CANALOPLASTY IN A CASE OF STEROID-INDUCED UNCONTROLLED OCULAR HYPERTENSION

The need for significant IOP lowering does not necessarily need to involve invasive or bleb-forming procedures.

BY JAMES T. MURPHY, MD

The precise mechanism for IOP elevation in steroid-induced glaucoma is unclear, although the weight of evidence suggests that outflow resistance occurs at the level of the trabecular meshwork (TM). Several theories regarding the etiology of steroid-induced IOP elevation have been proposed, including that glucocorticoids:

1. alter the composition and makeup of proteins and glycans within the TM, thereby leading to accumulation of byproducts that yield mechanical obstruction of outflow;
2. may impact TM cell morphology such that glucocorticoid responsiveness is increased;
3. deposit crystalline particles as they break down locally; and/or
4. decrease synthesis of prostaglandins.[1,2]

Management of steroid-induced glaucoma can be challenging. Discontinuation of steroids is recommended as a first course of action, although this may not always be a reasonable request in patients whose vision depends on treatment with long-acting steroid implants. While several authors have proposed safe and effective techniques for removing steroid drug depots, accessing the posterior chamber necessitates an invasive surgery with all attendant risks for complications. Furthermore, certain patients, such as patients with diabetic eye disease, can develop macular edema (ME) that responds only to intravitreal steroids, and so other factors, including the overall health of the eye and best-corrected visual acuity, must be considered in the risk-benefit analysis.

CASE PRESENTATION

A 44-year-old woman was referred to my office by a local retina specialist for evaluation of IOP elevation following her second injection of a dexamethasone intravitreal implant 0.7 mg (Ozurdex; Allergan, an AbbVie Company) for treatment of ME associated with idiopathic retinal vasculitis-aneurysms-neuroretinitis syndrome. The patient had previously received several treatments of panretinal photocoagulation, focal laser, intravitreal bevacizumab (Avastin, Genentech), and intravitreal triamcinolone (Triesence, Alcon) for the ME with only partial resolution. After implantation of the initial dexamethasone implant, the patient experienced a significant reduction in ME and concomitant improvement in vision. Unfortunately, following the second administration of the implant, the IOP rose to 39 mm Hg in the right eye.

At the time of the evaluation, the patient was phakic with little to no cataract formation in both eyes (see Figures 1-2 for relevant imaging). Central corneal thickness was average

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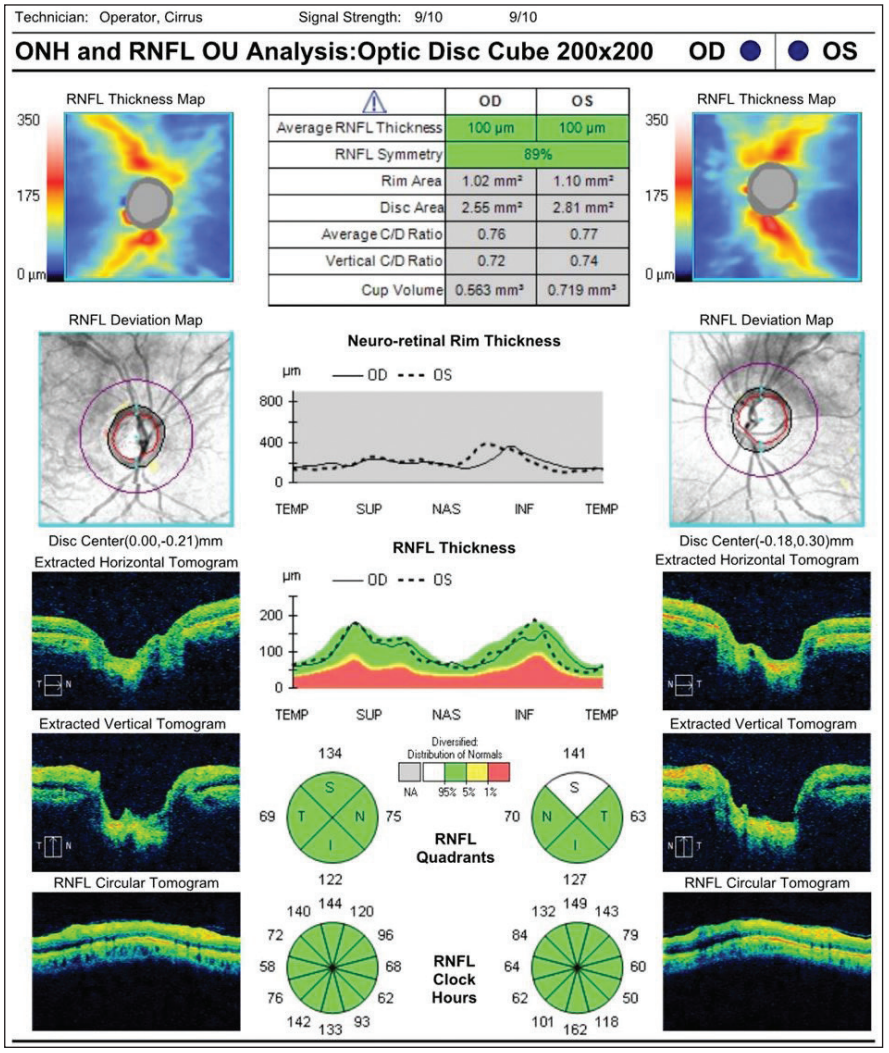

Figure 1. Optic nerve head and retinal nerve fiber layer analysis for a 44-year-old patient presenting with steroid-induced ocular hypertension.

in both eyes. At the initial evaluation, I discussed the full spectrum of treatment for IOP elevation. As is common, the patient was hesitant to agree to surgical intervention right off the bat, so I started maximum topical treatment. We decided to trial a 2-week course of acetazolamide; however, the patient returned to the office within a week unable to tolerate the side effects despite dietary potassium supplementation and adequate water intake. IOP was 31 mm Hg in the right eye, and over the next 2 weeks, the pressure leveled out in the mid-twenties. We went through the motions of maximum tolerable topical treatment and even selective laser trabeculoplasty (SLT), but none of these options cumulatively achieved a safe target IOP. Ultimately, canaloplasty with iTrack (Nova Eye Medical) was performed in the right eye. In pre-operative surgical counseling for this phakic patient, I discussed the risk of accelerating cataract formation, the potential that the procedure might not achieve target pressure, and that a more invasive procedure involving an implant and/or a bleb might be required.

At the day 1 follow-up, pressure was 19 mm Hg with some cell and circulating red blood cells in the anterior chamber, which is common. She was using prednisolone acetate 1% four times daily, and all glaucoma drops had been discontinued following surgery the previous day (to her relief). I reassured her that I expected the IOP to be lower at follow-up in 1 week when the red blood cells had cleared and inflammation was reduced. Sure enough, at her 1-week follow-up, IOP was 14 mm Hg, and the anterior chamber was quiet. A steroid taper was initiated in an extended way due to her history. She recently came in for a routine follow-up pressure and field check. She continues to maintain IOP in the low- to mid-teens and is using no topical glaucoma eye drops. Her field remains normal and her retinal nerve fiber layer remains stable. She continues to see her retina specialist on a regular basis.

CONSIDERING THE OPTIONS

A referral for vitrectomy to remove the steroid depot was considered. However, as this option was unlikely to resolve the immediate risk posed by the pressure elevation, coupled with the risk profile associated with vitrectomy (in particular, the risk for cataract development and progression as well as reactivation of her underlying retinal condition), we discussed management options intended to achieve the target pressure, with the idea that we could explore implant removal at a later time, should it become necessary.

Within the category of procedural glaucoma options, the high pressure suggested a role for incisional surgeries, such as trabeculectomy or tube implant surgery. Such an approach would effectively bypass the outflow resistance presumed to be occurring at the level of the TM. Yet, the age of the patient and her desire to return

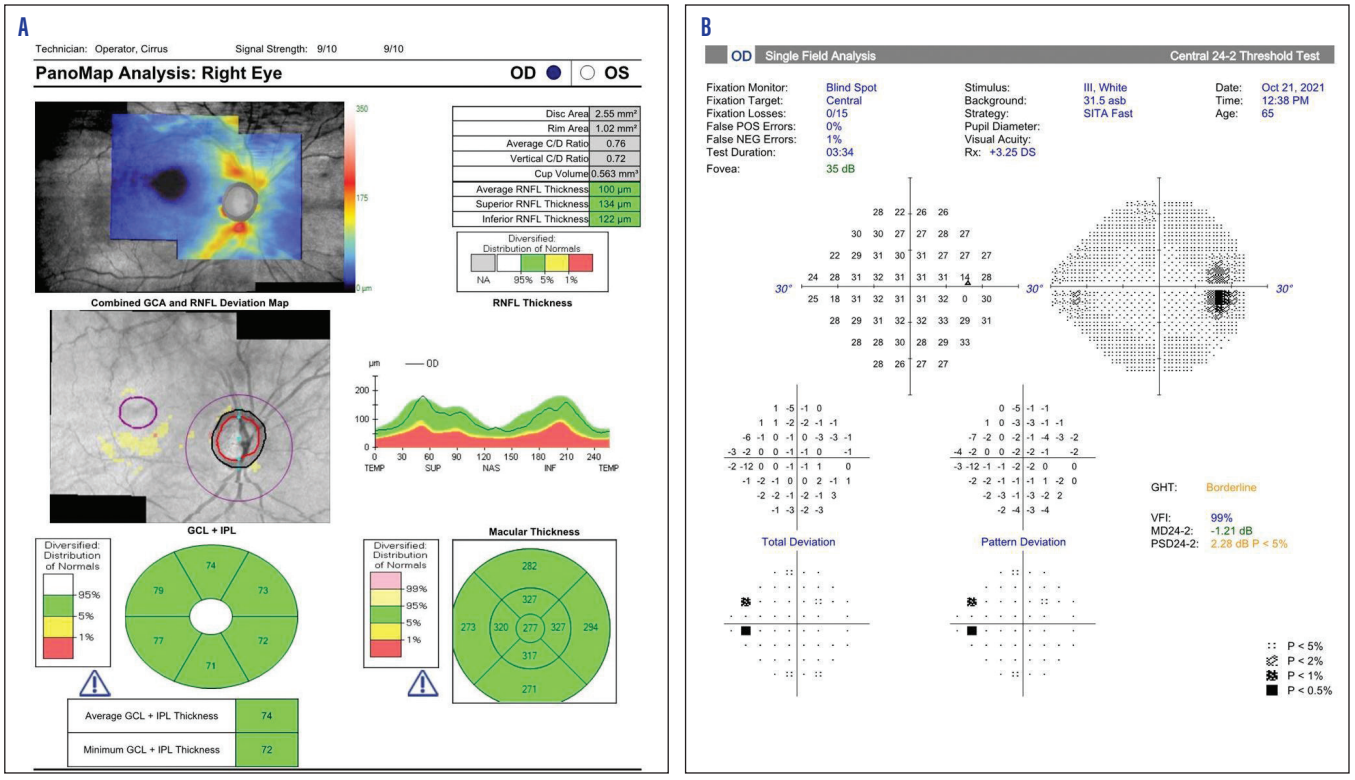

Figure 2. PanoMap analysis (A) and visual field map (B) of the right eye of the patient in Figure 1 at the time of the initial evaluation.

promptly to her busy, active lifestyle made these more invasive options less-than-ideal. The lifespan of the patient was an additional consideration: If we could perform a minimally invasive procedure to address the acute IOP elevation, invasive glaucoma surgeries could be reserved for a later time and only considered if they become necessary, but if we started with a tube or bleb, this approach begins the process of using up conjunctival real estate that every glaucoma specialist tries to avoid. In the back of every glaucoma specialist's mind is planning three [surgical] steps ahead and using conjunctival real estate judiciously.

Several minimally invasive options were considered and utilized. SLT mechanistically addresses resistance at the TM, and there is some suggestion that it may remodel the TM architecture to facilitate physiologic outflow; however, as is sometimes the case and was so for this patient, the need for IOP lowering is sometimes beyond what SLT can realistically achieve. In one retrospective study, SLT produced a ~30% reduction in IOP among eyes with ocular hypertension following receipt of a dexamethasone implant; notably, however, mean IOP post-Ozurdex in that cohort of patients was 25.4 mm Hg.[3] Other laser options, such as endocyclophotocoagulation, are associated with a risk for inflammatory complications, making them less than ideal in steroid-induced pressure elevation and a treatment I tend to avoid if uveitis or a history of macular edema is in the equation, active or not.

Finally, the array of implant-based options would address outflow resistance at the presumed source of the issue: In the Schlemm canal and/or TM. However, these surgical approaches were not suitable for this patient for several reasons. First, with no cataract present, such a procedure would have to be performed as a standalone option, and there is incomplete evidence regarding efficacy in this setting, and of course there were insurance limitations to this approach at the time this patient presented. Second, a stenting procedure would be unlikely to achieve sufficient IOP lowering. Third, placement of a stenting device contributes to greater outflow only at one specific 3-clock-hour segment (or alternatively two focal points) within the conventional pathway; a better option would be a procedure that addresses potential outflow resistance for 360°, which is precisely what canaloplasty with iTrack achieves.

WATCH THE SURGERY ON EYETUBE

For a closer look at the iTrack procedure, see the iTrack sidebar.

iTRACK

During the canaloplasty procedure with iTrack (Nova Eye Medical), the microcatheter is advanced for 360° of Schlemm canal (SC), which functions to mechanically remove any adhesions. This is followed with pressurized viscodilation of the entire SC to push any existing herniations out of the collector channel ostia and further encourages removal or downstream displacement of any cellular or proteinaceous debris. It also dilates the canal by two to three times its physiological diameter.[1-3] The use of an ophthalmic viscosurgical device with synthetic hyaluronic acid (HA) for viscodilation has the potential to improve the balance of HA in the trabecular meshwork (TM). Studies indicate that HA is functional in clearing deposition of extracellular matrix in the TM,[4] and low levels of HA are a risk factor for postoperative inflammation and scarring.[5] Taken together, the various mechanisms associated with canaloplasty address outflow resistance in the TM, SC, and the collector channels (ie, all points of outflow resistance in the proximal and distal portions of the aqueous pathway), while also helping to restore physiologic outflow for 360°.[6]

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CONCLUSION

Left untreated, steroid-induced pressure elevation is a potentially sight-threatening complication, and so it requires prompt intervention to achieve adequate IOP control. However, "prompt" does not necessarily have to translate to "aggressive" or "invasive."

Because of the expanding glaucoma surgical options, including an expanding array of MIGS options, we can consider glaucoma surgical intervention in a stepwise approach, even in situations requiring urgent reduction of IOP that historically meant going straight to trabs or tubes. The canaloplasty procedure's efficacy stems from its ability to mechanistically facilitate physiologic outflow in both the proximal and distal portions of the conventional outflow pathway and potentially improve innate mechanisms for counteracting IOP fluctuations and elevations. In the context of steroid-induced pressure elevation, doing so is rational and highly favorable, and buys time for the steroid implant to dissolve without risking an invasive implant removal or requiring a glaucoma surgical intervention that permanently alters the eye's outflow pathway from physiological to bypass. ■

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