



# The Profile and Management of Glaucoma in Adult Aphakic Patients Following Complicated Cataract Surgery

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## Abstract

**Objectives:** To determine the profile and clinical course of glaucoma in adult aphakic patients following complicated cataract surgery.

**Materials and Methods:** Retrospective chart review of 22 adult aphakic patients (29 eyes) with glaucoma.

**Results:** Mean age was  $57.69 \pm 14.18$  years when aphakia occurred. Mean age at time of presentation to our glaucoma clinic was  $62.57 \pm 12.47$  years. Mean follow-up time was  $42.83 \pm 57.04$  months. Changes between the first and last follow-up visits were as follows: mean intraocular pressure decreased from  $26.21 \pm 13.86$  mmHg to  $18.14 \pm 9.63$  mmHg ( $p=0.003$ ); mean number of glaucoma medications used increased from  $1.41 \pm 1.27$  to  $2.07 \pm 1.04$  ( $p=0.005$ ); and mean vertical cup/disc ratio increased from  $0.69 \pm 0.25$  to  $0.78 \pm 0.24$  ( $p=0.024$ ). Glaucoma was managed using medications in 26 eyes (89.7%), whereas 3 eyes underwent surgical treatment. However, surgery alone was not sufficient to control intraocular pressure and additional glaucoma medications were needed.

**Conclusion:** Prevention of glaucomatous optic neuropathy in aphakic patients is challenging both medically and surgically. Although a significant decrease in intraocular pressure can be achieved with glaucoma medications, glaucomatous disc changes may progress.

**Keywords:** Aphakia, glaucoma, secondary glaucoma, complicated cataract surgery

## Introduction

The success rate of cataract surgery has improved along with advances in microsurgical techniques. The aim of modern cataract surgery, in most cases, is to implant an artificial lens in the capsular bag. Rarely, cataract surgery results in aphakia due to intraoperative complications. However, in some cases aphakia is preoperatively planned, including cases with congenital cataract, high myopia, traumatic cataract, and aphakia in the fellow eye.

Aphakia causes complex mechanical and biochemical changes in the vitreous and anterior segment structures and the precise mechanism of glaucoma in aphakia is not fully understood.<sup>1,2,3,4</sup> Aphakic glaucoma is a rare secondary glaucoma associated with poor control of intraocular pressure (IOP) using ocular hypotensive agents; glaucoma surgery in such patients is less successful than in those with primary glaucomas.<sup>5,6,7,8,9</sup>

The aim of the present study was to determine the profile and clinical course of glaucoma in adult aphakic patients following complicated cataract surgery.

## Materials and Methods

This study was conducted at Ankara Training and Research Hospital, Ophthalmology Clinic, Glaucoma Clinic in Ankara, Turkey. The study was approved by the review board of the hospital and performed in accordance with the principles of the Declaration of Helsinki. The study included 29 eyes of 22 adult aphakic patients who presented between 1990 and 2011 due to glaucoma following complicated cataract surgery. Patients' data were retrospectively reviewed. Glaucoma specialists performed detailed ophthalmological examination of each patient, including assessment of best corrected distance visual acuity (BCVA) via

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Snellen chart, IOP measurement via Goldmann applanation tonometer, and anterior segment examination via slit-lamp biomicroscopy. Gonioscopy and fundoscopic examination was performed whenever possible. The visual acuities were expressed in decimal notation. Visual field testing could not be performed because of poor visual acuity in most of the eyes. Demographic data and the number of glaucoma medications used were recorded for each patient. Glaucoma was diagnosed based on chronic elevation of IOP with glaucomatous optic disc changes. Clinical changes from presentation to the last follow-up visit were compared.

#### Statistical Analysis

Data were analyzed using SPSS v.17.0 for Windows (SPSS, Inc., Chicago, IL, USA). Quantitative variables are shown as mean  $\pm$  standard deviation (range), and categorical data are shown as numbers and percentages. Fisher's exact test was used to determine differences between categorical data. The Wilcoxon signed-rank test was used to compare two dependent variables. The level of statistical significance was set at  $p<0.05$  (two-tailed distribution).

#### Results

The study included 29 eyes (58.6% right eyes and 41.4% left eyes) of 22 patients (54.6% male and 45.5% female). Mean age of the patients when aphakia occurred was  $57.69\pm14.18$  years (median 60 years, range 30-80 years). In all, 3 patients (1 eye each) had a history of glaucoma, 1 of which underwent trabeculectomy prior to aphakia. In the remaining 26 eyes, mean time from occurrence of aphakia to diagnosis of glaucoma was  $89.00\pm134.17$  months (median 8 months, range 0-300 months). Mean age at presentation to the glaucoma clinic was  $62.57\pm12.47$  years (median 64 years, range 30-81 years).

Mean duration of follow-up was  $42.83\pm57.04$  months (range 1-192 months). Glaucoma was managed using topical anti-glaucomatous medications in 26 eyes (89.7%). In total, 3 eyes of 3 patients underwent surgical treatment for elevated IOP despite meticulous use of glaucoma medications. Fundoscopy could not be performed because of corneal edema and/or corneal opacities in 6 of 26 eyes treated medically and in 1 of the 3 eyes treated surgically. The ocular findings of all eyes at time of admission are summarized in Table 1. Thirteen eyes (44.8%) had peripheral anterior synechia while 5 eyes (17.3%) had vitreous in the anterior chamber, which may clarify the glaucoma mechanism (Table 1).

The mean IOP of all eyes included in the study was  $26.21\pm13.86$  mmHg (range, 6-65 mmHg) at presentation, versus  $18.14\pm9.63$  mmHg (range, 8-50 mmHg) at last follow-up visit ( $p=0.003$ ). Twenty eyes (69%) were being treated with antiglaucoma medications at time of presentation, versus all eyes (100%) at last follow-up visit. Mean number of glaucoma medications used was  $1.41\pm1.27$  (range: 0-4) at presentation and  $2.07\pm1.04$  (range: 1-4) at last follow-up visit ( $p=0.005$ ). Mean vertical cup/disc (C/D) ratio was  $0.69\pm0.25$  (range: 0.3-1) at presentation versus  $0.78\pm0.24$  (range: 0.3-1) at last follow-up

visit ( $p=0.024$ ). Vertical C/D ratio was  $\geq0.7$  in 9 eyes (45%) at presentation and in 11 eyes (55%) at last follow-up visit ( $p=0.002$ ).

Among the medically treated eyes, BCVA improved in 2 eyes during follow-up because of improvement in comorbid diabetic macular edema, whereas ocular comorbidities other than progression of glaucoma (dry-type age-related macular degeneration in one eye and wet-type age-related macular degeneration in the other) caused a reduction in BCVA in 2 eyes. In the remaining 22 medically treated eyes, mean BCVA was  $0.23\pm0.31$  (0-1) at presentation, versus  $0.18\pm0.29$  (0-1) at last follow-up visit ( $p=0.624$ ). Table 2 shows the clinical changes from presentation to last follow-up visit in medically treated eyes.

Findings of the eyes which were treated surgically are shown in Table 3. In one of these eyes, Molteno aqueous shunt implantation was performed at another clinic and the associated findings were not available in the patient's chart. At presentation, this eye had corneal edema, corneal leukoma, vitreous in the

**Table 1. Ocular findings of patients at admission**

	Medically treated eyes n=26 (89.7%)	Surgically treated eyes n=3 (10.3%)		
	n	%	n	%
<b>Anterior segment findings</b>				
Corneal edema and/or opacities	9	34.6	1	33.3
Peripheral anterior synechia	13	50.0	0	0
Vitreous in the anterior chamber	3	11.5	2	66.7
<b>Posterior segment findings</b>				
Could not be evaluated	6	23.1	1	33.3
Cup/disc ratio $\geq0.7$	9	45.0*	2	100*
<b>Other comorbidities</b>				
Diabetic retinopathy	3	15.0*	0	0*
Age-related maculopathy	1	5.0*	0	0*
Degenerative myopia	1	5.0*	0	0*

\*Percentage of eyes in which fundoscopic examination could be performed

**Table 2. Clinical changes from presentation to the last follow-up visit in the medically treated eyes**

	At presentation mean (range)	At last follow-up visit mean (range)	p
BCVA*	0.065 (0-1)	0.02 (0-1)	0.624
IOP (mmHg)	22.5 (6-65)	15 (8-50)	0.003
Medication (n)	1 (0-4)	2 (1-4)	0.005
C/D ratio**	0.7 (0.3-1)	0.8 (0.3-1)	0.014

\*BCVA was assessed in 22 eyes. \*\*C/D ratio was assessed in 20 eyes.

BCVA: Best corrected distance visual acuity, IOP: Intraocular pressure, C/D ratio: Cup/disc ratio

**Table 3.** Findings before and after surgery in eyes treated surgically.

	Eye 1 (Molteno implant)		Eye 2 (Trab with MMC)		Eye 3 (Trab with MMC)	
	Before surgery	After surgery	Before surgery	After surgery	Before surgery	After surgery
BCVA	N/A	NLP	0.2	0.1	0.01	0.01
IOP (mmHg)	N/A	20	50	20	31	18
Medication (n)	N/A	2	3	1	3	3
Anterior segment	N/A	Corneal edema and leukoma, vitreous in the anterior chamber	No extra pathological finding	No extra pathological finding	Vitreous in the anterior chamber	Vitreous in the anterior chamber
C/D ratio	N/A	N/A	0.9	1	1	1
Follow-up (mo)	N/A	75	1	4	0	6

BCVA: Best corrected visual acuity, IOP: Intraocular pressure, C/D ratio: Cup/disc ratio, Trab: Trabeculectomy, MMC: Mitomycin-C, NLP: No light perception, N/A: Not available

anterior chamber, and no light perception. Fundus examination could not be performed because of corneal edema and leukoma. The patient was followed for 75 months and IOP was controlled with 2 medications during follow-up. The other two surgically treated eyes underwent trabeculectomy with adjunctive use of mitomycin C at our clinic. Surgery alone was not sufficient to control IOP and additional medications were required. No surgery-related complications were encountered.

## Discussion

Glaucoma in aphakic patients was among the most common causes of secondary glaucoma prior to advances in modern cataract surgery, which resulted in a significant decline in the incidence of post-surgical aphakia.<sup>5,10</sup> Recent studies of aphakic glaucoma have mostly focused on pediatric cases following congenital cataract surgery, whereas the literature concerning aphakic glaucoma in adults is relatively outdated.

Some ocular comorbidities, including corneal opacities, dense cataract, glaucoma, high myopia, previous vitrectomy, and traumatic cataract, may increase the risk of aphakia during cataract surgery in adults.<sup>11</sup> It has been shown that glaucoma together with dense cataract presents the highest risk for aphakia during cataract surgery.<sup>11</sup> In the present study, three patients had a history of glaucoma and one patient had degenerative myopia prior to cataract surgery.

Several mechanisms have been implicated in aphakic glaucoma, including pupillary block glaucoma, malignant glaucoma, ghost cell glaucoma, vitreous in the anterior chamber, epithelial ingrowth, and protracted inflammation; however, these are not present in a significant number of patients.<sup>4,9,12,13</sup> In some studies, synechial closure of the angle was reported as the most common finding in aphakic glaucomatous eyes, as in our study (Table 1).<sup>9,14</sup> In the present study, none of the previously described mechanisms were observed in 11 (37.9%) eyes. Some researchers have posited theories suggesting that exposure of the anterior chamber to the posterior chamber is associated with certain chemical factors that alter angle structure and function, but none has yet been proven.<sup>1</sup>

IOP control and prevention of optic nerve damage with ocular hypotensive agents are often more difficult than in cases

with primary glaucomas. It is thought that a 30% reduction in IOP is required for preventing glaucomatous optic neuropathy in a significant number of glaucoma patients.<sup>6</sup> In the present study, although a 33% decrease in IOP was achieved in the medically treated eyes, there was a significant increase in C/D ratio and a slight decrease in visual acuity (although nonsignificant). This may be because of most of the patients referred to our clinic had advanced glaucomatous optic neuropathy, and a lower target IOP level should be considered in these patients.

Because surgical management of glaucoma in aphakia is difficult, numerous surgical procedures have been used to control glaucoma progression.<sup>6,8,13,15,16,17,18</sup> The success rate of trabeculectomy in aphakic glaucoma varies by study. Some studies reported trabeculectomy as a successful option, while others did not.<sup>6,8,15,16,19</sup> In the present study, trabeculectomy was performed in two eyes, but in both cases the procedure was not sufficient to control IOP and additional medications were required.

Glaucoma drainage devices (GDDs) have been used successfully in cases of aphakic glaucoma.<sup>20,21,22,23,24</sup> Tube occlusion due to vitreous incarceration is an important cause of failure of GDDs in aphakic eyes.<sup>20,21,25</sup> In the present study, Molteno implantation was performed in one eye at another clinic and despite the presence of vitreous in the anterior chamber, IOP was controlled with two medications during follow-up.

The long average interval between glaucoma diagnosis and presentation to our glaucoma clinic was notable in our study. Most of the patients diagnosed and referred to our glaucoma clinic had late-stage disease and most of the eyes had poor visual acuity at presentation.

## Conclusion

Most of the patients in our study presented with poor vision and advanced-stage glaucomatous changes. As it is difficult to detect peripheral narrowing of the visual field in aphakic patients, IOP and optic disc changes should be assessed regularly to detect glaucoma early. Although a favorable decrease in IOP can be achieved using glaucoma medications, glaucomatous disc changes can progress in aphakia, especially in patients with late-stage disease. Because the management of glaucoma in aphakic

patients can be more difficult than that of primary glaucomas, early referral to a glaucoma specialist should be considered in all cases of suspected glaucoma.

#### Ethics

**Ethics Committee Approval:** University of Health Sciences, Ankara Training and Research Hospital (11.20.2016 approval number: 5232).

**Informed Consent:** Retrospective study.

**Peer-review:** Externally peer-reviewed.

#### Authorship Contributions

**Concept:** Ümit Ekşioğlu, Mehmet Yakın, Özgür Balta, Evin Şingar-Özdemir, Hande Hüsnüye Telek, Firdevs Örnek, Ilgaz Yalvaç, **Design:** Ümit Ekşioğlu, Mehmet Yakın, Özgür Balta, Evin Şingar-Özdemir, Hande Hüsnüye Telek, Firdevs Örnek, Ilgaz Yalvaç, **Data Collection or Processing:** Mehmet Yakın, **Analysis or Interpretation:** Mehmet Yakın, Ümit Ekşioğlu, **Literature Search:** Mehmet Yakın, **Writing:** Mehmet Yakın, Ümit Ekşioğlu.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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