Original Article

GENDER BASED STUDIES OF CORNEAL ENDOTHELIAL CELL COUNT

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ABSTRACT:

OBJECTIVES: The aim of this study is to find out the difference of endothelial cell count of human cornea between genders (male, female).and to investigate whether there is any correlation between age, gender, endothelial cell count and endothelial cell morphology in healthy subjects.

RESEARCH DESIGN AND METHOD: Specular bio microscopy was done in 120 eyes of 60 normal persons from age group between 15 to 35 years. Endothelial cell count, endothelial cell morphology and central corneal thickness was measured. These were finally analyzed in relation to the male /female gender and age.

RESULT: Mean endothelial cell count was 2088 ± 169.0 cells per mm2 in right eye of male and was 2165 ± 230.2 cells per mm2 in right eye of female. Mean endothelial cell count was 2133 ± 362.3 cells per mm2 in left eye of male and was 2185 ± 268.1 cells per mm2 in left eye of female. The difference found was not significant between genders. Independent sample t-test (p=0.142) for right eye and independent sample t-test (p=0.528) for left eye. There was insignificant relation found between gender and age. Independent sample t-test (p=0.156). That was proved statistically that there was significant increase in endothelial cell density with age between 15 to 35 years. Right eye (r=0.05) and left eye (r=0.1) .There is no significant change in morphology between genders, the cells are hexagonal in all aged (15 to 35).

CONCLUSION: In a sample of 120 eyes of 60 volunteers in both genders, we found statistically insignificant difference in endothelial cell density between genders. A significant increase in endothelial cell count with age between 15 to 35 years was noted.

INTRODUCTION:

Specular microscope is an instrument that projects light onto the human cornea and captures the image reflected. This image reflection is due to the optical interface between the aqueous humor and endothelial layer of the cornea. Finally analyzed by the specular microscope and displayed in the form of specular photomicrograph.[1]

Endothelial cell density is necessary for the evaluation of the status of cornea. Specular microscopy makes it possible to study corneal endothelial cell density. This device illuminated through one half of a microscope lens and recorded the specular reflection from the endothelial surface through the other surface.[2]

The endothelium of the cornea consists of a single layer of cells (hexagonal in shape). This structure has an essential role in maintaining the corneal transparency by controlling the hydration of cornea. At birth the cell count is between 4000 cells per mm^2 and 5000 cells per mm^2. The cell count will decrease to about 2000 to 3000 cells per mm2 in a normal human eye. [3]

Corneal endothelial morphology is predisposed by many factors, like continuous use of contact lens. The use of contact lens is more common in myopia. Extent of myopia can also be responsible for the morphological changes occurring in endothelium.[4]

Corneal endothelium is a single layer and is derived from the neural crest. It is helpful for keeping the cornea in a dehydrated state necessary for a proper vision. In humans the normal range of endothelial cell count is 2 to 5x103 cells/mm^2. An endothelial cell count below the threshold of 300 to 400 cells/mm^2 is associated with irreversible corneal swelling, epithelium blistering, loss of vision and need of transplantation.[5]

Endothelial cell density is clinically a very important parameter, a reduced number of healthy endothelial cells directly affect the metabolic function of corneal endothelium as regeneration of endothelial cells of human cornea do not occur the entire life, wound healing actually occurs by cell spreading leading to polymorphism and polymegathism. So, both corneal endothelial cells density and morphology is important for assessment of functional reserve of endothelium of a patient. [6]

Corneal endothelial cell density (ECD) is considered as a principle criterion in corneal bank for evaluation in case of corneal transplantation. Endothelial density of the cornea that is to be grafted determines the survival of the graft with time for maintains corneal clarity. An endothelial density of 2000 up to 2400 cells per mm^2 is taken as a standard by many eye banks for corneal delivery. Therefore, it's important to have an accurate and corrective process for evaluation of endothelial density in the eye banks for donation purpose.[7]

Multiple processes such as Oxidative stress, apoptosis, unfolded protein responses etc. have a role in accelerated corneal endothelial cell loss, disturbing the corneal metabolic pumps. As corneal endothelial pumps are the major sites of oxygen consumption in the AC of the human eye ball. Corneal endothelial dysfunctions can also lead to stromal hydration with increased corneal oxygen permeability from the air. The increased O_2 in the cornea leading to increased oxidative stress finally accelerates the endothelial damage.[8]

One of the causes of endothelial cell loss is corneal homograft rejection. This homograft rejection is due to immune response, termed as “graft failure due to rejection”, which results in the damage of the graft's endothelial cells leading to the endothelial cell loss disturbing the metabolic pumps in the cornea. [9]

Inflammatory processes may affect the corneal endothelial cell count. Infectious corneal ulcers result in the inflammation and scarring of the corneal tissue, affecting the endothelial cell count. But statistically there is no significant relation found between presence of a healed corneal ulcer and a decrease in the endothelial cell count.[10]

Diabetes mellitus has a harmful effect on the human endothelial count. It considerably decreases the count. The polyol pathway is often considered as an important contributor in osmotic and oxidative stress in the situation of diabetes means playing role in diabetic corneal pathology. This cornel endothelium damage due to diabetes can be limited by Topical Aldose reductase inhibitors.[11]

Refractive surgeries also influence the corneal endothelial count and central corneal thickness mostly the refractive surgery done in case of myopic refractive error. The common refractive surgery for myopic correction is LASIK. This procedure causes a decrease in the corneal endothelial cell density and pachymetry. These changes do not significantly result in polymegathism.[12]

The endothelial cell analyses provide important information about corneal role and capability. The purpose of endothelial count has become a common practice clinically for providing information about corneal endothelium layer necessary for maintaining corneal transparency. Including assessment of endothelium in case of surgeries like cataract, phakic IOL implantation etc. The best method of the endothelial cell analysis is the use of specular biomicroscopy. It is a non-contact endothelial imaging method. The main advantage of specular microscopy is as it reduces the risk of endothelial damage and transformation of any kind of infection.[13]

Diabetes mellitus also affect the structure of the human corneal endothelium. Especially a change in the shape (polymorphism) and size (polymegathism) has been noticed in diabetic patients. An increased level of glucose in the human body results in the glycogen accumulation in the cornea which causes a remarkable decrease in the endothelial density.[14]

Normal corneal metabolism depends on a specific level of oxygen, below which a series of corneal response occurs. Including increase in corneal hydration, increase in stromal lactate, etc. These acute responses are reversible when oxygen amount needed is restored. However chronic exposure to low oxygen level can leads to permanent corneal morphological changes in the endothelium. These morphological changes may further cause alteration in corneal physiology.[15]

STUDY DESIGN, MATERIAL AND METHODS:

This was a descriptive, cross-sectional study. Patients fulfilling the inclusion criteria were selected from out-patient department (OPD) of Mayo Hospital Lahore. Consent was obtained. Before specular microscopy, visual acuity, IOP and slit lamp examination was done. Then the patient was asked to look into the specular microscope and endothelial cell count was taken.

RESULTS:

Table 1: Endothelial cell count of right eye

Gender		N	Range	Minimum	Maximum	Mean		Std. Deviation
		Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Male	Endothelial cell count of right eye	30	855	1591	2446	2088	30.86	169
Female	Endothelial cell count of right eye	30	803	1643	2446	2166	42.03	230

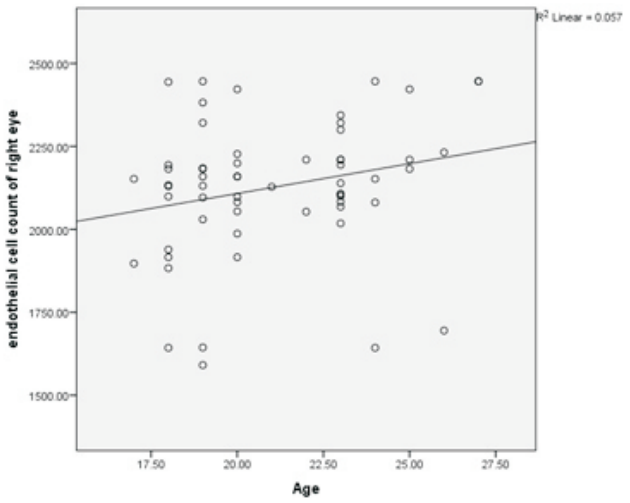
This table describes that the mean endothelial cell count in right eye of male is 2088.30 ± 169.03 with standard error 30.86. And the mean endothelial cell count in right eye of female is 2165.93 ± 230.24 with standard error 42.03. Independent sample t-test (p = 0.142) insignificant i.e. there is no difference between endothelial cell counts in right eye of both the genders.

Table 2: Endothelial cell count of left eye

Gender		N	Range	Minimum	Max	Mean		SD
		Statistic	Statistic	Statistic	Statistic	Statistic	SE	Statistic
Male	Endothelial cell count of left eye	30	1495	1721	3216	2133	66.2	362.38
Female	Endothelial cell count of left eye	30	1151	1841	2992	2185	49	268.13

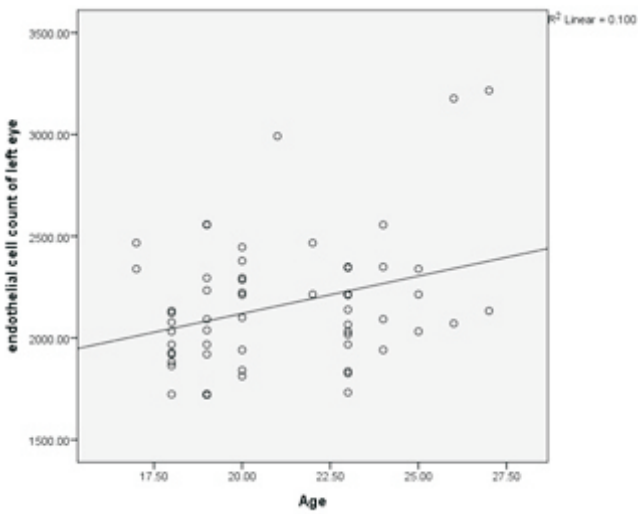
This table describes that the mean endothelial cell count in left eye of male is 2133.13 ± 326.38 with standard error of 66.16. And the mean endothelial cell count in left eye of female is 2185.43 ± 268.13 with standard error of 48.95. Independent Sample t-test was insignificant (p = 0.528) i.e. there is no difference between endothelial cell counts in left eye of both the genders

Fig 1: Endothelial count right eye vs age



The endothelial cell density of right eye has a slight positive correlation with age from 15 to 35 years (r2=0.057).

Fig 2: Endothelial count left eye vs. age



The endothelial cell density of left eye has a slight positive correlation with age from 15 to 35 years (r2=0.100).

According to this box plot the mean age value in case of male is 22 years and in female is about 20 years.

Correlations

		Age	Gender	Endothelial cell count of Right eye	Endothelial cell count of Left eye
Age	Pearson Correlation	1	-0.186	.280*	.316*
	Sig. (2-tailed)		0.156	0.03	0.014
	N	60	60	60	60
Gender	Pearson Correlation	-0.19	1	0.157	0.083
	Sig. (2-tailed)	0.156		0.231	0.528
	N	60	60	60	60
Endothelial cell count of Right eye	Pearson Correlation	.280*	0.157	1	0.18
	Sig. (2-tailed)	0.03	0.231		0.17
	N	60	60	60	60
Endothelial cell count of Left eye	Pearson Correlation	.316*	0.083	0.18	1
	Sig. (2-tailed)	0.014	0.528	0.17	
	N	60	60	60	60

*. Correlation is significant at the 0.05 level (2-tailed).

EXPLANATION:

This table shows the correlations between variables.

Star over the values show significant correlation.

- Age show a significant correlation with endothelial count of left and right eye.
- Endothelial cell count has no significant correlation with gender.
- Age and gender also do not show any significant correlation.

DISCUSSION:

Corneal endothelium is a single layer consisting of hexagonal cells playing important role in maintaining the corneal hydration. This is carried out by many pump mechanisms in the corneal endothelium necessary for the transparency of cornea. At birth the normal corneal endothelial count is 4000 to 5000 cells/mm^2, which usually declines with age to about 2000 to 3000 cells/mm^2. A cornea with endothelial count less than 500 cells per mm^2 or less than that will be at a risk resulting in corneal edema, loss of vision, corneal swelling and will need transplantation of the cornea.

Endothelial cell analysis is important as, it provide important information about corneal functioning capability. The information collected is important for maintaining corneal transparency, in assessment of donor corneas, and in surgeries like IOL implantation. In case of corneal delivery ECD of 2000 to 2400 cells/mm^2 is considered as a standard worldwide.

So the best method for evaluation of corneal endothelial cell count is the use or Specular bio microscopy which is a non-invasive technique. The benefit of this technique is as it lowers the changes of infection as well as damage to the cornea.

Several studies have discussed the relationship of endothelial cell density with age, gender. According to this study, it is clear that no statistically significant difference in endothelial cell density exist among genders, and no significant difference of the count between the two fellow eyes. This can be supported by many other studies like endothelial cell count conducted in Iranian eyes, Indian eyes, Turkish eyes and Malay eyes.[3]

There are some studies that differ from this study like study of endothelial density in Filipino eyes, where there is a significant difference of endothelial count in both genders (female have 7.8% greater count than male).[34] Another study describes that there is a remarkable difference in corneal endothelial count among genders (female have 2.9% greater count than male).[13]

Many studies describe that endothelial cell density decreases with advancing age. But according to this study the count is increased with age. The reason is that, I selected 60 normal subjects with age ranging from 15 to 35 years. In older age there may be decrease in corneal endothelial cell count and also morphological changes occur in endothelial cells.

CONCLUSION:

There is no statistically significant difference in corneal endothelial cell count between gender. Endothelial cell count in both eyes is positively correlated with age (15 to 35) years.

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