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Evaluation of secondary glaucoma following penetrating keratoplasty

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Abstract: *Glaucoma following Penetrating Keratoplasty is a serious problem on account of its frequency of occurrence, risk of graft failure, irreversible visual loss due to optic nerve damage and difficulty in diagnosis and management. This is a study of 98 patients who underwent penetrating keratoplasty.in this study we have tried to evaluate incidence, etiological factors and ultrasound biomicroscopy findings of late onset secondary glaucoma following penetrating keratoplasty.*

Keywords: *Glaucoma, Penetrating keratoplasty, Risk factors, Aphakia , Pseudophakia*

I. Introduction

Using the World Health Organization's (WHO; Geneva, Switzerland) blindness definition,45 million people worldwide are bilaterally blind ,of which 6 to 8 million are blind due to corneal diseases .In India there are around 6.8 million people who have corneal blindness with vision<6/60 in atleast one eye and of these ,about 1 million have bilateral corneal blindness . If the present trend continues ,it is expected that the number of corneal blind individuals in India will increase to 10.6 million by 2020.

In India nearly 3.5 million good quality donor corneas are required to restore vision in all the eyes that can be treated with keratoplasty. Appx 20,000 corneas or eyes are collected annually, while every year ,appx 40,000 new cases of corneal blindness are added to the existing backlog.

Penetrating Keratoplasty , with its refined techniques and advanced research, has promised visual rehabilitation to a majority of patients and has proven its worth.

Glaucoma following Penetrating Keratoplasty is a serious problem on account of its frequency of occurrence, risk of graft failure ,irreversible visual loss due to optic nerve damage and difficulty in diagnosis and management. The chronic elevation of intraocular pressure is a cause of significant ocular morbidity and is an important underlying factor in the poor visual acuity which frequently follows successful Keratoplasty with an optically clear graft.

Post keratoplasty glaucoma , an entity most difficult to monitor an account of inaccurate IOP measurement with tonometers ,problematic visual field recording and inaccurate disc assessment, still poses a challenge to ophthalmologists worldwide and has eluded a host of researchers and surgeons to discover a normogram for the benefit of such patients. Improved technology, enthusiasm and a thirst for excellence has led to a new frontier in the diagnosis and management of such patients i.e. pneumotonometers ,tonopen , lasers etc and has given a new hope for these patients but it is for prospective studies to investigate into the benefit and relative risks before such modalities become established worldwide in management of post penetrating keratoplasty glaucoma.

Awareness of susceptible groups and avoidance of predisposing factors may allow more rigorous supervision, so early diagnosis may be made and prolonged periods of raised pressure may be avoided. With the various new modalities in medical and surgical treatment peeking over the horizon,it shall definitely lead to a new dimension for the better and longer survival of vision in such compromised eyes.

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II. Aims Of Study

- To find out incidence of late onset secondary glaucoma following penetrating Keratoplasty
- To study etiological factors contributing to secondary glaucoma following penetrating keratoplasty
- To study the association of late onset secondary glaucoma following penetrating Keratoplasty with pre operative Ultrasound bio-microscopy findings.

III. Materials And Methods

Preoperative Assessment

The study was done in 98 eyes of 98 patients.A complete detailed history taking, preoperative examination with slit lamp bio-microscopy and intraocular pressure measurement was done in each and every patient. Intraocular pressure was measured with tonopen and in case of severely scarred or grossly oedematous cornea, IOP was assessed digitally. UBM was done in patients in whom details of anterior segment not appreciated by slit lamp. Preoperative glaucoma was defined as IOP more than 21 mm Hg or found out to be digitally high.

Operative Procedure

All penetrating keratoplasty were performed in a standard manner & ocular anaesthesia was acquired by peribulbar technique with lignocaine, bupivacaine and hyaluronidase 150 U/ml or with retro bulbar lignocaine 1.5-2 ml with facial nerve block in all patients. Pre operative ocular hypotension was achieved by giving Tab. Acetazolamide 250 mg (2 stat in the morning).

In all cases donor cornea(button) was 0.5 mm larger than recipient corneal button excised. After the donor button size was determined, the host cornea was marked superficially with the appropriate trephine, anterior chamber entry was done with 15 no blade and then button was excised with corneo scleral scissors. In all patients with A.C.IOL, the IOL was removed. In cases where vitreous was adherent to cornea or was present in anterior chamber or in aphakic eyes or where IOL was removed, an open sky vitrectomy was performed using cotton swabs and corneo-scleral scissors. Synechiae were broken by a synechiotome and viscodissection was done using hydroxypropylmethyl cellulose. Pupilloplasty was done in all cases of sector iridectomies using 10/0 nylon suture in order to create a more rigid iris diaphragm.

The donor cornea was then sutured in place with 4 intermittent cardinal sutures of 10/0 nylon and rest intermittent 12 interrupted sutures with 10/0 nylon were taken accordingly. The AC was formed with BSS or air.

Postoperative Management

Post operatively, all the patients were routinely treated with topical prednisolone acetate (1%) eye drops 6 times per day for 1 month then prednisolone drops were substituted by dexamethasone (0.1%) 4 times daily for 1 month and then dexamethasone was replaced by flourometholone(0.1%) 4 times a day then it was tapered very slowly. Systemic antibiotics, anti inflammatory & analgesics were given for 5 days. Some patients were given oral acetazolamide for few days. In few cases where patients were likely to develop severe post operative inflammation systemic steroids (Tab Prednisolone) were used in the range of 1 mg/kg/day in a gradual tapering dose spanning over weeks.

As late onset post PK glaucoma is defined as glaucoma developing 4 weeks after PK, for the purpose of study, patients were followed up at the interval of 1 month with slit lamp examination & intraocular pressure measurement(IOP) to exclude the developing early onset post PK glaucoma. Then patients were followed up at the interval of 3 month and 6 months in similar way. In the presence of graft infection and epithelial defect, IOP was determined digitally and not by tonopen.

Diagnostic Criteria

Post-PK glaucoma- Elevated IOP greater than 21 mm Hg, with or without associated visual field loss or optic nerve head changes.

IV. Results

Incidence of Glaucoma according to indication for keratoplasty

Indication for keratoplasty	**Total**	**Glaucoma**	
	No of patients	No of patients	Percentage
Corneal scarring	41	8	19.51%
Adherent leucoma	23	8	34.78%
Corneal dystrophy	10	1	10%
PBK	20	4	20%
ABK	4	3	75%
Total	98	24	24.5%

In this study, post PK glaucoma was seen in 75% of patients with ABK, 34.78% of patients with adherent leucoma followed by PBK, corneal scarring & corneal dystrophy.

AC IOl	Post PK Glaucoma		Total
	Yes	No	
Yes	3	0	3
No	21	74	95
Total	24	74	98

AC IOL Vs Post PK Glaucoma

On applying fisher exact test, pre operative finding of AC IOL was found statistically associated with development of post PK Glaucoma (P value-0.0133)

Aphakia	Post PK Glaucoma		Total
	Yes	No	
Yes	4	2	6
No	20	72	92
Total	24	74	98

Aphakia Vs Post PK Glaucoma

On applying chi-square test (with Yates correction), pre operative finding of aphakia as found statistically significantly associated with development of post PK Glaucoma (P value-0.0466)

PAS on UBM	Post PK Glaucoma		Total
	Yes	No	
Yes	9	7	16
No	6	28	34
Total	15	35	50

PAS Vs Post PK Glaucoma

On applying chi-square test, pre operative finding of Peripheral anterior synechiae on UBM was found statistically significantly associated with development of post PK Glaucoma (P value-0.005)

Graft size	Post PK Glaucoma		Total
	Yes	No	
<8.0 mm	18	71	89
>8.0 mm	6	3	9
Total	24	74	98

Graft Size Vs Post PK Glaucoma

On applying chi-square test (with correction), graft size of >8.00mm was found statistically associated with development of post PK Glaucoma (P value-0.0073)

In this study final analysis was done with 98 patients to observe late onset glaucoma following PK. In the study, maximum no of patients (33,33.67%) were in age group of 30-45 years and mean age was 47.67+15.79 years and out of 98 patients, 69 (70.41%) were males and 29 (29.59%) were females. 41 (41.84%) patients had corneal scarring, 23 (23.47%) had adherent leucoma, 20 (20.47%) had pseudophakic bullous keratoplasty, 10(10.2%) had corneal dystrophy and 4(4.08%) had ABK.

Out of 98 patients, UBM was done in 50 patients. Out of these 50 patients 16(32%) had peripheral anterior synechiae, 18(36%) had Adherent leucoma, 28(56%) were phakic, 13(26%) had PC IOL, 3(6%) had AC IOL and 6(12%) were aphakic. Graft size was 7.5 mm in 64(65.31%) patients and > 8 mm only in 9(9.18%) patients.

Out of 98 patients, 11(11.2%) patients had developed post PK glaucoma by the end of 3 months but at 6 months 24(24.4%) patients had post PK glaucoma. Post PK glaucoma was seen in 75% of patients with ABK, 34.78% of patients with adherent leucoma followed by PBK, corneal scarring & corneal dystrophy.

Pre operative finding of AC IOL was found statistically associated with development of post PK Glaucoma (P value-0.0133).Pre operative finding of aphakia as found statistically significantly associated with development of post PK Glaucoma (P value-0.0466).Pre operative finding of Peripheral anterior synechiae on UBM was found statistically significantly associated with development of post PK Glaucoma (P value-0.005).Graft size of >8.00mm was found statistically associated with development of post PK Glaucoma (P value-0.0073)

V. Discussion

In the present prospective analytic study of 98 patients undergone optical PK, around half (49%) of the patients were in 15-45 years of productive age group of life and these patients have risk of development of glaucoma leading to graft failure for remaining years of life.Post PK glaucoma is the second leading cause of Graft failure after Graft rejection. In this study, out of 98 patients, 14(14.3%) developed graft rejection, 24 (24.5%) developed glaucoma, 16(16.3%) developed Graft infection & 27 (27.6%) developed Graft Failure. Similar rate for graft rejection was noted by Maguire, Stark, Gottsch j et al[(51)]and for glaucoma by Foulks GN(14) & Olson RJ [(15)]

The leading indications for penetrating keratoplasty in developing countries are corneal scarring and adherent leucoma[(52)] which is unlike in the developed countries where indications such as keratoconus, pseudophakic bullous keratopathy and fuch's endothelial dystrophy are more common.[(53)]In the present study, leading indications of PK were corneal scarring (41,41.84%) followed by adherent leucoma(23, 23.47%), PBK (20, 20.41%) corneal dystrophy (10, 10.20%) and ABK (4, 4.08%). Post PK glaucoma was seen in 3(75%) patients of ABK, 8(34.78%) patients of Adherent leucoma and in 1(10%) patient of corneal dystrophy. The study identified ACIOL(p value-0.0133) & Aphakia (P value-0.0466) as important risk factors for development of post PK Glaucoma. Significant association with ACIOL might be due to the fact that AC IOL directly damages trabecular meshwork in addition to the mechanical collapse of trabecular meshwork due to loss of posterior support and Aphakia leads to mechanical collapse of trabecular meshwork.

UBM was done pre operatively in 50(51.02%) patients in whom details of anterior segment were not appreciated by slit lamp and thus peripheral anterior synechiae were identified in 16(32%) patients on UBM. Pre operative finding of PAS was significantly associated with the development of glaucoma post operatively in this study (p value-0.005) and similar findings were also found by Nguyen NX et al[(54)]. Pre existing glaucoma and Aphakia have been identified as the important risk factors for post PK glaucoma by Simmons RB[(55)]et al and Sekhar GC[(56)] et al. Presence of PAS pre operatively may be an indicator for the presence of preoperative glaucoma which is likely to be missed because of difficulties in measuring IOP, disc and visual field evaluation in the presence of scarred and edematous cornea. DADA T at el had performed UBM in patients developing glaucoma after PK and noted presence of PAS on UBM in 96.7% of the patients[(57)] which signifies the importance of PAS in causation of post PK glaucoma.

PAS leading to progressive angle closure is the main cause for the development of post PK glaucoma with the degree of synechial closure strongly correlated with the need for surgery.[(7)]. Identification of PAS pre operatively by UBM may aid in proper synechiolysis intra-operatively & planning measures to prevent progression of PAS to reduce chances of development of glaucoma and graft failure. UBM serves as a useful tool for anterior segment evaluation and can help in planning the site for glaucoma filtering surgeries and drainage devices.[(58)] PAS can develop and progress with shallowing of anterior chamber so anterior chamber depth should be maintained during surgery and careful wound closure will prevent post-operative wound leaks. Some authors also recommend a routine peripheral iridectomy to avoid a postoperative pupillary block. Topical steroids and cycloplegics are also prescribed frequently after surgery to maximally suppress postoperative inflammation.[(59)]

A floppy atrophic iris may also lead to a higher incidence of PAS formation, which can be prevented by iris suturing or iridoplasty.[(71)(20)]

In addition to PAS, UBM can also identify presence of aphakia, AC IOL, mal-poisoning of IOL, presence of vitreous in AC, angle recession and many other anterior segment pathologies even in the presence of corneal opacity and oedema. Thus pre-operative UBM can identify risk factors leading to development of post PK complications & amount of risk can be quantified. If particular attention is paid for the presence of these risk factors pre operatively in PK patients, monitored vigilantly and treatment is started early and aggressively, it may be possible to reduce the chances of graft failure. Graft size of more than 8 mm was also found to be an important risk factor for development of post PK glaucoma (p value-0.0073).

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