

Content available at: <https://www.ipinnovative.com/open-access-journals>

Indian Journal of Clinical and Experimental Ophthalmology

Journal homepage: www.ijceo.org

Original Research Article

Evaluating the effect of corneal tissue preservation on graft survival after penetrating keratoplasty

Preeti Waskel¹, Ankit Jain², Sooraj Singh Kubrey¹, Naziya Md Rizwan Shaikh^{1,*}, Manisha Singh¹, Kavita Kumar¹¹Gandhi Medical College, Bhopal, Madhya Pradesh, India²Atal Bihari Vajpayee Government Medical College, Vidisha, Madhya Pradesh, India

ARTICLE INFO

Article history:

Received 20-09-2022

Accepted 11-10-2022

Available online 29-12-2022

Keywords:

Preservation

Death to enucleation time

Death to preservation time

Preservation to utilization time

Optical

Therapeutic

Hospital cornea retrieval program

ABSTRACT

Purpose: To study the various tissue preparation and preservation which affect the quality of donor tissue along with the effect of recipient factors on short term graft survival.**Materials and Methods:** The ambispective study was carried out in order to know predictive value of factors like donor, tissue preservation and recipient factors and the extent of the effect on short term graft survival. A total of 26 eyes of 13 donors were studied, out of which 23 eyes had undergone penetrating keratoplasty. Out of 23 eyes, 3 eyes had undergone therapeutic penetrating keratoplasty, 16 eyes undergone optical penetrating keratoplasty and 4 eyes undergone triple procedures; penetrating keratoplasty with cataract extraction with posterior chamber intra ocular lens implantation. The results of penetrating keratoplasty were studied over a period of 3 months with follow ups at 1 week, 1 month and the final follow up at the 3rd month. The indication for penetrating keratoplasty in recipients in this study were essentially optical and therapeutic. The Statistical analysis was performed by SPSS 23.0 version. Categorical variables were described by taking percentages (analyzed using Chi Square test; Subgroup analysis was based on Adjusted Standardized Residuals). The variables with p value <0.05 was considered as statistically significant.**Result:** Recipients with donor tissue from eyes retrieved within 4 hours of death and shorter preservation to utilization time have shown better graft survival.**Conclusion:** Practices including lid closure and eye drop instillation should be encouraged. Hospital cornea retrieval program should be promoted to ensure lesser death to enucleation time and preservation time for better graft outcome.This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.For reprints contact: reprint@ipinnovative.com

1. Introduction

According to the World Health Organization (WHO), corneal diseases are among the leading causes of visual disturbance and blindness, after cataracts and glaucoma worldwide.¹ As per WHO, globally, approximately 4.2 million people are having preventable visual impairment due to corneal opacities caused by corneal disorders.²

In India, approximately 6.8 million people were enrolled 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.³

In order to address this huge amount of corneal blindness large amount of corneal transplantation is needed which is solely dependent on voluntary corneal donations plus there is a need of careful post-operative care and follow-up.

The success of the procedure is not an overnight event, it depends upon various donor and Recipient factors and

* Corresponding author.

E-mail address: preetiwaskel4@gmail.com (N. M. R. Shaikh).

modifiable factors should be taken care of, to increase the success of the procedure. Starting from the enucleation procedure, quality donor tissue, careful tissue preparation excluding undue delay, shorter duration of preservation, systematic tissue evaluation, and uneventful transplantation altogether accounts for the good outcomes.

Out of all the other factors preservation of donor cornea influences the outcome of surgery to a greater extent. Aim of all corneal storage or preservation technique is simply to maintain cornea's viable state while holding the cornea for the period between enucleation and transplantation. This requires early enucleation and harvesting of donor cornea, appropriate preservation without undue delay and selection of appropriate recipient.

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 centre in central India.

2. Materials and Methods

A prospective study was conducted for 18 months in the eye bank of tertiary care eye centre 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 centre.

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. Early and late postoperative complications post keratoplasty were noted and managed accordingly. Modified grading of corneal clarity on the basis of corneal haze⁵ (British Journal of Ophthalmology 2009).

Statistical analysis was done by SPSS 23.0 version. Categorical variables were analysed 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.

In this study Maximum 9(69.2%) donor eyes were retrieved after 4 hours (69.2%) of donor's death and, were preserved for more than 6 hours (92.3%). Among those majority were stored in MK media (61.5%) and were utilized after 24 hours of preservation (69.2%).

1. Recipients with donor cornea from eyes which were retrieved within 4 hours 4(30.8%) of death of donor and were preserved for less than 24 hours after enucleation 3(30.8%) have shown better graft clarity at one month follow up though it was not statistically significant.
2. Recipients with donor tissue from eyes which were retrieved within 4 hours (30.8%) of death of donor have shown better graft survival at final follow up and this was statistically significant($p=0.038$).
3. In this study at final follow up, we have found that graft survival was better in 4(30.8%) recipients with donor cornea whose preservation to utilization time was less than 24 hours. This was found to be statistically significant($p=0.025$).

4. Discussion

The results of penetrating keratoplasty were studied over a period of 3 months with follow-up visits at 1 week, 1 month, and the final follow-up at 3rd months.

In our study we have found that at final follow up (3rd month) recipients with 4(30.8%) donor cornea tissue from eyes which were enucleated within four hours have shown better tissue quality and post corneal transplantation better graft survival compare to recipients with 9(69.2%) donor tissue from eyes which were enucleated after four hours of death of donor. The difference in the two groups was statistically significant ($p=0.038$). Similar results were seen in the study done by Vaishnavi R et al. and associates (2020)⁶ at department of Ophthalmology, Sri Ramachandra Institute of Higher Education and Research, Chennai, India have with 52 patients who had underwent penetrating keratoplasty (PKP) have found that, recipients with donor cornea of death to enucleation time of < 4 hours had better graft survival ($p=0.001$).

Also, in the study by Anuradha Raj et al. and associates (2017)⁷ at Department of Ophthalmology, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Jolly Grant, Dehradun, India in which they

had studied 91 subjects who underwent optical penetrating keratoplasty got similar result which shows that prolonged Death to Enucleation Time causes epitheliopathy and poor graft outcome.

So, early enucleation could result in better graft survival.

In our study in successive follow up, we have noted that graft survival was better in recipients with transplanted donor tissue 3 (23.7%) which after death were preserved for shorter duration that is, within 12 hours and utilized timely, compare to those 10 (76.9%) with prolonged preservation and delayed utilization. However, due to small sample size of our study, results were statistically insignificant.

Anuradha Raj et al. and associates (2017)⁷ from Department of Ophthalmology, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Jolly Grant, Dehradun, India had also found comparable results in their study that prolonged death to preservation time of donor tissue can cause epitheliopathy thus affect graft clarity and graft outcome.

Feyza Geidz et al. and associates (2015)⁸ had performed study a retrospective study with 365 eyes that underwent penetrating keratoplasty using corneas from 231 donors have found negative impact of death to preservation time on graft survival. Result in their study was contradictory compare to our result as graft survival criteria in their study was based on endothelial cell density of donor tissue whereas in our study criteria was graft clarity. Also, sample size in their study was more compare to our study sample.

Thus, death to preservation time may affect graft survival to some extent.

In our study moist chamber for short term storage and MK media as intermediate storage were used for preservation of donor corneas.

Graft clarity and survival shows that, at first follow up, recipients who had undergone transplantation with Mc Karey and kaufman stored donor corneas have shown better graft survival but due to less sample size statistical significance cannot be established.

Similar results were shown by Gregory A Stainer et al. (2013)⁹ and associates who had done a study at Department of Ophthalmology, University of Wisconsin Hospitals and Clinics, Madison with 130 patients who underwent penetrating keratoplasty with moist chamber and MK media stored donor corneas had found that, MK medium is better alternative when compared to moist chamber if used for preservation within 48 hours after the death of donor.

In this study, the mean duration of death to enucleation time (DET) was $<4.5 \pm 2.3$ hours. 4 corneal donor (30.8%) had death to enucleation time of ≤ 4 hours whereas 9 cases (69.2%) had death to enucleation time of ≥ 4 hours.

The mean death to preservation (DPT) time was 19.4 ± 11.0 hours. Corneas were preserved for was < 6 hours in 1 case (7.7%) and 6-12 hours in 2 cases (15.4%). Death

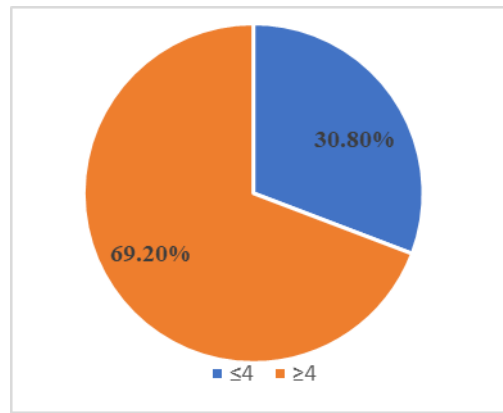


Fig. 1: Distribution of corneal donor according to death to enucleation time

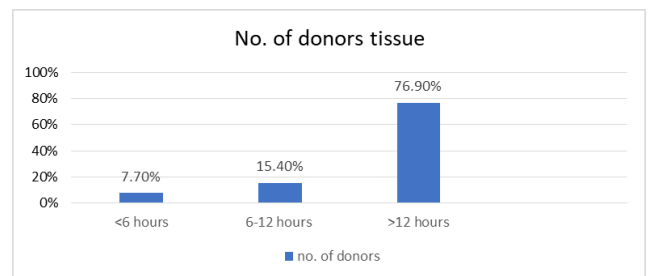


Fig. 2: Distribution of corneal donor tissue according to death to preservation time

to preservation time > 12 hours after enucleation before transplant in 10 (76.9%) cases.

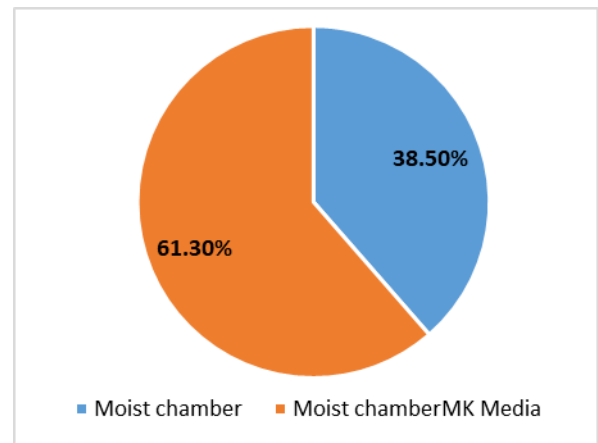


Fig. 3: Distribution of corneal donor tissue according to method of preservation

Donor graft preserved in MK media were 8(61.5%). Rest 5(38.5%) were preserved in moist chamber before transplantation.

Nine (69.2%) cases had preservation to utilization time of >24 hours and 4(30.8%) had < 24 hours.

Table 1: Tissue preparation and preservation factors

Tissue preparation and preservation factors	Variables	No. of cases (N =13)	Percentage (%)
Death to enucleation time (DET)	≤ 4 hours	4	30.8%
	≥ 4 hours	9	69.2%
Death to preservation time (DPT)	<6 hours	1	7.7%
	6-12 hours	2	15.4%
	>12 hours	10	76.9%
Method of preservation	Moist chamber	5	38.5%
	Mc karey and Kaufman (MK) media	8	61.5%
Preservation to utilization time	<24 hours	4	30.8%
	>24 hours	9	69.2%

Table 2: Effect of tissue preparation and preservation methods on graft clarity at 1st follow up (1 week)

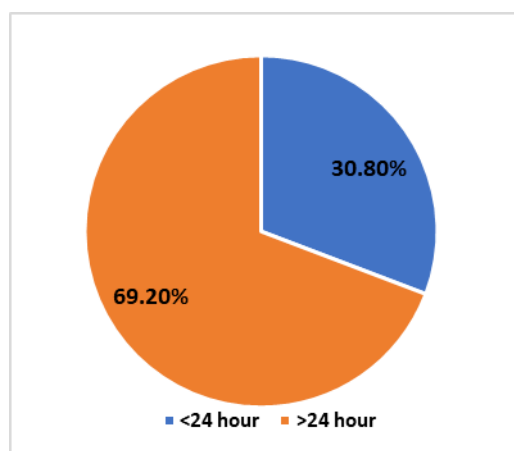
Tissue preparation and preservation factors		Graft clarity grading					P value
		Grade 0 (N=1)	Grade 1 (N=7)	Grade 2 (N=11)	Grade 3 (N=3)	Grade 4 (N=1)	
Death to Enucleation time	≤4 hours	1 (100)	2 (28.6)	3 (27.3)	2 (66.7)	0 (0)	0.387
	≥4 Hours	0 (0)	5 (71.4)	8 (72.7)	1 (33.3)	1 (100)	
Death to Preservation Time	<6 hours	0(0)	0(0)	2(18.2)	0(0)	0(0)	0.555
	6-12 hours	0(0)	3(42.9)	1(9.1)	0(0)	0(0)	
	>12 hours	1(100)	3(42.9)	5(45.6)	0(0)	0(0)	
Method of Preservation	Moist Chamber	1 (100)	2 (28.6)	4 (36.4)	2 (66.7)	1 (100)	0.391
	MK Media	0 (0)	5 (71.4)	7 (63.6)	1 (33.3)	0 (0)	
Preservation to utilization time	<24 hours	0 (0)	2(28.6)	5 (45.6)	0 (0)	1(100)	0.764
	>24 hours	1(100)	2(28.6)	6(54.5)	3(100)	0 (0)	

Table 3: Effect of tissue preparation and preservation methods on graft clarity at 2nd follow up (1 month)

Tissue preparation and preservation factors		Graft clarity grading					p value
		Grade0 (N=3)	Grade1 (N= 7)	Grade 2 (N=7)	Grade 3 (N=4)	Grade 4 (N= 2)	
Death to Enucleation time	≤4 hours	2 (66.7)	2 (28.6)	3 (42.9)	1 (25)	0 (0)	0.575
	≥4 Hours	1 (33.3)	5 (71.4)	4 (57.1)	3 (75)	2 (100)	
Death to Preservation Time	<6 hours	0 (0)	1(14.3)	1(14.3)	0 (0)	0 (0)	0.894
	6-12 hours	0 (0)	1(14.3)	2(28.6)	1(25)	0 (0)	
	>12 hours	3(100)	5(71.4)	5(71.4)	3(42.9)	2(100)	
Method of Preservation	Moist Chamber	2 (66.7)	4 (57.1)	3 (42.9)	3 (42.9)	0 (0)	0.512
	MK Media	1 (33.3)	3 (42.9)	4 (57.1)	3 (75)	2 (100)	
Preservation to utilization time	<24 hours	1(33.3)	6(85.7)	1(14.3)	0 (0)	0 (0)	0.169
	>24 hours	2(66.7)	1(14.3)	6(85.7)	4(100)	2(100)	

Table 4: Effect of tissue preparation and preservation methods on graft survival at final follow up (3rd month)

Tissue preparation and preservation factors		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)	
Death to	≤4 hours	2 (100)	0 (0)	2 (40)	4 (57.1)	0 (0)	*0.038
Enucleation time	≥4 Hours	0 (0)	5 (100)	3 (60)	3 (42.9)	4 (100)	
Death to	< 6 hours	0 (0)	0 (0)	0 (0)	2(28.6)	0 (0)	0.151
Preservation Time	6-12 hours	0 (0)	2(40.0)	0 (0)	0 (0)	2(50.0)	
Method of Preservation	>12 hours	2(100)	3(60.0)	5(100)	5(71.4)	2(50.0)	0.096
	Moist Chamber	2 (100)	1 (20)	3 (60)	4 (57.1)	0 (0)	
Preservation to utilization time	MK Media	0 (0)	4 (80)	2 (40)	3 (42.9)	4 (100)	*0.025
	<24 hours	1(50)	3(60)	3(60)	0(0)	1(25.0)	

**Fig. 4:** Distribution of corneal donor tissue according to preservation to utilization time

5. Conclusion

Hospital cornea retrieval program (HCRP) is positively affecting graft outcomes. Thus, should be promoted to ensure lesser death to enucleation time and preservation time in order to get better outcome post corneal transplantation.

Tissue preservation and preparation factor which have been found to be positive predictors for successful graft survival includes early eye ball/ cornea retrieval after death of the donor and timely preservation. Thus, early retrieval of eyes/ cornea should be practiced in order to prevent degraded deteriorating effects of post-mortem changes, which in turn affect quality of donor tissue and ultimately the graft outcome. In our country, the prevalence of the corneal blindness is high, and the number of corneal donations is less. Hence, proper and careful utilization of corneas will help in decreasing of corneal blindness.

6. Ethics Committee Approval

The study protocol was reviewed and approved by the Institutional Ethics Committee (IEC). This study was

conducted as per the Declaration of Helsinki.

7. Conflict of Interest

None declared.

8. Source of Funding

No source of outside funding.


References

- Bourne RRA, Flaxman SR, Resnikoff S, Ackland P, Braithwaite T, Cicinelli MV, et al. Global causes of blindness and distance vision impairment 1990-2020: a systematic review and meta-analysis. *Lancet Glob Health*. 2017;5(12):1221–34.
- Oliva MS, Schottman T, Gulati M. Turning the Tide of Corneal Blindness. *Indian J Ophthalmol*. 2012;60(5):423–7.
- Dandona L, Dandona R, Srinivas M, Giridhar P, Vilas K, Prasad MN, et al. Blindness in the Indian state of Andhra Pradesh. *Invest Ophthalmol Vis Sci*. 2001;42(5):908–16.
- Saini JS, Reddy MK, Wagh S. Donor Corneal Tissue Evaluation. *Indian J Ophthalmol*. 1996;44(1):3–13.
- Tandon R, Gupta N, Kalaivan M, Sharma N, Titiyal JS, Vajpayee RB. Amniotic Membrane Transplantation as an Adjunct to Medical Therapy in Acute Ocular Burns. *Br J Ophthalmol*. 2011;95(2):199–204.
- Vaishnavi R, Venkatakrishnan P, Thiyagarajan P. Post mortem retrieval time limits and time from retrieval to processing for ocular tissue. Vaishnavi; Post mortem retrieval time limits and time from retrieval to processing for ocular tissue, Hospital cornea retrieval programme - a way forward. *Eur J Mol Clin Med*. 2021;8(3):1367–79.
- Raj A, Dhasmana R, Bahadur H. Factors associated with surface epithelial keratopathy after optical penetrating keratoplasty. *J Curr Ophthalmol*. 2017;29(2):108–15.
- Gediz F, Yüksel B, Küsbeci T, Akmaz O, Kartı Ö. The Effect of Donor- and Recipient-Related Factors on Corneal Graft Survival in Penetrating Keratoplasty. *Semin Ophthalmol*. 2019;34(1):11–8.
- Keates RH, Rabin B. Extending corneal storage with 2.5 percent chondroitin sulfate (K-Sol). *Ophthalmic Surg*. 1988;19(11):817–20.


Author biography

Preeti Waskel, Resident  <https://orcid.org/0000-0001-6676-8125>

Ankit Jain, Senior Resident

Sooraj Singh Kubrey, Associate Professor  <https://orcid.org/0000-0002-0155-3104>

Kavita Kumar, HOD

Naziya Md Rizwan Shaikh, Resident  <https://orcid.org/0000-0001-6100-2657>

Manisha Singh, Senior Resident  <https://orcid.org/0000-0003-0139-6847>

Cite this article: Waskel P, Jain A, Kubrey SS, Shaikh NMR, Singh M, Kumar K. Evaluating the effect of corneal tissue preservation on graft survival after penetrating keratoplasty. *Indian J Clin Exp Ophthalmol* 2022;8(4):514-519.