CASE REPORT

Large air bubble in the Berger space during cataract surgery

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For treating retinal or Descemet membrane detachment, an expansive gas is purposefully injected into the vitreous cavity or the anterior chamber. However, it is important to consider the potential complications associated with gas injection, such as intraocular pressure elevation, intraocular lens (IOL) opacification, and gas bubble migration. It is crucial to deal effectively with unexpected intraocular air bubbles. The Berger space is an interspace between the posterior lens capsule and the anterior vitreous hyaloid that provides potential for gas bubble migration. In this study, the features and management during cataract surgery for an individual with a large air bubble in the Berger space is described. A 26-gauge needle was used to puncture the posterior capsule and aspirate the gas bubble; however, this intraoperative strategy was considered inappropriate. Other strategies, such as pars plana aspiration and posterior capsule capsulorhexis before IOL implantation, may be considered in similar cases in the future.

JCRS Online Case Rep 2021; 9:e00051 Copyright © 2021 Published by Wolters Kluwer on behalf of ASCRS and ESCR

A n expansive gas is routinely injected into the vitreous cavity or the anterior chamber (AC) to treat retinal detachment or Descemet membrane detachment during ophthalmic surgery. Moreover, an air bubble can be injected into the AC at the end of sutureless phacoemulsification cataract surgery to hinder the unexpected inflow of the ocular surface fluid, decrease the rate of posterior wound gape, or reduce AC inflammation. Although intraocular gas injection shows positive treatment efficacy, it is imperative to consider the potential complications associated with it in clinical practice, such as elevation of intraocular pressure (IOP), hydrophilic intraocular lens (IOL) opacification, progressive lens nuclear sclerosis, gas bubble migration, and myopic shift in pseudophakic eyes.

It is crucial to deal effectively with unexpected intraocular air bubbles during cataract surgery. The Berger space, located between the posterior lens capsule and the anterior vitreous hyaloid, is an important circular interspace formed by the Wieger ligament. We believe that the knowledge gained from the rare case reported in this study can significantly improve treatment strategy for similar conditions encountered in the future. To the authors’ knowledge, this is the first case report of the presence of a big air bubble in the Berger space during cataract surgery. This report aims to describe the clinical effectiveness of the treatment strategy used in this case and discuss alternative management approaches.

CASE REPORT

A 41-year-old man with myopia in both eyes and a history of blunt trauma in his left eye was referred to the cataract department of Shanxi Eye Hospital in August 2020. He was diagnosed with cataract; the corrected distance visual acuity was 18/20 in the right eye (refraction prescription, −4.5 −0.5 × 165), and visual acuity was hand motion in the left eye. The AC angle was assessed using ultrasound biomicroscope examination, and the result confirmed angle recession (Figure 1). The axial length (AL) and the anterior chamber depth (ACD) of the left eye measured using ultrasound technology were 24.19 mm and 3.95 mm, respectively. A target refraction of −4.00 diopters (D) was prepared for the left eye taking into consideration the refraction of his right eye. Phacoemulsification and hydrophilic acrylic IOL +22.5 D, (PY-60AD, HOYA) implantation was performed in the left eye. Correspondingly, the AL, ACD, and IOL power with the same target refraction for the right eye, measured using the IOLMaster 500 (v. 7.5, Carl Zeiss Meditec AG), were 24.39 mm, 3.90 mm, and 21.50 D, respectively.

During the entire surgical procedure, some unusual situations were encountered: (1) clear corneal incision: the eyeball was soft even with the ophthalmic viscosurgical device (OVD) injected in the AC prior to incision, and it was not easy to make the triple incision; (2) capsulorhexis: the ACD was too deep and the lens/iris diaphragm moved posteriorly after OVD filling, which might indicate zonular weakness; (3) phacoemulsification:

Submitted: September 11, 2020 | Final revision submitted: February 3, 2021 | Accepted: February 6, 2021

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Supported by the National Natural Science Foundation of China under grant no. 81971697.

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scattered small bubbles were located at the back of the posterior capsule after phacoemulsification (Figure 2, A); and (4) cortical removal: during irrigation/aspiration, the air from the tube ran into the Berger space, possibly because of the relatively weak/defective zonular support and the relatively enlarged gap between the suspensory ligaments (Figure 2, B).

After IOL implantation, it was decided to aspirate the air bubble in the Berger space using a 1 mL syringe (26-gauge), with the needle puncturing the bulging capsule through the main incision. Posterior capsule rupture (PCR) was detected during OVD removal after successful air bubble aspiration. The IOL was tilted and repositioned into the sulcus (Figure 3). The patient’s corrected distance visual acuity was 20/20 in the left eye (refraction prescription, −2.75 −1.0 × 10) at 1 week after the operation.

**DISCUSSION**

Cataracts with weak/defective zonular support may cause intraoperative surgical complications, such as dislocated lens, fluid misdirection syndrome, and a gas/air bubble running into the vitreous cavity. Few case reports have described the presence of a large air bubble running into the Berger space and its management.

In this case, a sharp syringe needle was used to aspirate the air bubble; however, this strategy was considered inappropriate. Since our treatment plan was unsuccessful, we suggest the use of more effective and safer methods, such as pars plana puncture, anticipating self-absorption, or posterior continuous curvilinear capsulorhexis (PCCC).

Because of the fluctuating AC stability, OVD aspiration following posterior capsule puncture could increase the risk for PCR. If this manipulation is performed immediately before a watertight clear corneal incision, the PCR rate might be reduced. However, because of the unexpected damage to the posterior capsule, this is not a safe step. It is also not recommended to insert the aspiration tip between the iris and the anterior capsule to aspirate the air bubble because this manipulation may cause further zonular damage, and the surface tension of the bubble makes it hard to absorb without establishment of direct contact. Another technique is to depress the IOL–capsular bag complex posteriorly and try to enlarge the sulcus space to allow the posterior air to migrate forward; this technique may be useful for small air bubbles. We tired this technique in this case but failed. This may be because the air bubble was relatively large and it was hard for it to escape from the sulcus space and the spaces between the suspensory ligaments.

There are 3 main recommended manipulations and corresponding complications that need to be taken into account: (1) Awaiting self-absorption after an IOL implantation: the normal metabolic cycle of an air bubble is approximately 5 to 7 days. During this period, potential complications, such as IOP elevation (surgical peripheral iridectomy may be needed), myopia shift of target refraction, IOL dislocation, and special position requirements, should be considered. Two cases of AC air bubble injection to treat Descemet membrane detachment have been encountered in our clinic. In these cases, the air bubble coursed into the Berger space, with shallower ACD and an IOP around 35 mm Hg on postoperative day 1. For treatment, we used pupil dilation and pressed on the posterior

**Figure 1.** UBM examination of white cataract. A: White cataract during surgery. B: Angle recession; tear in the ciliary body face (white arrow), and remaining iris that was attached to the sclera spur (black arrow). C and D: No direct communication between the supraciliary space and the anterior chamber was found in the images acquired from different scanning directions. UBM = ultrasound biomicroscopy.

**Figure 2.** Air bubble entry into the Berger space. A: Scattered small bubbles (red circle) were located to the back of the posterior capsule. B: Air in the pipe ran rapidly into the anterior chamber after pedal presses for irrigation/aspiration. C: Schematic diagram demonstrating the air bubbles running into the Berger space through the gaps of weak suspensory ligaments (green arrow) forming a big air bubble (green circle). D: Big air bubble at the back of the posterior capsule (yellow circle). E: Big air bubble (blue circle) continued to be present after IOL implantation. F: Failed attempt to aspirate the bubble from the sulcus space using the aspiration tip.
lip of the clear corneal incision while the patient was seated. After IOP reduction, the air bubble entered and then escaped from the AC. (2) PCCC before IOL implantation: puncturing first without a PCR is challenging owing to the high surface tension of the big air bubble. Therefore, OVD is injected into the capsular bag to support the AC and balance the surface tension of the air bubble. A cystotome is preferred to raise the posterior capsule flap and ensure that no OVD runs out of the AC during this procedure. Perfect completion of a PCCC posterior to the midlimbus to ensure that the puncture location should be 3.0 mm (aphakic) and 3.5 mm can be performed before or after an IOL implantation. The combined with a syringe cannula aspiration of the air bubble is AC during this procedure. Perfect completion of a PCCC posterior capsule flap and ensure that no OVD runs out of the tension of the air bubble. A cystotome is preferred to raise the capsular bag to support the AC and balance the surface tension of the big air bubble. Therefore, OVD is injected into the first without a PCR is challenging owing to the high surface from the AC. (2) PCCC before IOL implantation: puncturing After IOP reduction, the air bubble entered and then escaped the lip of the clear corneal incision while the patient was seated. In this study, we described a case of cataract surgery with a large air bubble in the Berger space and the alternative strategies for its management. Zonular weakness might have been the main cause of the development of this bubble. The risk factors associated with it, such as blunt trauma, high myopia, and pseudoexfoliation syndrome, should also be taken into consideration when deciding the surgical plan large.

**WHAT WAS KNOWN**
- Gases with different expansive properties have been purposefully injected into the vitreous cavity or anterior chamber to treat retinal detachment or Descemet membrane detachment.

**WHAT THIS PAPER ADDS**
- Large air/gas bubbles in the Berger space mainly results from zonular weakness of the eye.
- Recommended manipulations, such as self-absorption, posterior continuous curvilinear capsulorhexis, and aspiration from pars plana, may be useful to treat such cases.

**REFERENCES**

Disclosures: None reported.

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