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Research Article

The Cornea is the Most Transplant and Needed Tissue in the World

Ruben Dario Camargo Rubio*

Intensive Care-Transplant Coordination, Colombian Association of Critical Medicine and Intensive Care, Colombia

***Corresponding Author:** Ruben Dario Camargo Rubio, Intensive Care-Transplant Coordination, Colombian Association of Critical Medicine and Intensive Care, Colombia.

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Abstract

The cornea is the most transplanted and most needed tissue and part of the body in the world. Vision loss, cases of blindness and moderate or severe visual impairment increase day by day, varying from region to region and from continent to continent. and only this tissue can be obtained from a person who died of brain death or circulatory death. It is a body tissue that is donated, through the human values of generosity, altruism and will of the donor who makes use of his or her right to autonomy and self-determination.

The donated cornea is processed and analyzed at a local eye bank to verify that its use is safe, where a biomicroscopic examination of the anterior pole is performed with the slit lamp, assessing the state of the epithelium, stroma and corneal endothelium. to detect possible injuries to these structures. Once properly reviewed, and if it is suitable, a corneal transplant is performed, a surgical procedure in which part of the cornea of a recipient person is replaced with corneal tissue from a donor. Many people participate in this process from the detection of the cornea donor to its implantation; the intensivist doctor, the transplant coordinator, eye banks, ophthalmological surgeons essential in the management of viable and adequate tissues. Therefore, the objective of this reflection is to understand the process of operational management of corneal donation and transplantation.

Keywords: *Corneal Tissue; Corneal Donor; Corneal Transplant; Transplant Coordinator*

Abbreviations

WHO: World Health Organization; HLA: Major Histocompatibility Antigen; EBAA: Eye Banking Association of America; HETBs: Human Eye Tissue Banks; PK: Penetrating Keratoplasty; LSCD: Limbal Stem Cell Deficiency; SJS: Stevens-Johnson Syndrome

Introduction

The number of people affected by common causes of vision loss has increased substantially as the population increases and ages. Preventable vision loss due to cataracts (reversible with surgery) and refractive errors (reversible with spectacle correction) continue to cause the majority of cases of blindness and moderate or severe visual impairment in adults aged 50 years and older [1]. It is estimated that each year there are two million new cases of blindness due to damage to the cornea in the world and corneal disease is the fifth leading cause of blindness in the world. The main etiologies of corneal blindness worldwide are due to anterior corneal pathology with normal endothelium, the prevalence in developing countries is secondary to anterior corneal pathology due to infections and trauma [2]. Around 53% of the world's population does not have access to a corneal transplant and according to the latest data provided by the WHO (World Health Organization), 9% of blind people worldwide are blind due to corneal pathologies. The main global causes of blindness

among people aged 50 years or older in 2020 are cataracts (15.2 million cases), followed by glaucoma (3.6 million cases), under corrected refractive error (2.3 million cases), age-related macular degeneration (1.8 million cases) and diabetic retinopathy (0.86 million cases) [3]. Fortunately, for decades, donation and transplants (operative management of organ and tissue donation) have existed, a process in which surgeons extract this neurological or circulatory part of the donated eye post-mortem and transplant it to a patient who he needs it. The cornea, currently, is the most transplanted part of the human organism in the world and with a lower risk of rejection, thanks to the privileged immunological situation that this tissue has, due to the absence of lymphatic and blood vessels in the area. Typically, HLA (Major Histocompatibility Antigen) typing and systemic immunosuppressive drugs are not used, and 90% of corneal allografts survive. However, some conditions deprive the corneal allograft of its immune privilege and promote rejection, which remains the leading cause of corneal allograft failure at 30% [4]. In the world there are 12 million people blind due to their cornea and 97% of corneal transplant operations restore vision to the recipient.

Materials and Methods

A narrative description was made based on the process of donation and transplantation of organs and tissues, established worldwide for obtaining human biomaterials for transplantation. Each of the steps required to achieve the objective of corneal transplantation is detailed, which is to restore vision to those who have lost it due to natural, traumatic or infectious causes.

Results and Discussion

Pre-donation cornea characteristics

The increased demand for transplants is accompanied by strict quality control of tissues in HETBs (Human Eye Tissue Banks). This quality control begins with the process of selecting the corneal donor in the intensive care unit, appropriate techniques for tissue maintenance, personal history, serology tests and infectious tests of the donor, eyeball enucleation technique, preservation of the corneas and the count of endothelial cells present in the tissue. The good quality of the donated cornea and the adequate maintenance of the tissue until its use are of fundamental importance for a good final visual prognosis [5].

Assessment of the donor cornea before extraction

The donor cornea should be transparent, smooth and healthy, without scars, swollen or damaged. The corneas of children under 2 years of age are very flexible, have a high curvature and a narrow usable diameter, as well as an extreme thinness that causes technical difficulties for their handling, for these reasons they are not considered as donors. Proper assessment, evaluation, and selection of the donor cornea can result in adequate feasibility, safety, and efficacy of the use of 1 donor cornea for 2 recipients who required anterior lamellar and posterior lamellar keratoplasties, respectively [6].

Corneal donor management

During the management of organ and corneal tissue donors with brain death, it should be verified that their eyelids are closed, and eye drops or solutions (artificial tears) should be applied to keep the eyeballs moist and lubricated. Avoiding dryness when the eyes remain open, which generates loss of corneal epithelium, this being a risk factor for not being an adequate graft. Corneal care is aimed at preventing the corneas from drying out and getting injured [7].

Background assessment of the cornea donor

The potential corneal donor is contraindicated if: the death is of unknown cause, if it is impossible to carry out serological studies of the donor due to loss of the sample due to hemodilution, ingestion of a toxic substance or exposure to it, which can be transmitted in a dose toxic to tissue receptors. Donors with malignant diseases may be evaluated and taken into account for corneal donation, except those affected by retinoblastoma, melanoma of the anterior pole, hematological neoplasia or malignant tumors that could affect the

anterior pole of the eye. People with a history of rapidly progressive dementia or neurological degenerative diseases of unknown origin. Viral infections: HIV, rabies, hepatitis B, hepatitis C, congenital rubella, sepsis, syphilis, tuberculosis. Recent febrile processes, fungal endocarditis, bacterial endocarditis. Belonging to high-risk groups (drug addicts, sexually promiscuous, polytransfused, hemophiliacs, tattoos less than six months old, prison history, children of mothers with AIDS), Active infection with herpes simplex and herpes zoster. Any of these donor histories can lead to graft failure [8].

Evaluation of the donor cornea after extraction

After being removed, the corneas are analyzed in an eye bank to verify that they are safe to use. A biomicroscopic examination of the anterior pole is performed with the slit lamp. Dimensions are verified, ruling out microcornea or megalocornea, presence or absence of senile arch, abnormalities of the anterior chamber (blood or synechiae), as well as possible intraocular surgeries. The characteristics of the epithelium are also assessed (assessment of edema, erosions or particles), absence of opacities that affect the corneal button, vascularization, folds in Descemet's membrane, alterations in curvature or thickness, degenerative processes, absence of signs of infection and absence of lesions in the anterior segment that could deteriorate the corneal tissue [9].

Avoid contamination of the cornea

Eye banks are intended to obtain, prepare and distribute fresh eyeballs. The collection of donated material must be carried out under maximum aseptic conditions. Enucleation is carried out within the first six to eight hours postmortem and must be stored in a humid chamber at +4°C and used within the first 24 hours of death due to neurological or circulatory causes. When the cornea is separated from the eyeball, they are kept in McCarey-Kaufman medium (M-K medium) and in a humid chamber at +4°C, which allows the period of their use to be extended, from four to eight days [10]. According to the EBAA (Eye Banking Association of America), eye banks provide tissue for more than 85,000 corneal transplants each year, restoring sight to many people.

Contamination can occur at each stage of the process: procurement, preparation, processing for preservation and distribution or during implantation in the recipient. The absence of contamination depends on control in each of the stages. Ocular tissue normally contains bacteria from the conjunctival commensal flora and eventually other pathogens, depending on the cause of death of the donor and the time elapsed between death and enucleation. The cornea is a biological or biomaterial that does not resist conventional sterilization procedures, as they lose their functionality or are toxic, so the absence of contamination depends on control at each of the stages [11].

Corneal transplantation

Who benefits

Surgery is used for patients with: Trauma/infection of the cornea, Keratoconus (the cornea becomes cone-shaped), Fuch's dystrophy, Pseudophakic bullous keratopathy, Corneal degeneration. Study showed the first three indications for keratoplasty which were: bullous keratopathy (BK) 46.2%, active infectious keratitis (22.3%) and the group of corneal dystrophies and degenerations, including Fuchs endothelial dystrophy. (9%). Keratoconus ranked sixth (4.9%). 73.3% of the procedures were penetrating keratoplasties and 21.7% were posterior lamellar and 3.5% were anterior lamellar. Results that of course vary depending on each transplant center [12].

Surgical procedure

Until a few years ago, penetrating corneal transplantation was performed PK (penetrating keratoplasty), which involved replacing the layers of tissue that form it. The cornea is made up of the epithelium and its basement membrane, Bowman's membrane, stroma, Descemet and endothelium, so that, although transparency was recovered, a significant disorder occurred in the optical structure of the cornea. Technological advances in the field of Ophthalmology are now allowing us to be much "more precise" and replace only one or several of the layers of the cornea." Today there are different types of corneal transplants. In some cases, only the front layer and the middle layer of the cornea are replaced. In other cases, only the inner layer is removed [13]. Endothelial transplantation or deep anterior lamellar

keratoplasty has become the gold standard for the treatment of corneal endothelial dysfunctions, and disorders affecting the corneal stromal layers, replacing full thickness transplantation, known as penetrating keratoplasty with results faster and more predictable visuals, eliminating the risk of endothelial rejection [14]. The adoption by specialist surgeons of new forms of lamellar transplant surgery, which selectively replace only the diseased layers of the cornea, has been a fundamental change in recent years [15].

Corneal transplantation in layers requires sophisticated technology to perform it precisely, so today many experts have a microscope with a computer-guided system, which allows cutting with precision the exact diameter of the implant, the orientation with which it has to be placed, as well as where the incisions should be made to implant the new tissue without generating astigmatism. This system allows us to control, to the extent possible, that the anatomy of the eye is maintained since the recovery of vision does not depend solely on the transplant, but also on how the optical structure remains. At the same time, this guidance system serves to delimit the depth and extent of the altered area, as well as to eliminate the opaque area sectorally. With the latest diagnostic techniques, it is possible to locate the damaged area in the tissue structure of the cornea, at a depth of, for example, 200 microns and a diameter of 8 mm. During the transplant, this area can also be delimited and eliminated and replaced with the implant. When performing this type of intervention on the cornea, the optical structure of the eye is not altered, so that prescription problems in the patient are minimized for better recovery of vision. Another important aspect is the use of chemical suture in combination with conventional suture, so that by performing fewer stitches we achieve less inflammation and, therefore, less deformity of the optic cup, improving the patient's visual quality [16]. Corneal transplant can be performed under general anesthesia or local anesthesia, representing an outpatient surgery because the patient can generally go home on the same day of the intervention.

Primary graft failure

It is the presence of corneal edema on the first postoperative day after corneal transplantation. Probable reasons are: iatrogenic or surgical trauma, storage deficiency, transportation or improperly stored tissue, and inherent cellular deficiency in the tissue. According to the recommendations of the American Eye Bank Association, the minimum endothelial count for the donor tissue should be 2000 cells and the storage time should be less than 7 days. When these variables are taken into account, the failure of the primary graft is reduced [17].

Graft rejection

The diagnosis of graft rejection is made only when the graft has remained clear for at least 2 weeks after corneal transplantation. The challenge is to differentiate it from primary graft failure and the other caused by non-immunological graft failures. According to a detailed review of the literature, the incidence of graft rejection is highest within the first 18 months and then declines, although graft rejection has been reported even more than 20 years after primary transplantation [18]. Warning signs that indicate corneal transplant rejection include: pain in the eye, very sensitive to light. redness of the eye, cloudy or blurred vision. Management of corneal graft rejection is based on early detection and aggressive steroid therapy [19]. Epithelial rejection comprises approximately 2% of graft rejections. Endothelial rejection is the most common, with an incidence of 50%. Subepithelial rejections have an incidence of 1% and are the least common type. The incidence of mixed rejection is approximately 30% [20]. Rejection can be controlled, the goal of treatment is to reverse the rejection episode as soon as possible, minimize the loss of donor endothelial cells and preserve graft function, dexamethasone 0.1% successfully reverses most episodes of endothelial rejection. The best treatment for corneal graft rejection is to treat and prevent an episode of immune-mediated graft rejection. Prevention can be divided into preoperative, intraoperative, and postoperative risk factors for graft rejection [21].

Corneal transplant prognosis

The prognosis depends on several factors: First: meticulous preoperative case selection. Second: storage and transportation of the donor graft. Third: the preoperative moment. Fourth: the intraoperative surgical technique. Fifth: the meticulous postoperative examination. Sixth: early detection and classification of rejection. Seventh: rapid and timely intervention with corticosteroids [22].

Corneal limbal stem cell transplant

The loss of barrier function of limbal stem cells found in the sclero-corneal limbus, a transition zone that surrounds the cornea and separates the conjunctiva [23]. They are physical (anti-angiogenic with continuous renewal of the corneal epithelium) and functional. When the barrier function is lost, direct destruction of these limbal stem cells is caused, giving rise to limbic insufficiency or LSCD (Limbal stem cell deficiency) in which the fundamental pathophysiological fact is the inability to regenerate the corneal epithelial cells in such a way that Conjunctival cells appear replacing the normal corneal epithelium, called "conjunctivalization" of the cornea [24]. In this procedure, a transplant of the cornea is not performed, but stem cells from the corneal limbus are performed, which can be transplanted from the patient's own healthy eye; they do not require immunosuppression or from a cadaveric donor eye in brain death prior to extraction. requiring systemic immunosuppression after cadaveric limbal grafting. The success rate of this technique is around 75 percent of cases, according to international studies [25]. Corneal limbus stem cell transplantation is a treatment for certain corneal pathologies (thermal eye burns, chemical accidents. SJS (Stevens-Johnson syndrome) and necrolysis, contact lenses with chronic irritation). Like all surgery, it has risks of complications after it (infections, rejection, granuloma).

Discussion

The cornea as a transplantable tissue is one of the most precious since it is related to vision, greatly improving the quality of life. It is also an immunoprivileged tissue that makes it unique among solid tissues and organs. It provides each of the layers that compose it separately to the transplant, practically does not require the use of immunosuppressant's and its incidence of rejection is minimal. It is the most performed transplant in the world and in which important technological advances have been obtained, but the deficit of available corneas is still considerable, with a proportion of one in seventy needed.

Transplant coordination programs that are dedicated to detecting brain-dead donors achieve in some countries a greater number of solid organs than tissues such as cornea, bone or skin. Tissues such as corneas have advantages over solid organs in their extraction since these can be removed after brain and circulatory death, up to 6 - 8 hours in the morgue if the corpse is not refrigerated. Even with all this, they are insufficient, with demand being greater than supply in developing countries; however, it is the tissue that is most transplanted in developed countries.

Conclusion

Campaigns in favor of corneal tissue donation and campaigns against low vision and blindness treatable by this procedure are necessary in all countries of the world. There is fragmentary data by country on the dynamics of corneal transplantation and there is no global map that shows what strategies can be to improve the information situation not only of donation but also of corneal transplantation. The future points to synthetic corneas, but lack of funding for science and technology.

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Conflict of Interest

I declare that there was no sponsorship for the completion of this review. I declare that I have no conflict of interest and that this article has not been submitted to any other journal or previously published.

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