

Potentiality of Crematorium based Corneal retrieval program as Hospital Corneal Retrieval Programs: Donor Profiles, Tissue Quality for corneal transplantation surgeries at a Tertiary Eye Care Center in Nepal

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Abstract

Purpose:

The aim of this study is to compare tissue quality between crematorium based and hospital based corneal retrieval programs in Nepal.

Methods:

It is a retrospective review of all 696 corneal donors from year 2020 to 2021. Information were taken from Electronic medical recors and eye bank records. Information extracted included demographic variables, cause of death, death to preserve time, cell density and quality of tissue from Hospital Corneal Retrieval Program (HCRP) and Crematorium based Corneal Retrieval Program (CCRP).

Results:

The average (sd) age of the donor in CCRP and HCRP tissue retrieving methods was 51.4 (19.7) and 48.9 (20.0) respectively which was statistically similar, $p=0.104$. A total of 183 (64.4%) and 268 (65.0%) male donors contributed to the CCRP and HCRP groups, respectively, $p=0.868$.

Of the serology tested tissues, 475 (85.7%) in CCRP and 715 (87.5%) in HCRP were suitable for surgery ($p=0.341$). Among them, similar proportions were used for optical purpose i.e 432 (90.9%) in CCRP and 637 (89.1%) in HCRP. For therapeutic purposes, similar proportion was seen i.e 43 (9.1%) in CCRP and 78 (10.9%) in HCRP, ($p=0.299$). Reasons for tissues being not suitable for surgery were likewise comparable, with

Multiple scars, sero-positive status, and foreign bodies/infiltration were the primary reasons for tissues being not suitable for surgery in both groups. Most of the NSFS tissues were used for the training purpose (72.2% in CCRP vs 70.6% in HCRP). Death-to-preservation times was statistically similar between the retrieval methods for either optical or therapeutic tissues, $p=0.375$. While mean cell density was found to be significantly higher in HCRP compared to CCRP for optical quality tissues (2591.5 vs. 2519.5 cells/mm²; $p=0.003$), no significant difference was found for therapeutic-quality tissues in both retrieving methods. Overall, demographic characteristics, tissue quality, and tissue preservation time were similar between CCRP and HCRP.

Conclusion:

Corneal donation is the only way to get transplantable eye tissue in Nepal, so this study is important for improving eye banking. Death to tissue preserve times and tissue quality found in both tissue revival methods were similar. Structured retrieval programs and rigorous screening ensure high-quality tissue availability.

Introduction

Corneal blindness is one of a leading cause of blindness globally, particularly in low and middle income countries like Nepal. It is estimated that more than 10 million people globally suffer from bilateral

corneal blindness, having the corneal transplantation being the only appropriate treatment to restore vision [1].

Globally, both hospital-based corneal retrieval (HCRP) and funeral-site retrieval is practiced, although funeral-site approaches remain less common [2].

Eye bank Under Tilganga Institute of Ophthalmology in Nepal plays a critical role ensuring the timely retrieval, evaluation, and distribution of donor corneas in several countries with establishing an eye banking system with Hospital based Corneal Retrieval Program (HCRP) and Crematorium based Corneal Retrieval Program (CCRP) [3], though facing some challenges.

Establishing quality equivalence between crematorium- and hospital-retrieved corneas in Nepal could justify scaling CCRP and offer a transferable model for other countries seeking to expand access to sight-restoring transplantation [4, 5].

Some studies have shown that tissue suitability and transplant outcomes are associated with donor demographics such as age, gender, and cause of death [6].

This study aims to analyze the demographic and clinical profile of corneal donors at a tertiary eye care centers in Nepal. By evaluating tissue quality, distribution patterns, comparing donor characteristics across HCRP and CCRP, the study helps to strengthen the Eye bank service in Nepal which ultimately helps to reduce the burden of the corneal blindness in Nepal.

Methodology

It is a retrospective review of all 696 corneal donors from year 2020 to 2021. Data were retrieved from the old record of the Nepal Eye Bank Department of Tilganag Institute of Ophthalmology. Information were taken from demographic variables, cause of death, autopsy status, serology results, quality of tissue and seasonal trends from Hospital Cornea Retrieval Program (HCRP) and Crematorium based Corneal Retrieval Program (CCRP).

This study was approved by Tilganga Institute of Ophthalmology-Institutional Review Committee (TIO-IRC) (Ref: 28/2021). Written informed consent was taken from the next to kin of donor who had consented for eye donation. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data was entered in Microsoft Excel where it was cleaned. The cleaned data was transferred to IBM SPSS for the statistical analysis. P values for eye-level data were derived from Generalized Estimating Equations (GEE) linear models accounting for donor-level clustering. For person-level data, the Chi-square test or Fisher's exact test was used for categorical variables, and the independent t-test was used for normally distributed continuous variables. A two-tailed p-value less than 0.05 was considered statistically significant.

Results

The average age of the donor in CCRP and HCRP group was 51.4 (19.7) and 48.9 (20.0) respectively which was statistically similar, $p = 0.104$. In the CCRP group, 183 donors (64.4%) were male compared to 268 (65.0%) in the HCRP group, showing a statistical similar gender distribution, $p = 0.868$. The overall pattern of the age group remained comparable across two groups. Adults aged 25–59 years showed the largest proportion of donors, 123 (43.3%) in CCRP and 199 (48.3%) in HCRP, which was closely followed by older adults aged 60–99 years, 124 (43.7%) in CCRP and 150 (36.4%) in HCRP. Most donors were Hindu in both groups (90.1% in CCRP vs. 90.8% in HCRP). Ethnicity distribution was also statistically similar, with Brahmin ethnicity comprising 28.9% in CCRP and 28.2% in HCRP, and Janajatis 24.6% vs. 29.6%, respectively. Causes of death shows the similar trend, with hanging being most common (24.6% in CCRP vs. 26.0% in HCRP), followed by cardiovascular disease (19.0% in CCRP vs. 24.8% in HCRP) and respiratory disease (21.8% in CCRP vs. 15.5% in HCRP). Overall, it was found that the demographic and clinical variables were closely comparable between CCRP and HCRP (Table 1).

Table 1
Demographic information of donor in CCRP and HCRP group

Variables	Category	CCRP		HCRP		P value
		Count	%	Count	%	
Age	(Mean, SD)	51 (19.7)		48.9 (20)		0.104
Gender	Female	101	35.6%	144	35.0%	0.868
	Male	183	64.4%	268	65.0%	
	Total	284	100.0%	412	100.0%	
Age group	Older children (5 to 9)	1	0.4%	1	0.2%	0.489
	Young Adolescent (10 to 14)	6	2.1%	8	1.9%	
	Older adolescents (15 to 19)	16	5.6%	28	6.8%	
	Young adults (20–24)	14	4.9%	26	6.3%	
	Adults (25 to 59)	123	43.3%	199	48.3%	
	Older adults (60 to 99)	124	43.7%	150	36.4%	
	Total	284	100.0%	412	100.0%	
Religion	Buddhist	27	9.5%	38	9.2%	0.6179
	Hindu	256	90.1%	374	90.8%	
	Kirat	1	0.4%	0	0.0%	
	Total	284	100.0%	412	100.0%	
Ethnicity	Brahmin	82	28.9%	116	28.2%	0.568
	Chhetry	63	22.2%	73	17.7%	
	Dalit	19	6.7%	22	5.3%	
	Janajati	70	24.6%	122	29.6%	
	Newar	48	16.9%	76	18.4%	
	Other (Madhesi/Tharu)	2	0.7%	3	0.7%	
	Total	284	100.0%	412	100.0%	

The main cause of death of Donor was suicidal attempt with hanging which was 70 (24.6%) in CCRP and 107 (26.0%) in HCRP. The next most common causes were cardiovascular disease, which was 54 (19.0%) in CCRP and 102 (24.8%) in HCRP and respiratory disease, which was 62 (21.8%) in CCRP and 64 (15.5%) in HCRP. The pattern of cause of death in both program was found to be similar (Fig. 1).

Among the serology performed tissues, 475 (85.7%) in CCRP group and 715 (87.5%) in HCRP group were found to be suitable for the surgery. The distribution of the tissue quality suitable for the surgery in two retrieving methods is statistically similar, $p = 0.341$. Among tissue which are suitable for the surgery, 432 (90.9%) and 43 (9.1%) from the CCRP group were used for optical and therapeutic purpose. In HCRP group, 637 (89.1%) and 78 (10.9%) were used for optical and therapeutic purpose. This distribution is statistical similar in tissue retrieving methods, $p = 0.299$ (Table 2).

Table 2
Comparison of suitable for surgery between CCRP and HCRP

Variable	CCRP		HCRP		OR (95% CI)	p value
	Count	%	Count	%		
Suitable For Surgery (SFS)						
No, (NSFS)	79	14.30%	102	12.50%	1.1 (0.7 to 1.6)	0.78
Yes, (SFS)	475	85.70%	715	87.50%	Reference	
Total	554	100.00%	817	100.00%		
Types of SFS,						
Optical	432	90.90%	637	89.10%	1.2 (0.8 to 1.9)	0.399
Therapeutic	43	9.10%	78	10.90%	Reference	
Total	475	100.00%	715	100.00%		

P-values were derived from GEE linear models accounting for donor-level clustering.

The most common reason for the tissues found not suitable for surgery (NSFS) in both CCRP and HCRP groups was the presence of multiple scars, (34.2% in the CCRP group and 31.4% in the HCRP group). The second most frequent cause for NSFS was Sero-positive test results seen in 22 (27.8%) of CCRP tissues and 30 (29.4%) of HCRP tissues. Foreign bodies or infiltrations also contributed substantially, showing 21 (26.6%) of CCRP and 27 (26.5%) of HCRP tissues. A smaller proportion of tissues were excluded for surgery due to low endothelial cell counts (1.3% in CCRP and 2.0% in HCRP). Unclear or unspecified medical history accounted for 8 (10.1%) of NSFS cases in the CCRP group and 11 (10.8%) in the HCRP group.

Regarding the use or disposition of NSFS tissues, a majority were used for training purposes i.e 57 (72.2%) in the CCRP group and 72 (70.6%) in the HCRP group. The remaining tissues were discarded, representing 22 (27.8%) in the CCRP and 30 (29.4%) in HCRP groups (Table 3).

Table 3
Reason for not suitable for surgery in CCRP and HCRP

Reason	CCRP		HCRP	
	Number	percentage	Number	percentage
Sero Positive	22	27.8%	30	29.4%
Multiple Scar	27	34.2%	32	31.4%
Less Endocelial cell count	1	1.3%	2	2.0%
Foreign Bodies or Infiltration	21	26.6%	27	26.5%
Unclear and Non specified medical History	8	10.1%	11	10.8%
Total	79	100.0%	102	100.0%
Discard/Used for Training	Number	percentage	Number	percentage
Discard	22	27.8%	30	29.4%
Used for Training	57	72.2%	72	70.6%
Total	79	100.0%	102	100.0%

The mean death to tissue preserve time (D-P time in minutes) was statistically similar between CCRP and HCRP across both tissue quality groups. For optical-quality tissues, average (sd) D-P time in CCRP and HCRP were 395.5 ± 157.4 and 407.5 ± 151.4 minutes respectively, a mean difference of 12.0 minutes found was not statistically significant ($p = 0.375$). Similarly, for therapeutic-quality tissues, average (sd) D-P time in CCRP and HCRP were 405.5 ± 141.6 and 373.8 ± 149.7 minutes respectively, a mean difference of 31.7 minutes found was not statistically significant ($p = 0.415$).

For optical-quality tissues, average (sd) cell density in CCRP and HCRP were 2519.5 ± 354.3 and 2591.5 ± 416.9 respectively, a mean difference of 72.0 found statistically significant ($p = 0.003$), showing higher cell density in HCRP compared with CCRP among optical tissues. For therapeutic-quality tissues, average (sd) cell density in CCRP and HCRP were 2228.2 ± 690.9 and 2148.1 ± 649.4 respectively, a mean difference of 80.2 found was not statistically significant, $p = 0.575$ (Table 4).

Table 4
Comparison of mean DP minute and cell density according to tissue quality

Quality	Site	Number	Mean D-P In Minute	Difference mean (SD)	P value
Optical	CCRP	221	395.5 (157.4)	12 (13.5)	0.375
	HCRP	316	407.5 (151.4)		
Therapeutic	CCRP	22	405.5 (141.6)	31.7 (38.7)	0.415
	HCRP	42	373.8 (149.7)		
Quality	Site	Number	Mean Cell Density (per mm ²)	Difference mean (SD)	P value
Optical	CCRP	429	2519.5 (354.3)	72 (24.6)	0.01
	HCRP	630	2591.5 (416.9)		
Therapeutic	CCRP	33	2228.2 (690.9)	80.2 (142.7)	0.911
	HCRP	63	2148.1 (649.4)		

P-values were derived from GEE linear models accounting for donor-level clustering.

Discussion

Since 1996, Nepal Eye Bank at the Tilganga Institute of Ophthalmology has been utilizing a unique approach to address corneal blindness by sourcing donations from the Pashupatinath temple crematorium [4]. This study found no significant differences in donor demographic characteristics including age, gender, religion, and ethnicity between crematorium-based corneal retrieval program (CCRP) and hospital corneal retrieval (HCRP) program. In our study, the average age of the donor in CCRP and HCRP group was 51.4 (19.7) and 48.9 (20.0) respectively which is similar to study [7], but found significantly less compare to developed countries [8–10].

The main cause of death of Donor from HCRP and CCRP sources found similar as suicidal attempt with hanging found bit higher with very less proportion compared to cardio vascular and respiratory diseases which seems mostly similar to study [7].

The proportion of tissues suitable for the surgery, grading of optical and therapeutic corneas, and the reasons for tissues being unsuitable were found to be similar across the two retrieval methods as similar to study [7], whereas studies in other countries found to be different [9, 11] as suitability rate noted 36% to 43% [12, 13].

Death-to-preservation time and endothelial cell quality further indicates that CCRP can maintain preservation standards compared with hospital-based corneal retrieval method. The average DPT appeared found bit higher as approximate 6.59 compared to 5.7 hours [7] where, noted up to 18.5 hours

in other study [9] that seem varies with climate and existing ambient temperature from one to another geographic regions.

So, Nepal eye Bank is trying its best to establish a tradition of eye donation in Nepal just after passing away of loved one for restoring sight to corneal blind people of Nepal and its beyond for eliminating corneal blindness. The limitation of this study supposed to be voluntary donation was excluded since it was found very less. Also the other parameter of tissue quality was not included as they do not significantly matter.

Conclusion

Death to tissue preserve times were similar between tissue retrieval methods and tissue quality found in both method was also similarly consistent. Structured retrieval programs and rigorous screening ensure high-quality tissue availability. Enhancing public awareness and expanding retrieval networks can further improve donation rates and reduce burden of the corneal blindness in Nepal. So this study concluded that CCRP is viable model for eye donation in the context of quality as HCRP where there is no significant difference, So, can initiate it in all regions globally.

Abbreviations

HCRP: Hospital Based Corneal Retrieval Program, CCRP: Crematorium Based Corneal Retrieval Program, NSFS: Not Suitable for Surgery, SFS: Suitable for Surgery, D-PT: Death to preservation time, CD: Cell density

Declarations

Ethics approval and consent to participate

This study was approved by Institutional Review Committee (IRC) of Tilganga Institute of Ophthalmology (Ref: 28/2021). Written informed consent was obtained from the next to kin of donor who had consented for eye donation. There were also 2 witnesses from their family or friends in written informed consent for the publication of this study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Written informed consent to publication (including images, personal and medical history details of the donors) was obtained from the case as donor of cornea either from crematorium or from Hospital.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and ethical restrictions.

Competing interests

The authors declare no competing interests.

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Author contributions

Poudel, M: analyzed the data, manuscript preparation, Gurung, R. and Bajracharya, L: overall guidance, planning, assist in literature review, Twyana, S: collected the patient's clinical and surgical data, assist in manuscript preparation. All authors read, edited and approved the final manuscript.

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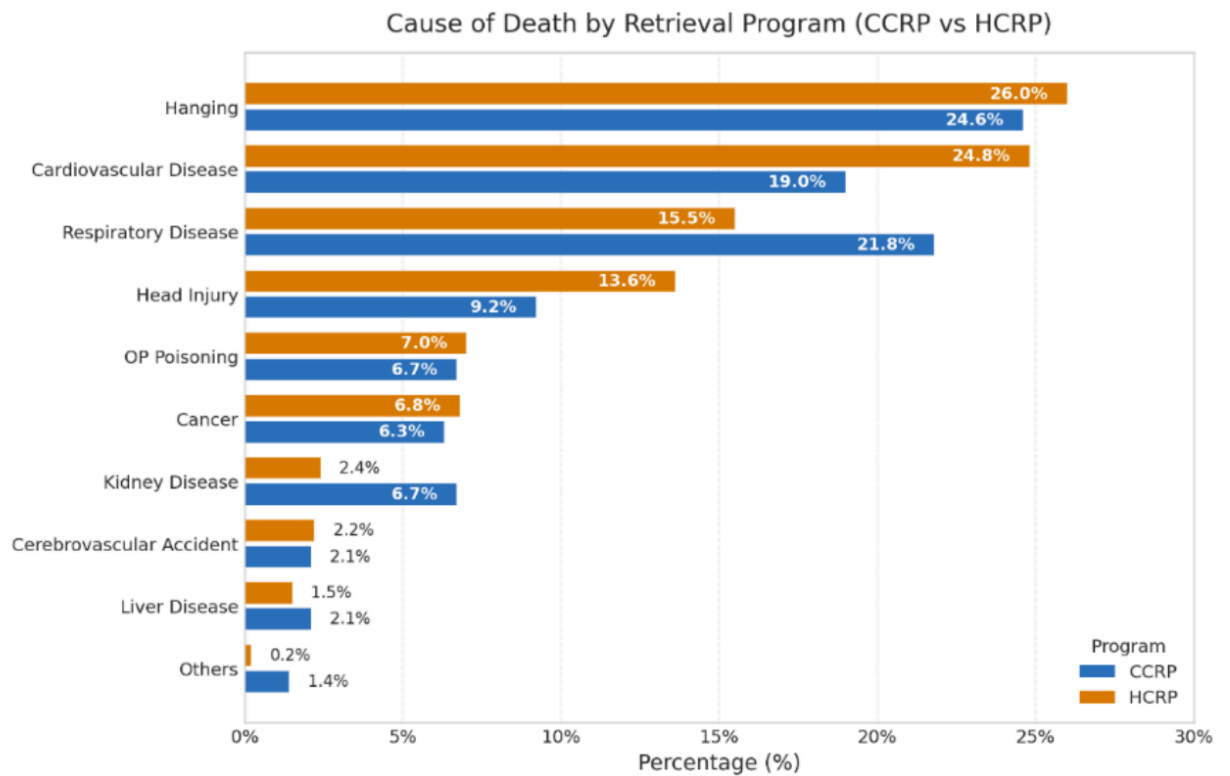
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Figures



Totals: CCRP n=284; HCRP n=412. Bars show program-wise percentages.

Figure 1

Cause of death according to retrieval programs in CCRP and HCRP