

Restoring the Intermediate Segment

Approaches to traumatic iridodialysis and cyclodialysis.

BY WILLIAM ERIC SPONSEL, MB, ChB, MD

Ocular trauma frequently damages the cornea, lens, and retina. Standard methods of managing such injuries use ultrasonic, radiological, slit-lamp, and ophthalmoscopic imaging. Because damage to the intermediate segment of the eye (ie, the iris root, zonule, and ciliary body) is obscured from view, it is often ignored. The clinician's failure to detect and resolve anterior uveal injury can result in either profound hypotony that may lead to phthisis or ocular hypertension with axonal loss. Both conditions are painful and may cause blindness.

Before the advent of ultrasound biomicroscopy (UBM), the available methods for viewing the intermediate segment included gonioscopy and liquid immersion ultrasound. Hyphema, corneal edema, and a collapse of the anterior chamber preclude gonioscopy in many trauma cases. Immersion ultrasound provides insufficient detail to help direct and facilitate careful surgical exploration. Contradistinctively, preoperative UBM provides the surgeon with useful 3-D mapping information. A thoughtful application of UBM findings may lead to surgical success, even when one's expectations are appropriately guarded. With UBM, the precise placement of drainage sclerostomies over supraciliary effusion and hemorrhage is possible, as is identifying cyclodialysis zones that require resuturing of the scleral spur and reattachment of the ciliary body. Optical coherence tomography may ultimately provide similarly useful images, but its resolution diminishes in patients who have dark uveal pigmentation, thus limiting its clinical applicability.

In the following three patients, all of whom presented within a few weeks of each other at the South Texas Medical Center in San Antonio, my colleagues and I used a P45 Ultrasonic Workstation UBM (Paradigm Medical Industries, Inc., Salt Lake City, UT), courtesy of Erin Doe, MD, a glaucomatologist at the Brooke Army Medical Center in Fort Sam Houston, Texas. The UBM's

50-MHz VHF mode provides microscopic digital images that reveal hidden anatomy and pathology beneath the iris, sclera, and ciliary body.

CASE 1

Severe, Bilateral Trauma

A 54-year-old white male had been kicked in the face by a horse and suffered severe trauma to both eyes 10 years earlier. His right eye had been enucleated, and his left eye afforded such limited vision that he required a stick to walk. The patient's left eye had (1) extensive traumatic angle recession with posteriorly displaced reattachment of the iris root, (2) a large, circinate, supraciliary effusion beneath the ciliary body, (3) a cortical cataract lacking zonular support (zonulolysis) causing phacodonesis, (4) a prelenticular pupillary membrane, (5) cystoid maculopathy, and (6) chronic severe hypotony. These problems were accompanied by a prephthisical change of the globe's shape, corneal edema, and a recent onset of

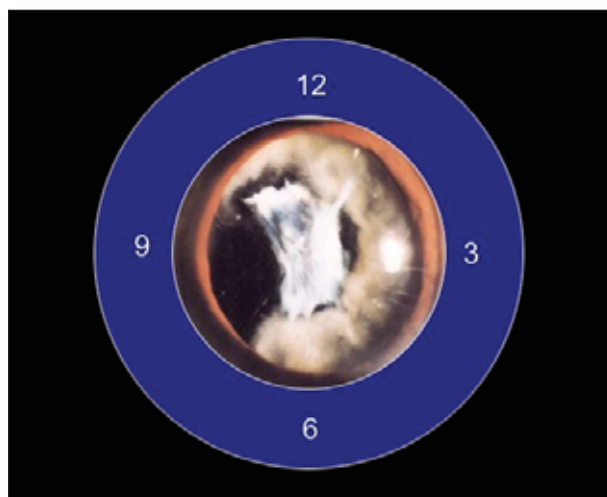


Figure 1. The patient's prephthisical eye had a calcified pupillary membrane, a large supraciliary fluid space, a grossly congested ciliary body, and a posterior reattachment of the scleral spur that was well behind the corneoscleral junction.

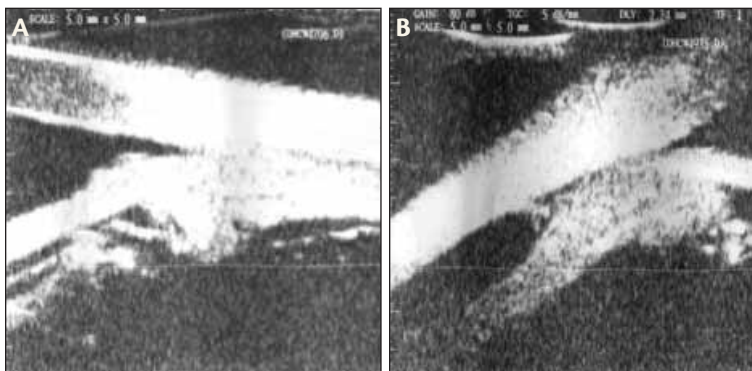


Figure 2. UBM reveals small cyclodialysis clefts at the 11- and 12-o'clock positions and a large accumulation of supraciliary fluid at the 4-o'clock position in a patient's left eye (A). A large area of fluid extended nasally to the 7-o'clock position, but there was little accumulation of fluid adjacent to the cyclodialysis cleft (B).

ocular pain. His BCVA vacillated between 20/400 OS and hand motions, with a refraction of $-9.75 + 1.00 \times 30$. The patient's left eye was too soft to applanate, and UBM confirmed the presence of extensive broad but shallow effusions from the 9- to the 2-o'clock position with associated, massive, uveal swelling (Figure 1). An area of angle recession was evident from the 2- to the 5-o'clock position.

After detailed informed consent, the patient underwent elective reconstructive surgery. The removal of the fibrotic pupillary membrane before capsulorhexis revealed a widely dilated pupil as a result of the scarred posterior reattachment of the scleral spur. I used a clear corneal approach and carefully performed low-infusion phacoemulsification on the dense cataract. I left the peripheral posterior synechiae in place to stabilize the zonular capsule and performed manual I/A. I then gently inserted a foldable Acrysof MA60 lens (Alcon Laboratories, Inc., Fort Worth, TX) beneath the iris and anterior cap-

sule, with its haptics bracing the capsular bag into the sulcus.

After securely positioning the IOL, I drained more than 2 mL of straw-colored supraciliary fluid through several strategically placed sclerostomies. Repeated replacement of the anterior chamber's fluid with BSS facilitated the drainage. The supraciliary fluid's drainage should continue after uveal tissue initially presents within the margins of each sclerostomy, because uveal swelling can account for a high proportion of the total fluid drained (Figure 2). After completing primary drainage, I grasped the retracted pupillary margin with two pairs of forceps, pulled the peripheral iris back into view, and re-established a central pupil. I then repeated the drainage and fluid re-

placement. Once all four drainage sites stopped yielding fluid during the anterior chamber's reformation, I determined that there was no immediate need to plicate the scleral spur to the corneoscleral junction, because hydrostatic pressure alone held the uveal tissue in place.

Using viscoelastic to reform the anterior chamber in this case would have posteriorly displaced the entire iris diaphragm and peeled off the re-applied uvea. I advised my assisting surgeon that, if our efforts were successful, this chronically hypotonous patient would resume making aqueous and, with little or no normal angle structure remaining, would soon need glaucoma surgery.

Three days postoperatively, the patient presented to the ER with an IOP of 60 mm Hg that rapidly responded to medication. He received an Ahmed Glaucoma Valve (New World Medical, Inc., Rancho Cucamonga, CA) approximately 3 months later, and he ultimately attained a visual acuity of $>20/100$ OS that allowed him to read large print and walk without assistance.

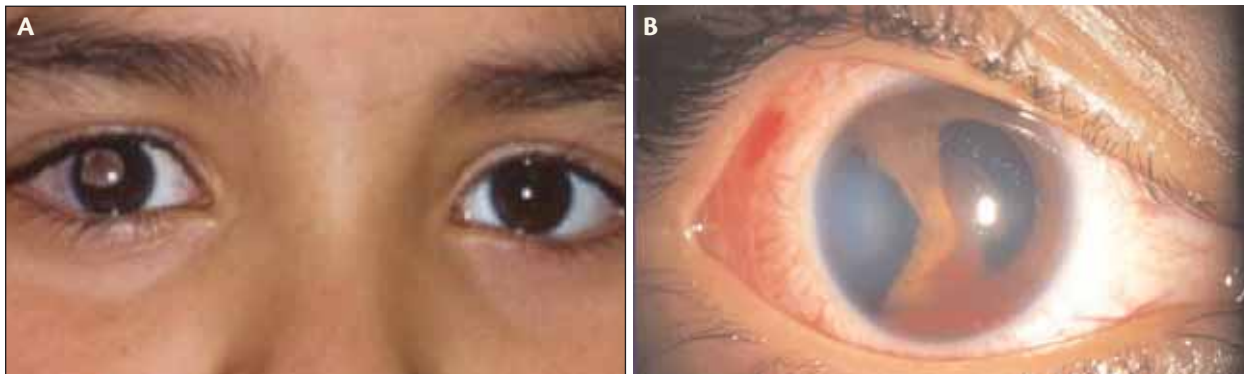


Figure 3. Before surgery, the patient had an afferent pupillary defect and an IOP of 0 mm Hg OD (A). His eye had extensive temporal irido- and cyclodialysis, zonulolysis, and hyphema (B).

CASE 2

Cyclodialysis Cleft With Supraciliary Fluid Pockets

An 81-year-old Hispanic male presented with a painful left eye. He had a history of corneal stromal edema. He had been scheduled for assessment in the cornea clinic with presumptive Fuch's dystrophy, but I was invited to assess his hypotony in the glaucoma clinic when he first arrived. His BCVA was 20/200 OS, and his IOP was <1 mm Hg OS. A thorough patient history and careful gonioscopy revealed that he had undergone bilateral cataract extraction 5 years earlier. Postoperatively, the patient's visual acuity remained 20/20 OD, but his left eye irregularly cycled through periods of relative clarity and total blurring. He demonstrated a mild, afferent pupillary defect in his hypotonous left eye, and a slit-lamp fundus examination revealed macular folds consistent with hypotony maculopathy. Gonioscopy confirmed pigmentary accumulation inferiorly and temporally and a small, single-clock-hour, nondisplaced cyclodialysis superiorly.

UBM revealed fluid extending downward to the 4- and 7-o'clock positions, on either side of the small cyclodialysis cleft. The scarred area at the 12-o'clock position contained little adjacent supraciliary fluid. I prescribed Cyclogyl 2% (Alcon Laboratories, Inc.) q.i.d. for his left eye instead of primary repair. Within 1 month, the patient's left eye had an IOP of 10 mm Hg, a clear cornea, and no residual macular folds. His visual acuity, which had previously vacillated between hand motions and 20/40 since cataract extraction, now measured 20/15 OS. UBM with cycloplegia showed an obstruction of the small cyclodialysis cleft with peripheral iris root and a spontaneous resorption of all the supraciliary fluid. Later, the patient was treated with surgical closure of the cyclodialysis cleft, which allowed the restoration of his normal pupillary function. He had no further ocular problems.

CASE 3

Hemi-Iridodialysis and Cyclodialysis

An 8-year-old Hispanic male had suffered an injury to his right eye from a BB gun 11 days before presenting. His IOP had been almost zero since the injury. The temporal iris was detached and scrolled nasally. The iris was encased in fibrin and vitreous, and the temporal zonule was destroyed (Figure 3). The lens appeared to be intact, but there was no evidence of macular function. His visual acuity was < 20/400 OD. The boy was in great pain and appeared at risk for recurrent bleeding.

UBM showed extensive cyclodialysis and supraciliary effusion with angle recession beyond the ends of the cyclodialysis. The patient was scheduled for surgical

ALPHAGAN® P

(brimonidine tartrate ophthalmic solution) 0.15% sterile



INDICATIONS AND USAGE

ALPHAGAN® P is indicated for the lowering of intraocular pressure in patients with open-angle glaucoma or ocular hypertension.

CONTRAINDICATIONS

ALPHAGAN® P is contraindicated in patients with hypersensitivity to brimonidine tartrate or any component of this medication. It is also contraindicated in patients receiving monoamine oxidase (MAO) inhibitor therapy.

PRECAUTIONS

General: Although **ALPHAGAN® P** ophthalmic solution had minimal effect on the blood pressure of patients in clinical studies, caution should be exercised in treating patients with severe cardiovascular disease.

ALPHAGAN® P has not been studied in patients with hepatic or renal impairment; caution should be used in treating such patients.

ALPHAGAN® P should be used with caution in patients with depression, cerebral or coronary insufficiency, Raynaud's phenomenon, orthostatic hypotension, or thromboangiitis obliterans. Patients prescribed IOP-lowering medication should be routinely monitored for IOP.

Information for Patients: As with other drugs in this class, **ALPHAGAN® P** ophthalmic solution may cause fatigue and/or drowsiness in some patients. Patients who engage in hazardous activities should be cautioned of the potential for a decrease in mental alertness.

Drug Interactions: Although specific drug interaction studies have not been conducted with **ALPHAGAN® P**, the possibility of an additive or potentiating effect with CNS depressants (alcohol, barbiturates, opiates, sedatives, or anesthetics) should be considered. Alpha-agonists, as a class, may reduce pulse and blood pressure. Caution in using concomitant drugs such as beta-blockers (ophthalmic and systemic), anti-hypertensives and/or cardiac glycosides is advised.

Tricyclic antidepressants have been reported to blunt the hypotensive effect of systemic clonidine. It is not known whether the concurrent use of these agents with **ALPHAGAN® P** ophthalmic solution in humans can lead to resulting interference with the IOP lowering effect. No data on the level of circulating catecholamines after **ALPHAGAN® P** administration are available. Caution, however, is advised in patients taking tricyclic antidepressants which can affect the metabolism and uptake of circulating amines.

Carcinogenesis, Mutagenesis, and Impairment of Fertility: No compound-related carcinogenic effects were observed in either mice or rats following a 21-month and 24-month study, respectively. In these studies, dietary administration of brimonidine tartrate at doses up to 2.5 mg/kg/day in mice and 1.0 mg/kg/day in rats achieved 86 and 55 times, respectively, the plasma drug concentration estimated in humans treated with one drop of **ALPHAGAN® P** ophthalmic solution into both eyes 3 times per day.

Brimonidine tartrate was not mutagenic or cytogenic in a series of in vitro and in vivo studies including the Ames test, chromosomal aberration assay in Chinese Hamster Ovary (CHO) cells, a host-mediated assay and cytogenic studies in mice, and dominant lethal assay.

Reproductive studies performed in rats with oral doses of 0.66 mg base/kg revealed no evidence of impaired fertility due to **ALPHAGAN® P**.

Pregnancy: Teratogenic Effects: Pregnancy Category B. Reproductive studies performed in rats with oral doses of 0.66 mg base/kg revealed no evidence of harm to the fetus due to **ALPHAGAN® P** ophthalmic solution. Dosing at this level produced an exposure that is 189 times higher than the exposure seen in humans following multiple ophthalmic doses.

There are no adequate and well-controlled studies in pregnant women. In animal studies, brimonidine crossed the placenta and entered into the fetal circulation to a limited extent. **ALPHAGAN® P** should be used during pregnancy only if the potential benefit to the mother justifies the potential risk to the fetus.

Nursing Mothers: It is not known whether this drug is excreted in human milk; in animal studies brimonidine tartrate was excreted in breast milk. A decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother.

Pediatric Use: In a well-controlled clinical study conducted in pediatric glaucoma patients (ages 2 to 7 years) the most commonly observed adverse events with brimonidine tartrate ophthalmic solution 0.2% dosed three times daily were somnolence (50% - 83% in patients ages 2 to 6 years) and decreased alertness. In pediatric patients 7 years of age or older (>20kg), somnolence appears to occur less frequently (25%). Approximately 16% of patients on brimonidine tartrate ophthalmic solution discontinued from the study due to somnolence.

The safety and effectiveness of brimonidine tartrate ophthalmic solution have not been studied in pediatric patients below the age of 2 years. Brimonidine tartrate ophthalmic solution is not recommended for use in pediatric patients under the age of 2 years. (Also refer to Adverse Reactions section.)

Geriatric Use: No overall differences in safety or effectiveness have been observed between elderly and other adult patients.

ADVERSE REACTIONS

Adverse events occurring in approximately 10-20% of the subjects included: allergic conjunctivitis, conjunctival hyperemia, and eye pruritus.

Adverse events occurring in approximately 5-9% of the subjects included: burning sensation, conjunctival folliculosis, hypertension, oral dryness, and visual disturbance.

Events occurring in approximately 1-4% of subjects included: allergic reaction, asthenia, blepharitis, bronchitis, conjunctival edema, conjunctival hemorrhage, conjunctivitis, cough, dizziness, dyspepsia, dyspnea, epiphora, eye discharge, eye dryness, eye irritation, eye pain, eyelid edema, eyelid erythema, flu syndrome, follicular conjunctivitis, foreign body sensation, headache, pharyngitis, photophobia, rash, rhinitis, sinus infection, sinusitis, stinging, superficial punctate keratopathy, visual field defect, vitreous floaters, and worsened visual acuity.

The following events were reported in less than 1% of subjects: corneal erosion, insomnia, nasal dryness, somnolence, and taste perversion.

The following events have been identified during post-marketing use of **ALPHAGAN® P** ophthalmic solution in clinical practice. Because they are reported voluntarily from a population of unknown size, estimates of frequency cannot be made. The events, which have been chosen for inclusion due to either their seriousness, frequency of reporting, possible causal connection to **ALPHAGAN® P**, or a combination of these factors, include: bradycardia; hypotension; irritis; miosis; skin reactions (including erythema, eyelid pruritus, rash, and vasodilation) and tachycardia. Apnea, bradycardia, hypotension, hypothermia, hypotonia, and somnolence have been reported in infants receiving **ALPHAGAN® P** ophthalmic solution.

OVERDOSAGE

No information is available on overdosage in humans. Treatment of an oral overdose includes supportive and symptomatic therapy; a patent airway should be maintained.

DOSAGE AND ADMINISTRATION

The recommended dose is one drop of **ALPHAGAN® P** in the affected eye(s) three times daily, approximately 8 hours apart.

ALPHAGAN® P ophthalmic solution may be used concomitantly with other topical ophthalmic drug products to lower intraocular pressure. If more than one topical ophthalmic product is being used, the products should be administered at least 5 minutes apart.

Rx Only

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U.S. Pat. 5,424,078; 5,736,165; 6,194,415; 6,248,741; 6,465,464; 6,562,873; 6,627,210; 6,641,834; 6,673,337



Figure 4. The surgeon creates a stepped incision (A) and a half-thickness planar corneoscleral ridge (B). He unscrolled the iris root (C and D) and attached the peripheral iris to the sclera with 10-0 nylon (E). After performing a manual vitrectomy (F), he created sclerostomies over the largest areas of supraciliary and pars plana/choroidal detachment (G). Finally, the surgeon implanted a tube shunt (H and I).

repair of the cyclodialysis and the iridodialysis with an anterior vitrectomy and transscleral drainage. Based on my experience in case 1, I tentatively scheduled optional implantation of an Ahmed Glaucoma Valve and a scleral graft.

After carefully performing the peritomy, I created a stepped incision posterior to the limbus (Figure 4A). I used a crescent blade to create a half-thickness planar corneoscleral ridge for the full extent of the wound (Figure 4B). Keeping the internal Descemet's openings below 2 clock hours at a time will avoid an expurgation of the ocular contents. After clearing overlying fibrin and vitreous and carefully instilling viscoelastic, I unscrolled the iris root (Figures 4C and D). I attached the peripheral iris to the anterior lip of the stepped incision with 10-0 nylon sutures (Figure 4E). After closing the central area, I carefully opened the adjacent area with a blade and performed another vitrectomy (Figure 4F).

After repairing the anterior and intermediate segments, I strategically placed sclerostomies (Figure 4G) overlying the largest areas of supraciliary and pars plana/choroidal detachment as shown on preoperative UBM. I completed a slow, repetitive transzonular fluid replacement with BSS using a 30-gauge cannula via an oblique 25-gauge paracentesis. This process continued as long as fluid exited through each sclerostomy. Finally, I placed the Ahmed Glaucoma Valve (Figures 4H and I)

to avoid postoperative ocular hypertension and associated pain that could readily compromise my efforts.

The child rapidly recovered from the 6-hour procedure. He had a central oval pupil with normal sphincter function, a UCVA of 20/30 OD, full peripheral visual fields, and a consistent IOP of approximately 16 mm Hg without medication.

SUMMARY

The three cases presented herein illustrate the utility of UBM in the assessment of intermediate segment trauma. I now recognize that, in some cases, prophylactically placing a shunt may be prudent after the surgical repair of the trauma, because postoperative nausea or eye-rubbing could readily undo the meticulous repair. Large clefts must be repaired primarily. In smaller cyclodialyses, if the detached scleral spur remains aligned with its normal anatomic attachment site, pharmacologic cycloplegia may temporarily induce the cleft to reseat, allowing spontaneous resorption of massive quantities of cir-

culate supraciliary fluid. Most importantly, the precise attachment of the scleral spur is key to the success of all repairs. If resutured too far anteriorly or posteriorly, the ciliary body will remain detached with persisting supraciliary fluid, and long-term hypotony and eventual phthisis are likely. Thorough supraciliary drainage facilitates initial repair and helps stabilize the repositioned uveal tissue. □

These three cases were part of a presentation that was awarded Best Paper Award at the 2003 International Congress of Glaucoma Surgery.¹ The author wishes to acknowledge the contributions of Erin Doe, MD, of Brooke Army Medical Center, who performed the UBM; Fernando Trujillo, MD; Gianmarco Paris, MD; and Leana Long, MD, who assisted with the procedures.

William Eric Sponsel, MB, ChB, MD, is Chief of Glaucoma Services and Professor and Director of Clinical Research in the Department of Ophthalmology at the University of Texas Health Science Center in San Antonio. He stated that he holds no financial interest in the products or companies mentioned herein. Dr. Sponsel may be reached at (210) 567-8421; sponsel@uthscsa.edu.



1. Sponsel WE. Complex referral surgery for the glaucoma subspecialist: approaches to chronic iridodialysis, cyclodialysis, angle recession, and uveal prolapse. Paper presented at the Second International Congress on Glaucoma Surgery; February, 2003; Luxor, Egypt.