Original article

Endothelial cell loss after small incision cataract surgery

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Abstract

Background: The corneal endothelium plays an important role in maintaining the dehydrated state and the transparency of the cornea. Some degree of endothelial cell loss invariably occurs in all types of cataract surgery but the amount of endothelial cell loss varies with the surgical technique.

Aim: To evaluate the density of the central corneal endothelial cells before and after small incision cataract surgery (SICS) with posterior chamber intraocular lens (PC IOL) implantation.

Materials and methods: A total of 100 eyes of 100 patients undergoing SICS with PC IOL were included in the study. Endothelial cell density was measured with non-contact specular microscope pre-operatively and post-operatively on Day 1, Day 7 and at one month.

Results: The mean endothelial cell count pre-operatively was 2673 ± 358.85 cells / sq mm while post-operatively at 1 month it was 2249.77 ± 354.04 cells / sq mm.

Conclusion: There is 15.83 % reduction in endothelial cell count after SICS with PC IOL implantation, which is comparable with other modes of cataract surgery like extra-capsular cataract extraction and phacoemulsification.

Keywords: endothelial cell, small incision cataract surgery, specular microscope

Introduction

Globally, in 2002 more than 161 million people were visually impaired, of whom 37 million were blind (Resnikoff et al 2002). Age-related cataract remains a major cause of blindness throughout the world and more so in developing countries. Because of the increasing population and the increasing life expectancy, the number of older people will double from 606 million in 2000 to 1.2 billion in 2025. In fact, it is estimated that 75 % of older people will be living in low and middle income countries by 2025 (Evans 2008).

In the last couple of decades, the choice of cataract surgery has shifted to mainly sutureless small incision cataract surgery (SICS) or phacoemulsification (PE). Phacoemulsification is the preferred choice in the western developed countries or in urban settings. SICS is significantly faster, less expensive, and less technology dependent than phacoemulsification. The visual acuity and the complication rates are similar to phacoemulsification

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(Ruit et al 2007). SICS may be the more appropriate surgical procedure for the treatment of advanced cataracts in the developing world (Ruit et al 2007).

But often concern has been raised regarding the endothelial cell loss following SICS. This study was done to evaluate the endothelial cell loss following SICS with PC IOL implantation.

Materials and methods

This study was conducted at a tertiary ophthalmological center in India. It was a prospective study done over a period of two years. All patients with age-related cataract above the age of 40 years were included in the study. Patients with corneal pathology, traumatic cataract, pseudo exfoliation syndrome, conjunctival scarring, diabetes mellitus, uveitis, glaucoma, vitreo-retinal pathology, prior intraocular surgery, high myopia, collagen vascular disease and any active ocular disease were excluded from the study. Likewise, patients with posterior capsular rent and vitreous loss during surgery were also excluded from the study. A detailed history was taken and examination was done in all patients to exclude the above conditions.

All the surgeries were performed by senior experienced surgeons at a tertiary care ophthalmic centre in India under peri-bulbar anesthesia. A 6-7 mm frown incision was given 1-2 mm behind the limbus after peritomy and proper wet field bipolar cautery. Continuous curvilinear capsulorhexis was done with or without the aid of trypan blue, after injecting 2 % hydroxyl propyl methyl cellulose (HPMC). After hydroprocedures, the nucleus was prolapsed into the anterior chamber (AC) with a Sinsky hook. The nucleus was delivered using irrigating vectis and the cortex was aspirated with a Simcoe bi-way cannula. This was followed by implantation of a 6.5 mm PMMA IOL in the bag.

The density of the central corneal endothelial cells and the central corneal thickness was measured with a non-contact specular microscope (SP 2000P Topcon) pre-operatively and post-operatively on Day 1, Day 7 and at one month.

Results

The age and gender distribution are shown in Table 1. The majority of the patients were in the age group 51 - 60 years with almost equal distribution among genders. Most of the patients presented with immature senile cataract (74 %); 22 % had mature cataract and 4 % had hypermature cataract. The best corrected visual acuity (BCVA) pre-operatively and post operatively at 6 weeks is shown in Table 2.

Table 1

Age and gender distribution

Age group	Males	Females
40 - 50	9	13
51 - 60	22	13
61 - 70	10	14
71 - 80	6	8
81 - 90	2	3
Total	49	51

Table 2

Best corrected pre and post-operative visual acuity

Visual acuity	Pre-operative BCVA	Post-operative BCVA
6/6 - 6/18	0	97
6/24 – 6/60	69	3
< 6/60	31	0

Table 3

Mean endothelial cell count (cells/mm^2)

Time of examination	Endothelial cell count / mm^2 (± SD)
Pre-operative	2673.04 ± 358.85
Post-operative Day 1	2309.01 ± 326.46
Post operative Day 7	2274.28 ± 327.7
Post-operative 1 month	2249.77 ± 354.04

Table 4

Mean endothelial cell loss / mm²

Time of examination	Mean Endothelial cell loss / mm^2	% of cell loss
Post-operative Day 1	364.03	13.61
Post-operative Day 7	398.76	14.91
Post-operative 1 month	423.27	15.83

Table 3 shows the mean endothelial cell count preoperatively and post operatively at Day 1, Day 7 and at one month. A gradual decrease of endothelial cell density is evident. The mean endothelial cell loss at 1 month was 423.27 cells / sq mm. The corresponding decrease in percentage was 15.83 % (Table 4).

Discussion

There is a lot of concern about endothelial cells because they cannot regenerate. Various studies have been undertaken to evaluate the endothelial cell loss after different types of cataract surgery to indirectly assess the safety of the surgical technique. In SICS the nucleus is prolapsed in the anterior chamber before delivery, which leads to the concern of endothelial cell loss.

In our study we found that the mean percentage endothelial cell loss with SICS was 15.83 % at 1 month postoperatively. The nucleus delivery was done with irrigating vectis. The endothelial cell loss is almost similar to that found by Wright et al (1999), where the endothelial cell loss 3 months post-operatively in SICS patients was 16 %. But they did the SICS using an AC maintainer by the Blumenthal technique. In the study by Sasikumar et al (2001), SICS was done using irrigating vectis for nucleus delivery. They reported a low endothelial cell loss of 6.07 % at 8 weeks. Vajpayee et al (1998) evaluated endothelial damage following SICS with the nucleus tri-section (manual phaco-fracture) technique. They reported the endothelial cell loss to be 17.66 ± 3.65 % at the end of 3 months.

Some studies have evaluated endothelial cell loss among different modes of surgery with the same inclusion and exclusion criteria. Bourne et al (1981) observed that the mean percent cell loss was slightly higher with phacoemulsification (16.1 %) than with ECCE (14.2 %). The small difference was not statistically significant. George et al (2005) evaluated endothelial cell loss in all the three popular modes of surgery. They reported the mean endothelial cell loss in SICS to be 4.21 %, compared to 4.72 % in ECCE and 5.41 % in PE at 6 weeks postoperatively.

There is a wide difference in the endothelial cell loss between the studies even when the mode of surgery is the same, for e.g. SICS. This is due to various factors - different inclusion and exclusion criteria, different methods of nucleus delivery while doing SICS, different types of irrigating solutions and the different types of ophthalmic visco-surgical devices (OVD) used.

The endothelial cell loss was low in the studies by Sasikumar et al (2001) and George et al (2005). This is probably due to the fact that only immature cataracts with grade I-II nuclear sclerosis were included by Sasikumar et al and immature cataracts with nuclear sclerosis grade 3 or less were included by George et al. But when only hard cataracts were included in the study by Stumpf et al (2006), the endothelial cell loss was high. They observed endothelial cell loss at 6 months to be 28.5 % and 34.77 % in ECCE and PE respectively. According to Bourne et al (2004), the presence of a hard cataract was a significant factor in endothelial cell loss in both ECCE and PE. Patients with a hard cataract had a significantly higher cell loss (17.6 %) compared with 12.7 % in those with a lesser degree of brunescence ($p = .025$).

Another important factor contributing to endothelial cell loss is the method of nucleus delivery. Since more manipulation is needed in nucleus fragmentation in the anterior chamber, endothelial cell loss is high in the study by Vajpayee et al (1998). The endothelial cell loss with irrigating vectis is low as observed by Sasikumar et al (2001) and hence it is popular and safe.

Other factors which need to be evaluated are the use of different irrigating solutions and OVD's used, since they play an important role in protecting the corneal endothelial cells.

The occurrence of a capsule rupture and vitreous loss at surgery leads to a higher endothelial cell loss (18.9 % versus 11.5 %, p = 0.003) as reported by Bourne et al (2004). Since we excluded surgeries with posterior capsule rent, this factor did not play any role in our study.

It is important to note that in a single center with similar inclusion and exclusion criteria, the endothelial cell loss between ECCE, SICS and PE was not statistically significant (George et al 2005).

Conclusion

The endothelial cell loss in SICS is comparable to that in the previously-popular ECCE as well as to that in the currently-popular phacoemulsification. Hence, SICS is as safe as ECCE and phacoemulsification as far as endothelial cell loss is concerned.

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