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Modern versus Traditional Penetrating Corneal Transplant Immunoreactions

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Abstract

In the last ten years, new lamellar keratoplasty methods have been developed, including Descemet stripping automated endothelial keratoplasty/Descended membrane endothelial keratoplasty (DMEK) for posterior keratoplasty and Deep Anterior Lamellar Keratoplasty (DALK) for anterior keratoplasty. Endothelial allograft rejection, the primary cause of graft failure following penetrating keratoplasty, is prevented by DALK. With DSAEK/DMEK, the risk of endothelial graft rejection is much lower than it was after PK. Thus, in the low-risk scenario, the clinical issue of endothelial graft rejection appears to be almost completely resolved with modern lamellar procedures. There are endothelial immune reactions in DSAEK/DMEK and epithelial, subepithelial, and stromal immune reactions in DALK, even with lamellar grafts, and not all keratoplasties can be done in a lamellar way. Therefore, In the "high-risk" situation, where the cornea's (lymph)angiogenic and immunological privilege is lost as a result of acute inflammation and pathological neovascularization, endothelial graft rejection in PK is still very important. The therapy solutions that are currently available for these eyes are still inadequate. We will discuss the four most popular keratoplasty procedures in this review: PK, DALK, DSAEK, and DMEK. We'll list their indications, describe the procedures, and make observations on any issues or results. We will also provide an overview of the immunology of corneal transplants. Endothelial graft rejection will receive particular attention, and we will report on its prevalence, clinical manifestation, and available treatments and preventative measures. Finally, we will project future developments in the fields of keratoplasty and preventing corneal allograft rejection.

Keywords: Corneal transplantation; Keratoplasty; Graft rejection

Introduction

Anatomy of the cornea

The transparent, avascular front portion of the eye, known as the cornea, serves as a physical barrier to the outside world and is crucial in the refraction of light. The epithelium, Bowman's layer, stroma, Descemet membrane, and endothelium are among its five layers [1]. The epithelium, the cornea's outermost layer, is made up of five to six layers of stratified, non-keratinized cells that in humans measure about 50 m. Intercellular tight junctions, which are formed by the cells in the highest layers, inhibit the invasion of microbes and other potentially hazardous foreign substances [2]. A population of stem cells, known as the limbus, which is located in the basal layers of the vascularized junction between the cornea and the conjunctiva, maintains the corneal epithelium. The remarkably (lymph) vascularized Vogt Palisades are stromal invaginations that are thought to be a limbal epithelial stem cell niche are seen in the limbus. The limbus is the boundary between the highly hemmed and lymph vascularized conjunctiva and the physiologically avascular cornea [3]. The Bowman's layer, an acellular membrane made of randomly oriented collagen fibrils, supports the corneal basal epithelial cell layer. The cornea owes its clarity and biomechanical strength to the corneal stroma, which has a highly ordered structure made of highly organised collagen I and V fibres. These collagen fibrils are produced by corneal keratocytes, which are mostly found in the anterior stroma and are very infrequent within the stromal tissue [4].

The Descemet membrane, which lies beneath the corneal stroma, is primarily made of collagen IV and is formed by a monolayer of dormant endothelial cells. This monolayer's primary job is to maintain the cornea's dehydration by continuously pumping fluid from the stroma into the aqueous humour [5]. The cornea has numerous nerves, immunological cells, putative mesenchymal stem cells, and hem- and lymphvascular sprouts adjacent to the limbus in addition to the features already mentioned. The recommended treatment for damaged corneal transparency, integrity, or function is corneal transplantation.

History of keratoplasty

The oldest and most effective type of tissue transplantation is corneal transplantation (keratoplasty). Galen made the first surgical attempts to treat opaque corneas (by superficial keratectomy) between 100 and 200 A.D. In the late 1800s, methods for anterior lamellar keratoplasty were developed. Von Walther and Koenigshofer suggested that the anterior cornea be removed without the deeper layers and the Descemet's membrane being grafted. The first partially successful lamellar (xeno) transplant was carried out by Von Hippel in 1886, when a rabbit's full thickness cornea was placed on the lamellar corneal bed of a human eye [6]. The patient's vision briefly became better, but the transplants later become opaque. Eduard Zirm carried out the first successful keratoplasty in which the graft stayed clear in 1905. It was a graft. Generated from a human eye that had been surgically removed just before a full-thickness keratoplasty (PK), and the transplant was then fastened with overlay sutures. At six months after surgery, the patient's visual acuity was 6/36.

Due to a lack of understanding of fundamental antisepsis and immunology concepts as well as surgical methods, corneal

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transplantation did not significantly advance in the decades that followed [7]. The contemporary era of PK had begun by the middle of the 1950s as a result of the invention of antibiotics, corticosteroids, and advancements in surgical methods. As a result, keratoplasty methods have advanced from lamellar to penetrating procedures, which until recently were the basis of corneal transplant surgery. However, new minimally invasive lamellar keratoplasty methods have been developed in the recent ten years for a number of corneal disorders, and they produce generally superior results than full-thickness PK. As a result, the majority of keratoplasties can now be carried out in a lamellar fashion, bringing about substantial improvements in corneal transplantation [8]. The method used currently for Deep Anterior Lamellar Keratoplasty (DALK), which uses methods like Anwar's "large bubble technique," is a treatment for anterior corneal disorders. The main cause of graft failure following PK is endothelial graft rejection, which is prevented by DALK but not epithelial, subepithelial, or stromal immune reactions. Descemet stripping automated endothelial keratoplasty and Descemet membrane endothelial keratoplasty, the latter of which was developed by Melles, are now the two most widely used procedures for posterior lamellar keratoplasty [9]. When compared to PK, especially subsequently, the risk of endothelial graft rejection following posterior lamellar keratoplasty is much lower. Thus, there are endothelial immune reactions in DSAEK/DMEK and epithelial, subepithelial, and stromal immune reactions in DALK even with current lamellar grafting procedures. Additionally, not all corneal transplants can be carried out, due to the fact that not all countries have access to these cutting-edge procedures and that some corneal diseases still call for the replacement of all corneal layers. Immune-mediated endothelial graft rejection is significant in these situations, particularly in pathologically vascularized high-risk eyes, which account for around 10% of all grafts, yet the therapy options that are currently available are still inadequate [10].

Types of keratoplasty

Penetrating keratoplast

Although fewer PK treatments are being conducted as a result of the development of improved lamellar transplantation techniques, PK is still a significant and required surgical procedure, especially when newer surgical techniques are not practical.

Indications and Surgery

Normal applications of PK are made to restore the visual function to opaque or anatomically aberrant corneas. Additionally, ocular perforation brought by by infections or immunological conditions like rheumatoid arthritis is a sign of PK. Long-term endothelial dysfunction can also cause stromal scarring and neovascularization, making PK the treatment of choice [11]. Another sign is corneal opacification brought on by bacterial, viral, or fungal infection, which can harm the corneal endothelium in addition to the anterior cornea. Those who have keratoconus PK has also been used to treat them, but DALK is now the preferred method of care. PK surgery is distinct from other ocular treatments like vitreous or cataract surgery, which typically take place in a closed environment. Parts of the PK technique, in contrast, are carried out in full awareness. Due to the increased risk of serious complications such expulsion haemorrhage; operation time is a crucial consideration. Intraocular pressure typically keeps the shape of the eye in place, but during PK the eye will be unable to do so and will collapse, especially in vitrectomized and aphacic eyes. Additionally, choroidal haemorrhage could occur and a vitreous body with high pressure could abruptly pour out during corneal resection [12].

Conclusion

According to our research, the donor cornea should be 0.25 mm bigger than the recipient cornea that was removed. The donor cornea is prepped by cutting from the endothelium side, perhaps with a Baron vacuum trephine. Alternative trephination methods include nonmechanical ones. A scleral ring may be applied to the recipient to prevent collapse following corneal resection, particularly following vitrectomy or in cases of aphakia. The cornea's centre is then identified and marked. Typically, a Baron vacuum trephine and punches are utilised to respect the recipient cornea. Additionally, non-mechanical methods, such as the use of excimer or femtosecond lasers, can be used to remove tissue from the host and the donor. To prevent Urrets-Zavalia syndrome once the patient's cornea has been removed, surgical iridectomy is essential. The donor then The recipient's cornea is stitched to it. To support the anterior chamber, eight temporary sutures are first inserted, then two more, either continuously or intermittently. If sutures should later become loose in a vulnerable site, such as following an infection or keratitis, interrupted sutures may be utilised for simpler manipulation. A Mallory/Placido disc ring can be used to alter suture strength after PK surgery to lessen astigmatism since astigmatic correction during surgery has a significant impact on visual acuity after PK.

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