Glaucoma management in patients scheduled to corneal transplantation

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ABSTRACT

Intraocular pressure elevation during and after corneal transplantation is a serious complication which may cause loss of transplanted tissue and serious visual compromise. If the patient has glaucoma this should be treated before the transplantation surgery. In case of pressure raise during the transplantation there are various methods for regulating the IOP. In cases of post transplantation glaucoma topical antiglaucoma medications and filtrating interventions must be pursued. Recent advances in trans scleral diod lazer applications are promising and can be used for regulating IOP on every occasion before and after trans surgery with confidence.

Keywords: Corneal transplantation, glaucoma.

INRODUCTION

Currently, penetrating keratoplasty (PK) and endothelial keratoplasty are the most commonly used techniques for corneal transplantation.

Glaucoma is an important issue which most often challenges us to manage before, during and after these surgeries and, if not treated adequately, it is a serious problems which may lead loss of vision after corneal transplantation.[1]

In this review, we initially discuss the glaucoma diagnosis, and control and methods to control glaucoma while preparing the patient for corneal transplantation. We also discuss potential hazards which can be anticipated during transplantation and how to control such these hazards and management of glaucoma after transplantation.

Etiology and Pathophysiology

Early alterations of intraocular pressure (IOP) following penetrating surgery occur due to persistence of visco-elasticity in anterior chamber, shrinking of donor cornea by stretching resulting from corneal sutures and resultant shortening that narrows the angle at the corneal limbus region, and outflow in the angle due to inflammation caused by surgery per se.

Late IOP elevation occurs due to structural changes that decrease the drainage of trabecular network resulting from steroid sensitivity, occlusions caused by cells in trabecular network resulting from chronic inflammation and narrowing in drainage canals resulting from anterior peripheral adhesions.[2]

Early IOP elevation after DMEK often results from pupil block caused by air in anterior chamber. Instead of 12 °Clock iridotomy, 6°Clock iridotomy prevents this complication.

At late phase, topical steroid and inflammation may lead glaucoma as similar to those in penetrating cases.[4]

How intraocular pressure can be assessed and managed before surgery in a patient scheduled to corneal transplantation?

High IOP is a problem which can lead loss of eye during and after PK surgery. Thus, it must be reduced to normal and even lower levels (12-13 mmHg).[2]

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Received: 11.03.2024
Accepted: 15.03.2024
TJ-CEO 2024; 19: 1-4.
DOİ: 10.37844/TJ-CEO.2024.19.1

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Primarily, how we can recognize elevated IOP? It can be failed to measure IOP in individuals with irregular cornea. Schiotz method can be helpful in such cases. Digital measurement can also be very useful in experienced clinicians. If we think that the pressure is high despite all assessments or at least if there is a suspicion, it will be appropriate to make intraocular pressure which can be felt manually by frequent administration of 360° transscleral diode laser weeks before surgery if possible. This prevents expulsion during surgery; in addition, it allow better management of graft after surgery. It may cleanse ocular surface from highly toxic glaucoma agents, facilitating adaptation of novel tissue to ocular surface of ocular surface.

What should we do if intraocular pressure cannot be managed with topical agents? In the prior paragraph, I mentioned that transplantation surgeons consider a normal intraocular pressure as high, preferring an IOP below normal. Although this cannot be achieved in all instances, it should be aimed in the transplantation surgery. First of all, transplantation should be avoided when a desired IOP level cannot be achieved with anti-glaucoma agents. The IOP must be reduced to desired level. As the experience of surgeon increases, their sensitivity towards issues related to pressure also enhances to a level of obsession. This favors the patient and the professionalism of the physician.

When anti-glaucoma agents fail, surgical modalities are used. Filtration surgery is conventional but often prone to blockade. Treatments targeting the Schlemm's canal are impractical due to corneal opacity. I think transscleral diode laser (TSDL), which has recently been introduced, is a breakthrough application However, it is often misjudged as over-effective or minimally effective. The TDSL is an excellent technique when used appropriately. It has made a breakthrough in the control of glaucoma in the permanent keratoprosthesis and transplantation group.

The foundation of my transscleral laser application algorithm is to prepare the eye, which will undergo corneal transplantation, to the lowest possible pressure level for the procedure. Even in cases where I cannot measure the pressure with a tonometer before transplantation, I expect to feel the eye quite soft in the palpation. I think that it would be appropriate to perform a one order of laser even immediately before the transplantation. It is unlike to lead bleeding from the ciliary body during per-operative laser application. If bleeding occurs, resulting in stiffening eye, the transplantation procedure is postponed. Within a few weeks, the eye will normalize, and it will be observed that the pressure reaches the desired softness. Ultimately, it is highly relieving to start transplantation procedure with a very low intraocular pressure.

Potential problems and management in a patient with uncontrolled IOP when corneal transplantation is performed

In such case, expulsion, is unavoidable, which is the bleeding of choroidal vessels, which are under pressure for a long time due to the sudden drop in pressure and the extrusion of all intraocular contents by release of the choroidal vessels during corneal excision. However, since it is indisputable that the IOP should be controlled months before corneal transplantation, per-operative IOP elevation may be due to non-glaucomatous reasons. What are the factors that increase IOP during transplantation? If transplantation surgery will be performed with local anesthesia, retrobulbar injection can increase pressure. In corneal transplantation, general anesthesia provides substantial convenience; thus, efforts should be made to perform corneal transplantation under general anesthesia. Otherwise, it will be more likely to encounter a scary scenario mimicking expulsion following corneal extraction. In this scenario, the choroid does not bleed; however, the lens and vitreous are displaced anteriorly due to retrobulbar pressure. The compression on bulbus by blepharostat is another factor that increases intraocular pressure. The wire blepharostat increases IOP peroperatively in the procedures performed in eyes with narrow eyelids and children. The pressure can be relieved by canthotomy if needed. A canthotomy is performed if sufficient eyelid opening cannot be achieved with screw adjustable blepharostats which are easier to control. However, if sufficient lid opening cannot be achieved, a canthotomy is performed. It should be kept in mind that canthal ligaments should be attached using vicryl sutures at the end of surgery. Even it is forgotten, no significant problem is seen.

In cases where greft is larger than recipient by 0.5 -1.0 mm, postoperative pressure control is more straightforward. The difference between donor and recipient is one of the primary elements of the general doctrine. The tension resulting from small greft and tight sutures lead narrowing of iridocorneal and deceleration of outflow.[3]

At the end of surgery, removal of visco-elastic material and subconjunctival steroid injection can facilitate postoperative pressure control.

In DMEK cases, complete filling of anterior chamber with air may lead sudden increase in pressure through pupil

block. Incomplete filling with air and peripheral iridectomy may prevent the complication. In particular, iridectomy at 6 o'clock instead of 12 o'clock should be preferred since as it allows sitting position during surgery.[4]

Management of a patient with IOP elevation after corneal transplantation

At early postoperative period after corneal transplantation, manual pressure control can be performed since epithelium formation isn't completed and contact with corneal surface is undesired. Primarily, we desire a soft eye at this period. Thus, we attempt to achieve preoperative intraocular pressure as low as possible. IOP can be slightly increased due to bleeding and fibrin resulting from trauma in anterior segment during surgery. Thus, 200 ml of mannitol can be routinely given to the patient at the end of surgery. During first week, dual anti-glaucoma eye drops and diazomid twice daily are given. IOP affects recovery of donor cornea. The lower pressure, novel cornea will become transparent faster.

It is easier to manage late-onset glaucoma. Accurate pressure measurements can be performed if corneal recovery is achieved, optic nerve changes are monitored and even visual field can be assessed. Thus, late-onset glaucoma can be managed as similar to those in normal glaucoma patients.

Topical anti-glaucomatous agents are highly effective in controlling postoperative pressure control. They rapidly become effective with longstanding effects. However, there may adverse effect that may delay healing such as punctate epitheliopathy and cornea anesthesia.[5]

Oral carbonic anhydrase inhibitors can be used in early postoperative period. If chronic use is required, one must be cautious regarding metabolic acidosis, paresthesia of fingertips, digestive problems and renal stone formation. It should be kept in mind that they can rarely lead greft failure by affecting pump function of corneal endothelium.[6]

Prostaglandin analogs are used as s single drop when compared to beta-blockers, carbonic anhydrase inhibitors and alpha-agonists. Given the relatively higher adverse effects of other agents, prostaglandin analogs can be considered as more appropriate choice after corneal transplantation. However, it is known that the molecule increases the development of cystoid macular edema and the recurrence of herpetic keratitis.[7,8]

Selective laser trabeculoplasty (SLT) can be used in the treatment of post-keratoplasty glaucoma and peripheral iridotomy using Nd-YAG laser can be performed in case of pupil block. When corneal transparency is inadequate, it should be kept in mind that transscleral laser is the most effective tool. As I always mention, transscleral laser (TSL) (except pupil block) should be applied sufficiently before corneal transplantation.

Given surgical treatments, trabeculectomy and drainage implants are among options. Surgical procedures are employed when response to medical therapy is insufficient or in cases experiencing difficult in surface healing due to highly toxic agents in order to avoid such toxic effects. There is no conclusive data favoring that drainage implants and trabeculectomy are superior.[9]

I use mitomycin C-soaked sponges (0.2 mg/mL) to reduce fibrosis at the area of filtration in trabeculectomy cases. The sponge-soaked MMC was applied to the area for 2 minutes. It is important to dry area surrounding bleb and to avoid corneal contact. Otherwise, corneal epithelial defects are inevitable and the risk for infection is increased due to delayed healing of epithelium. If mitomycin C will be used, excessive thinning of subconjunctival tissue over bleb should be avoided; otherwise, ablation and leakage of bleb will be unavoidable. It will be more appropriate to attenuate conjunctiva over bleb in cases where MMC isn't used.

In drainage implantation, bleb is far from cornea since it is formed within inactive area called "no man's land" and MMC leads less damage to corneal epithelium. In such cases, drying area surrounding bleb is of important. It is possible to achieve success if the surgery is performed meticulously.[10]

It is highly possible that eyes undergoing cornea transplantation might have underwent ocular surgery. Peripheral adhesions and conjunctival scar formation have influence on the outcome of drainage surgery. Although drainage implantation seems to be more effective and straightforward, it is appropriate to prefer trabeculectomy if surgery is needed; it is affordable and has better results.[11,12]

Drainage implants can cause cellular damage and graft failure due to increased number of inflammatory cells resulting from mechanical trauma at endothelium related to silicone implant and increased inflammatory cell recruitment. Thus, rate of graft loss varies from 30% to 90% in different series. The wide variation in the outcomes may be due to etiology of cases underwent surgery, number of previous surgeries and inadequate experience of surgeons.

In fact, the glaucoma problem in cornea transplantation is an issue where most experienced surgeons can learn novel insights from each case. One should be conservative in some instances or act courageously in some instances.

There is a group of studies on pre-transplantation drainage implantation.[13]

As I mentioned in the first part of the manuscript, I believe that TSL is more effective, sage and affordable in these cases. However, it is classical doctrine to use cyclophotocoagulation in refractory cases unresponsive to trabeculectomy and drainage implantation. This approach was valid and accurate in the era where TSL hasn't been introduced. Given the importance of surgeon's competence in trabeculectomy and drainage implantation as well as etiological challenges, TSL can be considered as first choice in routine practice. TSL minimizes surgical dexterity and variability across cases. Success rate up to 70% was reported with TSL at long-term follow-up.[14]

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