Use of cryopreserved donor corneal tissues first time in India for therapeutic penetrating keratoplasty during COVID-19 pandemic – A case series

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Coronavirus disease (COVID-19) pandemic caused restricted eye retrieval leading to acute scarcity of donor corneas. Nine patients with perforated corneas needed urgent donor tissues where we used 10 cryopreserved corneal tissues for therapeutic penetrating keratoplasty (TPK). Repeat TPK was done in one eye for recurrence of infection. The anatomical integrity of the eyeball was maintained in seven eyes, while two eyes were lost to phthisis. Thus, cryopreserved corneas can be taken into consideration for TPK when other donor tissues are not available.

Key words: Cryopreserved cornea, therapeutic penetrating keratoplasty

COVID-19 pandemic led to acute scarcity of corneal tissues due to restrictions in eye donations. Patients presenting with large corneal perforations during the lockdown period faced this acute scarcity. Few patients lost their eyes due to the unavailability of corneal tissues. This is when we came across the option of cryopreserved corneas to save the eyeball.

Case Report

Total nine eyes of nine patients (male) underwent TPK from June 2020 till November 2020. In one eye, TPK was repeated, so a total of 10 cryopreserved grafts were used. Eight patients had fungal corneal infiltrates leading to perforations (confirmed on culture growths), one had pseudocornea due to severe peripheral ulcerative keratitis.

The procedure of cryopreservation – done in eye bank

Unused corneas on completion of the expiry period were transferred to the sterile empty vials (one cornea in one vial) with an aseptic technique in a laminar flow hood. These vials were then stored at -80°C temperature in a special freezer for cryopreservation. This allowed indefinite preservation.

Travel time for donor corneal tissues (maintained a cold chain) from an eye bank to a hospital ranged from 24 to 36 h, due to lockdown restrictions in transports.

Surgical technique

All surgeries were performed by one surgeon. Trephination of infected host cornea with a surrounding clear margin of a minimum of 0.5 mm was done. Meticulous removal of all suppurative tissues, membranes over the iris, was done. The bed was irrigated thoroughly with saline followed by a voriconazole solution of 50 μg/mL. Intraoperative, cryopreserved corneas had more Descemet membrane folds; more stromal edema, more epithelial defects compared to usual therapeutic corneal grafts [Fig. 1]. Large graft size (12 mm) was used in five eyes; 1 mm oversizing of the grafts were done to form a deep anterior segment postoperatively. Graft size ranged from 7.5 to 9.5 mm in the other four eyes [Table 1], where 0.5 mm oversizing of grafts were done [Fig. 2]. 8-0 nylon interrupted sutures were used for more than 11 mm grafts and 10-0 nylon interrupted sutures were used for less than 11 mm grafts. All donor corneoscleral rims were sent for bacterial and fungal culture.

Postoperatively, patients were regularly followed up, topically voriconazole 1% given half-hourly along with cycloplegics and oral ketoconazole 400 mg BD continued till complete remission of infection. Follow-up ranged from 5 to 12 months (an average of 8.2 months).

Results

The anatomical integrity of the eyeball was maintained in seven eyes. While the other two eyes were lost to phthisis. Out of seven eyes, persistent epithelial defects healed over 1 month in fives eyes while in 2–3 months in the rest two eyes. Four out of 9 eyes had a recurrence of infection, out of which one eye required repeat TPK [Fig. 3]; three eyes responded well to treatment. Large fulminant fungal corneal ulcers were the reason for recurrences. Best-corrected visual acuity in eight patients ranged from the perception of light to finger counting 2 m, no perception of light in the patient
with phthisis. No organism was grown in culture for 9 out of 10 corneoscleral rims. One rim grew aspergillus fumigatus in culture. The same eye had twice the recurrence of infection which responded to treatment. None of the eyes went into endophthalmitis.

**Discussion**

In the year 2019–2020, COVID-19 pandemic struck the world. In India, there was an acute shortage of corneal tissues during the lockdown in many places. In other places, eye banks with surplus corneal tissues reviewed different methods of tissue preservation. Cryopreservation is one of the age-old methods used by EBCRC (Eye Bank Coordination And Research Centre Ramkrishna Bajaj Eye Bank, Mumbai) eye bank. Cryopreservation is a technique where different temperatures -197°C with dextran, -70°C, and −20 in a balanced salt solution containing antibiotics are shown safe. To preserve the viability of endothelial cells, a cooling rate of 1°C/min is shown the safest. Different studies support inconsistent viability of endothelial cells making such corneal tissues acceptable for therapeutic than the optical purpose. EBCRC eye bank used the technique described by Mozghan et al.

The cryopreserved cornea was the first time clinically used by O’Neill P et al. Successful use of cryopreserved corneas for deep anterior lamellar keratoplasty in keratoconus has been described. Different studies support inconsistent viability of endothelial cells making such corneal tissues acceptable for therapeutic than the optical purpose. EBCRC eye bank used the technique described by Mozghan et al.

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In the Y-F Yao et al. study, the average duration of cryopreservation before surgical use was 9.5 (SD 8.3) months. In our case report, it was 15.3 (SD 4.2) months.

In our case report, factors responsible for poor prognosis were large fulminant subtotal to total corneal abscesses, larger

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**Table 1: Results of nine patients**

| No | Age/sex | Diagnosis                           | Recipient cornea culture | Donor rim culture | Graft-host size (mm) | Recurrence | Anatomical integrity | BCVA |
|----|---------|-------------------------------------|--------------------------|-------------------|---------------------|------------|----------------------|------|
| 1  | 51/M    | Pseudocornea postsevere peripheral ulcerative keratitis | No growth               | No growth         | 12-11               | No         | NO, phthisis          | No PL|
| 2  | 74/M    | Perforated fungal corneal ulcer     | Aspergillus fumigatus    | No growth         | 12-11               | Yes (4 months postop) ? New infection, treated | Yes   | PL+                  |
| 3  | 70/M    | Perforated fungal corneal ulcer     | Aspergillus fumigatus    | 9.5-9             | Yes (15 days post op, 2 months post op); treated | Yes   | HM                   |
| 4  | 45/M    | Perforated fungal corneal ulcer     | Fusarium                 | No growth         | 12-11               | Yes (5th day post op), repeat TPK done, no recurrence. | Prephthisis | PL+          |
| 5  | 63/M    | Perforated fungal corneal ulcer     | Fusarium                 | No growth         | 12-11               | Yes (10th day post op); treated | Yes   | PL+                  |
| 6  | 72/M    | Perforated fungal corneal ulcer     | Fusarium                 | 7.5-7             | No                  | Yes        | HM                   |
| 7  | 21/M    | Perforated fungal corneal ulcer     | Fusarium                 | 9.5-9             | No                  | Yes        | HM                   |
| 8  | 75/M    | Perforated fungal corneal ulcer     | Fusarium                 | 12-11             | No                  | Yes        | FC 2 m                |
| 9  | 35/M    | Perforated fungal corneal ulcer     | Aspergillus fumigatus    | 8.75-8.25         | No                  | Yes        | PL+                  |
graft sizes, and longer duration of cryopreservation. We also faced major transport issues due to COVID-19 strict lockdown protocols. Our all efforts lead to saving the eyes of seven patients by maintaining anatomical integrity till better corneal tissues become available.

**Conclusion**

Thus COVID-19 pandemic opened the door for cryopreserved corneas as an option for therapeutic PKP when other corneal tissues are unavailable.

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**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.
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