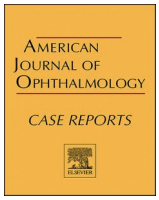
American Journal of Ophthalmology Case Reports 34 (2024) 101954

Contents lists available at ScienceDirect

American Journal of Ophthalmology Case Reports

journal homepage: www.ajocasereports.com/



Dynamic angle closure following pars plana vitrectomy with perfluoropropane gas

Debora H. Lee [a], Melody Ziari [b], Ruchi D. Shah [a], Gioconda Mojica [a], Asadolah Movahedan [a,*]

[a] Ruiz Department of Ophthalmology and Visual Science, University of Texas Health Science Center, Houston, TX, USA
[b] UT Health Science Center at Houston, McGovern Medical School, Houston, TX, USA

ARTICLE INFO

Keywords:
Secondary angle closure glaucoma
Aphakia
Iridodonesis
Perflouropropane (C3F8)
Retinal detachment
Pars plana vitrectomy

ABSTRACT

Purpose: To report the clinical course of an aphakic patient who developed positional secondary angle closure glaucoma following pars plana vitrectomy (PPV) with perfluoropropane (C3F8) gas tamponade.

Observations: A 23-year-old male presented due to a two-year history of vision loss in the left eye. Best-corrected visual acuity (BCVA) was 20/200 and intraocular pressure (IOP) was 12 mm Hg OS. Exam revealed iridodonesis and aphakia of both eyes, and a total RRD in the left eye. The patient underwent scleral buckle plus PPV with 15 % C3F8 gas and was instructed to maintain face-down positioning for 5 days. On post-operative day 1, IOP was 32 mm Hg and exam revealed significant diffuse corneal edema, a large epithelial defect, and 85 % C3F8 fill of the vitreous cavity. Patient was started on IOP-lowering drops but continued to have elevated IOP and corneal epithelial sloughing over the next 3 weeks. He was taken for a superficial keratectomy, but when placed supine under the microscope, a large new gas bubble was visualized overlying the pupil in a now shallow anterior chamber (AC) and IOP was 52 mm Hg. The patient was positioned back upright and the gas bubble migrated posteriorly out of the AC with return of IOP to 25 mm Hg. The dynamic nature of his IOP raised concerns for intermittent angle closure by C3F8 induced by supine positioning. Thus, a pars plana aspiration of the C3F8 gas was performed and resulted in normalization of the IOP.

Conclusions and importance: Dynamic, positional secondary angle closure glaucoma can occur after vitrectomy with C3F8 in the setting of aphakia. This is the first report to capture C3F8 gas migration causing intermittent acute angle closure in real-time. Due to its intermittent nature however, the diagnosis may not be initially apparent at the slit lamp. Thus, we suggest this potential complication should be carefully monitored for and discussed when advising post-vitrectomy positioning in aphakic patients.

1. Introduction

Angle closure glaucoma is a known complication of vitreoretinal surgery, including pars plana vitrectomy (PPV).[1] Angle closure can arise from several mechanisms, including posterior pressure, factors directly affecting the iris and angle, or forward movement of the lens resulting in pupillary block.[2] Angle closure following PPV with gas and silicone oil has been documented in association with gas expansion, overfill, pupillary block, and anterior chamber (AC) migration.[2–4] However, we present the first case of dynamic position-dependent angle closure glaucoma following PPV with perfluoropropane (C3F8) gas tamponade.

2. Case report

A 23-year-old male presented with a two-week history of progressively darkening vision in the left eye. Past ocular history was significant for intracapsular cataract extraction without intraocular lens (IOL) placement for congenital cataracts in both eyes at 4 months of age. Best-corrected visual acuity (BCVA) was 20/25 OD and 20/150 OS. Intraocular pressure (IOP) was 11 mm Hg OD and 12 mm Hg OS. Slit-lamp exam was significant for iridodonesis and aphakia of both eyes, and fundoscopic exam revealed a macula-off rhegmatogenous retinal detachment (RRD) from 3 to 10 o'clock with a tear at 9:30 in the left eye. He was recommended surgical management with vitrectomy but was subsequently lost to follow-up due to the COVID-19 pandemic.

Two years later, the patient presented to the county hospital for

* Corresponding author. University of Texas Health Sciences at Houston 6400 Fannin Street, Suite 1800, Houston, TX, 77, USA.
E-mail address: asadolah.movahedan@uth.tmc.edu (A. Movahedan).

https://doi.org/10.1016/j.ajoc.2023.101954
Received 13 July 2023; Received in revised form 11 October 2023; Accepted 30 October 2023
Available online 4 November 2023

evaluation. BCVA in the left eye was 20/200 and IOP was 30 mm Hg. Funduscopic exam revealed a 360-degree macula-off RRD without definite retinal breaks; the view to fundus was hazy due to vitreous haze from grade B proliferative vitreoretinopathy (PVR). At this time, patient underwent combined scleral buckle (SB) and pars plana vitrectomy (PPV), membrane peel, endolaser, and 15 % C3F8 gas. A #41 encircling silicone band (DORC Scleral Buckling Products, Zuidland, Netherlands) was used for the SB. In addition, inferior peripheral iridotomy was performed, as well as superficial keratectomy to improve view. Surgery was without complications and upon discharge, patient was instructed to maintain face-down positioning for 5 days.

On post-operative day 1, patient endorsed left eye pain and intermittent compliance with face-down positioning. In the operative eye, VA was hand motion and IOP was 32 mm Hg. There was significant diffuse corneal edema with a large epithelial defect, as well as a deep AC with 3+ cell/pigment. The vitreous chamber contained C3F8 gas with 85 % fill, and the retina was attached. At this time, a bandage contact lens was placed, and patient was started on maximum IOP lowering medical therapy and standard postoperative steroids and antibiotics. Over the next 3 weeks however, patient continued to have left eye pain with persistently elevated IOP and corneal epithelial sloughing. The etiology of his high IOP was unclear at this time. However, due to the severe corneal epithelial sloughing, decision was made to perform a superficial keratectomy and amniotic membrane graft placement.

On post-operative month 1, patient returned for the procedure in the minor operating room, where he was placed supine and positioned under the microscope. However at this time, the left eye was noted to feel hard on digital palpation, and on inspection, a large new gas bubble was visualized overlying the pupil in a now shallow AC. A Tono-Pen (Reichert AVIA Tonometer, Depew, NY) was used to measure an IOP of 52 mm Hg (Video 1, Figs. 1B and 2A). The patient was immediately positioned back upright, and the gas bubble was observed to migrate posteriorly out of the AC. The AC then deepened, and his eye began to soften slowly with return of IOP to 25 mm Hg. At this time, the dynamic nature of his IOP raised concerns for intermittent angle closure by C3F8 induced by supine positioning. Upon further questioning, patient revealed he had had increased pain when he went to bed (i.e., positioned supine). The decision was thus made to perform a pars-plana aspiration of the C3F8 gas, which resulted in deepening of the AC and normalization of the IOP (Fig. 2B). At post-operative month 4, BCVA was 20/200 and IOP was 16 mm Hg off IOP lowering eyedrops and the retina remained attached.

3. Discussion

Our case demonstrates an aphakic patient who developed positional secondary angle closure after RRD repair with C3F8 gas tamponade. This is the first report that captures in real-time the dynamic nature of C3F8 migration into the anterior segment, causing intermittent acute angle closure. In our case, the diagnosis was not initially apparent due to a seemingly normal IOP and largely unrevealing exam at the slit lamp. Only after the patient was positioned supine was the complication revealed and addressed via pars-plana aspiration of the C3F8 gas.

The mechanism by which this phenomenon occurred is likely free migration of C3F8 gas between the vitreous and anterior segment. This occurred in a patient who had an abnormal anterior segment, suggested by the history of intracapsular cataract extraction and presence of iridodonesis on initial examination. We believe that the C3F8, during periods while in the posterior chamber (PC), pushed the iris anteriorly to appositionally close the angle and raise the IOP. Secondary angle closure glaucoma due to gas in the PC has previously been described. Chin et al. detailed four cases of pseudophakic patients developing elevated IOP following PPV with gas placement. They hypothesized that gas migrated anteriorly through the zonules or capsule to then become trapped in the PC. They suggested that delayed migration following surgery may result from improper positioning or a partial fluid fill inferiorly in the vitreous cavity, allowing for easier migration of gas anteriorly.[5] In our case, gas could migrate into the PC, but in contrast, could also migrate back into the vitreous and allow for subsequent normalization of IOP. We suspect that this free bidirectional passageway of gas was possible due to the absence of capsular bag and zonulopathy, as evidenced by the patient's iridodonesis. Another mechanism that has been cited in a similar case is pupillary block. Kumar et al. reported an aphakic patient who underwent PPV with C3F8 gas and presented post-operatively with high IOP. They proposed angle closure occurred due to pupillary block likely because of noncompliance with post-operative prone positioning.[3] We do not believe in our case however, there to have been a large pupillary block component given that the presence of peripheral iridotomy was not protective against angle closure. Lastly, the placement of a SB may have also contributed to high IOP. SBs can cause impaired venous drainage from the vortex veins, congestion and edema of the ciliary body, and subsequent anterior rotation with shallowing of the AC.[6] The use of an encircling scleral buckle may have shallowed the AC and predisposed our patient to positional angle closure. To a lesser degree, compression of the episcleral vasculature could have also increased the episcleral venous pressure and thereby IOP.

Several factors complicated the diagnosis in our patient; however,

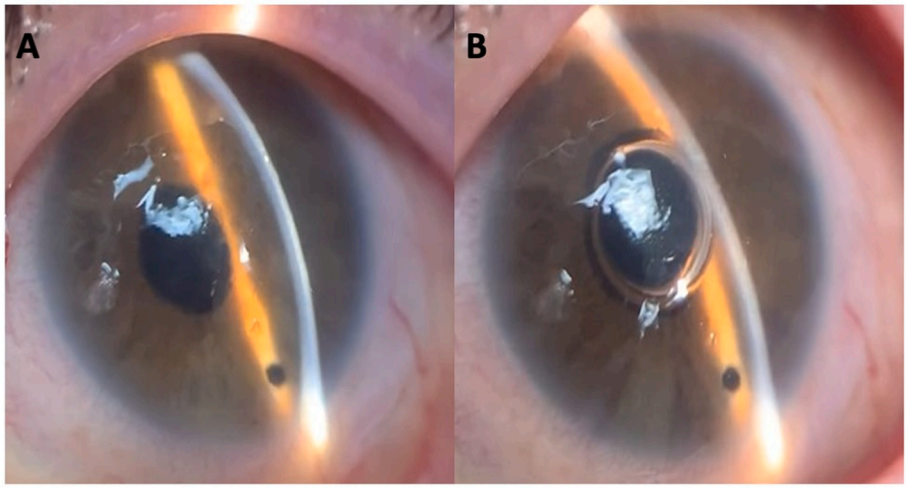


Fig. 1. Slit lamp examination of the anterior chamber in upright versus supine position. (A) Upright position reveals a deep AC, with a patent LPI present at 6 o'clock (B) Supine positioning led to migration of C3F8 gas towards AC and shallowing of AC (superiorly more than inferior).

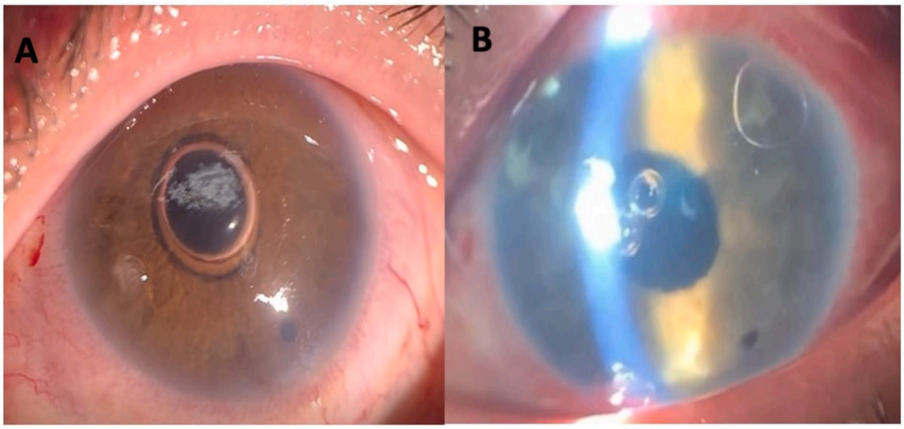


Fig. 2. Representative images of patient in supine position of pre-versus post-gas aspiration. (A) Prior to aspiration, the AC contains a large central gas bubble and appears notably shallow (B) Following aspiration, the AC has deepened considerably; there remain two small residual gas bubbles and a bandage contact lens has been placed.

important signs indicated the correct diagnosis. First, pre-operative documentation of iridodonesis and prior ocular history was crucial in helping to arrive to the correct diagnosis. Second, the patient had inconsistent compliance with face down positioning, making it difficult to detect the positional nature of his symptoms. The eye pain, which was initially attributed to a non-healing epithelial defect, was consistent with recurrent episodes of elevated IOP elicited by going to bed (e.g., supine positioning). We suggest that this complication, were it to arise, would likely occur after post-operative prone positioning requirements are lifted (i.e., gas may begin to migrate anteriorly). Third, the initial slit lamp examination displayed a normal IOP, unrevealing AC, but significant corneal edema. Diffuse corneal edema and predominant involvement of the epithelial and superficial stromal layers is consistent with edema secondary to IOP elevation. In prolonged angle closure greater than 24 hours, the cornea may remain edematous for up to weeks despite lowering of IOP.[5] High index of suspicion should be held for non-resolving post-operative corneal edema, in the setting of other abnormal findings such as those detailed above.

An aggressive and tailored approach to management may be required in cases of secondary angle closure from gas in the PC. Standard treatments for primary angle closure glaucoma (e.g., medical therapy, laser iridotomy) are likely ineffective given the angle closure results from mechanical forces of the gas rather than relative pressure gradients from pupillary block.[1,2] Kumar et al.[3] resorted to cyclophotocoagulation in his case of pupillary block with elevated IOP refractory to medical therapy and a PI. Chin et al.[5] successfully managed their four cases via paracentesis of the gas trapped in the PC. In our case, decision was made to instead perform complete removal of the gas via pars-plana aspiration. Removal of gas from the PC was thought likely to be ineffective in our patient because the residual gas in the vitreous would continue to refill the PC. Prior to proceeding with complete removal of the gas however, one must weigh the benefits on the cornea and permanent damage from angle closure against the risks of retinal re-detachment. In our patient, BCVA fortunately returned to baseline, IOP normalized, and retina remained attached post-operatively. However, the prolonged effects of ocular hypertension likely led to optic nerve damage and visual field loss, which could not be formally assessed due to media opacity (i.e., corneal edema) and poor vision, respectively.

Angle closure glaucoma is often asymptomatic and, if left untreated, can have serious consequences. Our case underscores that high IOP and unresolving corneal edema after placement of gas in the setting of abnormal anterior segment should raise suspicion for secondary angle closure. Due to its buoyant properties, gas may migrate anteriorly with supine positioning through disrupted zonules into the PC and push the iris forward to close the angle. If there is disruption of the capsular bag or zonular disruption is significant enough, gas can also migrate back posteriorly to the vitreous and relieve angle closure upon upright positioning. This may complicate the diagnosis as high IOP may not be immediately apparent and exam may be largely unremarkable at the slit lamp. Diagnosis can be further complicated by concurrent corneal edema, shallow anterior chamber, and gas in the AC or vitreous cavity.[5]

We describe a case of a young aphakic patient who developed positional angle closure with severe IOP rise following PPV with gas tamponade. This finding is highly important given that severe IOP rise from supine positioning can lead to permanent vision loss. Due to its intermittent nature however, the diagnosis may not be initially apparent at the slit lamp. Thus, this potential complication should be monitored for and discussed when advising post-vitrectomy positioning in aphakic patients. We also hypothesize this effect is exaggerated in the presence of iridodonesis but implicated in all aphakic patients. Early aspiration of the gas should be considered, particularly in patients with difficulty maintaining face-down positioning.

Consent

Consent to publish this case report has been obtained from the patient in writing.

Funding

No funding or grant support.

Authorship

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

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajoc.2023.101954.

References

1. Kornmann HL, Gedde SJ. Glaucoma management after vitreoretinal surgeries. *Curr Opin Ophthalmol*. 2016;27(2):125–131.
2. Parivadhini A, Lingam V. Management of secondary angle closure glaucoma. *J Curr Glaucoma Pract*. 2014;8(1):25–32.
3. Kumar A, Kedar S, Garodia VK, Singh RP. Angle closure glaucoma following pupillary block in an aphakic perfluoropropane gas-filled eye. *Indian J Ophthalmol*. 2002;50(3):220–221.
4. Leung VC, Fung SSM, Muni R, Ali A. Phacomorphic angle-closure following silicone oil tamponade in a pediatric patient. *J Glaucoma*. 2018;27(6):e106–e109.
5. Chin EK, Almeida DRP, Strohbehn AL, Mahajan VB, Russell SR, Folk JC. Elevated intraocular pressure following pars plana vitrectomy due to trapped gas in the posterior chamber. *Retin Cases Brief Rep*. 2016;10(4):334.
6. Perez RN, Phelps CD, Burton TC. Angel-closure glaucoma following scleral buckling operations. *Trans Sect Ophthalmol Am Acad Ophtalmol Otolaryngol*. 1976;81(2):247–252.