TRANSSCLERAL LASER TREATMENT FOR GLAUCOMA


Slow-coagulation TSCPC: the ultimate minimally invasive glaucoma surgery?

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The concept of treating glaucoma by decreasing aqueous humor production via destruction of the ciliary body dates back to the 19th century. Hancock described surgical cyclotomy for IOP lowering in 1861.[1] In the 1930s, results of nonpenetrating surface cyclodiathermy and penetrating cyclodiathermy were first reported.[2,3]

Cyclocryotherapy was introduced in the 1950s as a less destructive, more predictable, and more reproducible procedure compared with cyclodiathermy, with more reasonable safety and efficacy for the management of glaucoma.[1] However, significant complications, including pain, intense intraocular inflammation, hemorrhage, hypotony, retinal detachment, and vision loss, posed major barriers to acceptance of the technique. Several other approaches have been employed to achieve cyclodestruction, including beta-irradiation,[4] cycloelectrolysis,[5,6] surgical excision of the ciliary body (cyclectomy),[7] therapeutic ultrasound,[8,9] and microwave treatment.[10]

Laser cyclophotocoagulation (CPC) was first attempted using a 693-nm ruby laser,[11] but it did not gain popularity until Nd:YAG[12] and, later, diode[13] lasers were used. Today, diode laser photocoagulation is the main clinically utilized means to achieve cyclodestruction, through either a transscleral (TSCPC) or an endoscopic approach.

A CLOSER LOOK AT TSCPC

Traditionally, TSCPC has been reserved for refractory glaucoma with uncontrolled elevation of IOP in the presence of poor vision or limited visual potential. It is used particularly in the setting of failed previous glaucoma surgery with conjunctival scarring hindering further filtration surgery or glaucoma drainage device implantation. TSCPC has also been used to provide pain relief to patients with painful blind eyes as a globe-sparing procedure. Complications attributed to TSCPC include severe intraocular inflammation, pain, conjunctival scarring, macular edema, hypotony, and vision loss.

In the most commonly used TSCPC technique, a G-Probe handpiece (Iridex) is used to deliver near-infrared laser energy (810 nm), which is strongly absorbed by the melanin in the pigmented ciliary body epithelium, in an incremental, continuous wave (CW) fashion. Administration is guided by the "pop" sound that signifies tissue coagulation and destruction of the ciliary body epithelium. However, the unpredictability of results, complications, and short-lived IOP-lowering effects of the so-called *pop* technique have limited widespread use of this technique for primary glaucoma surgery, especially in light of a sparsity of data supporting its efficacy, predictability, and reproducibility.

AT A GLANCE

- Diode laser photocoagulation is the most commonly used means to achieve cyclodestruction, through either a transscleral (TSCPC) or an endoscopic approach.
- TSCPC is an effective and reasonably safe procedure if the appropriate diode laser settings are used and postoperative inflammation is treated aggressively.
- In the authors' experience, slow-coagulation TSCPC settings appear to achieve similar IOP-lowering outcomes and yield minimal side effects compared with standard pop-titrated TSCPC.

Recently, diode laser settings and delivery methods have been optimized with the aim of reducing complication rates and thereby broadening the use of TSCPC. The amount of laser energy and the mode of delivery has been suggested to correlate directly with complications. A micropulse (MicroPulse, Iridex) mode, which delivers diode laser energy in an on-and-off cyclical fashion, has been developed for ablation of the ciliary processes to treat glaucoma.

Micropulse TSCPC has been shown to reduce aqueous humor production with less total laser energy and presumably less collateral damage to surrounding tissues than with CW laser.[14] Theoretically, the *on* micropulse cycles allow energy to build up in the targeted pigmented tissues, eventually reaching the coagulative threshold, and the nonpigmented structures are allowed to cool during the *off* cycles without reaching the coagulative threshold, thereby minimizing collateral tissue damage.

Another approach, the slow-coagulation technique of Douglas Gaasterland, MD (personal communication), uses fixed low-energy CW settings, depending on the degree of iris pigmentation empirically, delivered over a longer continuous duration.[15] In our experience, the slow-coagulation settings appear to achieve similar IOP-lowering outcomes and yield minimal side effects compared with the standard pop-titrated higher-energy CW settings and technique.

RETROSPECTIVE STUDY

We performed a retrospective study to compare the outcomes of standard pop-titrated TSCPC and slow-coagulation TSCPC for the treatment of glaucoma.[16] The study included 78 eyes with glaucoma that underwent TSCPC (52 slow coagulation and 26 pop coagulation). Patient demographics, treatment course, surgical techniques, settings, and outcomes were assessed. The main outcome measures were postoperative visual acuity, IOP reduction, and postoperative complications.

"WE HAVE BEEN USING SLOW-COAGULATION CW DIODE TSCPC AS A PRIMARY GLAUCOMA SURGICAL PROCEDURE WITH GREAT SUCCESS AND MINIMAL COMPLICATIONS IN RESOURCE-POOR COUNTRIES AND IN OUR CLINIC FOR MORE THAN 2 YEARS TO DATE."

Baseline visual acuity and IOP were similar in the slow-coagulation and standard TSCPC groups ($P = .507$ and $P = .297$, respectively). The follow-up periods for the slow-coagulation and standard TSCPC groups were 16.4 months and 24.7 months, respectively ($P = .124$). Visual acuity remained better than light perception in 71.1% of patients treated with slow coagulation and in 65.0% of patients treated with standard TSCPC ($P = .599$). IOP remained below 20 mm Hg in 46% of patients treated with slow coagulation and in 44% of patients treated with standard TSCPC ($P = .870$). The mean number of complications (mean ±standard deviation) was higher in the standard TSCPC group (1.46 ±1.24) than in the slow-coagulation group (0.62 ±0.75; $P = .002$). No significant differences in the need for a second procedure (slow coagulation, 28.8%; standard, 23.1%; $P = .588$) or maximum number of medications needed to control IOP postoperatively ($P = .771$) were observed between the two groups.

In this case series, slow-coagulation TSCPC and standard pop-titrated TSCPC were similarly effective in maintaining visual acuity and achieving IOP lowering. Although no significant differences in visual acuity or IOP between the two groups were observed, the complication rate was significantly lower in the slow-coagulation technique group than in the standard TSCPC technique group. In particular, intraocular inflammation and conjunctival burn or scarring were significantly lower in the slow-coagulation group.

CONCLUSION

Given the recent trend to use TSCPC in eyes with good visual potential,[17-19] optimization of TSCPC settings to achieve efficient IOP lowering while minimizing the risk of significant complications is paramount. Our study supports the use of slow-coagulation TSCPC as a safer procedure for glaucomatous eyes that are refractory to standard medical and surgical treatment, especially in comparison with more invasive intraocular glaucoma procedures. In addition to refractory glaucoma, we have been using slow-coagulation CW diode TSCPC as a primary glaucoma surgical procedure with great success and minimal complications in resource-poor countries and in our clinic for more than 2 years to date.

TSCPC is an effective and reasonably safe procedure if the appropriate diode laser settings are used and postoperative inflammation is aggressively treated. Slow-coagulation TSCPC may be the ultimate primary minimally invasive glaucoma surgery, owing to its significant IOP-lowering potential, simple technique, energy and IOP lowering titratability, and semisterile and entirely extraocular approach. We typically do not use pre- or postoperative antibiotics with slow-coagulation TSCPC, although we use aggressive postoperative anti-inflammatory medications to

minimize vision loss due to fibrin formation and macular edema.

Slow-coagulation TSCPC also spares the conjunctiva, allowing the possibility of future glaucoma filtration or drainage implant surgery with postoperative mobile conjunctiva, and it has a lower complication profile than intraocular glaucoma surgery. Additional studies, including randomized controlled trials, are needed to support the use of TSCPC, particularly the slow-coagulation technique, as a *primary* surgical procedure for glaucoma treatment. ■

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