Dry Eye Syndrome is as shown in Figure 2.

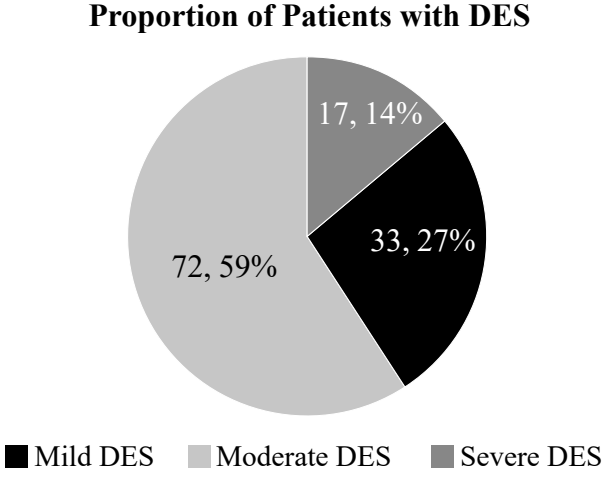

Figure 1: Distribution of DES according to severity.

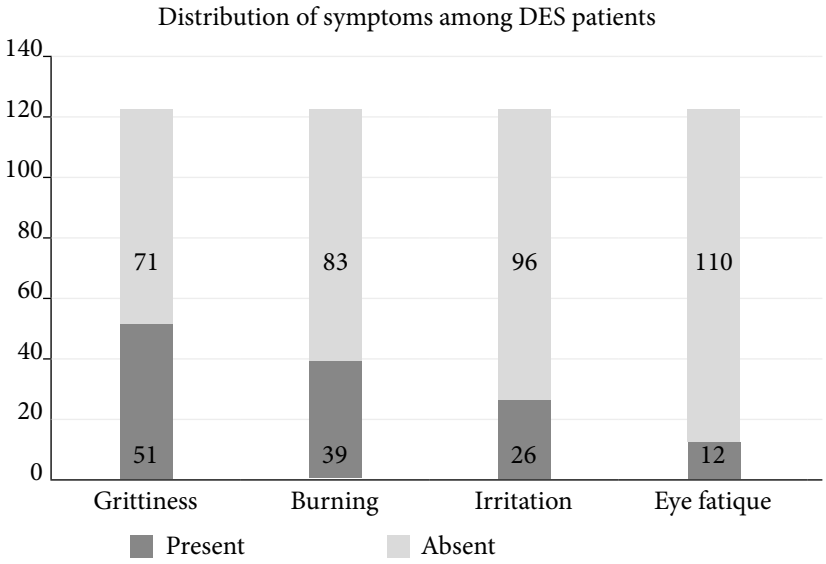

Figure 2: Distribution of symptoms among DES patients.

Statistically, there was a significant difference ($p < 0.001$) in the presence of Dry Eye Syndrome in relation to duration of diabetes. The mean duration of diabetes (in years) among people with DES was 7.99 ± 5.33 as compared to those without DES of 2.40 ± 1.55. FBS in mg/dl was significantly ($p < 0.001$) higher among patients with DES (178.33 ± 70.35) as compared to those without (108.47 ± 21.75). PPBS in mg/dl was also significantly ($p < 0.001$) higher among the DES group (260.64 ± 82.70) as compared to those without (134.40 ± 39.03). Glycemic control based on HbA1C values was poor among the DES group (9.508 ± 2.01) as compared to no DES group (6.387 ± 0.64) and the difference was statistically significant ($p < 0.001$).

DISCUSSION

In our study, the majority of patients who had Type 2 DM, in the age group of 51-60 years had dry eyes showing a significant association between age and dry eyes. 52.5% of male patients and 47.5% female patients were found to have dry eyes. The gender difference was statistically significant ($p=0.03$). Higher prevalence could be because of diabetes per se and partly attributed to ageing.

In the Beaver Dam Offspring Study, the overall prevalence of dry eye was 14.4%. The prevalence varied from 8.4% in patients younger than 60 years to 19% in patients aged > 60 years (Paulsen et al., 2014). In a follow-up study performed 5 years later, Moss et al (2004) found that dry eye developed in 13.3% of participants and the incidence was significantly associated with age and greater in patients with diabetes which was consistent with our study.

We also found a significant association between dry eye disease and duration of diabetes. Longer the duration of diabetes, higher was the prevalence of dry eye disease. In patients having Type 2 Diabetes Mellitus, most of the long-term complications of diabetes are well known to correlate with duration and dry eyes could also be a part of this.

In our study, significantly elevated FBS and PPBS levels were found to be associated with dry eyes, indicating some role of hyperglycemia. There was significant association between HbA1c levels and DES ($p<0.001$). Seifart et al (1994) also found a positive correlation between HbA1c values and the presence of DES which was comparable with our study.

Among 122 patients with DES, 51 complained of grittiness, followed by symptoms of burning sensation and irritation in other subjects. These symptoms were reported more frequently compared with the other dry eye symptoms.

Tear physiology usually changes with age, as in reflex secretion by the lacrimal gland, tear film stability and tear volume. Reflex secretion of tears measured by Schirmer's 1 method, reduces significantly with advancing age as observed by Schirmer (Haeringen, 1997). It was found that there was no correlation between tear evaporation rate and age. Primarily, the evaporation is controlled by the lipid layer of tear film. Also, lipid layer thickness seems to be constant for different age groups (Paschides., 1991).

In our study, significant differences in TBUT and Schirmer's test were observed ($p < 0.05$). Abnormal TBUT value (< 10 sec) was seen in 28.5% of diabetic groups. Schirmer's test was abnormal (< 10mm / 5 minutes) in 25 % of diabetic subjects. Study done by Seifart et al (1994) found 52.8% of diabetics had dry eye symptoms among 92 patients included in their study and corneal sensitivity, Tear film BreakUp Time (TBUT), total and basal tear secretions was significantly lower in Type 2 Diabetes Mellitus patients which was consistent with our study. A study by Dogru et al (2001) also found significantly reduced TBUT and Schirmer's test values in diabetic patients with poor metabolic control.

Presence of autonomic dysfunction, abnormalities in the tear film dynamics, decrease in corneal sensation, along with micro vascular damage to lacrimal gland contribute to the increased prevalence of dry eye in diabetics (Zhang et al., 2016). High prevalence of DES in our study could be attributed to reduced tear secretion in DM patients caused by autonomic dysfunction and partly due to ageing. DES due to ageing would have been a confounder in this study and thereby it is one of the limitations of this study. Autonomic dysfunction in diabetes indicates complications like peripheral neuropathy and hence patients with such complications are expected to have high incidence of DES. Further categorization of groups of diabetic with complications would give more comprehensive results. Another limitation is that it is a cross sectional study. A longitudinal study would have helped to assess whether DES occurred in patients before or after the onset of DM.

Patients diagnosed as DES in our study were treated according to DEWS protocol. The patients in this study responded well to non-preservative topical lubricants. Patients were also advised regarding proper lid hygiene and warm compresses.

CONCLUSION

In our study, there was a high prevalence of dry eyes among type 2 DM patients. Also, there was significant association between dry eye

disease and duration of DM. Our study strongly recommends that clinical evaluation of dry eye should be an essential part of ocular examination in diabetic patients to prevent conditions leading to severe visual impairment which may affect the quality of life of these patients.

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