e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(2); 530-537

Original Research Article

A Hospital-Based Assessment of the Effectiveness of Surgical Management of Malignant Glaucoma in Phakic Eyes

Amit Rajan[1], Farmood Alam[2], Arun Kumar Sinha[3]

[1]Senior Resident, Department of Ophthalmology, Bhagwan Mahavir Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India
[2]Senior Resident, Department of Ophthalmology, Bhagwan Mahavir Institute of Medical Sciences, Pawapuri
[3]Prof. & Head, Department of Ophthalmology, Bhagwan Mahavir Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India

Received: 25-12-2022 / Revised: 15-01-2023 / Accepted: 03-02-2023
Corresponding author: Dr. Amit Rajan
Conflict of interest: Nil

Abstract

Aim: This study aimed to provide additional data on cases of phakic eyes characterized by long time intervals between malignant glaucoma onset and surgery and to assess the therapeutic safety and efficacy of surgery.

Methods: The present study was conducted at Department of Ophthalmology, Bhagwan Mahavir Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India for one year and included consecutive patients who underwent core vitrectomy-phacoemulsification-intraocular lens (IOL) implantation-capsulo-hyaloidotomy at least 1month after the onset of malignant glaucoma.

Results: 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); 8 eyes (80%) developed the condition after trabeculectomy. The mean onset to surgery interval was 6.9 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.

Conclusion: Core vitrectomy-phacoemulsification-IOL implantation-capsulo-hyaloidotomy is safe and effective for treatment of long onset phakic malignant glaucoma.

Keywords: Phakic, Malignant Glaucoma, Surgical Management, Long Time Interval.

Introduction

Malignant glaucoma or aqueous misdirection syndrome is described as elevated intraocular pressure (IOP) and a uniform flattening of the central and peripheral anterior chamber in the presence of a patent iridotomy. It occurs most often after filtration surgery in eyes with angle closure glaucoma. [1-3] but has also been described after cataract extraction [4], laser iridotomy [5], capsulotomy [6], cyclophotocoagulation [7], and initiation of topical miotic therapy. Though relatively uncommon, its

management has usually been challenging. Medical therapy with cycloplegics, aqueous suppressants, and hyperosmotic agents has been the standard initial treatment. In pseudophakic eyes refractory to the above medical treatment, neodymium: yttrium-aluminium-garnet (Nd: YAG) laser posterior capsulotomy and hyaloidotomy and pars plana vitrectomy (PPV) have been used with variable success. [1,2,8]

Malignant glaucoma, also referred to as aqueous misdirection syndrome, is a severe disease characterized by a uniform flattening or shallowing of the central and peripheral anterior chamber in the absence of suprachoroidal effusion, hemorrhage, or pupillary block. [9,10] For phakic eyes, it is thought that cilio-lenticular block hampers forward movement of the aqueous humor; moreover, the backward movement of the aqueous humor increases the cilio-lenticular block, thereby creating a vicious cycle. [11,12]

Surgical treatment of malignant glaucoma is based on interrupting the sequence of events lying at the foundation of its pathophysiological process. In the classical form of this complication, aqueous humor accumulates in the area of the vitreous cavity due to ciliary block, and, as a result of this, there is an increase in the vitreous pressure that is transferred to the structures of the anterior segment causing a forward movement of the lens-iris diaphragm.9 Most often, malignant glaucoma develops quickly, within days after primary surgery with a clear cause-effect relationship with the performed procedure, although its occurrence can also be postponed. [13] Recurrences of malignant glaucoma are observed both after PPV that was initially effective and after conservative treatment. [14,15] It seems that the characteristic clinical picture of malignant glaucoma with recurrences is caused by the preservation of the primary mechanism that is found at the basis of aqueous humor accumulation in the posterior segment of the eye.

This study aimed to provide additional data on cases of phakic eyes characterized by long time intervals between malignant glaucoma onset and surgery and to assess the therapeutic safety and efficacy of surgery.

Methods

The present study was conducted at Department of Ophthalmology, Bhagwan Mahavir Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India for one year and included consecutive patients who underwent core vitrectomy-phacoemulsification-intraocular lens (IOL) implantation-capsulo-hyaloidotomy at least 1mo 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, or 3) lens subluxation. Age, sex, pre-existing 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. Continuous variables are described by the mean, median and range. Categorical variables are described by the rate or ratio. The preoperative and postoperative visual acuity (VA), IOP, number of IOP-lowering medications used, and ACD were compared by Wilcoxon signed-rank test.

Results

Table 1: Demographic and clinical data

Variables	Mean±SD	Median, range
Age, years	48.7±15.7	48, 17-72
Onset to surgery interval, mo	6.9±13	1, 1-48
AL, mm	19.7±2.7	19.7, 15.7-22.8
Corneal endothelium densitya, /mm2	947.2±1148.4	320.5, 0-2780
Preoperative VA, logMAR	2.1±0.9	2.7, 0.5-2.8
Postoperative VA logMAR	1.6±0.8	1.7, 0.2-2.8
Preoperative IOP, mm Hg	32.7±14.1	27.7, 14-60
Postoperative IOP, mm Hg	20.4±11.6	16.4, 7-47
Preoperative number of IOP-lowering medications used	2.9±1.2	3, 1-5
Postoperative number of IOP-lowering medications used	1±1.5	0, 0-4
Preoperative ACDc, mm	0.45±0.49	0.22, 0-1.25
Postoperative ACDd, mm	2.77±0.66	2.86, 1.59-3.71
Follow-up, mo	14.3±9.2	13.5, 3-37
Sex (male:female)	3:7	

Eye (OD:OS)	8:5	
Diagnosis	PACG	
Previous treatment, %		
Trabeculectomy	80	
Diode laser cyclodestruction	10	
Pilocarpine	10	
Rate, %		
Anatomical success	100	
Complete success	38.5	
Qualified success	77	
Recurrence	0	
Complication, n		
Corneal endothelial decompensation	2	

Table 2: Preoperative clinical data of all patients

S.	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	40/M	OD	48	2.7	14	3	0	19.7	0	12
2	45/M	OD	3	2.7	27 2	0.86	22.8	0	12	21
3	39/F	OS	12	2.7	24	3	0	22.8	0	13.5
4	47/M	OD	12	1	27.7	3	0.19	17.9	2529	
5	60/M	OD	1	2.7	52	4	1.24	15.8	2780	9
6	55/F	OD	6	2.7	33	1	0	17.4	NA	17
7	56/M	OS	2	2.7	34.6	2	0.78	21	641	6
8	62/F	OD	1	0.5	22	4	1.25	22.3	2363	24
9	66/M	OD	1	1.5	15	1	0.05	17.7	1030	18
10	59/M	OS	1	0.52	46	5	0.72	21.7	2023	3

Table 3: Post-operative clinical data of all patients

S.		**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	
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); 8 eyes (80%) developed the condition after trabeculectomy. The mean onset to surgery interval was 6.9 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, more commonly referred to as malignant glaucoma, is a term used to describe a spectrum of disorders with several common features which typically include a shallow or flat anterior chamber with elevated, normal, or occasionally low intraocular pressure at some point during the course of the disease in the presence of a patent peripheral iridectomy with no retinal pathology such as suprachoroidal hemorrhage or choroidal effusion. [9,18] Eyes with primary angle closure disease appear to be particularly susceptible to develop this condition. [19,20] The phenomenon commonly follows an intraocular surgery, most commonly glaucoma filtering surgery, or laser procedures such as laser iridotomy, laser cyclophotocoagulation, laser posterior capsulotomy and laser suture lysis, and in rare instances has been reported to occur spontaneously as well. [21]

The patients included in the present case series had the following characteristics: 1) All had been diagnosed with PACG; 2) Short axial length (mean 19.7 mm, range 15.7- 22.8 mm); 3) Low corneal endothelium density (mean 947.2/mm2, range 0-2780/mm2); 4) Long time interval between onset and surgery (mean 6.9mo, range 1-48mo). Except for two cases with long time intervals because of well-controlled of malignant glaucoma via medications in Krėpštė et al [22], all eyes in the previously reported studies had short time intervals. In contrast, the present study included patients with long time intervals. In contrast to the long-time interval of follow-ups, all the 10 cases included in the present study were treated with medical treatment including 1% atropine sulfate, topical steroid, and topical and systemic IOP lowing medications once they were diagnosed at our hospital. If reformation of the anterior chamber was not achieved in 7d, surgery was performed. Patients with the above characteristics are commonly considered to have a very poor prognosis with minimal benefit expected from surgery because that the degree of optic disc damage caused by high IOP and corneal endothelial dysfunction caused by physical lens-cornea touch might be different according to disease duration. However, in our case series, the improvements in VA, IOP, number of IOP-lowering medications used, and ACD were not inferior to those of previous reports which included patients with short time intervals. A possible explanation for the good surgical outcome of the present study is the surgical technique used.

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. [29]

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

In conclusion, the present study indicated that core vitrectomy phacoemulsification-IOL implantation-capsulo-hyaloidotomy is safe and effective treatment for malignant glaucoma patients with long time intervals between malignant glaucoma onset and surgery, achieved a high rate of anatomical success and low rate of postoperative complications. The surgeries significantly reduced the IOP and the number of IOP-lowering medications used, deepened the ACD.

References

1. Harbour JW, Rubsamen PE, Palmberg P. Pars plana vitrectomy in the management of phakic and pseudophakic malignant glaucoma. Archives of Ophthalmology. 1996 Sep 1;114(9):1073-8.
2. Byrnes GA, Leen MM, Wong TP, Benson WE. Vitrectomy for ciliary block (malignant) glaucoma. Ophthalmology. 1995 Sep 1; 102(9): 1308-11.

3. Tomey KF, Senft SH, Antonios SR, Shammas IV, Shihab ZM, Traverso CE. Aqueous misdirection and flat chamber after posterior chamber implants with and without trabeculectomy. Archives of Ophthalmology. 1987 Jun 1;105(6):77 0-3.
4. Lynch MG, Brown RH, Michels RG, Pollack IP, Stark WJ. Surgical vitrectomy for pseudophakic malignant glaucoma. American journal of ophthalmology. 1986 Aug 1;102(2) :149-53.
5. Cashwell LF, Martin TJ. Malignant glaucoma after laser iridotomy. Ophthalmology. 1992 May 1;99(5): 651-9.
6. Arya SK, Sonika, Kochhar S, Kumar S, Kan M, Sood S. Malignant glaucoma as a complication of Nd: YAG laser posterior capsulotomy. Ophthalmic Surgery, Lasers and Imaging Retina. 2004 May 1;35(3):2 48-50.
7. Azuara-Blanco A, Dua HS. Malignant glaucoma after diode laser cyclophotocoagulation. American journal of ophthalmology. 1999 Apr 1; 127(4):467-9.
8. Little BC, Hitchings RA. Pseudophakic malignant glaucoma: Nd: YAG capsulotomy as a primary treatment. Eye. 1993 Jan;7(1):102-4.
9. Luntz MH, Rosenblatt M. Malignant glaucoma. Surv Ophthalmol 1987; 32(2):73-93.
10. Trope GE, Pavlin CJ, Bau A, Baumal CR, Foster FS. Malignant glaucoma. Clinical and ultrasound biomicroscopic features. Ophthalmology 1994;101(6): 1030-1035.
11. Wang ZH, Huang JJ, Lin JL, Liang XW, Cai XY, Ge J. Quantitative measurements of the ciliary body in eyes with malignant glaucoma after trabeculectomy using ultrasound biomicroscopy. Ophthalmology 2014 ;121(4):862-869.
12. Teichmann K. Aqueous misdirection syndrome is not actually caused by aqueous misdirection. J Glaucoma 2003;12(2):184; author reply 184; author reply 185.
13. Levene R. Malignant glaucoma: proposed definition and classification. InShields MB, Pollack I, Kolker A: Perspectives in glaucoma. Transactions of the First Scientific Meeting of the American Glaucoma Society. Thorofare, NJ, Slack 1988 (pp. 243-350).
14. Byrnes GA, Leen MM, Wong TP, Benson WE. Vitrectomy for ciliary block (malignant) glaucoma. Ophthalmology. 1995 Sep 1;102(9):13 08-11.
15. Harbour JW, Rubsamen PE, Palmberg P. Pars plana vitrectomy in the management of phakic and pseudophakic malignant glaucoma. Archives of Ophthalmology. 1996 Sep 1;114(9):1073-8.
16. Zhao YE, Gong XH, Zhu XN, Li HM, Tu MJ, Coursey TG, Pflugfelder SC, Gu F, Chen D. Long-term outcomes of ciliary sulcus versus capsular bag fixation of intraocular lenses in children: an ultrasound biomicroscopy study. PLoS One 2017;12(3):e017 2979.
17. Garza-Leon M. Corneal endothelial cell analysis using two noncontact specular microscopes in healthy subjects. Int Ophthalmol 2016;36(4): 453-461.
18. T RUBEN SI, Tsai J, HITCHINGS RA. Malignant glaucoma and its management. British Journal of Ophthalmology. 1997 Feb 1;81(2):163 -7.
19. Simmons RJ. 'Malignant glaucoma'. Br J Ophthalmol 1951;56(3): 263–272.
20. Chandler PA. 'Malignant glaucoma'. Am J Ophthalmol 1951; 34: 993–1000.
21. Tomey KF, Senft SH, Antonios SR, Shammas IV, Shihab ZM, Traverso CE. Aqueous misdirection and flat chamber after posterior chamber

implants with and without trabeculectomy. Archives of Ophthalmology. 1987 Jun 1;105(6):77 0-3.
22. Krėpštė L, Žemaitienė R, Miliauskas A. Clinical characteristics and outcomes of malignant glaucoma after different procedures treated with pars plana vitrectomy: a 10-year retrospective study. Medicina (Kaunas) 2018;54(4):E65.
23. Schwab C, Glatz W, Schmidt B, Lindner E, Oettl K, Riedl R, Wedrich A, Ivastinovic D, Velikay-Parel M, Mossboeck G. Prevalence of posterior vitreous detachment in glaucoma patients and controls. Acta Ophthalmol 2017;95(3):276-280.
24. Sebag J. Age-related changes in human vitreous structure. Graefes Arch Clin Exp Ophthalmol 1987;225(2):89-93.
25. Sharma A, Sii F, Shah P, Kirkby GR. Vitrectomy-phacoemulsification vitrectomy for the management of aqueous misdirection syndromes in phakic eyes. Ophthalmology 2006;113(11):1968-19 73.
26. Debrouwere V, Stalmans P, van Calster J, Spileers W, Zeyen T, Stalmans I. Outcomes of different management options for malignant glaucoma: a retrospective study. Graefes Arch Clin Exp Ophthalmol 2012;250(1):131-141.
27. Debrouwere V, Stalmans P, Van Calster J, Spileers W, Zeyen T, Stalmans I. Outcomes of different management options for malignant glaucoma: a retrospective study. Graefe's Archive for Clinical and Experimental Ophthalmology. 2012 Jan;250(1):131-41.
28. Bitrian E, Caprioli J. Pars plana anterior vitrectomy, hyaloido-zonulectomy, and iridectomy for aqueous humor misdirection. American journal of ophthalmology. 2010 Jul 1;150(1):82-7.
29. Bhuiyan M. M. Perforation rate of appendicitis and negative appendectomies in children in Mankweng Hospital. Journal of Medical Research and Health Sciences, 2020;3(6), 991–995.