Diode Laser Ablation for Threshold Retinopathy of Prematurity

Short-term Structural Outcome

Mitchell H. DeJonge, MD; Philip J. Ferrone, MD; Michael T. Trese, MD

Objective: To describe short-term structural outcomes and associated ocular complications in premature infants treated with diode laser ablation for retinopathy of prematurity.

Methods: The records of all infants who were diagnosed as having threshold retinopathy of prematurity and treated with diode laser therapy at our hospital from January 1, 1992, through December 31, 1996, were retrospectively reviewed. Sixty-four eyes reached threshold during this period. Three eyes received cryotherapy in addition to laser treatment and were excluded, leaving 61 eyes eligible for review.

Results: Of the 61 eyes with threshold disease treated exclusively with diode laser, 4 (7%) had zone I disease and 57 (93%) had zone II disease at the time of initial laser treatment. Three (5%) of the 61 eyes progressed to stage 4 disease (2 eyes, stage 4A; 1 eye, stage 4B). There were no cataracts or other ocular complications noted secondary to laser treatment based on short-term follow-up (mean follow-up, 120 days).

Conclusion: In this population of infants, diode laser ablation appears to be a safe and effective treatment for threshold retinopathy of prematurity.

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RETINOPATHY OF prematurity (ROP) is a well-documented morbidity in very low-birth-weight infants. The goal of therapy once an infant has developed threshold ROP is to prevent retinal detachment and to optimize long-term visual outcome. The multicenter study of cryotherapy for ROP (Cryo-ROP) documented that cryotherapy is an effective treatment to prevent the progression of ROP beyond threshold.[1] However, the study also reported significant ocular and hemodynamic complications related directly to the traumatic nature of the application of cryotherapy. Due in part to these complications and to the technical difficulty of posterior cryotherapy application, laser ablation has now gained acceptance as an alternative to cryotherapy.[2-8] Gold[9] recently reported that 71% of ophthalmologists who treat ROP now use either argon or diode laser as their preferred method of treatment.

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Despite their widespread use in the treatment of ROP, neither diode nor argon laser therapy has been studied extensively. Reports detailing small series of patients treated exclusively with diode laser therapy have indicated that it appears to be at least as effective as cryotherapy in stopping the progression of ROP beyond threshold.[2-6] Likewise, argon laser therapy has also been reported to be effective in the treatment of threshold ROP.[7,8] Of concern, however, are several reports that have noted the development of cataracts following both argon and diode laser ablation.[9-12] Because of these reports and the need for continued investigation into laser therapy for ROP, we retrospectively evaluated our 5-year experience with diode laser ablation to determine the rate of progression beyond threshold ROP and to detail any associated short-term ocular complications.

RESULTS

The baseline characteristics of the 33 study patients (61 eyes) are listed in the **Table**.

Between 1992 and 1996, 64 eyes (including the 3 eyes excluded from further study due to cryotherapy) progressed to threshold. This represents 10.8% of all eyes of 296 infants born weighing less than

From the Departments of Pediatrics (Dr DeJonge) and Ophthalmology (Drs Ferrone and Trese), William Beaumont Hospital, Royal Oak, Mich. Dr Ferrone is now with Long Island Vitreo-Retinal Consultants, Great Neck, NY. *The authors have no commercial or proprietary interest in the manufacture or distribution of diode laser equipment, nor did they have financial interest in reviewing or evaluating diode laser therapy for retinopathy of prematurity.*

PATIENTS AND METHODS

After hospital Human Investigation Committee approval was obtained, the diagnosis and procedure records of all infants born in our nursery between January 1, 1992, and December 31, 1996, were retrospectively reviewed to identify all infants who were diagnosed with and treated for threshold ROP. Indirect diode laser therapy was used exclusively in our neonatal intensive care unit during this period. Thirty-five infants (64 eyes) were identified. Two of these patients (3 eyes) who were treated in early 1992 during the transition period from cryotherapy to diode laser therapy received cryotherapy in addition to diode laser therapy at the discretion of the attending ophthalmologist and were therefore excluded from the study. These 3 eyes of these 2 infants were not different from the study group in any category evaluated (gestational age, birth weight, age at treatment, and severity of threshold ROP). Ophthalmologic examinations were initially performed at 4 to 6 weeks of chronologic age. Follow-up examinations were performed weekly or biweekly following the initial examination until discharge, depending on the presence and the severity of the retinopathy. Postdischarge examinations were performed in the outpatient clinic. For the purpose of this short-term outcome study, follow-up examinations for 4 months following the initial laser treatment were documented.

The criteria for laser ablation of the avascular retina was threshold ROP as defined in the Cryo-ROP study: at least 5 contiguous or 8 total clock hours of stage 3 ROP in zone I or II in the presence of "plus disease."[1] Diode laser treatment was performed within 72 hours of the diagnosis of threshold ROP by 1 of 2 pediatric retina specialists (P.J.F. and M.T.T.). Laser treatments were performed using an indirect diode laser system. Burns were delivered through a 28-diopter handheld aspheric lens using a power ranging between 300 and 350 mW with a usual burn duration of 0.2 seconds. Following the procedure, no special postoperative care or ophthalmologic medications were used. Follow-up examinations were performed 1 to 2 days following the laser treatment, and then at weekly intervals. Eyes were retreated with laser if there was persistent plus disease 2 to 3 weeks after laser treatment.

All infants received anesthesia during the procedure. The decision to use general anesthesia (ie, controlled airway with endotracheal tube or laryngeal mask) vs intravenous sedation (with spontaneous respirations) was at the discretion of the attending anesthesiologist and neonatologist and was based on the medical condition of the infant at the time of the procedure.

1251 g during the review period. At the time of initial laser treatment, 4 (7%) of the 61 eyes treated exclusively with diode laser had zone I disease and 57 eyes (93%) had zone II disease. The mean ± SD number of clock hours at the time of initial treatment was 6.3 ± 1.8. The mean number of laser burns applied to each affected eye per session was 580. Forty-eight eyes required 1 laser treatment each, 10 eyes required 2 treatments, and 3 eyes required 3 treatments. Three (5%) of the 61 eyes progressed to partial retinal detachment (2 eyes, stage 4A; 1 eye, stage 4B). These 3 patients (a single eye was involved in each patient) did not differ statistically from the rest of the group in terms of birth weight (639 ± 42 g), gestational age at birth (24.3 ± 0.6 weeks), or postconceptional age at initial treatment (37.7 ± 0.5 weeks). The 3 eyes that progressed all had zone II disease with 5 clock hours of stage 3 ROP at the time of initial laser treatment. The 2 eyes with stage 4A disease had been treated once with laser, the eye with stage 4B disease had received 2 laser treatments. The 2 eyes with stage 4A disease had their retinas completely reattached with lens-sparing vitrectomies. The eye with stage 4B disease also had its retina reattached with a lens-sparing vitrectomy; however, there was a residual superior retinal fold and a dragged macula postoperatively.

Baseline Characteristics of 33 Study Patients (61 Eyes)

Characteristic	Mean ± SD	Range
Birth gestational age, wk	24.5 ± 1.4	23-28
Birth weight, g	671 ± 168	365-1030
Initial treatment age, wk		
Postnatal	12.4 ± 2.0	9-17
Postconceptional	36.9 ± 2.0	33-43
Laser burns to affected eye per session	580 ± 269	156-1238
Clock hours of stage 3 ROP*	6.3 ± 1.8	5-12

*ROP indicates retinopathy of prematurity.

One eye had a visually insignificant cataract present prior to laser surgery, which did not worsen following laser treatment. No cataracts were seen in the other treated eyes during the follow-up period.

COMMENT

After the results of the Cryo-ROP study were published in 1988, cryotherapy became the standard of care for threshold ROP. However, since that landmark study, laser ablation has increasingly become the therapy of choice for threshold ROP. The increased use of laser can be attributed to 3 factors: (1) laser treatment requires less manipulation of the eye, (2) it is less traumatic to the patient; and (3) it is technically easier to apply when the disease is posterior. Unlike cryotherapy, it is unlikely that laser will be evaluated by a prospective randomized trial. Therefore, retrospective reviews and small clinical trials must continue to be performed and reported in an attempt to evaluate the safety and efficacy of diode laser therapy for ROP.

Because cryotherapy currently is the criterion standard against which all other ROP treatments are measured, we compared results of our patient population with those of the Cryo-ROP study. In our patients, the mean gestational age and birth weights were lower than those of infants in the Cryo-ROP study (24.5 ± 1.4 weeks vs 26.3 ± 1.9 weeks and 671 ± 168 g vs 800 ± 165 g, respectively) but the chronologic age at which threshold was reached was similar (36.9 vs 37.2 weeks). Our infants

had, on average, fewer affected clock hours than infants in the Cryo-ROP study (6.3 vs 9.6). Of the 61 eyes treated with diode laser therapy, 3 progressed to stage 4 disease. One of these eyes (2% of all treated eyes) progressed to stage 4B disease—an "unfavorable outcome" by the Cryo-ROP definition. By comparison, the Cryo-ROP study had an unfavorable outcome in 23.5% of the treated eyes.[1]

We recognize the potential for bias where noncontemporaneous studies are compared. Standard neonatal intensive care unit care including ventilator management, the use of surfactant, and the use of antenatal and postnatal steroids have changed dramatically over the past 10 years. An increase in survival of extremely low-birthweight infants has resulted in the development of retinopathy in infants who previously would not have lived. However, if anything, this would increase the risk of complications, which is contrary to what was found. In addition to a change in patient population, a shift in "severity bias" may now exist given the positive results of the treatment eyes in the Cryo-ROP study. As Palmer[13] suggests, this shift in severity bias may lead to treatment of eyes with marginal threshold disease, eyes that might be expected to resolve spontaneously. This would spuriously improve the results of treatment.[13] Our laser-treated infants had fewer affected clock hours than those in the Cryo-ROP study. The significance of this difference with regard to treatment outcome is unknown.

Recently, concerns have been raised about the formation of cataracts following laser therapy.[9-12] Cryotherapy was not shown to be associated with cataracts in the Cryo-ROP study.[1] In the present series, 1 child did have a small, visually insignificant cataract present prior to laser treatment that did not worsen after laser treatment. No cataracts attributable to laser therapy were seen during short-term (4-month) follow-up.

In this population of infants with threshold ROP treated with indirect diode laser therapy, only 5% of 61 treated eyes progressed beyond threshold disease. No complications occurred. These findings suggest that indirect diode laser therapy for ROP is an effective treatment to optimize short-term structural outcome.

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Reprints: Mitchell H. DeJonge, MD, William Beaumont Hospital, 3601 W 13 Mile Rd, Royal Oak, MI 48073 (e-mail: mdejonge@beaumont.edu).

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100 Years Ago in the ARCHIVES

A look at the past . . .

Notwithstanding the rather extravagant claims which have recently been put forth as to the success obtained in the treatment of detachment of the retina by operative procedures more or less novel, it may still be held, I think, that complete recoveries from this very grave condition, especially recoveries occurring in highly myopic eyes, are sufficiently rare to justify one in reporting even a single case of this character.

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