Case Report

A Challenge in Diagnosing Aqueous Misdirection Glaucoma after Keratoplasty

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ABSTRACT

Background: *The purpose of this case presentation is to report the difficulty of diagnosis and management of an aqueous misdirection of glaucoma after penetrating keratoplasty (PK).*

Case Illustration: *A 35-year-old male presented to the Glaucoma Division of Cipto Mangunkusumo Hospital with complain of painfull, redness on the left eye (LE), vomiting, headache. He was reffered from Infection and Immunology Division with diagnosis of secondary glaucoma after keratoplasty due to corneal ulcer and had been treated with glycerin, oral acetazolamide, timolol 0.5% eye drop (ED). The examination showed visual acuity of LE at presentation was 1/300 good projection and the intraocular pressure (IOP) was 48 mmHg. Slit lamp examination showed opaque corneal graft, shallow or flat central and peripheral anterior chamber. Iris, pupil, lens and funduscopy were hard to be evaluated. The patient assessed with aqueous misdirection of glaucoma after keratoplasty. Sclerotomy and anterior chamber reformation was then performed. One day after surgery, the examination revealed deep anterior chamber and decreased IOP to 24 mmHg, patient received no improvement on visual acuity.*

Conclusion: *The goal addressed in management of aqueous misdirection of glaucoma after keratoplasty are reducing the IOP and preserving optimal graft clarity. However, until recently, there is no consensus about the management of aqueous misdirection of glaucoma after keratoplasty. Scleromotomy with reformation of an anterior chamber is the alternative treatment when medical therapy fail to control the IOP.*

The primary goal after corneal transplantation is reestablishment of visual acuity for the patient. The success of PK depends on many pre-operative, intraoperative, and post-operative factors, including the health of the donor cornea, indication for PK, suture technique preferred, the quality of post-operative management, and the presence of high intraocular pressure (IOP).[1] The increase of intraocular pressure after PK has been first noted by Irvine and Kaufman in 1969.[2] It is a serious clinical problem due to its frequency of occurrence, difficulty in diagnosis and management, risk of graft failure.

The incidence of aqueous misdirection glaucoma after PK has been no data reported until now. But the incidence of glaucoma after PK varies from 9% to 31% in the early post-operative period and from 18% to 35% in the late post-operative period.[3] Simmons et al also reported an incidence of 34% of penetrating keratoplasty glaucoma (PKG) following PK.[4] Klaudia et al reported an incidence of post PK glaucoma is high in the first year after keratoplasty was 89.4%.[2]

The mechanism that might be the causes of aqueous misdirection glaucoma after keratoplasty can occur due to pupillary block and inflammation. The last mechanism that could occur in this case was flat anterior chamber due to wound leakage of corneal graft.

Clinically, patient often presents with an acute or subacute glaucoma associated with reduced vision, pain, redness, high IOP, and shallowing or flat anterior chamber that occurs both centrally and peripherally.[5,6]

The diagnose of secondary glaucoma due to aqueous misdirection after keratoplasty is based on anamnesis, clinical manifestation, examination with a slitlamp, ultrasound biomicroscopy (UBM), anterior segment coherence tomography (AS-OCT), evaluation of intraocular pressure. Slit lamp biomicroscopy shows seclusio pupillae, iris bombe, and shallow anterior chamber. Gonioscopy shows an angle closure from iridotrabecular contact.[6,7] Differential diagnoses were malignant glaucoma and post-penetrating keratoplasty glaucoma, pupillary block, suprachoroidal hemorrhage. The diagnose and management are much more difficult than the glaucoma cases with their own cornea.

An initial medical therapy can be considered to decrease inflammation with cyclopegic and corticosteroid agents. Aqueous suppressants are generally used to reduce the IOP. Posterior sclerotomy, surgical peripheral iridectomy, Nd-YAG laser, vitrectomy-hyaloidotomy-iridectomy (VHI) or transscleral cyclophotocoagulation (TSCPC) were considered as an option in management of secondary glaucoma associated with aqueous misdirection after keratoplasty.[6,8,9]

Aqueous misdirection is an uncommon complication after keratoplasty, and details regarding the presentation and clinical outcome have not been previously reported.

The purpose of this case presentation is to report how to diagnose and control the IOP in aqueous misdirection of glaucoma after keratoplasty. This case also presents the importance of evaluating the wound leakage in the corneal graft at the end of the surgery.

CASE ILLUSTRATION

A 35 year-old male was consulred to Glaucoma Division from Infection and Immunology Division on March 26, 2013 with pain of the LE. He also complained redness, burred vision, headache, nausea, vomiting since 1 day after keratoplasty. The patient confirmed no history of hypertension, diabetes mellitus, and no family history of glaucoma. He had a history of trauma in the LE after got hit by insect when he drove motorcycle 1 month ago. From the Infection and Immunology Division, the patient was assessed with post-tectonic keratoplasty glaucoma due to ulcus perforated cornea ulcer on the LE.

In the previous history, patient came to Infection and Immunology Division on March 22, 2013 wih chief complaint of ocular blurred vision for 1 month, redness, itchy, watery. Ophthalmology examination showed visual acuity of the right eye (RE) 6/6 and LE was hand movement with good projection. The intraocular pressure (IOP) of the RE was normal per palpation. In the left eyelid, there were edema, spasm without lagophthalmus nor proptosis. There were conjunctival injection, ciliary injection of the left eye, corneal ulcer sized 4 x 1.5 cm, with >2/3 stroma, feathery edge (+). Anterior chamber was relatively deep, cells & flare were hard to be evaluated, hypopyon was 0.7 mm. It was hard to evaluate the iris, pupil, lens, and fundus. Hyphae was found in KOH examination. Ultrasonography examination revealed good posterior segment. Infection and Immunology Division assessed this patient with perforated corneal ulcer on the LE due to fungus. So that this patient was planned to undergo tectonic keratoplasty for LE. The surgery was done completely without any intraoperative complication.

On post-operative follow up, the IOP increased gradually and the patient got anti-glaucoma medication. Despite of the medication, the IOP still increased to 48 mmHg so that the patient was consulted to Glaucoma Division to get further management.

Ophthalmology examination showed visual acuity of 6/6 on the RE and hand movement on LE with good projection. The examination results of the RE were unremarkable. The IOP of the RE was 14 mmHg and 48 mmHg on the LE. The eyeball movement of both eyes were good to all directions. In the left superior eyelid, there were edema, spasm without lagophthalmus nor proptosis. There were conjunctival injection, ciliary injection on the LE, opaque corneal graft with sixteen stitches and buried knot. Anterior chamber on the LE was flat, no buble, no coagulum, no hypopyon. It was hard to evaluate

iris, pupil, lens, and fundus on the LE. Glaucoma Division was diagnosed for this patient with post-tectonic keratoplasty malignant glaucoma on the LE one day after perforated cornea ulcer. This patient was given hyperosmotic agent (glycerin) 100 cc for 3 times, topical nonselective beta blocker (Timol® 0.5% ED) 2 times daily, oral carbonic anhydrase inhibitor (Glaucon®) 4 times daily, Aspar K 2 times daily, sulfa atropine 1% ED 3 times daily, mefenamic acid 3 times daily, levofloxacin ED and natacen ED every hour.

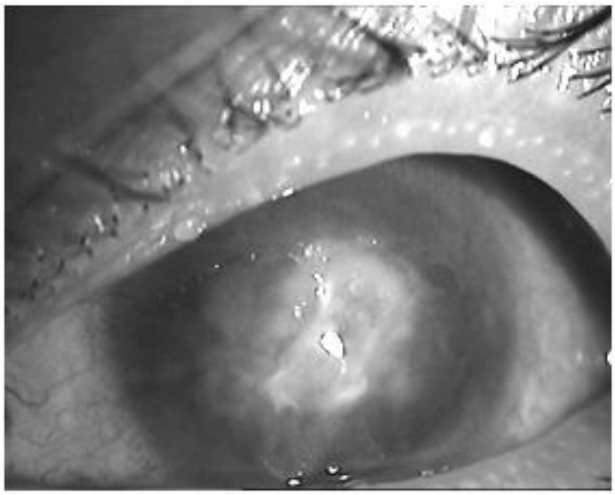

Fig 1. Size of corneal ulcer was 4 x 1.5 cm, with >2/3 stroma, feathery edge (+). Anterior chamber was relatively deep, cells & flare were hard to be evaluated, and hyopyon was 0.7 mm.

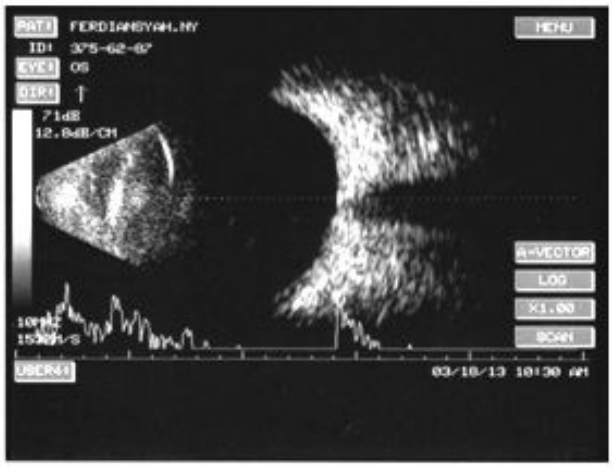

Fig 2. Ultrasonography. LE showed mild vitreous hazziness

On March 27, 2013, the patient said that ocular pain decreased, but still had nausea and vomiting. The visual acuity of the LE remained unchanged (hand movement with good projection), IOP decreased to 30 mmHg. The patient was planned to undergo sclerotomy, trabeculotomy with mmc and reformed of anterior chamber join operation with Infection and Immunology Division on March 28, 2013 on genereal anesthesia.

The operation of the LE was done on March 28, 2013. The operation performed were only sclerotomy and anterior chamber reformation. Conjunctival peritomy was performed in superior nasal 4 mm from limbal. During the surgery, sclerotomy was decided to be done with 25 G needle from superior limbal, adding the suture then anterior chamber reformation was done without any complication. Post-operatively, the patient was given Glaucon® 3 times daily, Aspar K 2 times daily, Timolol® 0.5% ED 2 times daily, sulfa atropine 1% ED 2 times daily, mefenamic acid 3 times daily, Cravit® and natacen ED hourly.

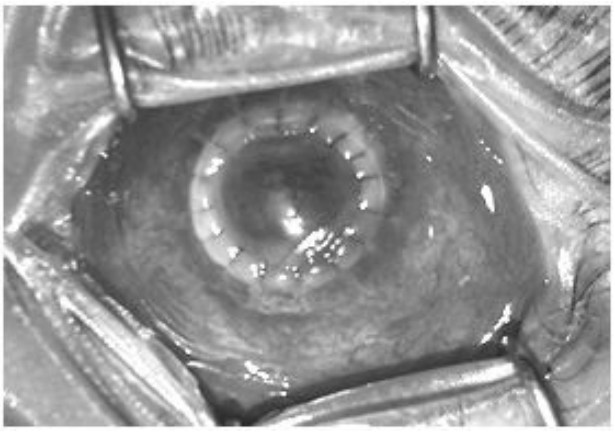

Fig 3. Picture before surgery showed flat anterior chamber and hyperemic conjunctiva.

Ophthalmology examination one day after surgery revealed deep anterior chamber and decreased IOP to 24 mmHg with the visual acuity of the LE remained unchanged. There was conjunctiva and ciliar injection, subconjunctiva bleeding at superonasal, corneal graft with seventeen stitches in buried knot. Anterior chamber deep, cells and flare were hard to be evaluated. There were fibrin, coagulum in iris at 5 o'clock, and no bubble. Iris and pupil were round and central. Lens and fundus were hard to be evaluated. The patient got Glaucon® 3 times daily, Aspar K 2 times daily, Timol® 0.5% ED 2 times daily, sulfa atropine 1% ED 2 times daily, mefenamic acid 3 times daily, Cravit® and

natacen ED hourly. Patient was allowed to go home and control four days afterwards.

Four days after surgery, the visual acuity of LE was still hand movement with good projection with IOP was 15 mmHg. There was conjunctiva and ciliar injection, corneal graft was hazy with seventeen 17 stitches in buried knot, and infiltrate in the edge of suture graft. Anterior chamber depth was in grade 3 with van Herick technique. Patient got Glaucon® 3 times daily, Aspar K 2 times daily, Timol® 0.5% ED 2 times daily, Cravit® and natacen ED every hour, itrakonazole 200 mg one time, sulfa atropine 1% ED 2 times daily, and the patient was asked to return in one week.

One week after surgery, follow up on April 12, 2013, the visual acuity of the LE remained unchanged, with IOP was 18 mmHg. There were conjunctival injection, opaque corneal graft, relatively deep anterior chamber on the LE. The patient got Glaucon® 3 times daily, Aspar K 2 times daily, Timol® 0.5% ED 2 times daily and the patient was asked to return in one week.

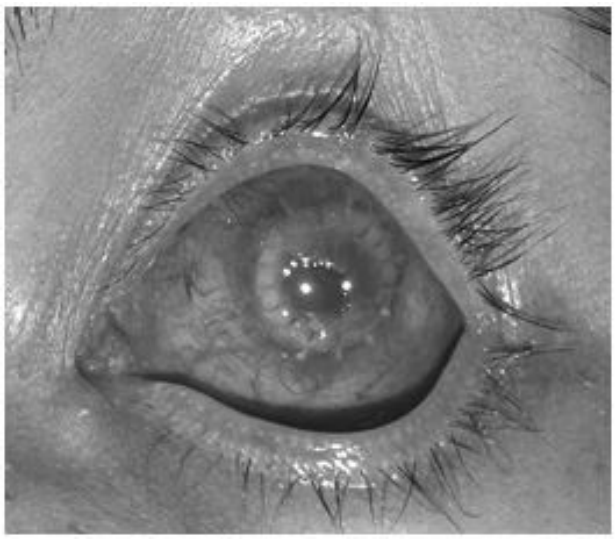

Fig 4. One week after surgery. Picture showed relatively deep anterior chamber and hyperemic conjunctiva

DISCUSSION

Patophysiology of aqueous misdirection glaucoma is multifactorial and may be related to distortion of the angle with collapse of trabecular meshwork, suturing technique, post-operative inflammation, use of corticosteroids, peripheral anterior synechiae (PAS) formation, and preexisting glaucoma. Patient came with chief complaint of ocular pain, headache, redness, blurred vision, vomiting after keratoplasty surgery. One day after keratoplasty surgery, the IOP decreased to 24 mmHg. Post penetrating keratoplasty glaucoma is defined as an elevated IOP greater than 21 mmHg, with or without associated visual field loss or optic nerve head changes.[10]

Kirkness et al reported a higher incidence of glaucoma in patients undergoing PK following corneal perforation, due to PAS formation and secondary angle closure.[11] However, this patient with history of perforated corneal ulcer on LE due to fungus got keratoplasty.

The diagnosis in this patient was complicated. It was also difficult to evaluate the condition of anterior chamber. The comprehensive history should include reports of previous trauma and previous reports of elevated pressure. However, it is important to determine if there are any anatomic changes that can be addressed to alleviate any significant increase in IOP. In this patient, gonioscopy can not visible due to the extensive anterior, posterior synechiae, shallowing or flat anterior chamber, opaque corneal graft.

The diagnosis of aqueous misdirection glaucoma after keratoplasty is primarily based on IOP measurement in the early post-operative period, optic disc changes[12] and progressive visual field changes in the late post-operative period. Patient with secondary glaucoma post-keratoplasty usually presents with recent history of keratoplasty, acute pain, headache, vomit, elevated intraocular pressure greater than 21 mmHg. In cases which records of intraocular pressure were not possible to do by Schiotz tonometry, digital tonometry was resorted to and only an unequivocal digital raise of pressure was considered as glaucomatous. In this case, slit lamp biomicroscopy showed a shallow anterior chamber. Visual field testing may be difficult to perform in patients with a corneal graft, especially in the early post-operative period. Gonioscopy showed angle closure from iridotrabecular contact. In eyes with opaque grafts and post–penetrating keratoplasty glaucoma, evaluation of the anterior segment and angle anatomy is not possible to do. The evaluation of IOP in the early

post-operative period; when the corneal surface is irregular, it can be measured with the pneumatic applanation tonometry, the tonopen, or recently the dynamic contour tonometry (DCT), despite the corneal thickness. In this case, tonopen was used to measure IOP in the early post-operative. In this case we could not do gonioscopy examination to see anterior chamber angle because it was obscured by corneal scars, edema and opacities at the host-recipient interface.

Ultrasound biomicroscopy (UBM) is useful to assess the angle and anterior segment anatomy in cases with corneal opacities which details of anterior segment are not clearly visible, in the thick cornea, the presence or absence of iridocorneal adhesions, peripheral anterior synechiae (PAS), and cyclitic membranes, secondary angle closure caused by anterior synechiae formation.[13]

AS-OCT allows a non-invasive, non-contact, and high-quality, real-time, cross-sectional imaging of the anterior segment. Example, an 88 year-old male with history of advanced glaucoma, on the both eyes were pseudophakic and had undergone penetrating keratoplasty. Slit lamp examination on the LE showed a completely opaque corneal graft and rim with vascularization (Fig 5). There was no view of the anterior chamber. OCT showed an opaque, thickened cornea and extensive PAS in all four meridians.[12]

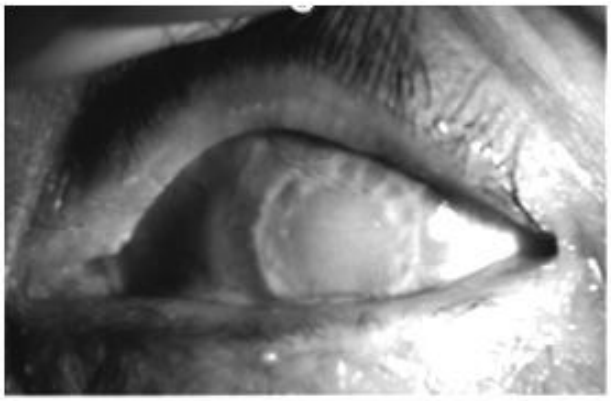

Fig 5. Slit lamp photograph

Diagnosis for the patient of this case can be appointed after glaucoma surgery was done because visual field testing, optic disc, and gonioscopy were difficult to perform in patients with a corneal graft, especially in the early post-operative period. UBM and AS-OCT were not available in RSCM Kirana.

The etiology of glaucoma after PK is multi-factorial and probably related to distortion of the angle with collapse of the trabecular meshwork, suturing technique technique, post-operative inflammation, and peripheral anterior synechiae.

In this patient, secondary angle closure glaucoma with pupillary block was caused by failure of anterior chamber formation and post-operative inflammation leading angle closure.

Other disorders that may induce post-operative anterior chamber shallowing include malignant glaucoma, pupillary block, post-penetrating keratoplasty glaucoma, and suprachoroidal hemorrhage. The diagnosis of PK glaucoma is made if IOP rises persistently after one month following PK in the presence of glaucomatous optic disc changes. Temporary IOP elevations due to inflammatory processes can occur in the early post-operative period, and this can interfere with the diagnosis of PK glaucoma.[2,14] Patients with a component of angle closure glaucoma are at greater risk for the development of malignant glaucoma. Malignant glaucoma presents with high intraocular pressure in the presence of patent peripheral iridectomy, axial shallowing of the anterior chamber, and absence of iris bombe. In cases of pupillary block glaucoma, a characteristic iris bombe is apparent, the anterior chamber will deepen after laser treatment.[6] A suprachoroidal hemorrhage presents with a shallow or flat chamber either intraoperatively or within a week post-operatively, normal or elevated intraocular pressure, ocular pain and increased inflammation. The findings include a dark brown or dark red choroidal elevation: with drainage through posterior sclerotomies will obtain bright or dark red blood is obtained.

Aqueous misdirection is a potential complication after keratoplasty that may occur days to months after surgery. The treatment goal in aqueous misdirection is clear to control IOP and reform the AC by breaking the cycle of aqueous misdirection and success of treatment is not well defined in the literature. In this case, there was a poor response to medical treatment. Successful IOP control, normalization in anterior chamber depth, and favorable visual outcomes were achieved with aggressive laser and surgical intervention.

The management of glaucoma depends largely on the clinical presentation. Management may include topical medications alone or in conjunction with surgical or laser interventions. The timing for surgical treatment varies depending on the degree of elevation of intraocular pressure. All of these kind of managements have been reported with various outcomes. Both medical treatment and surgery had been done in this case. Simmons et al reported that the initial management of malignant glaucoma mainly is medical. Topical cycloplegics (to promote the posterior displacement of the iris-lens diaphragm), topical aqueous suppressants and oral carbonic anhydrase inhibitors (to decrease the production of aqueous), systemic hyperosmotic agents (to shrink the vitreous), and topical steroids (to reduce the inflammation) have been recommended for medical therapy.[8] At the very first time, the patient received glaucoma medical therapy such as hyperosmotic agent (glycerin) 3 times 100 cc, topical beta blocker (Timol® 0,5%) ED 2 times daily, oral carbonic anhydrase inhibitor (Glaucon®) 4 times daily, Aspar K 2 times daily, sulfa atropine 1% ED 3 times daily and there were progressing elevated IOP until 30 mmHg with no improvement of visual function. However, when non-response occurs to conservative management, various other treatments have been recommended such as Nd:YAG capsulotmy or anterior hyaloidotomy, posterior sclerotomy and pars plana vitrectomy.[8,9]

Laser neodymium:YAG hyaloidotomy can be used in select pseudophakic and is effective in some cases by disrupting the anterior hyaloid and creating a chanel that can allow the fluid to flow to the anterior chamber. Argon laser also has been applied to the ciliary processes if they are visible through a peripheral iridectomy, so the processes shrink and no longer block the anterior flow of fluid.[15] The condition of this patient is phakic.

The surgical options available to treat the patients include pars plana vitrectomy. Simon et al reported 21 eyes requiring pars plana vitrectomy was successful in 67% of pseudophakic but only 25% of phakic eyes.[6]

The surgical options available to treat the patients include trabeculectomy, with or without antimetabolites, glaucoma drainage devices (GDD), and cyclo-destructive procedures. Several studies in the past have analyzed the success of each of these individual procedures, but no study to date has compared the surgical outcomes of these various procedures in the treatment of advanced glaucoma in patients with PKP. The procedure choice also may have been influenced by factors such as subconjunctival scaring, number of previous surgeries, number of additional procedures done at the time of the glaucoma procedure, patient age and general health, and preoperative VA.

The difficulty with glaucoma surgery after keratoplasty is to perform the operation with minimal adverse effects on the corneal graft. Mitomycin C is an antiproliferative agent which is used to improve the filtration effect of trabeculectomy. The efficacy and safety of trabeculectomy with mitomycin C after penetrating keratoplasty is still not clear. Ishioka et al reported that trabeculectomy with mitomycin C achieved a statistically lower ocular pressure compared with trabeculectomy without mitomycin C and the number of glaucoma medication required were also lower when mitomycin C was used and graft clarity rate was better in mitomycin C. Ishioka et al reported success rate in IOP control with mitomycin C trabeculectomy in patients with post penetrating keratoplasty glaucoma is 73% and that of graft clarity is 69.2%. Ramesh et al reported the incidence of graft failure after conventional trabeculectomy was 4% to 34%. Trabeculectomy is technically difficult and we didn't recommend the trabeculectomy in our cases, because the patient still in early post-operative periode, that can make conjunctival scarring and could carry a poor prognosis.

Penetrating keratoplasty and glaucoma drainage device (GDD) implantation have been successful in preserving vision and controlling IOP in patients with corneal opacities and glaucoma, although post-operative graft decompensation has been reported to occur in 43% to 60% of cases with a follow up of 19 to 38 months. Hodkin et al reported graft failure as the most frequent complication (46%) in 20 patients followed up for a mean of 26 months after Baerveldt drainage device implantation for complicated glaucoma, and Sherwood et al reported a graft failure rate of 42% among 26 patients followed up for 22 months after PK and

GDD implantation. Romaniuk et al found that Ahmed Glaucoma Valve (AGV) successfully controlled post-penetrating keratoplasty glaucoma in 73.5% eyes in 1 year.[16] Panda et al found that AGV successfully controlled post-penetrating keratoplasty glaucoma in 85% eyes in 1 year. The incidence of graft rejection following AGV have been reported between 15% and 41%. In this case, we did not use the glaucoma drainage device because of the pre-operative inflammation of anterior segment and we planned to do glaucoma drainage device if IOP was still high for one month.

Posterior sclerotomy was described with weber in 1877 as a surgical treatment for malignant glaucoma. This probably succeeded because of vitreous loss through the wound. This technique was described again during the 1950s and 1960s combined with reformation of the anterior chamber with air.[6] At one month post-operative sclerotomy and reformation anterior chamber follow up, visual acuity of the left eye remained unchanged hand movement with wrong projection and intraocular pressure getting normal. Diagnosis to this patient can be appointed after glaucoma surgery was done.

CONCLUSION

Uncontrolled IOP after penetrating keratoplasty is one of the leading causes of graft failure and visual loss in this patient population. It is mandatory that the IOP is monitored on a regular basis after corneal transplantation and aggressively treated if found high. Any patient with pre-existing glaucoma must be carefully evaluated prior to the corneal transplants. Optimal surveillance and aggressive medical and surgical management can salvage both graft and vision in these already compromised eyes. We also emphasize the role of the echographic examination, which must be performed as soon as possible in eyes in which malignant glaucoma is suspected.

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