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Original Research Article

To Evaluate the Therapeutic Safety and Efficacy of Surgery and to Offer Further Information on Cases of Phakic Eyes with Extended Intervals Between the Development of Malignant Glaucoma and Surgery

Amar Kumar[1], Tripti Thakur[2], M. S. Ali[3]

[1]Senior Resident, Department of Ophthalmology, IGIMS, Patna, Bihar, India

[2]Senior Resident, Department of Ophthalmology, IGIMS, Patna, Bihar, India

[3]Additional Professor, Department of Ophthalmology, IGIMS, Patna, Bihar, India

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Corresponding Author: Dr. Tripti Thakur
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Abstract

Aim: The objectives of this work were to evaluate the therapeutic safety and efficacy of surgery and to offer further information on cases of phakic eyes with extended intervals between the development of malignant glaucoma and surgery.

Methods: at the current study, which was carried out at the Department of Ophthalmology at the Indira Gandhi Institute of Medical Sciences in Patna, Bihar, India for one year, the participants were consecutive patients who had undergone core vitrectomy-phacoemulsification-intraocular lens (IOL) implantation-capsulo-hyaloidotomy at least one month after the commencement of malignant glaucoma surgical procedures.

Results: This retrospective study examined 10 malignant glaucoma patients who underwent core vitrectomy, phacoemulsification, IOL implantation, and capsulohyaloidotomy. All eyes exhibited primary angle-closure glaucoma (PACG);7 (70%) developed it after trabeculectomy. The average onset-to-surgery time was 6.8 months. IOP, number of IOP-lowering drugs, and ACD differed pre- and post-op (P=0.046, 0.004, and 0.005). Complete, qualified, and anatomical success occurred in 38.5%, 77%, and 100% of eyes.

Conclusion: The procedure of core vitrectomy-phacoemulsification-IOL implantation-capsulo-hyaloidotomy is a safe and successful treatment for long-term phakic malignant glaucoma.

Keywords: phakic; malignant glaucoma; surgical management; long time interval

Introduction

Malignant glaucoma (MG) is an uncommon and potentially severe kind of secondary angle closure. It is characterised by a widespread shallow front chamber of the eye, normal to high intraocular pressure (IOP), and the existence of one or more open iridotomies/iridectomies. Due to its assumed cause, this condition is sometimes referred to as ciliary block glaucoma, cilio-vitreo-lenticular block glaucoma, and aqueous misdirection syndrome. [1,2] Traditionally, MG is documented to happen in eyes with angle-closure glaucoma after undergoing filtration surgery. However, the syndrome may also occur following certain ocular procedures in eyes that are physically prone to it, regardless of whether glaucoma is present or not. The occurrence of this event can happen at any time following the intervention, ranging from the immediate aftermath to several years later. [3,4]

Following the diagnosis of MG, the initial care should involve the use of tropical cycloplegics, topical aqueous humour suppressants, and anti-inflammatory drugs. Nevertheless, it has been documented to have a success rate of just approximately 50% in patients, with an almost 100% recurrence rate. [5,6] Various lasers designed for office use can be employed as a secondary treatment option. The Nd:YAG laser, which aims to establish a direct connection between the front and back parts of the eye, has been a well-recognized choice for treating eyes without a natural lens for almost four decades. [7-11] The effectiveness of transscleral cyclophotocoagulation (TSCPC) has been the subject of discussion for the past ten years. Furthermore, the contraction of the ciliary body can lead to a decrease in the generation of aqueous fluid. This contraction can also cause the ciliary-hyaloid interface to become disrupted, resulting in the redirection of aqueous flow towards the front of the eye.

The surgical management of malignant glaucoma involves disrupting the series of events that underlie its pathophysiological process. In the classical manifestation of this complication, there is an accumulation of aqueous humour in the vitreous cavity due to ciliary blockage. Consequently, there is an elevation in vitreous pressure which is transmitted to the structures of the anterior segment, leading to a forward displacement of the lens-iris diaphragm. [12] Malignant glaucoma typically arises rapidly, usually within a few days following initial surgery, and is directly linked to the technique that was performed. However, it can also be delayed in some cases. [13] Recurrences of malignant glaucoma can occur following successful pars plana vitrectomy (PPV) as well as after conservative treatment. [14,15] The recurring clinical symptoms of malignant glaucoma are likely due to the continued presence of the major mechanism responsible for the buildup of aqueous humour in the back part of the eye.
The objective of this study was to gather more information about cases of phakic eyes that experience long periods of time between the beginning of malignant glaucoma and surgery. The study also aimed to evaluate the safety and effectiveness of surgery as a treatment option.

Methods

The present study was conducted in the Department of Ophthalmology, IGIMS, Patna, Bihar, India and included consecutive patients who underwent core vitrectomy-phacoemulsification-intraocular lens (IOL) implantation-capsulo-hyaloidotomy at least 1month after the onset of malignant glaucoma.

Malignant glaucoma was defined as uniform shallowing to flattening of the central and peripheral anterior chambers, and with intraocular pressure (IOP) over 22 mm Hg.

Patients were excluded if they had:

1) a suprachoroidal effusion or hemorrhage,

2) pupillary block,

3) lens subluxation.

Methodology

Age, sex, preexisting glaucoma type, previous surgery type, and preoperative and postoperative information, including onset to surgery interval (months), axial length (AL), corneal endothelium density (/mm2), number of IOP-lowering medications used, best-corrected visual acuity (BCVA), IOP, anterior chamber depth (ACD), follow-up duration (months), and complications were obtained from a review of the medical records. The time interval between onset and surgery is from the diagnosis time of the patients at the other hospitals to their surgeries in our hospital. The IOP was measured by Goldmann applanation tonometry. The BCVA was measured using a Snellen chart and then converted to the logarithm of the minimum angle of resolution (logMAR) for statistical analyses. The ACD was measured from the central inner corneal surface to the most anteriorly visible part of the lens (preoperative) or IOL (postoperative) by ultrasound biomicroscopy (UBM) as previously described. [16] The corneal endothelium density was counted by specular microscopy according to manufacturer's instruction. [17]

Treatment Protocol and Surgical Techniques
Medical treatment was attempted using 1% atropine sulfate, topical steroid, and topical and systemic IOP-lowing medications. If reformation of the anterior chamber was not achieved in 7d, surgery was performed using the following techniques. A 23-gauge vitrectomy probe was inserted through the pars plana, 3.5 mm posterior to the limbus, using a trocar under peribulbar anesthesia. A limited core vitrectomy was performed (2500-5000 cuts/min, 0-500 mm Hg vacuum) to debulk the vitreous body and soften the eye under microscope illumination. A temporal, self-sealing, transparent corneal incision was made to avoid the conjunctival bleb. An ophthalmic viscosurgical device was then injected to deepen the anterior chamber. Hydrodissection and hydrodelineation were performed after continuous curvilinear capsulorhexis. The lens was extracted using standard phacoemulsification and irrigation/aspiration. A foldable IOL was then implanted in the capsular bag. Subsequently, posterior capsulotomy and anterior vitrectomy were performed using a 23-gauge vitrectomy probe with irrigation of the corneal incision. The transconjunctival pars plana entry site was sutured with 7-0 absorbable sutures. Tobramycin and dexamethasone solution (Tobradex; Alcon, Fort Worth, TX, USA) was administered every 2h during week 1, and four times per day during weeks 2-4 after surgery. Tobramycin and dexamethasone ointment (Tobradex; Alcon, Fort Worth, TX, USA) was used every night during the first month. IOP-lowering medications were used if the postoperative IOP was higher than 21 mm Hg.

Data Analysis

Demographic and clinical data were analyzed by descriptive statistics using SPSS version 20.

Results

Table 1: Demographic and clinical data

Variables	Mean±SD	Median, range
Age, years	49.6±14.6	49, 17-72
Onset to surgery interval, mo	6.8±12	1, 1-48
AL, mm	19.6±2.8	19.7, 15.7-22.8
Corneal endothelium densitya, /mm2	946.4±1146.4	320.8, 0-2780
Preoperative VA, logMAR	2.2±0.9	2.7, 0.5-2.8
Postoperative VA logMAR	1.7±0.6	1.7, 0.2-2.8
Preoperative IOP, mm Hg	33.7±12.2	27.7, 14-60
Postoperative IOP, mm Hg	21.5±12.7	16.4, 7-47
Preoperative number of IOP-lowering medications used	2.8±1.2	3, 1-5
Postoperative number of IOP-lowering medications used	1±1.5	0, 0-4
Preoperative ACDc, mm	0.46±0.48	0.22, 0-1.25
Postoperative ACDd, mm	2.78±0.64	2.86, 1.59-3.71
Follow-up, mo	14.4±9.4	13.5, 3-37
Sex (male:female)	4:6	
Eye (OD:OS)	8:5	
Diagnosis	PACG	
Previous treatment, %		
Trabeculectomy	70	
Diode laser cyclodestruction	10	
Pilocarpine	10	
Rate, %		
Anatomical success	100	
Complete success	40	
Qualified success	80	
Recurrence	0	
Complication, n		
Corneal endothelial decompensation	3	

This retrospective study reviewed 10 consecutive malignant glaucoma patients who underwent core vitrectomy, phacoemulsification, IOL implantation, and capsulohyaloidotomy. All eyes had been diagnosed with primary angle-closure glaucoma (PACG); 7 eyes (70%) developed the condition after trabeculectomy. The mean onset to surgery interval was 6.8 months.

Table 2: Preoperative clinical data

S No.	Age/Sex	Laterity	Pre-operative						
			Onset to surgery interval (mo)	BCVA logMAR	IOP (mm Hg)	No. of medications used	ACD (mm)	AL (mm)	Corneal endothelium density (/mm2)
1	43/M	OD	48	2.7	14	3	0	19.7	0
2	48/M	OD	3	2.7	27 2	0.86	22.8	0	12
3	38/F	OS	12	2.7	24	3	0	22.8	0
4	46/M	OD	12	1	27.7	3	0.19	17.9	2529
5	62/M	OD	1	2.7	52	4	1.24	15.8	2780
6	56/F	OD	6	2.7	33	1	0	17.4	NA
7	58/M	OS	2	2.7	34.6	2	0.78	21	641
8	64/F	OD	1	0.5	22	4	1.25	22.3	2363
9	68/M	OD	1	1.5	15	1	0.05	17.7	1030
10	57/M	OS	1	0.52	46	5	0.72	21.7	2023

Table 3: Post-operative clinical data

S No.		Post-operative							
	No. of medications used	BCVA logMAR	IOP (mm Hg)	ACD (mm)	Anatomical success	Complete success	Qualified success	Recurrence	Complication
1	0	2.7	21	3.04	1	0	1	0	CED
2	0	1.4	13	2.14	1	1	1	0	CED
3	4	1.7	19	1.59	1	0	0	0	CED
4	2	2.8	21	Deep	1	1	0	0	
5	1	2.8	47	2.14	1	0	0	0	
6	0	2.7	21	3.04	1	0	1	0	
7	2	1.1	19.3	3.23	1	1	1	0	
8	1	0.2	16.4	3.71	1	0	1	0	
9	0	1.1	19.3	3.2	1	1	1	0	
10	4	0.3	42.8	3.45	1	0	1	0	

This retrospective study reviewed 10 consecutive malignant glaucoma patients who underwent core vitrectomy, phacoemulsification, IOL implantation, and capsulohyaloidotomy. All eyes had been diagnosed with primary angle-closure glaucoma (PACG); 7 eyes (70%) developed the condition after trabeculectomy. The mean onset to surgery interval was 6.8 months. Significant preoperative and postoperative differences were detected in the IOP (P=0.046), number of IOP lowering medications used (P=0.004), and ACD (P=0.005). Complete success, qualified success, and anatomical success was achieved in 38.5%, 77%, and 100% of the eyes, respectively. The demographic and clinical data are shown in Tables 1, 2 and 3.

Discussion

Aqueous misdirection syndrome, also known as malignant glaucoma, is a term used to describe a range of disorders that share certain characteristics. These disorders usually involve a shallow or flat anterior chamber, along with elevated, normal, or occasionally low intraocular pressure at some point during the disease. The condition occurs even when there is a clear peripheral iridectomy and no retinal issues such as suprachoroidal haemorrhage or choroidal effusion. [12-18] Eyes affected by primary angle closure disease have a heightened vulnerability to developing this disorder. [19,20] The occurrence typically arises after intraocular surgery, particularly glaucoma filtering surgery, or laser operations such as laser iridotomy, laser cyclophotocoagulation, laser posterior capsulotomy, and laser suture lysis. In rare cases, it has also been shown to happen spontaneously. [21] The patients covered in this current case series had the following characteristics: 1) All participants had been diagnosed with primary angle-closure glaucoma (PACG); 2) The participants had a short axial length, with a mean of 19.7 mm and a range of 15.7-22.8 mm; 3) The participants had a low corneal endothelium density, with a mean of 947.2/mm2 and a range of 0-2780/mm2; 4) The participants had a long time interval between the onset of symptoms and the surgery, with a mean of 6.9 months and a range of 1-48 months. All eyes in the previously reported research, except for two cases in Krėpštė et al [22] where malignant glaucoma was well managed with drugs over a lengthy period of time, had short time intervals. Conversely, the current investigation involved patients with extended time intervals. Unlike the extended duration of follow-ups, all ten cases included in this study were administered medical therapy, which consisted of 1% atropine sulphate, topical steroids, and topical and systemic drugs to regulate intraocular pressure, once they were diagnosed at our hospital. If the restoration of the anterior chamber was not accomplished within a period of 7 days, a surgical procedure was carried out. Patients exhibiting the aforementioned characteristics are typically regarded as having a bleak prognosis, with surgery expected to provide minimal benefit. This is due to the varying degrees of optic disc damage caused by high intraocular pressure (IOP) and corneal endothelial dysfunction resulting from physical contact between the lens and cornea, which may differ depending on the duration of the disease. Nevertheless, our case series demonstrated comparable gains in visual acuity (VA), intraocular pressure (IOP), the number of IOP-lowering drugs taken, and anterior chamber depth (ACD) when compared to earlier findings that included patients with shorter time intervals. The favourable surgical outcome observed in the present study can be attributed to the utilisation of the surgical technique employed.

This retrospective study reviewed 10 consecutive malignant glaucoma patients who underwent core vitrectomy, phacoemulsification, IOL implantation, and capsulohyaloidotomy. All eyes had been diagnosed with primary angle-closure glaucoma (PACG); 7 eyes (70%) developed the condition after trabeculectomy. The mean onset to surgery interval was 6.8 months. Significant preoperative and postoperative differences were detected in the IOP (P=0.046), number of IOP lowering medications used (P=0.004), and ACD (P=0.005). Complete

success, qualified success, and anatomical success was achieved in 38.5%, 77%, and 100% of the eyes, respectively. Previous studies reported that oxidative stress in eyes with glaucoma eyes might promote vitreous liquefaction [23], starting from the central vitreous and progressing to the cortex of the vitreous body.[24] Therefore, effective technique might involve creating a channel connecting the vitreous cavity and the anterior chamber, thus breaking the vicious circle of aqueous misdirection. Compared with most of the previous studies. [24-26]

Longstanding iridocorneal touch resulted in a decrease in corneal endothelium density, with a mean of 947.2/mm2; 50% of the eyes had a corneal endothelium density of 0. Only two of the six patients with a corneal endothelium density of 0 (counted by endothelioscopy) eventually developed postoperative corneal endothelial decompensation. Their Vas were restored to different degrees after Descemet membrane endothelial keratoplasty (DMEK) surgeries (all clinical data of these two eyes were obtained from the period before DMEK was performed). The above observation suggests that the postoperative corneal endothelial decompensation might not be occurred even though the preoperative endothelioscopy test result is poor. A possible explanation is that endothelioscopy might underestimate the corneal endothelium density in the eyes without anterior chamber. For these eyes, the corneal edema might recover with a certain period of time after operation.

In our study, two cases of pseudophakic malignant glaucoma were treated successfully by using an anterior chamber approach consisting of a capsulo-hyaloidectomy and anterior vitrectomy performed through a peripheral iridectomy, creating a permanent passage between the anterior chamber and vitreous cavity by eliminating the aqueous misdirection. Debrouwere et al. emphasized that total vitrectomy was not effective in 66% of their patients unless an zonulectomy was added to the procedure. [27] The necessity of the establishment of a permanent passage between the anterior chamber and vitreous cavity was well demonstrated in another study, all of the five pseudophakic patients were successfully treated with a combined pars plana anterior vitrectomy, hyaloidectomy, zonulectomy, and peripheral iridectomy, and no recurrence was observed. [28]

However, the vitreous cutter had to be inserted through a pars plana incision in their technique which was a rather blind and more dangerous technique than that of the safer anterior chamber approach used in our patients. Malignant glaucoma was not recurred in our patients. The procedure may not only prevent recurrences but also may be helpful in the achievement of long-term IOP control. It has the advantage of a shorter operation time, and appears to be technically easier and potentially safer to be used for the anterior segment surgeon. Malignant glaucoma is relatively a rare disease, which makes it difficult to collect a large group of patients.

Despite the small number of patients and short duration of follow-up, we believe that zonulectomy, hyaloidectomy, and anterior vitrectomy procedure performed through a peripheral iridectomy by using a vitreous cutter via clear corneal incision was a valuable option in the management of pseudophakic malignant glaucoma.

Conclusion

Finally, the current study showed that core vitrectomy phacoemulsification-IOL implantation-capsulo-hyaloidotomy is a safe and efficient treatment for patients with malignant glaucoma who have long intervals between the onset of the disease and surgery, achieving a high rate of anatomical success and low rate of postoperative problems. The operations deepened the ACD and greatly decreased the IOP and the number of IOP-lowering drugs utilized.

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