Current Options for Cyclophotocoagulation

An overview of transscleral diode photocoagulation and endocyclophotocoagulation.

BY MILDRED M. G. OLIVIER, MD

Since the 1930s, ophthalmologists have used several modalities of cyclodestruction to lower the IOP.[1-6] After trying a variety of wavelengths,[7-10] surgeons settled on the 810-nm wavelength used today for transscleral diode photocoagulation (TCP) and endocyclophotocoagulation (ECP); the 810-nm wavelength causes a more targeted destruction of the melanin in the ciliary epithelium[11] and less pain, discomfort, and inflammation.[12] TCP and ECP differ in their approach, but both damage the ciliary epithelium that produces aqueous humor. Regeneration of the ciliary epithelium may trigger a rise in IOP, making it necessary to repeat treatment to maintain the desired long-term pressure-lowering effects. In surgeons' quest to reduce the need for antiglaucoma medications in patients undergoing cataract surgery, ECP represents a viable alternative to TCP for lowering IOP in individuals with early to moderate glaucoma.

HOW TO PERFORM THE PROCEDURES

Transscleral Diode Photocoagulation

The surgeon uses the diode laser (Iridex Corporation) with the contact G-Probe.[9,10] After a peribulbar or retrobulbar injection, a lid speculum is placed into the operative eye. Transillumination may be used to ascertain the position of the ciliary body for better placement and alignment. The G-Probe is placed 1.2 mm posterior to the limbus, perpendicular to the ciliary body. A small protrusion, 0.7-mm deep, aligns the probe and indents the conjunctiva and sclera to allow penetration to the ciliary body. The wavelength ranges from 1,250 to 2,250 mW, and each application of laser energy lasts 2 to 4 seconds. The surgeon titrates the energy until he or she hears a small "pop" and treats a total of 270º (approximately 18 spots). Sparing the 3- to 9-o'clock positions avoids the ciliary nerves. (A video on TCP for refractory glaucoma is available at http://vimeo.com/33999211.)

Postoperatively, cycloplegics, antibiotics, antiinflammatories, and analgesics/narcotics decrease short-term pain and inflammation. The perioperative use of a block necessitates postoperative patching of the eye. Follow-up visits may occur between 1 and 6 weeks or sooner when the patient has better vision or the physician wishes. Some patients have difficulty with pain and inflammation after the effect of the injection wears off.

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One advantage of TCP over ECP is its portability, as the author found on a medical mission to Haiti with Eve J. Higginbotham, MD, many years ago. A 20% reduction in IOP was observed 1 week after TCP treatment, and a 30% reduction was found at 4 months. The sample size was small, and follow-up was limited. TCP, however, offers hope as a primary treatment in patients who reside in developing countries and those who have advanced glaucoma and reside in areas with poor access to medical care (ie, treatment and follow-up).[13]

Endocyclophotocoagulation

Whereas TCP is noninvasive, ECP is an invasive surgical procedure used in combination with cataract surgery to reduce the patient's dependence on antiglaucoma medication and in complex and refractive glaucomas (Table).[14,15] The E2 Microprobe Laser and Endoscopy System (Endo Optiks) has four components. They include the laser (a pulsed, continuous-wave energy with a xenon light source), a helium-neon laser aiming beam, a video monitor, and a recorder. ECP calls for an 18- to

TABLE. COMPARISON OF TRANSSCLERAL DIODE PHOTOCOAGULATION AND ENDOCYCLOPHOTOCOAGULATION

	TCP	ECP
Damages the ciliary epithelium to decrease aqueous production	Yes	Yes
May need to be repeated multiple times	Yes	Yes
Has low complication rate	Yes	Yes
Is noninvasive	Yes	No
Can be performed along with cataract surgery and other procedures	No	Yes
Is often used in patients with refractory glaucoma	Yes	Yes
Is useful for patients who cannot reach or refuse to go to the OR	Yes	No
Is portable	Yes	No
Allows direct visualization of the ciliary body	No	Yes
Relieves pain in a blind, painful eye	Yes	Yes

20-gauge probe with a 110° angle, with a depth of focus of 1 to 30 mm. In his sidebar discussion, Shan Lin, MD, describes how to perform the procedure.

ECP has advantages over TCP. The former permits direct visualization of the ciliary processes and can be combined with cataract surgery. ECP may also be performed on eyes that previously underwent penetrating keratoplasty. The postoperative drug regimen includes topical, sub-Tenon, or oral anti-inflammatory medications.

COMPLICATIONS

Possible complications in TCP are inflammation, hyphema, pain, hypotony,[16] vision loss (up to 2 lines),[17-19] phthisis bulbi,[20] malignant glaucoma,[21] sympathetic ophthalmia,[22,23] necrotizing scleritis,[24] and chronic pain. Rarely, a dry conjunctival surface or defective or soiled laser probes cause conjunctival burns. (Probes are designated for single use.)

Hyphema, hypotony, fibrin exudates, cystoid macular edema, and decreased visual acuity have been reported after ECP.[25] Because the procedure entails the insertion of a probe, the surgeon has to be careful not to damage the anterior lens capsule or the iris root[26] due to mechanical trauma or the inappropriate application of laser energy to the iris. Longer-term studies are needed to determine the complications of this procedure, which has shown relatively good results. Acute occlusive vasculopathy has also been reported.[27]

OUTCOMES

Success rates for TCP and ECP in high-risk cases have been variable.[28,29] Often used for cases of refractory glaucoma, the procedures may be a last resort for some patients.

One prospective evaluation looked at the 1-year results of TCP in 36 eyes of 36 patients with refractory glaucoma and an aggressive protocol (2,250 mW and 2,000 milliseconds) in patients with refractory glaucoma. There was a mean IOP decrease of 53% ($P < .05$), with 72% of the patients maintaining a pressure of less than 21 mm Hg. The number of medications needed dropped from 2.8 to 0.89. In addition, retreatment was required only once in 25% of the patients. Visual acuity improved in 33% of patients, worsened in 22%, and stayed the same in the remainder of the group with few significant complications. The complications of conjunctival injection and corneal edema noted in the study were reversible and transient.[30] A direct linear correlation was found between the success rate of the procedure and total energy.[31]

Several studies have used TCP as primary treatment for patients with good vision.[17,32,33] In one, patients had a preoperative median acuity of 20/30 and a median follow-up of 5 years. Thirty-one percent of eyes lost 2 or more lines of vision, and 50% of those were due to progression of their glaucoma. Other causes of vision loss included retinal detachment, cataract formation, macular edema,

Clinical Pearls for Endoscopic Cyclophotocoagulation

BY SHAN C. LIN, MD

Endoscopic cyclophotocoagulation (ECP) is a relatively safe and mildly effective procedure for treating glaucoma. Although cyclodestruction is traditionally reserved for end-stage glaucoma and/or glaucoma refractory to medical therapy and filtering surgery, ECP is typically performed on eyes with good visual potential that have not undergone a trabeculectomy or other penetrating surgery.[1,2] ECP is often performed in conjunction with cataract surgery in the glaucoma patient with mild or moderate glaucoma who is not on maximal medical therapy.[2] Recently, surgeons have become interested in ECP for opening the anterior chamber angle of eyes with plateau iris anatomy and narrow or closed angles.[3]

Figure. In this endoscopic view, the ciliary processes on the right have been treated and show whitening and shrinkage compared with the untreated processes on the left.

PROCEDURE

Like many other surgeries, ECP can be performed in various ways in the OR depending on the ophthalmologist's preferences. It requires local retrobulbar, sub-Tenon, or topical anesthesia. The surgeon may use one of two approaches, limbal or pars plana. In the limbal approach, after maximal pupillary dilation, the ophthalmologist uses a keratome to create an incision that is approximately 2.5-mm wide. Next, he or she accesses the ciliary processes by introducing a generous amount of viscoelastic between the iris and crystalline lens or pseudophakic posterior chamber lens. A maximum of 180º of the ciliary processes can be treated through the one incision with a straight probe or up to 270º with a curved probe. The surgeon can create a second incision directly opposite the original one to ablate the remaining untreated processes. Viscoelastic is irrigated out after the procedure, and the wound is closed with a 10–0 nylon suture. Cataract extraction and the implantation of an IOL may be combined with ECP, usually in that order.

For ECP to be performed through the pars plana incision, the eye must be aphakic or pseudophakic. After placing infusion, the surgeon makes a typical pars plana incision 3.5 to 4 mm from the limbus, performs an anterior vitrectomy, and inserts the laser endoscope. Two incisions may be created if more than 180º of processes are to be treated. He or she closes the sclerotomies with a 7–0 Vicryl suture (Ethicon, Inc.). Laser applications typically last 0.5 to 5 seconds at a power of 300 mW to achieve an endpoint of whitening and shrinkage of each ciliary process (Figure). To avoid a visible explosion ("pop") of the ciliary process, the surgeon can decrease laser power, duration, or both. He or she performs the procedure while viewing the video monitor.

INTRA- AND POSTOPERATIVE STEROIDS

Inflammation and cystoid macular edema (CME) are the primary causes of poor visual acuity after ECP.[1] At the time of surgery, subconjunctival, sub-Tenon, or intracameral corticosteroids should be delivered to the eye. Surgeons may prescribe topical prednisolone from four times a day to every hour, depending on the level of inflammation they observe after surgery and the risk for CME. Topical nonsteroidal anti-inflammatory agents may be considered, particularly for patients with a greater chance of CME.

SUMMARY

ECP is a useful tool for the glaucoma surgeon. Inflammation and CME are not infrequent complications and should be anticipated and prevented with appropriate steroid therapy.

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and macular degeneration. Sixty-seven percent of eyes maintained a visual acuity of 20/60 or better, and 16% had a visual acuity of less than 20/200.[32]

In a study of patients with refractory glaucoma, Chen and colleagues reported that ECP reduced IOP by 34% and decreased the number of medications needed from three to two (mean follow-up period, 12.9 months).[25] Trabeculectomy was shown to be as effective as ECP combined with cataract surgery. At the end of the study period, 90% of the patients had IOPs of less than 22 mm Hg.[34] In a study comparing ECP with the Ahmed Glaucoma Valve (New World Medical, Inc.), ECP was associated with fewer complications.[35] Twelve months after ECP in eyes with prior drainage devices and uncontrolled pressures, the IOP had dropped from 24 to 15.4 mm Hg on a lower mean number of medications with no serious complications.[35,36] Less success was found in pseudophakic pediatric glaucoma[37] and aphakic pediatric glaucoma. In the second group, the reduction in mean IOP was noted to be 32.6 to 22.9 mm Hg at last follow-up. The average number of procedures was 1.5, and retinal detachment occurred.[38]

CONCLUSION

TCP and ECP have a place in the surgical armamentarium not only for patients with end-stage, refractory glaucoma and poor visual acuity but also for patients with good visual acuity. That stated, these procedures are not without serious complications however rare, and TCP and ECP may need to be repeated to obtain the target IOP. These procedures can also be used as first-line therapy. ■

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