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Original research article

A comparative study of endothelial cell count and its morphology using specular microscopy in patients with senile cataract with or without pseudoexfoliation

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Abstract

The corneal endothelium which consists of a monolayer of polygonal cells maintain the corneal Deturgescence throughout the life. Average endothelial cell count is about 3000 cells/mm3 that decreases at the rate of 0.6% every year. At density less than 500cell/mm3, cornea decompensates and loses transparency affecting the vision. A Prospective study was conducted in the department of ophthalmology among 50 patients diagnosed with PXF with Cataract and 50 age matched cataract without PXF patients posted for cataract surgery were chosen. The study was approved by the institute research and ethical committee and written informed consent was obtained from each patient after explanation of nature of the study. The mean hexagonal pattern of endothelium (6A) in patients with pseudoexfoliation was 40.20±5.440 and in patients without pseudoexfoliation was 44.18±3.978 which is statistically significant (p<0.001). The regular hexagonal pattern of endothelium was significantly affected in patients with pseudoexfoliation. The decrease in the hexagonality is observed in all age groups.

Keywords: Endothelial Cell Count, Senile Cataract, Pseudoexfoliation"

Introduction

Pseudoexfoliation which was first described by Lindberg in 1917, is an age related systemic disorder with primary ocular manifestation with strong genetic component. Genetically linked to lysyl-oxidase-like-one (LOXL-1) gene, disorder is shown to be associated with accumulation of grayish white fibro granular extracellular pseudoexfoliative material produced by abnormal basement membrane of ageing epithelial cell in trabeculum, lens capsule, iris, ciliary body of the eye, corneal endothelium. These changes have shown to be related to cataract, glaucoma, lens subluxation, pseudouveitis, retinal vein occlusion and keratopathy [1].

The corneal endothelium which consists of a monolayer of polygonal cells maintain the corneal Deturgescence throughout the life. Average endothelial cell count is about 3000 cells/mm3 that decreases at the rate of 0.6% every year. At density less than 500cell/ mm^3, cornea decompensates and loses transparency affecting the vision in patients with PEX qualitative and quantitative morphological changes in corneal endothelium predispose to endotheliopathy that may be more susceptible to the effects of intra ocular surgery [2].

Studies have shown that high CCT leads to overestimation and low CCT leads to underestimation of IOP readings Hence, underestimation of IOP in cases of PEX would cause serious implication as such cases show faster progression of optic disc damage and poorer prognosis [3].

Focal production of PEX exhausts corneal endothelial cells, causing secondary degeneration and corneal decompensation. This typically occurs as a bilateral, asymmetric, slowly progressive corneal endotheliopathy.

PEX cases have shown to be associated with 5 times more likelihood of intra operative complications such as zonular instability, insufficient mydriasis, dropped lens material, shallow anterior chamber and thus make routine cataract surgery a challenging task. So meticulous examination and early diagnosis of PEX becomes essential to alert surgeon regarding complications [4].

Specular microscopy is used to view and record the corneal endothelial layer non-invasively. Specular Microscopy unlike any other microscopes instead of imaging the light transmitted through a substance, the specular microscope images the light reflected from an optical interface, using computer assisted morphometry, modern specular microscopes analyze the size, shape and population of the endothelial cells [5, 6].

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Methodology

A Prospective study was conducted in the department of ophthalmology among 50 patients diagnosed with PXF with Cataract and 50 age matched cataract without PXF patients posted for cataract surgery were chosen.

The study was approved by the institute research and ethical committee and written informed consent was obtained from each patient after explanation of nature of the study.

Sample size

50 eyes of 50 cataract patients with pseudoexfoliation.
50 eyes of 50 cataract patients without pseudoexfoliation.

Inclusion criteria

- Patients with senile cataract.
- Patients with senile cataract with pseudoexfoliation.
- Patients willing to give written informed consent for the study.

Exclusion criteria

- Patients not willing to give written informed consent.
- Traumatic, congenital, developmental and complicated cataract.
- Eyes with corneal pathology.
- Dry eye syndrome.
- H/O ocular surgery.
-

Preoperatively

Preoperative evaluation of all patients was carried out in which a detailed history was taken followed by systemic and ocular examination.

- The details of the patient's name, age, sex, address and occupation was noted.
- A detailed medical and ophthalmic history was elicited
- Best corrected visual acuity using Snellen's chart was recorded
- Anterior segment evaluation by slit lamp biomicroscopy was done
- Pseudoexfoliation material noted for its presence on the pupillary margin, and on the lens capsule in both eyes.
- lacrimal syringing was done
- Intraocular lens power calculation was done
- Posterior segment evaluation done
- Gonioscopy done under topical anesthesia (4% xylocaine) with a hand held four mirror indirect gonioscope.

The following points were specifically evaluated.

- The presence of excessive pigments in the trabecular meshwork.
- The presence of pseudoexfoliation material in the angle.
- The presence of Sampolesi's line.

Results:

Table 1: Endothelial cell count in patients with PXF and without PXF

Endothelial Cell Count								
PXF					Without PXF			
Age	**N**	**Mean**	**Std deviation**	**Std error mean**	**N**	**Mean**	**Std deviation**	**Std error mean**
50-59	11	2159.18	468.306	141.2	17	2674.12	145.432	35.272
60-69	22	2259.27	383.597	81.783	20	2702.45	120.432	26.929
70-79	14	2190.14	349.299	93.354	9	2734.00	111.426	37.142
80+	3	1631.00	218.749	126.29	4	2669.50	94.617	47.308

This table shows age matched endothelial cell density in our study. The endothelial cell count was significantly lower in patient with pseudoexfoliation in the age group of 80 and above.

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Table 2: Mean endothelial cell density

	Patients with PXF	Patients without PXF
ECD	2180.20±404.406	2695.86±124.944

The mean endothelial cell density in cataract patients with Pseudoexfoliation is 2180±404.406 cells per sq. mm and in patients without Pseudoexfoliation is 2696±124.944 cells per sq. mm showing the decreased endothelial cell density in patients with PXF compared to patients without PXF which is statistically significant ($p< 0.0001$)

Table 3: CV% in patients with PXF and without PXF

Coefficient of variation in the cell area								
PXF					Without PXF			
Age	N	Mean	Std deviation	Std error mean	N	Mean	Std deviation	Std error mean
50-59	11	39.09	4.549	1.371	17	36.8	3.661	0.888
60-69	22	39.18	4.316	0.920	20	38.20	4.137	0.925
70-79	14	40.43	6.235	1.666	9	36.44	2.007	0.669
80+	3	62.33	23.629	13.642	4	41.75	6.021	3.010

Table 4: Mean CV% Polymegathism

	Patients with PXF	Patients without PXF
CV%	40.90±8.693	37.70±3.986

The mean endothelial cell area in patients with pseudoexfoliation was 40.90±8.693 and in patients without pseudoexfoliation was 37.70±3.986 percent which is statistically not significant though in patients with PXF have higher polymegathism than patients without pseudoexfoliation.

Table 5: 6a in patients with PXF and without PXF

6A								
PXF					Without PXF			
Age	N	Mean	Std deviation	Std error mean	N	Mean	Std deviation	Std error mean
50-59	11	41.45	4.906	1.479	17	44.65	4.415	1.071
60-69	22	41.05	6.035	1.287	20	43.85	3.675	0.822
70-79	14	38.43	5.080	1.358	9	45.56	2.789	0.930
80+	3	37.67	2.517	1.453	4	40.75	4.992	2.496

Table 6: Mean 6a (pleomorphism)

	Patients with PXF	Patients without PXF
6A	40.20±5.440	44.18±3.978

The mean hexagonal pattern of endothelium (6A) in patients with pseudoexfoliation was 40.20±5.440 and in patients without pseudoexfoliation was 44.18±3.978 which is statistically significant ($p<0.001$). The regular hexagonal pattern of endothelium was significantly affected in patients with pseudoexfoliation. The decrease in the hexagonality is observed in all age groups.

Table 7: CCT in patients with PXF and without PXF

Central Corneal Thickness								
PXF					Without PXF			
Age	N	Mean	Std deviation	Std error mean	N	Mean	Std deviation	Std error mean
50-59	11	489.82	30.163	7.315	17	507.45	32.831	9.899
60-69	22	489.60	26.873	6.009	20	514.09	31.277	6.668
70-79	14	489.89	14.937	4.979	9	511.71	34.354	9.182
80+	3	480.75	14.315	7.157	4	532	11.533	6.658

Table 8: Mean CCT

Mean	Patients with PXF	Patients without PXF
CCT	489.02±25.142	513.02±31.428

The mean CCT in patients with pseudoexfoliation was 489.0±25.142 and in patients without pseudoexfoliation was 513.02±428.

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Table 9: Distribution of fundus

Fundus	Frequency	Percentage
No view	25	25
WNL	70	70
Glaucoma	5	5
Total	100	100

The above table shows distribution of fundus of patients in the study. In which 70% patients had normal fundus 5% patients had pseudoexfoliative glaucoma and 25% patient's fundus was not visible due to SMC and SHMC.

Discussion

Among 100 patients central corneal thickness obtained from specular microscopy shown that50% of the cases have mean corneal thickness 513 micro meters.50% of the cases have mean central corneal thickness as low as 489μm.The results are consistent with the studies presented by Kitsos *et al.* [7] Where they used ultrasonic pachymeter for the assessment of central corneal thickness. Our study findings are consistent with findings given by another study conducted by Acar *et al.* [8]

In our study, patients with pseudoexfoliation had significantly low endothelial cell density. Our findings are consistent with various other research studies such as Zheng *et al* [9], Quiroga *et al* [10], Kovliulas *et al* [11], Zarnowski *et al* [12].These researchers have clearly shown that pseudoexfoliation significantly influences cell density of corneal endothelium, the main reason is shown to be pseudoexfoliative material that settles on the endothelium penetrating it in the direction of Descemet's membrane and breaking the connections between the individual hexagonal cells, resulting in accelerated apoptosis of the cells. Apart from these other factors are Hypoxia of anterior chamber, changes in fibroblast of the endothelium and elevated concentration of TGF-α 1. Endothelial cell density of less than 800 cells results in corneal decompensation, allowing aqueous/ocular fluid to seep into the corneal stroma causing loss of corneal transparency. To determine patients that are at risk for corneal decompensation a simple test of knowing endothelial cell density can be used and alert surgeon to take necessary precautions.

Studies have shown that high CCT leads to overestimate and low CCT leads to underestimation of IOP readings. Hence, underestimation of IOP in cases of PEX would cause serious implication as such cases show faster progression of optic disc damage and poorer prognosis.

In our study we found that the mean endothelial cell density was 2695.86±124.944 in cataract patients without pseudoexfoliation and 2180.20± 404.406 in cataract patients with Pseudoexfoliation, which was similar to previous studies by Zheng *et al*, [9] Inoue k *et al* [13]. The corneal endothelial cell density was significantly lower in the PXF eyes.

In our study there was significant difference in the coefficient of variation for the cell area and the percentage of hexagonal cells between patients with PXF and patients without PXF.

In our study 5% patients had pseudoexfoliative glaucoma there is significant reduction in endothelial cell count and in patients with PEXG compared to the patients without PEXG Our study findings are consistent with findings given by L De Juanmarcos[14] showed and percentage of hexagonal cells were lower in PEX groups and in the POAG group compared with normal eyes, while the CV in cell size was greater. There was a tendency for greater cell loss and morphological abnormalities of the corneal endothelial cells in PXG eyes compared to PXS eyes, when all pseudoexfoliative eyes were analyzed together.

The mean hexagonal pattern of endothelium in patients with Pseudoexfoliation was 40.20±5.440 and in patients without Pseudoexfoliation was 44.18±3.978 which is statistically significant (p<0.001). The results are consistent with the studies presented by Yaksel N *et al*., [15] in this study the percentages of endothelial cell polymegathism and pleomorphism were higher in PXS and PXG patients compared with control subjects. The regular hexagonal pattern of endothelium was significantly affected in patients with pseudoexfoliation.

Conclusion

Our study showed that these cases have significantly lower endothelial cell density and increased risk of corneal decompensation after intra ocular surgeries. These pseudo exfoliative cases also have significantly low central corneal thickness which may under estimate the IOP reading and overlook an early glaucomatous damage. Early detection of pseudoexfoliative glaucoma can aid to render appropriate treatment. Thus evaluation of endothelial cell density and its morphology becomes an imperative pre-operative step in cases of pseudo exfoliation. The present study helps to make a comparative analysis of endothelial cell counts in patients with and without pseudoexfoliation syndrome for a better planning and management of these patients prior to cataract surgery.

To conclude careful preoperative analysis of endothelial cell density and its morphology in cataract patients with and without pseudoexfoliation helps to choose appropriate surgical strategies and to reduce the complications in majority of cases.

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