Corneal Blindness

An Alternative Future

Every year, August 25 to September 8 is India's National Eye Donation Fortnight. This is the time to promote awareness about eye donation and encourage people to take a pledge to donate their eyes after death. LVPEI runs a variety of activities and programs on our different campuses to spread awareness and showcase how eye donation transforms the lives of people with corneal opacity. Eye donations, either through redeemed pledges or when donated by the next of kin, are a vital, but not the only approach to tackling corneal opacities. A new world of innovation and opportunity is opening up, and LVPEI has a transformative role to play in this new world.

Corneal disease and the limits of keratoplasty

The cornea is the outermost transparent layer of the eye. It converges light onto the retina, facilitating vision. The opacification of this transparent layer is among the key causes of vision impairment and blindness worldwide. It is estimated that corneal opacities cause moderate to severe vision impairment in both eyes in 5.5 million people and in one eye in an additional 6.2 million people worldwide. In fact, the diseases causing corneal opacity are 2 to 8 times more common in low- and middle-income nations. India's national program aimed at addressing vision loss in India also targets corneal blindness and the National Eye Donation Fortnight is a part of this program.

For restoring sight in patients with corneal opacities, eye surgeons replace a diseased and opaque cornea with a healthy, transparent human corneal tissue (obtained through eye donation) in a procedure called keratoplasty or corneal transplantation. However, every aspect of this journey--obtaining human corneas, keratoplasty, and the long-term restoration of vision--has several challenges. The world has an insufficient supply of donor corneal tissue because of the lack of public awareness as well as myths around eye donation. In addition, not all donor corneal tissue is 'transplant grade'--in fact 30-40% cannot be used for transplants. Another crucial impediment is the lack of quality long-term care after successful transplantation.

Coupled with poorly run eye banks and inadequate human resources, these challenges result in the twin agonies of a prolonged wait list for the surgery and higher rates of graft failure. A graft failure can only be addressed with a fresh transplant—piling up more stress on the system. In my 25 years as a corneal surgeon, I have shared in this emotional roller-coaster with my donor cornea recipients: the despair of vision loss; a sense of hope when they visit us; the joy of regaining vision after a transplant; and the grief when a graft turns opaque.

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As the adage goes, 'prevention is better than cure.' I wrote to you in the past about how the LVPEI pyramidal network allows us to catch corneal abrasions early and treat them at negligible cost in our primary care Vision centres. By catching them early, we prevent the development of corneal infections that result in opacity. At LVPEI, we are also seeking solutions that preserve the shape and structural stability of the cornea, without needing a transplant.

Six years to this month, on the 13th of September, we set up a scleral lens manufacturing unit in our Kismatpur campus with the help and support of US-based BostonSight. Scleral lens 'sit' on the whites of our eyes, with a fluid reservoir between the cornea and the lens bathing the ocular surface. These specialty lenses maintain the shape of the cornea and when successful, reduce the need for surgical intervention. So, scleral lens are of great value for those suffering from complex corneal and ocular surface diseases. However, these lens were barely used in India because of the cost of importing them from the USA. With our own manufacturing unit in India now, Scleral lens use is picking up; we have supplied over 12,000 lenses to a network of 120 practitioners across India. I would like to record my appreciation for the leadership of BostonSight and the entire team of our scleral lens manufacturing unit for this success.

However, to my mind, there is a bigger, more audacious goal: Can we eliminate the need for eye banking and manufacture a synthetic cornea? In the September issue of the acclaimed journal Acta Biomaterialia, my colleagues Sayan Basu and Vivek Singh announced the successful evaluation of an alternative cornea replacement material they call the 'human decellularized cornea matrix hydrogel' (hDCMH). This hydrogel is exciting for many reasons: it is safe and efficacious for treating corneal wounds; it is easy to apply on the eye—most surgeons can do it; it heals faster and better than transplants. It is 3D printed and manufactured in an industrial setting and supplied anywhere without too many challenges. The material itself is rooted in donated corneas that are not 'transplant-grade'. In a way, this material will help us ensure that every donated tissue meets its primary purpose: sight restoration.

This work is cutting-edge and has implications for corneal blindness the world over. We are in the process of manufacturing the material in a 'GMP' environment for phase 0/1 clinical trials in patients with corneal wounds and ectasia. Sayan and Vivek are working with an interdisciplinary team from the Indian Institute of Technology Hyderabad (IIT H) and the Centre for Cellular and Molecular Biology (CCMB) on this material. We are thankful to the Sree Padmavathi Foundation, the Department of Biotechnology, and the Indian Council of Medical Research for believing in us and supporting this project.

As Sayan and Vivek note, "the huge gap between the demand and supply of donor corneal tissue worldwide, more so in the developing world, demands exploration of new approaches for the management of corneal blindness. Biomimetic cornea hydrogels, stem cells, and gene/molecular therapy are promising alternatives to corneal transplantation."

Sayan, Vivek, and all the team members from IIT H and CCMB – this is exciting work. On behalf of LVPEI and all our supporters and friends, I would like to convey our best wishes for the success of this project. Let me end with a famous quote by Malcolm Gladwell:

> *If you work hard enough and assert yourself, and use your mind and imagination, you can shape the world to your desires.*

With all these milestones this month, September then is a good time to articulate our collective ambition: use our imagination, compassion, and effort to eliminate corneal blindness and vision impairment for everyone, everywhere.

-Prashant Garg