Symposium on Organ and Tissue transplantation

Basic concepts of Keratoplasty

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INTRODUCTION

The history of corneal transplant surgery is a fascinating story of more than 200 years duration.

In, 1905 from the small town of Moravia in the Czech republic came the first report of a successful penetrating keratoplasty by Edward Zirm.[1] This event opened a wide gate for people suffering from corneal blindness. The rate of rejection of human corneas is generally below 5%, making corneal transplants the most efficacious form of transplant surgery.[2] This remarkable degree of success is achieved by the immune privileged status of the cornea, which is due to an combination of factors including absence of corneal vascularity and absence of corneal lymphatic vessels that prevents delivery of antigens to T-cells within lymph nodes.

The concept of corneal storage in artificial media was initially introduced by Mc Carey and Kaufman during the early 1970s.[3] Townley Paton and Jhon Mclean established the first eye bank in New York in 1944.[4]

The development of penetrating keratoplasty can be categorized into 3 eras:

1. The xenograft era which propose the replacement of diseased human cornea by clear animal cornea, (19th century).
2. The surgical keratoplasty era
3. The femtosecond laser era

The femtosecond laser was first developed by Dr Kurtz at the University of Michigan in the early 1990s.[5]

It was rapidly adopted in the surgical field of ophthalmology. Femtosecond laser emit light pulse of short duration at 1053 nm wave length that cause photo-disruption of the tissue with minimum collateral damage.[6]

Penetrating keratoplasty (PKP) has changed over the years, from the early 1900s , when the first procedure was performed without any modern surgical device[7] to the novel technique of femtosecond laser assisted keratoplasty and a well-matched donor recipient bed.[8]

METHODS

Literature search

A systematic review of published journal articles reporting on the basic concepts of keratoplasty was performed according to the Preferred Reporting Items for Systematic review and Meta Analysis (PRISMA) guidelines.[9]

DISCUSSION

Keratoplasty can be performed for various purposes and is classified as therapeutic, tectonic and optical. Therapeutic keratoplasty is done to remove the infective portion of the cornea mainly in the cases of recalcitrant or perforated infective keratitis. Tectonic keratoplasty provides support and maintains the integrity of the globe. Optical keratoplasty aims to restore vision and has seen various advancements with time.

There are many types of corneal transplants with different techniques, which are used for replacing selective anterior or posterior diseased part of cornea with a normal part of donor cornea.

Rock *et al.*[10] evaluated the indications for corneal transplantation and the changing trends for corneal transplantation from 2005

to 2016. The most common indications were found to be Fuchs endothelial corneal dystrophy (45.5%) and keratoconus (10.2 %). Other indications were bullous keratopathy (10.4%), trauma (4.3%) and corneal graft failure due to rejection (8.9 %), followed by infective keratitis and ulcers (16.8 %).

Postoperative outcome in DSAESK is associated with faster and early visual recovery.[11] Jordan et al.[12] conducted a study on 598 patients and found a rejection rate of 9%. In a study on deep anterior lamellar keratoplasty, Amayem and Anwar[13] found a visual acuity better than 6/9 in 95.8% cases in one-year post-operative follow up.

There have been various studies to evaluate the visual out comes and the complications post penetrating keratoplasty. Rahman et al.[14] reported a best corrected visual acuity (BCVA) of better than 6/12 in 48% of patients at 5 years of follow up.

Complications for PKP include graft rejection, graft failure, infection, expulsive hemorrhage and suture related complications. Pramanik *et al.*[15] reported a graft rejection rate of 21%.

Corneal donation in the modern era

Corneal donation is a complicated process, as it involves many social, ethical and legal issues.

To keep up with growing demand on corneal tissues, the first eye bank was started in New York by Paton in 1944.[16] To further promote eye banking and establish uniform standards and rules, ten such eye banks in America joined hands to form the Eye Bank Association of America.[16]

Role of eye banks

Eye banks play great role in corneal harvesting, processing and record keeping.

The eye bank keeps a vigil on controlling quality during harvesting, transportation, processing and storage until the donor cornea reaches the surgeon. It is important to ensure complete asepsis during retrieval of the cornea as any source of infection can lead to visually-threatening complications. Multiple cases of post keratoplasty graft infection have been reported because of the organism present in the storage media.[17]

Recent advancements in corneal transplantation

Femtosecond assisted- lamellar keratoplasty (FALK):

FALK has many advantages over manual keratoplasty. Lamellar as well as full thickness keratoplasty (PKP), can be performed using femtosecond laser.[18]

If the host and donor cut are in perfect alignment, this result in enhanced epithelial healing and reduction of post- operative astigmatism.[19]

Bioengineered cornea

The gap between availability of donor cornea and the requirement for visual rehabilitation has been managed by several methods. One of the methods is the development of bioengineered corneas. These are designed to replace the full thickness of the diseased cornea or part of the diseased cornea. These range from keratoprothesis, which replace the function of the cornea to the recent development of tissue-engineered hydrogels that help in the regeneration of the host tissue.[20] Furthermore, there are bioengineered lenticules that can be used to correct refractive errors by implantation into the cornea.[21]

CONCLUSION

More than one hundred years have passed since the first corneal transplant surgery was performed by Edward Zirm, and since then various advancements in techniques have evolved. Customized component to replace the diseased part of the cornea, improved instrumentation and engineering marvels have helped in reaching greater heights of sight restoration and visual recovery with better success rates. Improvements in eye banking techniques have greatly helped the surgical results. The future holds promise with further optimization of results and widening scope of services to reach remote areas.

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