

Prophylactic anterior vitrectomy during cataract surgery in eyes at increased risk for aqueous misdirection

Atalie C. Thompson, Pratap Challa*

Duke University, Department of Ophthalmology, Durham, NC, USA



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ABSTRACT

Purpose: Patients with chronic narrow angle glaucoma (CNAG) are at increased risk of developing aqueous misdirection (AM) following intraocular surgery. We present a retrospective case series on the use of posterior capsulorrhexis with core vitrectomy by an anterior approach (CAV) at the time of cataract extraction with or without glaucoma surgery as a prophylactic measure for the prevention of AM in CNAG.

Methods: Retrospective case series of six phakic eyes in four patients with CNAG and other risk factors for AM who underwent posterior capsulorrhexis and CAV at the time of cataract surgery with or without glaucoma surgery. The main outcome measures were best-corrected visual acuity (BCVA), intraocular pressure (IOP), and post-operative complications.

Results: Six eyes in four subjects underwent posterior capsulorrhexis with CAV at the time of cataract surgery. The case was combined with incisional glaucoma surgery in the five eyes with advanced visual field loss. The mean logMAR BCVA and IOP improved from 0.554 ± 0.398 and 25.2 ± 13 mmHg, respectively, at the pre-operative visit to 0.257 ± 0.218 and 12.2 ± 1.7 mmHg, respectively, at final follow-up. Both eyes with nanophthalmos developed non-appositional serous choroidals that resolved with atropine, but the left eye required additional treatment with synechiolysis, intraocular lens repositioning, limited AV and endocyclophotocoagulation. There were no permanent, vision-threatening complications.

Conclusions and importance: CAV can be safely combined with cataract surgery and glaucoma surgery, and it may be an effective intervention in eyes with CNAG and other risk factors for AM as a prophylactic measure against the development of AM.

1. Introduction

Aqueous misdirection (AM) is a rare, vision-threatening form of secondary angle closure glaucoma that can occur following incisional glaucoma or cataract surgery for chronic narrow angle glaucoma (CNAG).¹ When AM proves refractory to medical or laser therapy, vitrectomy by either an anterior^{2–4} or pars plana^{5–8} approach is pursued. Whether AM can be prevented in high-risk eyes is not known. Chaundry et al. reported on the safe use of pars plana vitrectomy (PPV) as a prophylactic measure at the time of cataract surgery in two patients with a history of contralateral AM.⁹ We present on the use of prophylactic core vitrectomy by an anterior approach (CAV) at the time of phacoemulsification with or without incisional glaucoma surgery in eyes at risk for AM.

2. Methods

We conducted a retrospective case series of 6 eyes in 4 patients with CNAG and visually significant cataract evaluated by the Duke Eye Center glaucoma service between August 1, 2014 and June 1, 2017 with follow-up through September 1, 2017. This study was approved by the Duke University Institutional Review Board with a waiver of informed consent.

All eyes had risk factors that placed them at increased risk for post-operative aqueous misdirection, such as CNAG and short axial length (AL) and/or anterior chamber depth (ACD), nanophthalmos, plateau iris, high pre-operative intraocular pressure (IOP), or history of contralateral AM.¹ Demographic and clinical data were collected including age, sex, race, intraocular pressure (IOP) by Goldmann applanation, Snellen best-corrected visual acuity (BCVA), AL and ACD (EyeSuite™ Biometry, LenStar 900, Haag-Streit Diagnostics), peripapillary retinal nerve fiber layer (RNFL) on Spectral Domain-Optical Coherence

* Corresponding author. Duke University Eye Center, 2351 Erwin Road, Durham, NC, 27705, USA.

E-mail address: chall001@mc.duke.edu (P. Challa).

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Tomography (Spectralis®, Heidelberg, Germany), mean deviation (MD) and pattern standard deviation (PSD) on SITA-fast 24-2 Humphrey visual field (HVF) (Carl Zeiss Meditec). HVFs were reviewed (ACT) for reliability parameters (< 33% fixation losses, false positive or false negatives) and severity was graded according to the American Academy of Ophthalmology's Preferred Practice Guidelines.¹⁰ BCVA was converted to logMAR units. Operative reports and clinical notes were reviewed for medical and surgical management and post-operative complications.

2.1. Surgical procedure

All surgeries were performed by an experienced glaucoma surgeon (PC). After creation of a clear cornea paracentesis with a Supersharp blade, the eye was filled with dispersive viscoelastic (VISCOAT, Alcon, Fort Worth, TX), and a beveled clear corneal incision was created approximately 90° away with a 2.2-mm-wide keratome blade. Additional steps to optimize visualization of the capsule, such as synechiolysis or insertion of a Malyugin ring, were performed as needed. A 5.5-mm continuous curvilinear anterior capsulorhexis was created with a cystotome and Utrata forceps. Phacoemulsification of the nucleus and irrigation-aspiration (I/A) of the cortex were performed.

The bag was re-inflated with cohesive viscoelastic (PROVISC, Alcon, Fort Worth, TX), and a 4.5 mm continuous capsulorhexis of the posterior capsule was created using a cystotome and Utrata forceps (Fig. 1A–C). Next, a coaxial 21-gauge vitrector was placed through the posterior capsule into the anterior hyaloid and a limited core vitrectomy by an anterior approach was performed at a rate of 800 cuts per minute on cut-I/A mode (Fig. 1D). If a patent iridotomy (PI) did not already exist, then a surgical iridectomy was created with the vitrector. Viscoelastic was injected into the anterior chamber prior to removal of the instruments to help prevent efflux of fluid. The wounds were tested with a Weck-cel sponge to ensure no vitreous was present. Additional viscoelastic was injected into the capsular bag followed by a foldable single-piece posterior chamber intraocular lens (IOL) (Acrysof SN60WF, Alcon). Once viscoelastic had been removed with the I/A handpiece, the corneal wounds were hydrated with balanced salt solution and the

main wound was secured with a 10-0 nylon suture. The five eyes with severe field loss underwent incisional glaucoma surgery (Table 1) after completion of these steps. Subconjunctival antibiotic and steroid were administered at the end of the case.

3. Results

Table 1 displays demographic and clinical data for each eye. The mean age was 72.3 ± 3.1 years. Five of the six eyes presented with advanced field loss (mean pre-operative MD -23 ± 8 dB, PSD 7.3 ± 2.2 dB). The average RNFL was 62.5 ± 19 microns. The mean AL was 21 ± 2.8 mm and ACD was 2.2 ± 0.65 mm. One subject had nanophthalmos in both eyes (right eye AL 17.6 mm, ACD 1.65 mm; left eye AL 17.48 mm, ACD 1.66 mm). All of the eyes were closed on gonioscopy, and one eye also had plateau iris.

Subjects were followed for an average of 17 ± 13.5 months. The mean logMAR BCVA was 0.554 ± 0.398 (Snellen BCVA ~20/71) at the pre-operative visit, 0.746 ± 0.271 (Snellen BCVA ~20/111) on post-op day one, and 0.257 ± 0.218 (Snellen BCVA ~20/36) at final follow-up. The average IOP at the pre-operative visit was 25.2 ± 13 mmHg, but improved to 13.3 ± 8.0 mmHg on post-op day one and 12.2 ± 1.7 mmHg at final follow-up.

Four eyes had no post-operative complications. Both eyes with nanophthalmos developed non-appositional serous choroidals that resolved with atropine. At the two-month post-op visit, the left nanophthalmic eye had persistent peripheral and central shallowing of the anterior chamber and BCVA of 20/100 despite atropine and aqueous suppression because there were shallow peripheral choroidals on B-scan. The IOP was only 12 mmHg. At post-op month four, the choroidals had resolved on B-scan, but the left eye was still shallow because posterior synechiae were causing the IOL to be tilted; the IOP was 10 mmHg. Since the IOL was tilted, she was taken to the operating room for synechiolysis, IOL repositioning, limited AV, and endoscopic cyclophotocoagulation, with subsequent deepening of the anterior chamber and improvement in the visual acuity to 20/40.

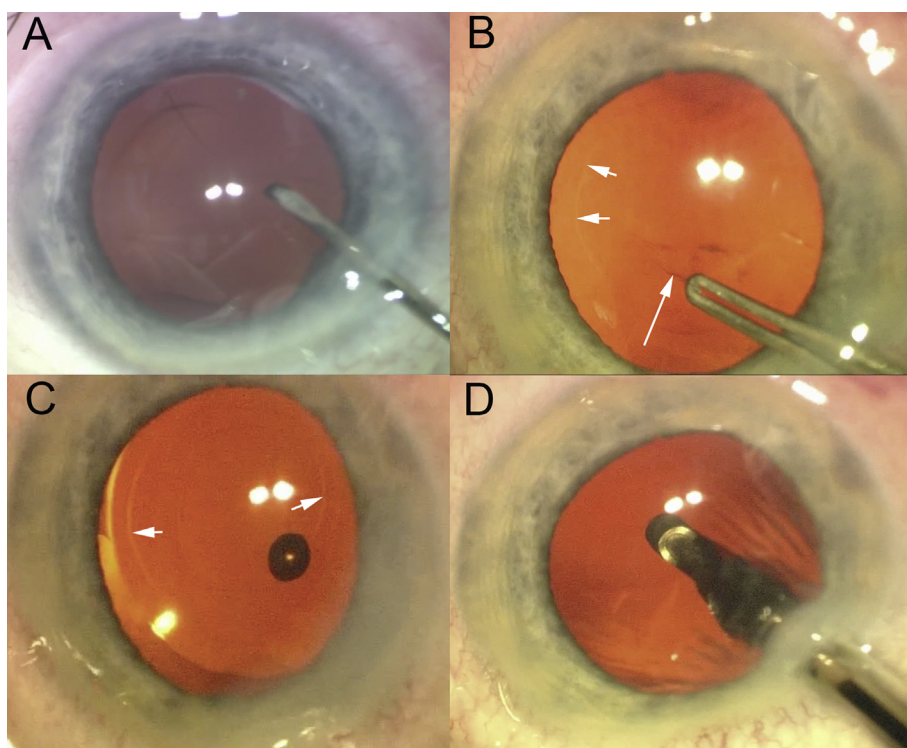


Fig. 1. Demonstration of the use of a cystotome blade (A) and Utrata forceps (B) to grasp and carefully guide the posterior capsule flap (long arrow) during the creation of a (C) 4.5 mm continuous capsulorhexis (short arrows) in the posterior capsule of eyes with chronic narrow angle glaucoma and risk factors for aqueous misdirection following phacoemulsification of the cataract. (D) Limited anterior core vitrectomy was performed (cut-I/A mode at 800 cuts/minute) by placing a coaxial 21-gauge vitrector through the posterior capsule into the anterior hyaloid face.

Table 1
Demographic and clinical characteristics of six phakic eyes with risk factors for aqueous misdirection, including chronic narrow angle glaucoma (CNAG).

Subject	Age (years)	Sex	Race	Eye	Ocular history	Biometry ^a			Pre-operative		Surgery	Post-operative complications		Final Post-operative		Follow-up time (months)
						AL ^a (mm)	ACD ^b (mm)	Snellen BCVA ^c (mmHg) ^e	IOP ^d (mmHg) ^e	Snellen BCVA ^c (mmHg) ^e		IOP ^d (mmHg) ^e				
2	69.5	Female	Caucasian	Right	<ul style="list-style-type: none"> - Severe stage CNAG - Nuclear sclerotic and cortical cataract - Nd:YAG laser peripheral iridotomy - Nanophthalmos - Gonioscopy: closed, no structures seen 	17.6	1.65	20/80	28	Phacoemulsification with intraocular lens implantation, posterior capsulotomy, and anterior vitrectomy	Non-appositional, serous choroidals that resolved with atropine.	20/40	13	15		
				Left	<ul style="list-style-type: none"> - Severe stage CNAG - Nuclear sclerotic and cortical cataract - Nanophthalmos - Gonioscopy: closed, no structures seen 	17.48	1.66	20/50	19	Yes, plus surgical iridectomy, Ahmed PP-7, and donor sclera patch graft	Chronic, large non-appositional, serous choroidals that took several months to resolve with atropine. Continued to be shallow because the IOL was tilted and posterior synechiae had formed. Thus, underwent synchiolysis, IOL repositioning, limited anterior vitrectomy and ECP ^f at post-op month 4.	20/40	11	12.2		
3	76.8	Female	Caucasian	Right	<ul style="list-style-type: none"> - Severe stage CNAG - Nuclear sclerotic cataract - Nd:YAG laser peripheral iridotomy - Gonioscopy: anterior trabecular meshwork in 1 quadrant, closed with no structures seen in 3 quadrants 	22.47	2.17	20/400	21	Yes, plus surgical iridectomy, Trabeculectomy with mitomycin C	None	20/70	11	33.8		
				Left	<ul style="list-style-type: none"> - Severe stage CNAG - Nuclear sclerotic cataract - Nd:YAG laser peripheral iridotomy - Gonioscopy: closed, no structures seen 	22.63	2.22	20/40	20	Yes, plus Baerveldt-350, and donor sclera patch graft	None	20/20	10	32.9		
4	71.3	Female	Caucasian	Right	<ul style="list-style-type: none"> - Severe stage CNAG - Nuclear sclerotic cataract - Nd:YAG Laser peripheral iridotomy - Plateau iris - Gonioscopy: closed, no structures seen, plateau iris formation 	21.91	2.13	20/70	50	Yes, plus Ahmed PP-7, and donor sclera patch graft	None	20/50	14	6.4		

^a Axial length (AL).
^b Anterior chamber depth (ACD) were obtained from (EyeSuite™Biometry, LenStar 900, Haag-Streit Diagnostics).
^c Best-corrected visual acuity (BCVA).
^d Intraocular pressure (IOP) was measured in.
^e Millimeters of mercury (mmHg) by Goldmann applanation.
^f Endocyclophotocoagulation (ECP).

4. Discussion

We demonstrate the safe and effective use of posterior capsulorhexis with CAV at the time of cataract extraction in eyes with risk factors for aqueous misdirection, such as CNAG, nanophthalmos, and/or contralateral AM. None of the eyes developed post-operative AM. One eye with nanophthalmos had long-standing choroidals that eventually improved, but her case was complicated by intraocular lens tilt from posterior synechiae, thus requiring synechiolysis with lens repositioning. The BCVA improved in all cases, with no permanent post-operative complications. Finally, five of the six cases were combined with incisional glaucoma surgery, and demonstrated successful lowering of the IOP.

Although PPV has been tried for the prevention of AM,⁹ CAV offers several advantages. CAV can be performed without the assistance of a vitreoretinal expert, which can save on operating room time and expense. CAV via a corneal incision is also a simpler technique, familiar to most anterior segment surgeons, and has been used to successfully manage both pseudophakic⁴ and phakic AM.³ However, surgery in an eye with AM is more technically challenging due to shallowing of the anterior chamber from posterior pressure. For this reason, Liu, et al. advised insertion of the IOL into the capsular bag, before creation of the posterior capsulorhexis or AV.³ This approach may not be possible to perform in eyes with weak zonules or capsular compromise as it requires tilting the IOL in the bag. Since our patients did not have AM at the time of surgery, we were able to safely perform the posterior capsulorhexis and CAV prior to insertion of the intraocular lens. The small size of the posterior capsulorhexis made insertion of the IOL possible. Conversion to use of the vitrector to create the posterior capsulorhexis and placement of the IOL in the sulcus would be logical alternative steps if there were concern for capsule-zonular compromise.

5. Conclusions

In summary, posterior capsulorhexis with CAV can be safely performed at the time of cataract surgery with or without glaucoma surgery, and this may be an effective means of protecting against AM in eyes with CNAG and other risk factors for AM. Larger studies are needed to determine whether this approach decreases the relative risk for AM.

Patient consent

A waiver of informed consent was granted by the IRB of Duke University due to the retrospective nature of this study. Patient consent was not obtained and this report does not contain personal identifying information.

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Conflicts of interest

The following authors have no relevant conflicts of interest or financial disclosures: Atalie Thompson, Pratap Challa.

Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.ajoc.2018.08.002>.

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