

Transscleral Diode Laser Photocoagulation for Type 1 Prethreshold Retinopathy of Prematurity

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Purpose: To report the outcomes of transscleral diode laser photocoagulation for treatment of type 1 prethreshold retinopathy of prematurity (ROP).

Methods: In this prospective interventional case series, 139 eyes of 73 infants with type 1 prethreshold ROP underwent transscleral diode laser photocoagulation of the avascular retina under topical anesthesia without making a conjunctival incision. Supplemental transpupillary diode laser photocoagulation was used for zone 1 ROP in one eye. All patients were followed for 6 months. Main outcome measures were regression of ROP, incidence of unfavorable outcomes and adverse effects.

Results: At the end of follow-up, neovascularization regressed completely in all eyes and no eye developed an unfavorable outcome. Repeated laser therapy was performed employing the same technique in 3 eyes (2.3%). Ocular adverse effects were minor including mild conjunctival injection and edema in all patients, small conjunctival lacerations in 12 eyes (8.7%), minor self-limited vitreous hemorrhage in 2 eyes (1.4%) and mild self-limited hyphema in one eye (0.7%).

Conclusion: Transscleral diode laser photocoagulation is a safe and effective treatment option for type 1 prethreshold ROP. This technique can be performed under topical anesthesia.

Keywords: Retinopathy of Prematurity; Transscleral; Laser Photocoagulation

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INTRODUCTION

Retinopathy of prematurity (ROP) is a grave ocular condition associated with significant morbidity in very low birth weight premature infants. In this disease, postnatal delay in vascularization of the retina, especially on the temporal side, may be followed by neovascularization which can progress to fibrovascular proliferation and tractional retinal detachment.¹

The goal of therapy is to prevent or halt neovascularization and subsequent proliferative changes, and to optimize long-term visual

outcomes. Several studies including two large randomized clinical trials demonstrated that ablation of the avascular retina is an effective modality for preventing progression of ROP.^{1,2} The Cryo-ROP study showed that cryotherapy for threshold ROP results in approximately 50% reduction in the rate of retinal detachment.² With the hope of improving the outcomes of therapy, the timing and indications for treatment of ROP have been questioned and some investigators have advocated earlier treatment.¹ The Cryo-ROP study reported significant ocular and hemodynamic complications directly related

to the application of cryotherapy. The Early Treatment of ROP (ETROP) study demonstrated that laser ablation of the peripheral avascular retina in infants with high risk prethreshold ROP is associated with favorable visual outcomes in approximately 90% of eyes.¹

Transpupillary laser treatment has been proven to be as effective as cryotherapy for the treatment of acute ROP and seems to entail fewer adverse effects.³⁻⁵ However, after transpupillary laser treatment delivered with the indirect ophthalmoscope, lenticular opacities and cataract formation have been reported with both argon and diode laser systems.⁵⁻⁷

Transscleral laser application has been used as an alternative method for retinal photocoagulation in ROP patients. Reports on small series of patients treated exclusively with transscleral diode laser have suggested that this modality appears to be at least as effective as cryotherapy and transpupillary laser therapy in terms of stopping the progression of ROP beyond threshold.⁸⁻¹¹ However, transscleral coagulation is less popular than the transpupillary method because many surgeons believe that transscleral laser application requires conjunctival incisions when a broad avascular zone is present. Moreover, some surgeons believe that transscleral coagulation is more traumatic than the transpupillary approach and also requires general anesthesia, which may entail additional morbidity.

We recently reported the results of a retrospective study on transscleral diode laser photocoagulation under topical anesthesia without conjunctival incisions for treatment of threshold ROP and achieved excellent results (93.2% favorable outcomes).¹¹ The purpose of the current study was to prospectively evaluate transscleral diode laser photocoagulation for treatment of prethreshold ROP.

METHODS

This prospective interventional case series was conducted from May 2008 to February 2009 and included all infants with type-1 prethreshold ROP, defined by the ET-ROP Study¹ as any ROP with plus disease, stage 3 ROP without

plus disease in zone I, and stage 2 and 3 ROP with plus disease in zone 2. We performed laser photocoagulation for zone I ROP, if it was associated with stage 1 disease. In zone I ROP patients in stages 2 and 3, we injected intravitreal bevacizumab and the patients were excluded from the study. All patients had at least 6 months of follow-up. The study was approved by the Institutional Review Board/Ethics Committee of Iran University Eye Research Center.

Transscleral diode laser treatment was performed under topical anesthesia with a retinopexy probe (IRIS DioPexy, IRIS Medical Instruments, Mountain View, CA, USA), which delivers infrared diode laser. Transscleral laser photocoagulation was performed through the conjunctiva without making any incisions and was targeted to the avascular retina immediately anterior to the ridge and extraretinal fibrovascular proliferation. The fibrovascular ridge itself was not treated. The laser was initially set at 350 milliwatt (mW) and 300 milliseconds and gradually increased to produce a moderate yellow-white laser burn. When photocoagulation was necessary in posterior zone 2 and zone 1, transpupillary diode laser photocoagulation was performed employing an indirect ophthalmoscope delivery system.

All procedures were performed after institution of an intravenous catheter under cardiorespiratory monitoring and direct observation by an anesthesiologist. After the procedure, topical chloramphenicol and betamethasone eye drops were prescribed three times a day for 1 week.

All eyes were examined the next morning to detect adverse effects such as conjunctival lacerations, hyphema, hemorrhage, infections, vitreous hemorrhage, and uveitis. These infants were re-examined 4 days later and were followed weekly until definite regression occurred. If extraretinal neovascularization and plus disease did not regress within 2 weeks of the first session of laser therapy, retreatment using the same technique was undertaken to ablate the remaining avascular retina. Unfavorable outcomes were classified in accordance with the Cryo-ROP study.² In addition, we considered

macular tractional ectopia as an unfavorable outcome. Therefore, retinal folds or tractional macular ectopia, retinal detachment or retrolental mass were considered as signs of an unfavorable result, while their absence denoted a favorable outcome.

Preoperative data including age, sex, birth weight and ROP grade, and postoperative data including complications associated with laser treatment and regression of retinal neovascularization were recorded. Anatomical outcomes were evaluated by indirect ophthalmoscopic examination. Regression of ROP was defined as regression of new vessels and a favorable outcome was defined as regression without retinal traction or macular ectopia.

RESULTS

A total of 139 eyes of 73 patients with mean birth weight of $1,328.6 \pm 290.4$ (range, 650–1,850) grams and mean gestational age of 29.2 ± 2.2 (range, 24–34) weeks were included in the study.

Treatment was performed at a mean of 54.4 ± 13 (range, 32–78) days after birth. The time interval between the diagnosis of threshold ROP and laser treatment was 24 hours or less. One eye had zone 1 ROP which was treated by transpupillary laser photocoagulation in addition to transscleral treatment, other eyes had zone 2 ROP.

The mean number of laser burns per eye was 776.8 ± 303 (range, 360–1,750) with mean laser power of 872 ± 221 (range, 450–1,400) mW. In 2 patients, treatment was stopped due to apnea. Laser treatment was then completed in the next session and the whole treatment was considered as one session. Mild bradycardia was seen in 9 cases which improved after temporary halting of laser therapy. All patients had transient conjunctival injection and chemosis together with small conjunctival lacerations in 12 eyes which healed spontaneously. Mild hyphema occurred in one eye (0.7%). No other major anterior segment complications such as burns in the cornea, iris, or lens were noted. Mild vitreous hemorrhage was seen in 2 eyes on the first postoperative day which resorbed spontaneously within 4 weeks.

Four days after laser treatment, plus disease subsided in 134 eyes (96.4%) but remained unchanged in the other eyes. Two weeks after treatment, 66 patients (128 eyes) were examined; ROP had regressed in 125 eyes (97.6%) while three eyes (2.3%) required additional laser treatment. Transscleral laser treatment was performed in these eyes with mean power of 1,130 mW and a mean number of 440 spots. ROP regressed in these eyes within the first week after retreatment.

At final scheduled examination (6 months after treatment), ROP had regressed completely in all eyes without any sign of macular dragging, retinal folds, retinal detachment or retrolental mass formation.

DISCUSSION

Few studies have reported the outcomes of transscleral diode laser photocoagulation for ROP.^{8–10} We previously published our results in a large series of patients with threshold ROP treated with transscleral laser retinal ablation.¹¹ In the present study, a series of infants with prethreshold ROP were treated using the same technique. The indication for treatment was based on recommendations of the ET-ROP study group.¹

ROP eventually regressed in all 139 treated eyes. In 97.6% of eyes one session was adequate and in the rest, a second treatment was required. In the current series, zone I was involved in only one eye which was treated with supplemental transpupillary laser ablation. Considering the fact that transscleral laser ablation for posterior ROP requires conjunctival opening, this modality may not be a good option. Moreover, after introduction of intravitreal bevacizumab for ROP, we shifted to the use intravitreal injection of bevacizumab for posterior ROP and eyes with severe ROP.¹² This approach allows normal vascularization to reach either the ora serrata or more anterior zones. In other eyes, the only treatment modality was transscleral approach.

Structural outcomes in our study were superior to the results of the ETROP study demonstrating only 9% unfavorable outcomes in treated eyes. This discrepancy seems to be due

to baseline characteristics of the patients which may result in a different response to treatment. For example, zone 1 ROP was present in 41.9% of ETROP treated eyes vs 0.7% of eyes in our study. Moreover, gestational age and birth weight were lower in the ETROP study.¹²

Adverse effects of treatment in the current series included transient apnea in 2 patients (1.4%) and transient bradycardia in 9 patients (6.45%). Both problems improved as soon as treatment was withheld. The rate of apnea and bradycardia was 8.6% in the ETROP trial.¹³ Ocular complications included conjunctival injection and chemosis in all eyes, small conjunctival lacerations in 12 eyes (9%) and mild transient hyphema in one eye. The outcomes were generally favorable and comparable to the transpupillary approach.^{1,5}

Indirect laser ophthalmoscopes which are currently used are typically heavy and some vitreoretinal specialists find it difficult to bear it on their heads for a prolonged time. Other advantages of transscleral treatment have been described in our previous report;¹¹ in brief, it may be easier to deliver spots on the peripheral retina as compared to through poorly dilated pupils, spot sizes are larger and therefore fewer spots are needed which may shorten treatment time, and the rare but important anterior segment complications of transpupillary treatment are circumvented.^{6,7} Furthermore, although partially opaque media due to anterior segment opacities or vitreous hemorrhage may pose a problem for laser delivery to the retina through the pupil, the transscleral route remains unhindered in these eyes.

Disadvantages of this technique include more severe conjunctival chemosis and congestion, and conjunctival lacerations in some eyes.

Taking all of these considerations into account, it may be concluded that transscleral laser ablation of the avascular retina for treatment of ROP is a viable alternative to transpupillary treatment. It can be used as the sole therapeutic modality or in combination with the transpupillary technique. We would like to further emphasize its advantages in some clinical settings such as eyes with poorly dilating

pupils and media opacity.

Conflicts of Interest

None.

REFERENCES

1. Early Treatment for Retinopathy of Prematurity Cooperative Group. Revised indications for the treatment of retinopathy of prematurity. *Arch Ophthalmol* 2003;121:1684-1694.
2. Cryotherapy for Retinopathy of Prematurity Cooperative Group. Multicenter trial of cryotherapy for retinopathy of prematurity. Preliminary results. *Arch Ophthalmol* 1988;106:471-479.
3. The Laser ROP Study Group. Laser therapy for retinopathy of prematurity. *Arch Ophthalmol* 1994;112:154-156.
4. McNamara JA, Tasman W, Vander JF, Brown GC. Diode laser photocoagulation for retinopathy of prematurity: preliminary results. *Arch Ophthalmol* 1992;110:1714-1716.
5. Paysse EA, Luiz JE, Coats DK, Contant CF, Steinkuller PG. Therapeutic outcomes of cryotherapy versus transpupillary diode laser photocoagulation for threshold retinopathy of prematurity. *J AAPOS* 1999;4:234-240.
6. Gold RS. Cataracts associated with treatment for retinopathy of prematurity. *J Pediatr Ophthalmol Strabismus* 1997;34:123-124.
7. Christiansen SP, Bradford JD. Cataract in infants treated with argon laser photocoagulation for threshold retinopathy of prematurity. *Am J Ophthalmol* 1995;119:175-180.
8. Seiberth V, Linderkamp O, Vardarli I. Transscleral vs transpupillary diode laser photocoagulation for the treatment of threshold retinopathy of prematurity. *Arch Ophthalmol* 1997;115:1270-1275.
9. Kieslbacl GF, Ramharter A, Baldissera I, Kralinger MT. Laser photocoagulation for retinopathy of prematurity: structural and functional outcome. *Acta Ophthalmol Scand* 2006;84:21-26.
10. Davis AR, Jackson H, Trew D, McHugh JD, Aclimandos WA. Transscleral diode laser in the treatment of retinopathy of prematurity. *Eye (Lond)* 1999;13:571-576.
11. Parvaresh MM, Modarres M, Falavarjani KG, Sadeghi K, Hammami P. Transscleral diode laser retinal photocoagulation for the treatment of threshold retinopathy of prematurity. *J AAPOS* 2009;13:535-538.

12. Nazari H, Modarres M, Parvaresh MM, Ghasemi Falavarjani K. Intravitreal bevacizumab in combination with laser therapy for the treatment of severe retinopathy of prematurity (ROP) associated with vitreous or retinal hemorrhage. *Graefes Arch Clin Exp Ophthalmol* 2010;248:1713-1718.
13. Early Treatment for Retinopathy of Prematurity Cooperative Group. Final results of the early treatment for retinopathy of prematurity (ETROP) randomized trial. *Trans Am Ophthalmol Soc* 2004;102:233-250.