A Comparative Study of Endothelial Cell Density in Cataract Patients with and without Dry Eye Disease

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ABSTRACT

BACKGROUND

Dry Eye Disease (DED) is one of the most frequently encountered conditions affecting 5% - 35% of the population. It is common in elderly patients and women. It is a disorder of lacrimal functional unit affecting the ocular surface and tear film. It is a multifactorial disorder due to inflammation of the ocular surface, lacrimal gland, neurotrophic deficiency and Meibomian gland dysfunction. However, the studies on corneal endothelial cell density in dry eye disease are limited. Also, corneal endothelial cell density is an important parameter to be assessed preoperatively before cataract surgery as a low preoperative endothelial cell density can lead to postoperative corneal decompensation due to loss of endothelial cells following surgery, thereby affecting the postoperative visual outcome. Hence, this study was undertaken to compare the endothelial cell density (ECD) in senile cataract patients with and without dry eye disease (DED).

METHODS

A cross-sectional, comparative study was performed on 30 eyes of 15 patients with DED and 30 eyes of 15 patients without DED presenting to clinical practice for cataract surgery in a tertiary care centre. All patients had complete ophthalmic evaluation and ECD was obtained using specular microscopy in both the groups. Data was analysed using student t –test to compare the two groups.

RESULTS

The mean endothelial cell density in patients with dry eye disease was 2418.03 ± 128.268 cells/mm^2 and in those without dry eye disease was 2620.43 ± 119.188 cells/mm^2. There was statistically significant difference between the two groups ($p<0.001$).

CONCLUSIONS

The endothelial cell density is significantly reduced in patients with dry eye disease. Careful preoperative analysis of endothelial cell density in cataract patients with and without dry eye disease (DED) helps to choose appropriate surgical strategies and to reduce the complications in majority of cases.

KEYWORDS

Dry Eye Disease (DED), Endothelial Cell Density (ECD), Specular Microscopy, Cataract

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DOI: 10.18410/jebmh/2020/211

Financial or Other Competing Interests: None.

How to Cite This Article:
Dakshayini M, Radhika SM, Mamatha, et al. A comparative study of endothelial cell density in cataract patients with and without dry eye disease. J. Evid. Based Med. Healthc. 2020; 7(20), 967-970. DOI: 10.18410/jebmh/2020/211

Submission 14-03-2020,
Peer Review 08-04-2020,
Acceptance 25-04-2020,
Published 12-05-2020.

BACKGROUND

Corneal endothelium is essential for the maintenance of the optical transparency of the cornea. Endothelial cells maintain corneal deturgescence by pumping fluid out of corneal stroma. This movement of water out of corneal stroma keeps the cornea transparent and thus maintain clear vision. The corneal endothelium consists of a single layer of hexagonal cuboidal cells lining the posterior corneal surface. The distinct arrangement of this cell layer (cell mosaic) can be imaged using a specular microscope. Specular microscopy is an excellent tool for a clinical estimate of endothelial cell density and also its function. Density 6000 cells/mm^2 at birth and the count falls by 26% in the first year of life. Another 26% lost over next 11 years. The mean endothelial cell count (ECC) in the normal adult cornea ranges from 2000 to 2500 cells/sq.mm.[1] There is on an average 0.6% reduction in the human central corneal endothelial cell density per year in normal corneas throughout the adult life with gradual increase in the polymegathism and pleomorphism.[2] Reduction in the endothelial cell count to 300-700 cells/mm^2 results in corneal endothelial decompensation and oedema.[3] This leads to loss of corneal transparency affecting the visual acuity. Thus endothelial cell density is an important parameter clinically and it provides an index of the functional capacity of the endothelium.[4]

Dry eye is a multifactorial disease that results in symptoms of discomfort, visual disturbance and tear film instability with potential damage to the ocular surface.[5] Any interruption to the Lacrimal Functional Unit, (a system composed of the lacrimal glands, ocular surface i.e. cornea, conjunctiva and meibomian glands, lids, and the sensory and motor nerves that supplies them) can destabilize the tear film leading to hyperosmolarity and eventually to ocular surface disease. It affects 5%-35% of the population.[6] It is common in elderly patients and women.[7]

The normal structure of tear film consists of three layers

a) Lipid layer: It is the outer most layer secreted by Meibomian, Zeiss and Moll glands. It is 0.1 µm thick and prevents overflow of tears and also retard the evaporation.
b) Aqueous layer: It is the middle layer secreted by main and accessary lacrimal glands. It is 7 µm thick. It functions to provide atmospheric oxygen to corneal epithelium, wash away debris and noxious irritants. It also has antibacterial substances like lysozyme and beta lysin.
c) Mucus layer: It is the inner most layer and about 0.2 µm thick stratum of tear film. It is secreted by conjunctival goblet cells and glands of Manz. It converts the hydrophobic surface of the cornea to a hydrophilic one leading to wetting of the corneal surface. This layer helps in lubrication.

Dry eye can be aqueous deficient type or evaporative type. Tear film instability seen in dry eye is due to a variety of conditions like aqueous deficiency due to lacrimal gland atrophy, Meibomian gland dysfunction (MGD) leading to lipid abnormalities, and excessive tear evaporation. Patients with Dry eye can present with symptoms of eye irritation, hyperemia, glare, eye fatigue, blurred vision and superficial punctate keratitis. Various clinical tests like Schirmer's test, tear break-up time (TBUT), tear osmolarity, and vital dye staining of the cornea, such as Rose Bengal and Lissamine Green are currently used in clinical practice to diagnose dry eye disease and also assess its severity and clinical endpoints.

Certain studies have revealed alterations in the corneal innervation mainly lower sub-basal nerve density in patients with dry eye.[8] As a result of this patients with DED have accelerated loss of corneal endothelial cells.[9] There are several studies on changes in various ocular structures like the lacrimal gland, tear film, conjunctiva and cornea in DED. However the data on corneal endothelial cell density in DED is very limited. Furthermore endothelial cell loss is inevitable after any cataract surgery. Hence this study was undertaken to evaluate endothelial cell density in patients with and without DED undergoing cataract surgery.

We wanted to evaluate the corneal endothelial cell density (ECD) using specular microscopy in senile cataract patients with and without dry eye disease (DED) in Indian population.

METHODS

A cross sectional study was conducted on 30 eyes of 15 patients with dry eye disease and 30 eyes of 15 patients without dry eye disease presenting to clinical practice for cataract surgery at Minto Ophthalmic Hospital, Regional Institute Of Ophthalmology, Bangalore during the period of January 2019-August 2019.

Inclusion Criteria

1. Patients willing to give written informed consent.
2. Age more than 50 years.
3. Cataract patients diagnosed with and without dry eye disease.

Exclusion Criteria

1. Patients not willing to give written informed consent.
2. Traumatic, congenital, developmental and complicated cataract.
3. Ocular allergic disease.
4. Keratitis and corneal pathology other than dry eye disease.
5. Pseudoexfoliation syndrome.
6. Ocular surgery, ocular trauma.
7. Contact lens wear.
8. Diabetes.

Of all the patients who satisfied the inclusion and exclusion criteria, demographic details, ocular and medical

history was taken. All patients underwent detailed ophthalmic examination which included the following,

a) Best corrected visual acuity by Snellen's LogMAR chart.
b) Anterior segment evaluation by slit lamp biomicroscopy.
c) Intraocular pressure was measured by Perkins applanation tonometry.
d) Posterior segment evaluation done in indirect ophthalmoscope as well as slit lamp biomicroscope with 90 D.
e) IOL power calculation using ZEISS IOL Master 800.
f) Dry eye evaluation done using Schirmer test and TBUT and values less than 15 mm (Schirmer) and <10 seconds (TBUT) were considered dry eye.
g) Corneal endothelial cell density was analysed using TOMEY EM- 3000 specular microscope.

Data analysis was done using IBM. SPSS statistics software 20.0 version. The data was summarized using mean ± SD, minimum and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. P value was calculated using Student T-test. P value <0.05 was considered significant.

RESULTS

A cross sectional study was conducted on 30 eyes of 15 patients with DED and 30 eyes of 15 patients without DED presenting to clinical practice for cataract surgery. Out of these 30 patients, 14 were females and 16 were males (Figure 1). In both the groups number of females were 7 and males were 8. Age of the patients ranged from 52 years to 85 years with a mean age of 63.43 + 8.402 (Figure 2). Most of the patients were in the age group of 60-69 years.

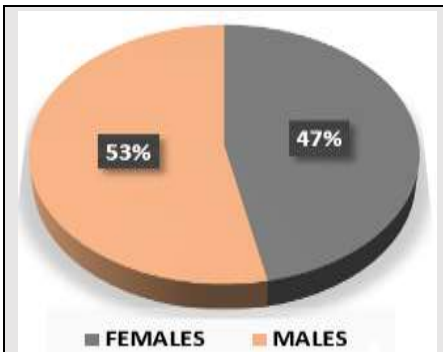

Figure 1. Gender Distribution

The mean endothelial cell density in patients with dry eye disease was 2418.03 ±128.268 cells/mm^2 and in those without dry eye disease was 2620.43 ± 119.188 cells/mm^2 (Table 1) and there was a statistically significant difference between the two groups (p<0.001) (Table 1). Thus the endothelial cell count is significantly decreased in patients with dry eye disease. The ECD in patients with moderate DED was 2451.04 ± 119.8 cells/mm^2 and in severe DED was 2286 ± 56.51 cells/mm^2 (Table 2). The mean endothelial cell count was significantly lower in patients with severe and moderate DED than those without DED (p<0.001).

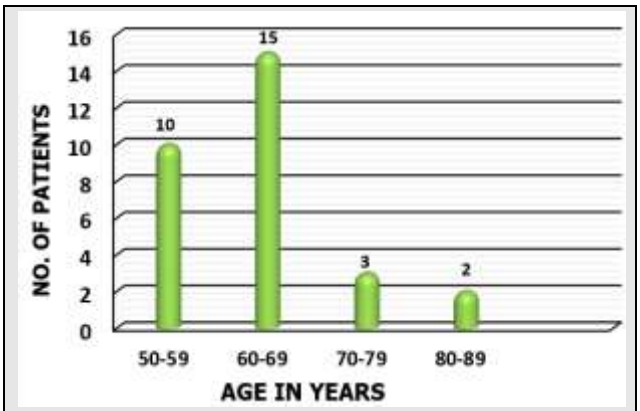

Figure 2. Age Wise Distribution of Patients

Eyes	Total Eyes	Mean	S.D.	P Value
Dry eye	30	2418.03	128.268	0.001
No Dry eye	30	2620.43	119.188	

Table 1. Endothelial Cell Density in DED and without DED

Eyes	Total Eyes	Mean	S.D.
Severe dry eye	06	2286	56.51
Moderate dry eye	24	2451.04	119.80
No dry eye	30	2620.43	119.188

Table 2. Endothelial Cell Density in Severe and Moderate Dry Eye and without Dry Eye

DISCUSSION

The present study showed a statistically significant difference in the corneal endothelial cell density in senile cataract patients with moderate to severe dry eye disease as compared to senile cataract patients without dry eye disease. Furthermore the endothelial cell density was reduced more in those with severe dry eye disease (2286 ± 56.51 cells/mm$^{2)}$ than in those with moderate dry eye disease (2451.04 ± 119.80 cells/mm^2). Thus dry eye disease involves not only the ocular surface and corneal epithelium but also the corneal endothelium is affected.

The mean endothelial cell density in senile cataract patients with dry eye disease was 2418.03 ± 128.268 cells/mm^2 and in those without dry eye disease was 2620.43 ± 119.188 cells/mm^2. These results were similar to a study by Kheirkha et al on 45 patients with moderate to severe dry eye disease in which the mean corneal endothelial cell density was significantly lower in the dry eye disease group (2595.8 ± 356.1 cells/mm^2) than in the control group (2812.7 ± 395.2 cells/mm^2, P=0.046). The study also concluded the reduction in the corneal endothelial cell density was correlating with clinical severity of the disease. He also suggested that the low corneal ECD may be due to significantly lower sub basal nerve density.[10] This was also supported by the observation that in conditions like diabetes, contact lens wear, herpes simplex keratitis, and pseudoexfoliation syndrome a decrease in density and/or function of both sub-basal nerves and endothelium has been shown.

In another study by Rania Fahmy, the mean endothelial cell density was significantly lower in subjects with severe dryness (2620.3 ± 252.2 cell/mm²) and moderate dryness (2801 ± 221.6 cell/mm²) than normal subjects (3067± 196.7 cell/mm²). ECD showed a significant correlation with clinical severity of the disease.[11]

Erdelyi et al did a study on 26 patients suffering from dry eye problems. Among these 26 patients,10 had aqueous tear deficiency, 8 patients had dysthyroid ophthalmopathy, 8 with chronic lagophthalmos and 10 normal controls. The mean corneal ECD in these groups was 2,572 ± 656 cells/sq.mm, 3,085 ± 575 cells/sq.mm, 2,573 ± 467 cells/sq.mm, and 3,193 ± 1,042 cells/sq.mm, respectively.[12] Although they showed a lower ECD in the aqueous tear deficient group than in the controls, the difference did not reach statistical significance, probably due to a small sample size.

The reduction in the endothelial cell density might not only be because of low sub-basal nerve density but also dry eye disease associated inflammatory damage might also have contributed to corneal endothelial cell damage. Hence the inflammation seen in dry eye disease may not be just confined to the superficial layers only, the deeper layers may also be involved.

It is inevitable that corneal endothelial cell loss occurs after any cataract surgery. Thus a preoperative low endothelial cell density can lead to a post-operative corneal decompensation, loss of corneal transparency and thus reduced vision. Hence corneal ECD is a clinically important parameter and a reduced endothelial cell density in senile cataract patients with dry eye disease could be at risk of post-operative corneal decompensation after cataract surgery.

CONCLUSIONS

The present study thus helps to make a comparative analysis of ECD in cataract patients with and without DED for better planning and management of these patients prior to cataract surgery. Careful preoperative analysis of endothelial cell density in cataract patients with and without dry eye disease (DED) helps to choose appropriate surgical strategies and to reduce the complications in majority of cases.

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