Ocular Surface Alterations in Diabetes Mellitus: The Role of Meibomian Gland Dysfunction in Dry Eye Disease

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doi.org/10.64643/IJIRTV13I4-208011-459

***Abstract*—AIM-To study association between meibomian gland dysfunction & dry eye in diabetes.**
METHODOLOGY- This study was conducted on 200 diabetic patients. They are evaluated after taking full history and a recent result of the average sugar level with hemoglobin (Hb)A1c. They underwent comprehensive ophthalmic examination which include BCVA, slit lamp examination, schirmer's test, tear film breakup time, tear film meniscus height, and rose Bengal stain.
Patients symptoms such as itching, dryness, grittiness, foreign body sensations, sticky eye discharges or any insensitivity to bright or low light were also noted.
RESULT- In our study, 46% (n=92) patients had Grade 1 MGD followed by 35% (n=70) had Grade 2; 9% (n=18) had Grade 3; and 10% (n=20) had Grade 4.
CONCLUSION- DM was found to be significantly associated with ocular surface abnormalities, including meibomian gland dysfunction. Furthermore, duration of DM, HbA1c level, and were predictive factors of DED in DM.

***Index Terms*—Ocular surface diseases, diabetes mellitus, dry eye disease, meibomian gland dysfunction.**

I. INTRODUCTION

[1]Diabetes[1] is a serious long-term metabolic disorder that develops when the body cannot utilise the insulin that is produced, either due to insufficient insulin synthesis or other factors. An estimated 537 million adults throughout the world, or 10.5% of all adults in this age range, suffer from diabetes. By 2045, the prevalence rate will exceed 12.8%.

[2]The term 'Ocular Surface' (OS)[2] was coined by Richard Thoft [2] to include the entire mucus membrane lining from the lid margins across the posterior surfaces of eyelids, the superior, inferior, medial and lateral fornices, the limbus, the corneal surface together with tear film.

[3]The 'lacrimal functional unit' [2,3,4,8] or ocular surface complex has been described as the integrated31 system that comprises the surface epithelium of the cornea, bulbar and palpebral conjunctiva, lacrimal gland, accessory lacrimal glands, and meibomian gland along with their apical (tears) and basal connective tissue matrices. The nasolacrimal duct and eyelashes with their associated glands of Moll and Zeis; along with sensory and motor nerves are responsible for the blink mechanism. [3,4,8.]

[4].Various mechanism are responsible, among which both insulin resistance and hyperglycemia[3] participate in the pathogenesis of diabetic dyslipidemia[4], which is implicated in dry eye and ocular surface disease. Diabetes mellitus3, significantly lowers the lipid layer,[7,8] of the tear film in addition to the most common and observable clinical findings of reduced tear secretion, instability of the tear film, altered goblet cell density, and diminished corneal sensitivity.[7,8.]

[4]. The diseases associated with (OS) are known as ―ocular surface diseases‖. Among the ocular surface diseases, dry eye syndrome and blepharitis are the most common. Multiple mechanisms, such as ocular surface and lacrimal gland inflammation, neurotrophic deficiency, and meibomian gland dysfunction (MGD), play significant roles.

Dry-eye disease (DED)[7,8] is a multifactorial ocular condition characterized by instability and loss of homeostasis of the tear film, ocular inflammation and damage, and neurosensory abnormalities. According to the Tear Film and Ocular Surface Society's Dry Eye Workshop II (TFOS DEWS II)[7] , it is usually classified as aqueous deficiency, in which there is a dysfunction of the lacrimal glands—evaporative, in which the most common cause is Meibomian gland dysfunction (MGD), and mixed forms.

Meibomian gland Dysfunction (MGD [8,9] is defined a chronic, diffuse abnormality of the meibomian glands, commonly characterized by terminal duct obstruction and/or qualitative/quantitative changes in the glandular secretion.

The dysfunction can be due to amount of secretion produced may be abnormal (either too little or too much meibum produced). Dysfunction could also be related to the quality of the meibum produced. MGD may result in evaporative dry eye, blepharitis, chalazion, unsealed lid during sleep, and meibomian gland atrophy.

II. MATERIALS & METHODS

After receiving approval from the institutional ethical committee, a cross-sectional study was carried out in the Outpatient Department (OPD) of the Department of Ophthalmology. The study included 200 diabetes mellitus subjects (both new and review patients) who presented to the Dept. Of Ophthalmology and gave consent to participate in the study. Before the assessment, the clinical tests that would be required to diagnose ocular surface diseases and tear film were performed.

Inclusion criteria: Patients giving consent for the study, who are aged between 20- 60 years and known case of Diabetes

Exclusion criteria: Age= <20 years & > 60 years. Patients with pterygium, any corneal opacity due to trauma, or who underwent ocular surgery in past 3 months,are on any systemic (anti-depressants drugs) or topical drugs (olopatadine) and contact lenses wearer.

Patients underwent comprehensive ophthalmic examination which include best corrected visual acuity, slit lamp examination, schirmer's test, tear film breakup time, tear film meniscus height, and rose bengal stain.

Patients symptoms such as itching, dryness, grittiness, foreign body sensations, sticky eye discharges or any insensitivity to bright or low light are evaluated.

For Meibomian glands dysfunction: it is evaluated by lightly pressing the fingers on the edge of the lids, one could possibly assess the expression and quality of the secretions expressed and look for any signs of MGD on the eyelids.

Staging of meibomian gland dysfunction according to the international workshop on meibomian gland dysfunction (Nelson,2011)[8,9]:

Stage 1 - + (minimally altered expressibilty and secretion quality)

Stage 2 - ++(mildly altered expressibilty and secretion quality)

Stage 3 - +++(moderately altered expressibilty and secretion quality)

Stage 4 - ++++(severely altered expressibilty and secretion quality).

III. OBSERVATION & RESULTS

A cross-sectional study was performed on all diabetes presenting to the Ophthalmology Dept. for 1 year. 200 individuals diagnosed from diabetes underwent assessment for the purposes of this research. The mean-age group of patients was 51-60 years seen in our research with incidence increasing with age. Male predominance was seen with male:female ratios of 1.3:1. In our study, we found the maximum duration of diabetes patients belong to was 5-10 years (n=94, 47%). In our study, we find most common symptom was foreign body sensation(62%) followed by itching 42% and most common sign was blepharitis (31%).

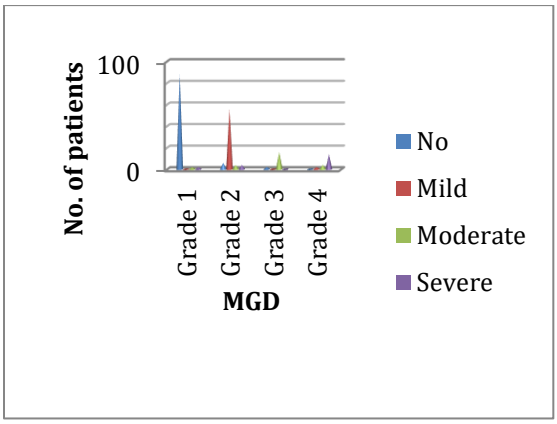
The prevalence of dry eye was 52% among the subjects with diabetes mellitus. Overall, 58 (29%) had mild dry eye, 26 (13%) had moderate dry eye, and 20 (10%) had severe dry eye. In our study, 46% (n=92) patients had Grade 1 MGD followed by 35% (n=70) had Grade 2; 9% (n=18) had Grade 3; and 10% (n=20) had Grade 4.

MGD grade 0 was significantly associated with no dry eye. MGD grade 1was significantly associated with mild dry eye. MGD grade2 was significantly associated with moderate dry eye and MGD grade 3 was significantly associated with severe dry eye (p-value <.05).

Table 1: Distribution of patients according to presence MGD (N=200)

MGD	Number of Patients	Percentage
Grade 1	92	46%
Grade 2	70	35%
Grade 3	18	9%

Grade 4	20	10%
Total	200	100.0



Graph 1: Meibomian gland dysfunction and severity of dry eye.

IV. DISCUSSION

The current study intended to determine the positive correlation between ocular surface diseases, dry eye, meibomian gland dysfunction and diabetes. In our study male predominance that is 58% n=116 is seen and mean age group is between 51-60 years.

Singh J et.al conducted a study on 250 patients, 138 (55.2%) of them were males. Ages ranged from 18 to 83 years, with a mean (SD) of 45.3 (16.9) years; 65 (26.0%) were aged between 18-30 years, 51 (20.4%) were aged 60 years or older, while the rest (134, 53.6%) were aged between 31-60 years. Similar was observed by Khetwani et al, Acharlu et al. and Sarkar et al concluded that the average age of patients was 54 ± 10.06 years, with 43% aged between 40 and 50 years.

The prevalence of dry eye was observed 52% in our course of the study. In an identical research study by Nora Burda et al., dry eye was observed in 53% of patients; in subsequent studies by and Masood Reza Manaviat et al., and Nepp et al., dry eye was identified in 54% and 43% of patients, respectively.

In the current investigation, 46% of patients had Grade 0 MGD, 35% had Grade 1, 9% had Grade 2, and 10% had Grade 3, exhibiting a beneficial relationship between dry eye severity and the MGD categories. Manjula et al. showed that 56% of those taking part in the research they performed had dry eyes, and 24 of them had the condition. Shamsheer et al. discovered that MGD was more prevalent in the diabetic group (15%) than in the control group (7%), with a p-value of 0.0015. Kumar et al. discovered that 50% had MGD, with 54% possessing varied degrees of dry eyes, which was of statistical importance (P = 0.001).

V. CONCLUSION

Dry eyes are often the consequence of defects in the ocular surface resulting from alterations in the layer of tear film, which are susceptible due to long duration of DM.

The duration of Type 2 diabetes is an important component in ocular surface disease.

Meibomian gland dysfunction is an important cause of dry eye and the frequency of the more severe form is significantly greater in diabetics. The present research concluded that those suffering from DM who have endured the condition for a longer duration encounter dry eyes more often than others.

All cases of diabetes mellitus should be accurately assessed for dry eye and damage to the ocular surface; this evaluation should be part of the screening process for diabetic retinopathy.

REFERENCES

[1]. Kumar A, Gangwar R, Ahmad Zargar A, Kumar R, Sharma A. Prevalence of diabetes in India: A review of IDF diabetes atlas 10th edition. Current diabetes reviews. 2024 Jan 1;20(1):105-14.

[2]. Dua HS, Said DG. The ocular surface: Functional anatomy, medical and surgical management. InCornea 2015 (Vol. 6, pp. 1-25). Karger Publishers.

[3]. Cousen P, Cackett P, Bennett H, Swa K, Dhillon B. Tear production and corneal sensitivity in diabetes. Journal of Diabetes and its Complications. 2007 Nov 1;21(6):371-3.

[4]. Dogru M, Katakami C, Inoue M. Tear function and ocular surface changes in noninsulin-dependent diabetes mellitus. Ophthalmology. 2001 Mar 1;108(3):586-92.

[5]. Lemp MA, Foulks GN. The definition and classification of dry eye disease. Ocul Surf. 2007 Apr;5(2):75-92.

[6]. Singh J, Priya Y, Bhat V. Prevalence, severity, and treatment outcomes of meibomian gland dysfunction in patients with dry eye symptoms at a Tertiary Care Center in South India. Cureus. 2022 Jun 7;14(6).

[7]. Nichols KK, Foulks GN, Bron AJ, Glasgow BJ, Dogru M, Tsubota K, Lemp MA, Sullivan DA. The international workshop on meibomian gland dysfunction: executive summary. Investigative ophthalmology & visual science. 2011 Mar 1;52(4):1922-9.

[8]. Holland EJ, Mannis MJ, Lee WB. Ocular Surface Disease: Cornea, Conjunctiva and Tear Film E-Book: Expert Consult-Online and Print. Elsevier Health Sciences; 2013 Jun 24

[9]. Yang Q, Liu L, Li J, Yan H, Cai H, Sheng M, Li B. Evaluation of meibomian gland dysfunction in type 2 diabetes with dry eye disease: a non-randomized controlled trial. BMC ophthalmology. 2023 Jan 31;23(1):44.

[10]. Kim BR, Kim HK, Yoo TK. The association between diabetes mellitus and meibomian gland dysfunction: A meta-analysis. International Journal of Diabetes in Developing Countries. 2025 Jun 20:1-0.