Angle-Closure Glaucoma and Goniosynechiolysis

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CASE PRESENTATION

An 83-year-old woman was referred for elevated IOP 1 month after undergoing repair of a macular hole with pars plana vitrectomy (PPV) and C_3F_8 in her left eye. Two weeks after the PPV, her IOP increased to the low 50s, and she developed iris bombé and a closed angle. An inferior laser peripheral iridotomy and medication reduced the IOP to 30 mm Hg. Two weeks after the peripheral iridotomy, the angle remained narrow, and the IOP was 38 mm Hg, despite treatment with bimatoprost and a fixed combination of timolol and brimonidine as well as oral acetazolamide 500 mg b.i.d. Moreover, the gas bubble allowed visualization of an inferiorly thinning neuroretinal rim. The patient was referred for a glaucoma evaluation.

An examination of the patient's left eye found a visual acuity of count fingers, an IOP of 42 mm Hg, a shallow anterior chamber with an open iridotomy inferiorly, and a moderate nuclear sclerotic and cortical cataract. Gonioscopic evaluation revealed a closed angle with peripheral anterior synechiae (PAS) over 280° (except for 80° open to the posterior trabecular meshwork inferiorly). There was 25% gas fill and a glaucomatous optic disc with a thin neuroretinal rim inferiorly and superiorly. The examination of the patient's right eye was significant only for a moderate cataract and narrow angles without PAS.

One week later, the IOP remained 39 mm Hg OS.

DISCUSSION

RNW: Dr. Lin, how would you have approached this case?

SCL: I would have considered performing ultrasound biomicroscopy (UBM) to help diagnose the causal agent. Certainly, the gas bubble was contributing to the closed angle. Because the gas bubble was diminishing, there could have been a ciliary body effusion causing anterior rotation of the angle. Some of what ophthalmologists have diagnosed as malignant glaucoma in the past has been shown by UBM to be effusions of the ciliary body and forward rotation of the lens-iris diaphragm rather than pushing from expanded vitreous.[1,2] A detached ciliary body could occur during vitrectomy or with postoperative inflammation and swelling.

RNW: What would you have done if the UBM had shown a shallow peripheral effusion?

SCL: The conservative medical treatment likely would not change. One would still use topical steroids and prescribe atropine to relax the ciliary body and move the lens-iris diaphragm posteriorly. One could also consider draining the effusion. Alternatively, one could perform a vitrectomy for aqueous misdirection.

RNW: Originally, my colleagues and I described two patients in whom the drainage of choroidal fluid was effective,[1] but I have not always had successful results with this approach. As you point out, it is key to differentiate ciliary body detachment from aqueous misdirection, because the management of each is different. In this particular case, what role do you think that the gas is playing?

SCL: Certainly, it is a major contributing factor. Postoperative pressure spikes after the use of intraocular gas are common. A recent study showed that approximately three-quarters of patients with a history of glaucoma and one-half of those without glaucoma developed an IOP spike after PPV.[3] Among individuals who have preexisting glaucoma or, as in this case, a narrow angle, the ability to tolerate the elevated IOP and forward rotation of the lens-iris diaphragm can be greatly impaired. I think that the vit-

rectomy and gas bubble likely played a significant role in pushing this patient over the edge.

RNW: If this patient presented to you with a closed angle, would compression gonioscopy have influenced your choice of treatment?

SCL: Three weeks is enough time to develop closed angles with PAS, and I think that this is probably what happened here. In that situation, iridoplasty likely would not open the angle.

RNW: Moreover, the anterior chamber is very shallow, and iridoplasty might not be feasible without burning the cornea. Suppose with compression gonioscopy the angle had opened. What approach would you have employed?

SCL: One possibility would have been to wait until the gas bubble was gone. The size of the bubble was only 25% by the time the patient was referred to you. It is possible that, when the gas bubble completely absorbed, the pressure would have improved and the anterior chamber might have permitted iridoplasty.

CR: Even if the angle had been open to compression, the pressure was 42 mm Hg at presentation, and there was evidence of changes in the optic disc.

RNW: How long could you wait for a gas bubble to dissolve with a pressure of 42 mm Hg when the eye is already demonstrating changes in the optic disc?

SCL: At this point, the physician is backed into a corner. Some clinicians might consider adjunctive glaucoma surgery in addition to taking out the lens. Perhaps a glaucoma drainage device could be implanted or a trabeculectomy performed. With angle-closure glaucoma (ACG), however, extraction of the lens alone may be the best treatment. Two recent articles from Hong Kong randomized patients with ACG (either controlled or uncontrolled) to treatment with phacoemulsification alone or phacotrabeculectomy. The data showed a significant IOP-lowering effect for both procedures, with a small advantage for phacotrabeculectomy in pressure lowering but likely more complications.[4,5]

RNW: Given that more than 180º of the angle were closed, we thought that removal of the lens alone would not be sufficient. Additionally, we thought that we had an opportunity to open the angle with synechialysis since it had closed relatively recently. In this case, we performed the goniosynechiolysis with gonioscopic visualization.

SCL: I perform goniosynechiolysis with a cyclodialysis spatula or a blunt instrument. I am conservative in my approach. Patients with normal pressures experience approximately a 10% drop with phacoemulsification, and those with open-angle glaucoma achieve a decrease of almost 20%. Patients with pseudoexfoliation and angle closure have even greater IOP lowering. Unpublished data from my colleagues and me from an ongoing prospective study show that the amount of the angle's opening correlates significantly with the amount of IOP lowering after phacoemulsification. Other mechanisms have been suggested to explain the decrease in IOP after phacoemulsification, including the release of prostaglandin; the vibration of the ultrasound itself, which causes changes in the trabecular meshwork[6]; and cleaning of pigment and debris from the trabecular meshwork by the irrigation.

ASM: Wouldn't knowing the volume of the lens be important to determining how much of an effect phacoemulsification might have on the IOP? Presumably, the lens with higher volume would have a greater pressure-lowering effect when removed.

RNW: This is a very good point, and it should be evaluated.

CR: Based on what we have talked about—the possible relationship between the degree of the angle's opening and the degree of IOP lowering—does it not make sense to couple the cataract extraction with goniosynechiolysis in patients who have PAS and closed angles prior to surgery? A 90% success rate for phacoemulsification with goniosynechiolysis in eyes with greater than 180º of PAS and uncontrolled IOP when performed within 6 months of acute angle closure has been reported.[7]

SCL: As I mentioned, prospective data from Hong Kong showed that phacoemulsification alone in ACG lowers the IOP significantly.[4,5]

RNW: Our empiric approach to eyes that have cataract and occludable angles without PAS or only minimal PAS is solely to take out the cataract. For eyes in which the angle does not open with compression, there are extensive PAS of 180º or more, and the angle closure has occurred within the past 6 months, we will combine goniosynechiolysis with cataract surgery. If more than 6 months have elapsed, then we perform a trabeculectomy combined with the cataract extraction. Dr. Rodarte, can you provide follow-up on the surgical approach and postoperative course of this patient?

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Steroid-Induced Glaucoma After Penetrating Keratoplasty

The challenges of managing glaucoma without compromising the corneal graft's survival.

BY EIYASS ALBEIRUTI, MD

A familiar situation to any ophthalmologist is when the treatment of one condition leads to the development of another. A classic example is steroid-induced glaucoma after corneal transplantation, as this case illustrates.

OPHTHALMIC HISTORY

A 47-year-old white man with a history of keratoconus and high myopia underwent repeat penetrating keratoplasty (PKP) in his right eye. Incidentally, 2 weeks later, he was also treated successfully with a single injection of bevacizumab for a choroidal neovascular membrane in his right central macula. Soon after the second PKP, the patient's IOP rose into the high 20s and low 30s, for which he was treated with brimonidine tartrate 0.1% and timolol maleate 0.5%. Despite therapy, 2 months after PKP, his IOP spiked to 40 mm Hg, presumably due to steroid response. His medication was switched from prednisolone acetate 1% to loteprednol etabonate 0.5%. Therapy appeared to effectively curb the elevation in IOP until the frequency of the steroid's dosing had to be increased to six times daily in response to signs of possible early rejection.

After tapering the loteprednol, the patient's IOP was once again controlled and remained in the teens over the course of a year, with low dosing frequency of the loteprednol and continued use of the brimonidine and timolol. An episode of rejection again required more frequent administration of the loteprednol and triggered a steroid response to nearly 30 mm Hg. Afterward, the steroid was tapered to once daily, but the elevated IOP persisted, despite the addition of travoprost 0.004%. The patient was referred to the glaucoma clinic for management, 6 months after the most recent episode of rejection and 2 years after the repeat PKP.

Figure 1. Right fundus showing Fuchs' spot and myopic disc.

GLAUCOMA EVALUATION

The patient's vision was 20/40 OD and 20/30 OS (corrected by a hybrid contact lens in his right eye and a rigid gas permeable contact lens in his left eye, spherical equivalent of -12.00 D OD and -10.00 D OS). His IOP measured 26 mm Hg OD and 15 mm Hg OS by applanation tonometry. His right eye had a clear corneal graft with a few buried sutures, a deep and quiet anterior chamber, a normal iris, and a clear lens. The conjunctiva was slightly injected but mobile. The posterior segment exhibited vitreous syneresis, myopic

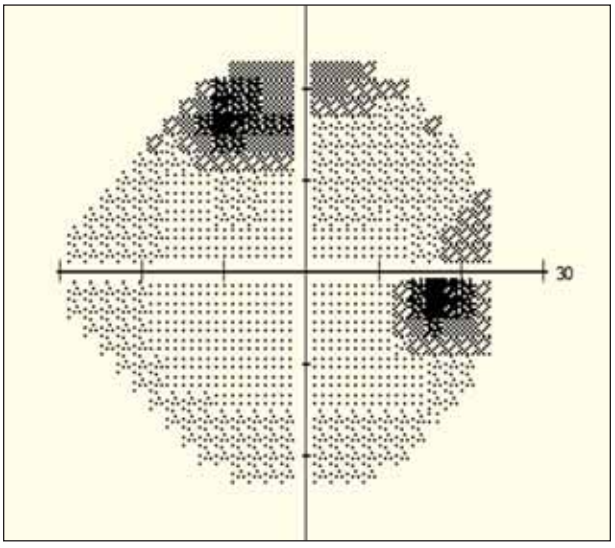

Figure 2. Visual field testing in the patient's right eye shows superior depression.

changes in the fundus (including a Fuchs' spot), and a slightly large disc with peripapillary atrophy and a shallow cup (Figure 1). The cup-to-disc ratio was in the range of 0.6. The patient's left eye demonstrated keratoconus but otherwise appeared similar to the right eye.

Gonioscopy revealed lightly pigmented angles that were open to the ciliary body band. Pachymetry measured 600 µm OD and 432 µm OS. Structural imaging of the optic discs yielded poor results due to corneal irregularity bilaterally, and visual field testing revealed superior depression in his right eye (Figure 2). Although it was difficult to accurately assess the extent of his glaucoma, my colleagues and I felt that the patient suffered only mild-to-moderate damage but that his IOP would need to be lowered to preserve the graft's survival and prevent glaucomatous progression.

DISCUSSION

Current Plan

Occurring in up to one-third of patients, secondary glaucoma after PKP is a well-known phenomenon.[1] Although a number of factors could be involved (including changes in the trabecular meshwork's anatomy, inflammation, and peripheral anterior synechiae), in this case, steroid response was clearly implicated as the major cause, based on the patient's well-documented history and a wide open angle on gonioscopy. As with any case of steroid-induced glaucoma, appropriate attempts had been made to taper the causative agent to the extent possible (while avoiding graft rejection) and switch to a less potent steroid, but even milder agents can be problematic. This patient was also placed on nearly maximal glaucoma medical therapy, excluding carbonic anhydrase inhibitors. These agents may interfere with corneal endothelial function, and in eyes with prior endothelial cellular loss or dysfunction, they may induce mild corneal thickening, if not outright decompensation on rare occasions.[2,3] For the time being, my colleagues and I have elected to avoid this class of medications unless surgery is the only option.

Instead, we plan a trial of laser trabeculoplasty. Despite limited reports on the use of trabeculoplasty in the setting of steroid-induced glaucoma,[4] this form of treatment is an option in this case. The patient's cornea is clear, and his angle is open. Moreover, we want to avoid an invasive procedure that has a high risk of causing graft failure. Although it remains to be seen how our patient will respond to laser trabeculoplasty, it is instructive to contemplate the possible next step, should he require further intervention.

Further Options

Trabeculectomy

Despite a high rate of bleb failure in the setting of PKP, the use of mitomycin C (MMC) during trabeculectomy has improved outcomes.[5] MMC does not seem to cause the epithelial toxicity observed with 5-fluorouracil, which is best avoided after PKP. In this case, the conjunctiva is relatively quiet and mobile with no signs of scarring, which makes trabeculectomy technically feasible. The patient is heavily dependent on his contact lenses, however, which is a relative contraindication for trabeculectomy, because the procedure may predispose patients to infection and the threat of endophthalmitis. Another consideration is the importance of avoiding hypotony and a shallow anterior chamber, which could damage the graft. Like any intraocular surgery, even uncomplicated trabeculectomy can lead to graft failure.

Glaucoma Drainage Devices

Drainage devices are increasingly used to treat glaucoma after PKP and provide fairly good IOP control, but it is now well known that tube shunt surgery results in an even higher rate of graft failure than trabeculectomy.[6,7] Possible reasons may include mechanical forces such as direct tube-cornea touch or the creation of an open channel of inflammatory mediators between the anterior chamber and the subconjunctival space. Inserting the tube into the vitreous cavity, however, is associated with a reduced risk of graft failure compared with its insertion in the anterior chamber.[8] Keeping the tip of the tube away from the cornea (eg, with placement in the sulcus) is a frequent practice at our institution. Because the eye in this case is phakic with a clear lens, the only reasonable option would be to place the tube shunt deep in the anterior chamber, close to the iris. A valved implant might be an appropriate choice to minimize the risk of hypotony.

Cyclophotocoagulation

Often regarded as a last option for many forms of glaucoma, cyclophotocoagulation (CPC) should be considered in the setting of corneal grafts. Like incisional surgery, CPC can effectively lower IOP (repeat treatments possibly being necessary),[9] and it is associated with a high rate of graft failure, up to 44%.[10] The known potential complications such as hypotony and even phthisis, however, may not be as easily and predictably avoided with CPC as with surgery. Nevertheless, in most cases, conservative treatments coupled with the adequate use of steroids can prevent significant inflammation and should minimize the risk of graft failure. Because this patient is phakic, a transscleral approach would be required.

Our Choice

The patient's high myopia, dependence on contact lenses, and native crystalline lens status pose limitations. Otherwise, trabeculectomy with MMC might be the best option for lowering his IOP and minimizing the risk of graft failure should laser trabeculoplasty not remedy the problem. In this case, placing a glaucoma drainage device in the anterior chamber and transscleral CPC are more viable choices, although each may carry an increased risk of graft failure in an eye that has already undergone two PKP procedures. Alternatively, although no published results are available, newer glaucoma procedures such as ab interno trabeculotomy and canaloplasty should not be dismissed as possibilities in these challenging situations. ❑

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CR: An uncomplicated cataract extraction by phacoemulsification with 360° goniosynechiolysis using a cyclodialysis spatula was performed. The goniosynechiolysis in the nasal quadrant was performed under gonioscopic control, with opening of the angle and visualization of the scleral spur confirmed during surgery. Six weeks postoperatively, the IOP was 16 mm Hg without pressure-lowering medications.

CONCLUSION

A patient with medically uncontrolled ACG and 280° of PAS 4 weeks after a PPV underwent cataract extraction by phacoemulsification and goniosynechiolysis. Six weeks after the procedure, her IOP remained reduced at 16 mm Hg from preoperative levels of 40 mm Hg, and her angle remained open. ❑

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