

Safety and efficacy of corneal tissue harvested from organophosphorous deceased patients

Swapna Sarangi, Srikant K Sahu¹, Smruti R Priyadarshini¹, Sujata Das¹

Purpose: To analyze the quality of tissues and outcome of corneal transplants from tissues harvested from the donors of organophosphorus poisoning victims. **Methods:** A retrospective study was carried out on corneas harvested from organophosphorus poisoning victims between January 2016 and December 2018. Details of quality of tissues and outcome following keratoplasty were collected from the eye bank and outpatient records, respectively. **Results:** Four hundred and seventy-eight donor corneas were collected from the victims of organophosphorus poisoning during the study period. The mean age of the donor was 38.8 ± 16.5 years. The mean donor-to-preservation time was 6.2 ± 3.2 hours. The mean endothelial cell density on specular microscopy was 2986.5 ± 369.0 cells/mm². Four hundred and twenty-two (88.2%) donor corneas were utilized. Of the 121 corneas utilized at our institute for transplantation, 73 and 48 corneas were for optical and therapeutic/tectonic indications, respectively. Of the 73 optical grafts, 25 patients were lost-to-follow-up and 58.3% (28/48) who came for one-year follow-up were found to be clear. **Conclusion:** Donor corneas retrieved from organophosphorus poisoning are safe for transplantation. The postoperative outcome of the tissue utilized from these donors is satisfactory.

Key words: Eye banking, corneal transplants, organophosphorus poisoning

Corneal opacity is the fifth leading cause of blindness globally after cataract, uncorrected refractive error, glaucoma, and age-related macular degeneration.^[1] Corneal blindness occurs due to various inflammatory and infectious diseases that cause corneal scarring.^[2] Microbial keratitis and corneal opacification are significant causes of corneal blindness leading to visual impairment in India.^[3] Corneal transplant is currently the only available treatment for corneal blindness patients. However, the low donor-to-recipient ratio poses a problem.

Organophosphorus pesticide self-poisoning is an important clinical and public-health problem, killing an estimated 200,000 people every year.^[4] As agriculture contributes ~15.8% to the Gross Domestic Product of India, hazardous effects of pesticides are common in India. This is mostly due to exposure to agricultural pesticides^[5] and lack of awareness among women and children. Studies have shown that organs of organophosphorus poisoning (OP) victims can be used after donation. Donation of organs such as kidney, liver, cornea, and heart from these victims has shown good graft survival in recipients.^[6]

There is a shortage of corneal donors as compared to the number of recipients available.^[7] While 12.7 million people across the globe need corneal transplant, there is only one cornea available for 70 needed.^[7] There are many factors concerning the lack of donors of corneal tissue, such as lack

of donors, transplantation system organization, and public attitude toward donation.^[8] Corneas harvested from OP victims can augment the existing pool of donors.

Not many studies have been published related to corneal graft survival in recipients who received cornea from OP victims. This study aims at analyzing the tissue profile and outcomes of corneal transplantation in recipients who received cornea from OP victims.

Methods

A retrospective study was carried out on the donor corneas retrieved from the victims of OP by a community eye bank in eastern India between January 2016 to December 2018. The data included donor corneas obtained from OP victims and utilized in our institute. The exclusion criteria included (i) donor corneas obtained from other victims and (ii) donor corneas utilized in other institutes/hospitals.

Results

A total of 3914 donor corneas were harvested by the eye bank during the 3-year study period (January 2016 to December 2018). Of these, 478 donor corneas were obtained from victims of OP and 422/478 (88.2%) donor corneas were utilized.

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Lady Hardinge Medical College, Connaught Place, New Delhi, Delhi,
¹Cornea and Anterior Segment Service, L V Prasad Eye Institute, Bhubaneswar, Odisha, India

Correspondence to: Dr. Sujata Das, Cornea and Anterior Segment Service, L V Prasad Eye Institute, Bhubaneswar - 751 024, Odisha, India. E-mail: sujatadas@lvpei.org

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Donor characteristics

The mean age of donors was 38.8 ± 16.5 years (range: 10–82). More than two-thirds (366/478; 76.6%) of donors were ≤ 50 years of age. The male: female ratio of the donors was 285:193. The cause of death was due to the consumption of organophosphorus pesticides. All donor corneas were collected in McCarey–Kaufman (MK) preservation media. The mean donor-to-preservation time was 6.2 ± 3.2 hours (range: 1.8–18.8). The donor body was refrigerated in 84 cases with a mean death-to-preservation time of 11.1 ± 3.6 hours, and the remaining corneas ($n = 394$) were with a mean death-to-preservation time of 5.1 ± 1.9 hours. The mean endothelial cell density on specular microscopy was 2986.5 ± 369 cells/mm² (range: 1808–3875). Four hundred and sixty-two (96.6%) corneas had a cell count of ≥ 2000 cells/mm². The mean corneal thickness obtained was 511.7 ± 6.6 μm (range: 500–536) [Table 1]. Out of 478 donor corneas, 411 corneas were graded as optical quality tissue.

Recipient characteristics

Out of 422 utilized corneas, the authors have information regarding usage for 278 (278/422; 65.9%) patients. The mean preservation-to-utilization time was 4.0 ± 2.3 days (range: 1–13). The mean age of recipients was 46.1 ± 20.6 years (range: 0.3–95) [Table 2]. The male: female ratio of the donors was 170:108. Microbial keratitis ($n = 71$; 25.5%) is the most common indication followed by corneal scar ($n = 69$; 24.8%) [Table 3].

Outcomes of keratoplasty

Of the 422 utilized corneas, 121 corneas (121/422; 28.7%) were utilized in our institute. In total, 73 and 48 corneas were for optical and therapeutic/tectonic indications, respectively. Of the 73 optical grafts, 25 grafts were lost-to-follow-up before the end of the first year. Of the remaining 48 optical grafts, 28 (58.3%) were found to be clear at the end of the first year [Table 4]. Out of 34 clear grafts (28 optical and 6 therapeutic) (visual acuity could not be assessed in an infant), 23 patients (69.7%) had best-corrected visual acuity of 20/60 or better. The mean specular count was 2049.2 ± 482.2 cells/mm² (range: 1316–2688) after a mean follow-up of 14 months after keratoplasty.

Discussion

Out of the six WHO regions in the world, Southeast Asia, including India, contributes 19.7% of suicides attributable to pesticide self-poisoning.^[9] The proportion of poisoning due to pesticide varies from 0.9% in the European region to 48.3% in the Western Pacific region.^[9] Organophosphates being the most ingested pesticides in rural Asia account for around two-thirds of cases. Organophosphates are used as pesticides, medications, and nerve agents.^[10] Organophosphate poisoning may occur via ingestion, inhalation, or contact with similar compounds. For many years, it has been a major concern that whether the organs retrieved from the victims of OP can be used for solid organ transplantation.^[6] They are often disregarded as organ donors due to the perceived risk of toxin transmission to donors or organ dysfunction.

Organophosphates bind acetylcholinesterase enzyme irreversibly. Thus, the manifestations of OP are due to increased acetylcholine within the synapse and neuromuscular junctions. Acetylcholine acts on both nicotinic and muscarinic receptors. The nicotinic manifestations of OP are mydriasis,

Table 1: Epidemiological data of donors

	<i>n</i> =478 [¶]	<i>n</i> =121 [§]
Donor Age in Years		
Mean \pm SD	38.8 \pm 16.5	39.8 \pm 15.6
Range	10-82	15-82
Number of Donors ≤ 50 Years of Age	366	95
Male: Female	285:193	77:44
Endothelial Cell Count (ECC)		
Mean \pm SD	2986.5 \pm 369.0	2990.8 \pm 344.6
Range	1808-3875	2145-3875
Number of Donors with ECC ≥ 2000	462	121
Pachymetry		
Mean \pm SD	511.7 \pm 6.6	512.3 \pm 6.6
Range	500-536	503-536
Death-to-Preservation Time (in hours)		
Mean \pm SD	6.2 \pm 3.2	7.2 \pm 4.4
Range	1.8-18.8	1.8-18.8

[¶]All donor corneas. [§]Donor corneas used in the tertiary eye care center in eastern India.

Table 2: Epidemiological data of recipients

	<i>n</i> =278 [¶]	<i>n</i> =121 [§]
Recipient Age in Years		
Mean \pm SD	46.1 \pm 20.6	43.7 \pm 21.5
Range	0.3-95	0.3-95
Number of Donors ≤ 50 Years of Age	143	69
Male:Female	170:108	78:43
Preservation-to-Utilization time (in Days)		
Mean \pm SD	4.0 \pm 2.3	3.1 \pm 2.2
Range	1-13	1-13

[¶]All recipient corneas. [§]Recipient corneas in the tertiary eye care center in eastern India.

tachycardia, and weakness, and muscarinic manifestations are miosis, defaecation, diaphoresis, bronchospasm, lacrimation, and salivation.^[11] Studies have shown that victims of organophosphorus and carbamates poisoning have been overlooked as organs donors; these victims can turn out to be successful organ donors.^[12-14]

In a study by Banerjee *et al.*^[15] on 968 patients, the mean age of persons presenting with OP was 34.47 years. The most common cause being suicide (82.02%) followed by accidental death (17.98%). This study highlights that suicidal OP occurs more commonly in younger individuals. In our series, the mean age is 38.8 years, stressing the fact that these young individuals can be potential donors of particularly good quality corneas and successful keratoplasty, as proved in our study.

A study by Boyes *et al.*^[16] observed that the vision of the subjects who were exposed to significantly high levels of organophosphorus poison remained normal. As the cornea is an avascular tissue, death due to OP should not be considered as a contraindication for procurement and use of donor corneas. Earlier, six corneas retrieved from paraquat poisoning have

Table 3: Indications and surgeries performed

Indications	Number (%) [¶]		Number (%) [§]	
	Number	(%)	Number	(%)
Microbial Keratitis	71	(25.5%)	45	(37.2%)
Corneal Scar	69	(24.8%)	21	(17.4%)
Bullous Keratopathy	64	(23.0%)	22	(18.2%)
Dystrophy	18	(6.5%)	11	(9.1%)
Failed Graft	36	(12.9%)	11	(9.1%)
Keratoconus	10	(3.6%)	6	(5.0%)
Other	10	(3.6%)	5	(4.1%)
TOTAL	278		121	
Surgeries Performed				
Therapeutic Penetrating Keratoplasty (TPK)	71	(26.6%)	45	(37.2%)
Optical Penetrating Keratoplasty (OPK)	136	(49.3%)	42	(34.7%)
Deep Anterior Lamellar Keratoplasty (DALK)	8	(2.9%)	7	(5.8%)
Descemet Membrane Endothelial Keratoplasty (DMEK)	6	(2.2%)	2	(1.7%)
Descemet's Stripping Endothelial Keratoplasty (DSEK)	47	(16.9%)	22	(18.2%)
Other	10	(2.2%)	3	(2.5%)
TOTAL	278		121	

[¶]Profile of all recipient corneas. [§]Profile of recipient corneas in the tertiary eye care center in eastern India.

Table 4: Outcome of surgeries at 1-year follow-up

	Clear		Failed		Lost to Follow-up	
	Number	(%)	Number	(%)	Number	(%)
Therapeutic Penetrating Keratoplasty (TPK)	6	(17.6%)	30	(57.6%)	9	(25.7%)
Optical Penetrating Keratoplasty (OPK)	16	(47.1%)	14	(26.9%)	12	(34.3%)
Deep Anterior Lamellar Keratoplasty (DALK)	5	(14.7%)	-		2	(5.7%)
Descemet Membrane Endothelial Keratoplasty (DMEK)	1	(2.9%)	1	(1.9%)	-	
Descemet's Stripping Endothelial Keratoplasty (DSEK)	6	(17.6%)	5	(9.6%)	11	(31.4%)
Other	-		2	(3.8%)	1	(2.9%)
TOTAL	34		52		35	

been used with good postoperative outcomes.^[6] More than 95% of corneas in our study had an endothelial count of >2000 cells/mm². We analyzed the postoperative outcome of corneas only used in our institute. Around 58.3% (28/48) of optical grafts were clear at the end of the one-year follow-up. The outcome of optical penetrating keratoplasty in various parts of India has reported a survival rate of 65%–67% at one year, which is similar to our study.^[17,18]

Conclusion

Our study proves that successful transplantation using OP deceased donor corneas can be carried out without any adverse effect or risk of potential transfer of toxin to the recipient eye or other body parts. A prospective study with a chemical analysis of corneal tissue may help in understanding the toxin levels and their relationship with endothelial function.

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Conflicts of interest

There are no conflicts of interest.

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