Enlarged Diode Laser Spot Using Indirect Ophthalmoscope Delivery in Conjunction With Indocyanine Green to Treat Large Choroidal Neovascularizations

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■ BACKGROUND AND OBJECTIVE: To evaluate the effectiveness of a new method of delivering diode laser (810 nm) spots through an indirect ophthalmoscope in conjunction with intravenous indocyanine green to treat choroidal neovascularizations (CNVs) larger than 5,400 μm.

■ PATIENTS AND METHODS: A prospective, non-comparative, interventional case series study was conducted with 8 patients with CNV secondary to age-related macular degeneration. Laser pulses were applied to the CNV within 5 minutes of an intravenous injection of 25 mg of indocyanine green. The laser spot was enlarged up to one disc diameter by shortening the distance between the indirect ophthalmoscope and the 20-diopter viewing lens. The follow-up period was 3 months.

■ RESULTS: Three eyes had an improvement in visual acuity of more than 2 lines, and fluorescein angiography showed stabilization of the membrane and reduction of the hemorrhages and subretinal fluid at the last follow-up. Three other eyes maintained the same visual acuity and two had a decrease in visual acuity of more than 2 lines at the 3-month follow-up examination.

■ CONCLUSION: Laser treatment delivered through an indirect ophthalmoscope system may be used as a palliative treatment for CNVs larger than 5,400 μm.

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INTRODUCTION

Age-related macular degeneration is the leading cause of visual impairment in people older than 60 years.1 Approximately 10% of the cases of age-related macular degeneration are the neovascular form2 with choroidal neovascularization (CNV) and associated manifestations such as retinal pigment epithelial or sensory retinal hemorrhagic or serous detachment and retinal pigment epithelial tears.3 Neovascularization is accompanied by fibrous tissue growth, which ultimately becomes the dominant pathologic change. These changes then result in disciform scarring involving the choroid, retinal pigment epithelium, and sensory retina. The neovascular form of the disease is responsible for 80% to 90% of cases with severe visual loss.4

Many different types of therapies have been used to treat this condition, including submacular surgery,5

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radiation therapy, and the use of anti-angiogenic agents such as thalidomide, interferon alfa-2a, or the more specific anti-angiogenic proteins, angiotatins and endostatin. Other therapies such as signal transduction therapy, transplantation of retinal pigment epithelial cells, and gene therapy are currently under investigation.

Laser photoagulation of classic CNV reduces the incidence of severe visual loss and is still the most accepted treatment modality for juxtafoveal and extrafoveal CNV membranes. However, because photoagulation damages the underlying neurosensory retina, severe visual loss is often experienced in patients with subfoveal lesions treated by photoagulation. In addition, 85% to 90% of these patients are not eligible for this treatment because the CNV is occult or too large.

New therapeutic modalities have been developed to decrease damage to adjacent tissues by the laser beam and thereby increase the effectiveness and specificity of laser therapy. These include transpupillary thermotherapy, photodynamic therapy, and, more recently, ICG-enhanced transpupillary thermotherapy and photodynamic therapy. In these procedures, the laser energy is delivered by a slit-lamp system. Photodynamic therapy is the present gold standard treatment for CNV. However, the verteporfin group study did not include eyes with CNVs larger than 5,400 μm. For these lesions, transpupillary thermotherapy is the therapeutic option.

The objective of this study was to assess the effectiveness of ICG-enhanced diode laser photoagulation for subfoveal CNVs larger than 5,400 μm associated with age-related macular degeneration using an indirect ophthalmoscope delivery system with enlarged spot. We describe a pilot study of 8 patients treated by this technique.

**PATIENTS AND METHODS**

**Study Design and Population**

A prospective, noncomparative, interventional case series study was conducted on 8 consecutive patients with CNV secondary to age-related macular degeneration who were referred to our hospital. The patients included had occult CNV secondary to age-related macular degeneration diagnosed clinically and angiographically and were not eligible for photodynamic therapy or had rejected that modality of treatment. In addition, the willingness and cooperation to participate and agree to attend all follow-up examinations was required. The exclusion criteria were history of allergy to radiographic dyes, severe systemic disease, and participation in other studies.

Permission for the study was obtained from the ethics committee of this hospital. All treatments were given in accordance with guidelines of national legislation, and the procedures conformed to the tenets of the Declaration of Helsinki. After explaining the different options, including surgery, a signed informed consent was obtained.

The best-corrected Snellen visual acuity and general ophthalmologic condition were assessed, and fluorescein angiography and fundus photographs were obtained before and after the procedures.

**Materials**

ICG (IC-GREEN sterile indocyanine green, 25 mg; Akorn, Buffalo Grove, IL) was used for all aspects of this study.

Laser treatment was administered with a commercially available indirect ophthalmoscope to deliver the energy from the diode laser with a wavelength of 810 nm (OcuLight SLx 810 nm Infrared Diode Laser with long pulses; IRIS Medical Instruments, Mountain View, CA).

**Intervention**

The patients received 25 mg of ICG per 10 mL of diluent in an antecubital vein followed by a saline solution flush 5 minutes before the laser treatment.

The power of the laser was set between 200 and 500 mW, and the exposure time was 60 seconds. A 20-diopter Volk lens (Mentor, OH) was used in each case, and a 1-disc diameter spot was obtained by shortening the distance between the 20-diopter lens and the indirect ophthalmoscope to approximately 30 cm. The transpupillary laser pulses were placed initially at the central part of the lesion and then moved more peripherally until the entire surface of the membrane was treated (Fig. 1). We avoided blanching lesions.

**Main Outcome Measures**

The outcome measures were the clinical resolution, angiographic resolution, or both of the CNV, and an improvement or stabilization of the visual acuity. The results are presented as the number (percentages) of resolved cases and the degree of visual improvement or deterioration in Snellen acuity.
RESULTS

Eight eyes of 8 consecutive patients were treated. The mean age of the patients was 71.1 years, with a range from 45 to 88 years. Five of the patients were women and three were men. Eight of the membranes were subfoveal, with a mean area of 4.12 disc diameters (range, 3.5 to 5.0 disc diameters). All membranes were associated with subretinal fluid and hemorrhages (Table 1). All patients underwent a single treatment session. The clinical and angiographic findings in one case before and after treatment are shown in Figure 2.

Three patients (37.5%) had an improvement of visual acuity of at least 2 lines 1 week after the treatment, and the visual acuity was the same at the 3-month follow-up examination. Visual acuity remained unchanged in three patients (37.5%), although they reported a subjective improvement, and two patients (25%) had a decrease of visual acuity at the 3-month follow-up examination (Table 2).

There was a good correlation between the involution of the CNV with the complete clearance of the subretinal fluid and hemorrhage and the improvement of visual acuity in 3 eyes. Three eyes showed partial resolution, and the remaining 2 eyes had no changes (Table 2).

DISCUSSION

Low irradiance, long exposure, and diode laser irradiation with large spot size are the characteristics of transpupillary thermotherapy as initially described in 1998 by Shields et al. for the treatment of choroidal melanomas. In 1999, Reichel et al. demonstrated the benefit of this procedure for the treatment of the occult CNV associated with age-related macular degeneration, and, most recently, this method has been modified by the use of ICG enhancement.

Previous studies have reported the use of transpupillary thermotherapy administered through slit-lamp–mounted delivery systems using different types of contact and no contact lenses. To the best of our knowledge, transpupillary thermotherapy using a
diode laser delivered through an indirect ophthalmoscope has not been reported. The usefulness of this technique with this particular system has some limitations because the inverted retinal image at low magnification may not provide enough details for accurate treatments. In addition, the presence of multiple reflecting surfaces at different angles of incidence can alter the laser transmission, thus making the treatment less predictable.

Experimental studies by Benner et al. demonstrated that 5 times more output energy was required to make equivalent burns with the diode laser delivered through an indirect ophthalmoscope than with the argon or krypton laser delivered through an indirect ophthalmoscope and that variation in burn intensity and diameter (10% to 28%) was common with all three laser indirect ophthalmoscopes.

Clinical experience based on previous studies suggested an initial laser setting of 800 mW, 60 seconds of exposure, and a 3-mm diameter laser beam for the treatment of occult CNV. In our study, the laser parameters were set at 1 disc diameter spot and a power setting of 500 to 800 mW. The treatment strategy was to place multiple confluent spots beginning in the center and moving more peripherally for complete and effective treatment of CNV without adverse effects.

The criteria for choosing a delivery system and laser lenses are still not set. Because the treatment variables have not been completely determined and the endpoint of the treatment is clinically difficult to assess, the treatment parameters may need to be adjusted for the particular characteristics of each case. Eyes with large CNVs may eventually be considered untreatable, but this technique should be considered as a palliative option for now.

A laser delivery system using an indirect ophthalmoscope is a useful method for the dye-assisted treatment of CNVs larger than 5,400 μm. However, many clinical and technical variables need to be analyzed to obtain the optimum parameters and case selection for this therapeutic modality. In addition, a longer follow-up period is needed and the necessity of retreatments must be studied further.

**REFERENCES**


