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Evaluating the effect of donor and recipient factors on graft survival after penetrating keratoplasty

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ABSTRACT

Purpose: Corneal diseases are one of the leading causes of visual loss and blindness, after cataracts and glaucoma across the globe. Management of corneal blindness requires corneal transplantation which is dependent on voluntary corneal donations and needs tremendous post-operative care and follow-up. The success of the procedure depends upon various donor and recipient factors that need to be studied.

Materials and Methods: A prospective study was conducted in the eye bank of the tertiary care eye center in central India after getting the approval of the institutional ethical committee. A total of 26 eyes of 13 donors were studied, out of which 23 eyes underwent penetrating keratoplasty, among these, 3 eyes underwent therapeutic penetrating keratoplasty, 16 eyes underwent optical penetrating keratoplasty and 4 eyes underwent triple procedures. Recipients were followed up at 1 week, 1 month, and 3rd months, and data were analyzed.

Results: Graft survival was significantly better in the recipients without pre-operative corneal vascularization (p=0.004). Corneas from a donor with open eyelids showed significantly poor graft survival. This was statistically significant (p= 0.047). On the other hand, based on donor lens status, we did not find any difference in the survival of the graft.

Conclusion: Practices like lid closure and eye drop installation should be promoted from the time of death, for preserving donor tissue quality. HCRP should be promoted and practiced at the national level as it is effective in increasing the rate of eye donation and positively affects graft outcomes.

1. Introduction

According to the World Health Organization(WHO), corneal diseases are one of the leading causes of visual loss and blindness, after cataracts and glaucoma across the globe. WHO says, globally, approximately 4.2 million people are having preventable visual impairment due to corneal opacities[1] In India, approximately 6.8 million people have been documented for having visual acuity less than 6/60 in at least one eye due to corneal diseases; among these, about 1 million people have bilateral involvement.[2,3]

Management of corneal blindness requires corneal transplantation which is dependent on voluntary corneal donations and needs tremendous post-operative care and follow-up. The success of the procedure is not an overnight event, it depends upon various donor and Recipient factors, modifiable factors should be taken care of, to increase the success of the procedure. Right from the enucleation procedure, quality of donor tissue, careful tissue preparation, duration of preservation, systematic tissue evaluation, and uneventful transplantation altogether accounts for the good results.

Donor tissue must be intact and needs to be free from ocular surface defects. Donor tissue layers must be assessed

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and graded as per standard criteria under a slit-lamp prior to transplantation. Endothelial cell density needs to be checked by specular microscopy for better graft survival. Graft survival gets affected by certain donor factors, tissue preparation & preservation factors, and recipient factors.

The present study was conducted to evaluate the role of donor factors and recipient factors in graft survival and complication of surgery at a tertiary care eye center in central India.

2. Materials and Methods

A prospective study was conducted for 18 months in the eye bank of tertiary care eye center in central India after getting the approval of the institutional ethical committee. The study group consisted of all recipients who underwent penetrating keratoplasty between 2018 to 2020 at the study center.

Demographic details of donor, cause of death, time of death, systemic illness along with the history of intraocular surgeries were noted. The procedure was explained and written consent was taken. Enucleation was performed under aseptic precautions and the eyeball was immediately transferred to a moist chamber. Slit-lamp examination was done and donor corneas were graded using a standard grading system (Eye Bank Association of America).[4]

After explaining the whole procedure and associated risks, written consent was taken, and penetrating keratoplasty was done. In triple procedure, cataractous lens was removed using the open sky technique, and posterior chamber intraocular lens was implanted.

Recipients were followed-up at 1 week, 1 month, and 3rd month and the effect of various donor and recipient factors on graft clarity was studied. Survival of the graft was assessed on the basis of visual acuity, graft clarity, graft host junction vascularization, anterior chamber, and presence of rejection signs were noted. Modified grading of corneal clarity on the basis of corneal haze was used[5] (British Journal of Ophthalmology 2009.

Statistical analysis was done by SPSS 23.0 version. Categorical variables were analyzed using the Chi-Square test. The variables with a p-value <0.05 was considered statistically significant.

3. Results

In the present study a total of 26 eyes of 13 donors were studied, out of which 23 eyes underwent penetrating keratoplasty, among these, 3 eyes underwent therapeutic penetrating keratoplasty, 16 eyes underwent optical penetrating keratoplasty and 4 eyes underwent triple procedures; penetrating keratoplasty with cataract extraction with posterior chamber intraocular lens implantation.

The majority of donors(38.5%) belonged to the age group of 41-60 years. The mean age of donors was found to be 50.2 ± 2.35 years. The youngest donor was of 15 years of age and the eldest was 88 years of age. Male recipients 19(82.6%) outnumbered the female recipients 4(17.4%).

Seven (26.9%) donor corneas were of very good quality, 15(57.7%) were of good quality, rest 4 were of fair to poor quality corneas. The majority of donated eyes 11(84.6%) were retrieved via Hospital Corneal Retrieval Programme (HRCP) and the remaining 2(15.4%) were retrieved at home. (Table 1)

The mean age of the recipients in this study was 47±19.8 years in the present study. Graft clarity according to age distribution shows no significant difference(p=0.443). There were 19 (82.6%) males and 4(17.4%) females. (Table 2)

4. Discussion

In the present study, graft survival of recipients concerning the transplanted cornea from young as well as old age donors had shown similar graft outcomes. However, the results were statistically insignificant.

Similarly, R. Doyle Stulting et al[6] and Mark J Mannis et al[7] found no association between the age of the donor and graft survival. Hyeon Yoon Kwon et al[8] have also documented similar results.

We found that corneas (84.6%) that were hospital retrieved showed better graft survival on postoperative day seven as well as on final follow-up. However, the difference in recipient graft survival with respect to the place of enucleation of donor tissue was statistically insignificant which can be attributed to the small sample size.

Anders Shehab et al[9] also concluded that recipients with donor cornea who are hospital retrieved have better graft survival post-transplantation.

We have found that 12(63.1%) recipients with donor tissue having adequate moistening showed better graft survival on postoperative day seven and also (68.4%) at final follow-up. But the difference in each of the groups was statistically insignificant.(p=0.239) However, there were no such studies in the literature to compare. This can be attributed to fact that the presence of moist air prevents dryness of donor cornea.

In our study, we have found that recipients who underwent penetrating keratoplasty with donor corneas in which eyelids were found open (26.1%) during enucleation have shown significantly poor graft survival at final follow-up. The difference between those two groups was also statistically significant(p=0.047). Michel et al[10] documented similar results. After death, if the eyelids remain open for a prolonged duration, the cornea gets exposed to an external environment which results in damage to the epithelium.

Recipients (65.2%) who underwent transplantation from the tissue of the donor's eyes without any intraocular

Table 1: Effect of donor factors on graft survival at I follow-up(1 week), II follow-up (1 month), and III follow-up (3 months)

Donor Factors		**n**	**Graft clarity grading**															**P-value**
			Grade 0 (N=2)			**Grade 1 (N=5)**			Grade 2 (N=5)			**Grade 3 (N=7)**			**Grade 4 (N=4)**			
Follow-up			I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
Age Group	<20	2	0	0	1	0	1	2	3	2	1	1	1	0	0	0	0	0.33
	21 – 40	2	0	0	0	2	1	0	0	0	3	2	2	1	0	1	0	
	41 – 60	5	1	1	1	2	2	4	5	2	2	0	3	2	1	1	0	
	>60	4	0	1	1	3	1	1	3	1	1	0	1	1	0	2	2	
Place of Enucleation	Hospital	11	1	2	3	6	4	7	9	5	6	3	5	3	1	4	1	0.352
	Home	2	0	0	0	1	1	0	2	0	1	0	2	1	0	0	1	
Ambient Room temperature and moistening	Present	9	1	1	1	3	2	2	3	2	1	0	1	3	0	1	0	0.239
	Absent	4	0	1	2	4	3	5	8	3	6	3	6	0	1	3	2	
Status of Lids	Closed	10	0	1	2	4	4	7	10	4	6	3	6	1	1	3	2	0.047
	Open	3	1	1	1	3	1	0	1	1	1	0	1	3	0	1	0	
Status of Lens	Transparent	8	0	0	1	2	2	2	3	2	4	3	3	1	0	1	0	0.572
	Cataractous	7	1	1	1	2	2	3	3	2	1	0	1	2	1	1	0	
	Pseudophaki	8	0	1	1	3	1	2	5	1	2	0	3	1	0	2	2	

Table 2: Effect of donor factors on graft survival at I follow-up (1 week), II follow-up (1 month), and III follow-up (3 months)

Recipient Factors		n	Graft clarity grading															P-value
			Grade 0 (N=100)			Grade 1 (N=7)			2 (N=11)			3 (N=3)			4 (N=1)			
Follow-up			I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
Age	<20	3	0	1	0	1	0	0	0	1	1	1	0	0	0	0	1	0.443
	21 – 40	4	0	0	0	1	2	1	3	1	2	0	1	1	0	0	0	
	41 – 60	8	0	1	1	4	1	2	3	3	0	2	3	5	0	1	1	
	>60	8	1	1	1	1	4	2	5	2	2	0	0	1	1	1	2	
Gender	Males	19	1	3	2	6	6	4	9	4	5	2	4	5	1	2	3	0.277
	Females	4	0	0	0	1	1	1	2	3	0	1	0	2	0	0	1	
Indications of Penetrating Keratoplasty	Adherent Leucoma	9	2	2	1	2	2	4	2	3	3	2	1	0	1	1	1	0.23
	Pseudophakic bullous keratopathy	7	1	1	1	2	2	4	3	2	0	0	0	0	0	0	0	
	Leucomatous corneal opacity	5	1	2	2	1	3	1	5	1	1	0	1	3	0	0	0	
	Others	1	0	0	0	0	0	0	1	1	1	1	2	2	0	2	2	
Pre-operative corneal vascularization	Present	1	0	0	0	5	5	1	8	6	4	2	3	7	1	2	4	0.004
	Absent	16	1	3	2	2	2	4	3	1	1	1	1	0	0	0	0	
Type of keratoplasty	Optical penetrating keratoplasty	7	1	2	1	4	5	5	9	6	3	2	2	5	0	0	2	0.005
	Therapeutic penetrating keratoplasty	16	0	0	0	2	0	0	1	0	0	0	2	1	0	2	2	
	Triple procedure	3	0	1	1	1	2	0	1	1	2	1	0	1	1	0	0	

or cataract surgeries have shown better graft survival as compared to pseudophakic donors. This can be attributed to some endothelial compromise post-cataract surgeries or intraocular surgeries, that may affect graft survival. But due to less sample size, these findings were statistically insignificant. R. Doyle Stulting et al[6] also found that post keratoplasty eyes with pseudophakic corneal edema underwent more rejections 34%.

In the present study, no significant effect of age and gender of recipients on graft clarity was noted (p=0.277). Sugar A et al[11] also similar results.

Recipients without pre-operative corneal vascularization had statistically significantly better graft survival. (p=0.004). Rafael et al[12] also documented similar results with a survival rate (74%).

Optical penetrating keratoplasty recipients showed better graft clarity compared to those who had undergone therapeutic penetrating keratoplasty but the difference in the clarity was statistically insignificant(p=0.005).

5. Conclusion

Modifiable donor and Recipient factors should be taken care of, to increase the success rate of the procedure. Practices like lid closure and eye drop installation should be promoted from the time of death, for preserving donor tissue quality. HCRP should be promoted and practiced at the national level as it is effective in increasing the rate of eye donation and positively affects graft outcomes.

6. Source of Funding

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7. Conflict of Interest

None declared.

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