Endoscopic Laser Photocoagulation for Management of Neovascular Glaucoma

Sung Chul Lee¹,², Guang One Kim², Dae Hyun Kim², Soon Hyun Kim¹, and Oh Woong Kwon¹

Abstract

We used endoscopic laser photocoagulation to treat neovascular glaucoma in eight eyes of seven patients. New vessels of the iris and anterior chamber disappeared or stabilized after photocoagulation in seven eyes (88%), while the vision improved in four eyes (50%). The endoscopy was excellent for observing the peripheral retina and ciliary process tissue. We found the endoscopic laser was suitable for wider photocoagulation of ischemic retina against media opacity.

Key Words: Endoscopy, laser photocoagulation, neovascular glaucoma

INTRODUCTION

Neovascular glaucoma (NVG) is a difficult form of glaucoma consisting of vessel proliferation involving the iris and the anterior chamber angle. Diseases resulting in retinal ischemia such as central retinal vein occlusion, diabetic retinopathy, central retinal artery occlusion, carotid artery obstruction, and orbital tumor are known to be the causes.¹-⁴ According to the degree of progression, the treatment methods consist of panretinal photocoagulation, anterior chamber angle photocoagulation, filtering surgery, glaucoma implants, cyclophotocoagulation, cryotherapy, beta-blockers, carbonic anhydrase inhibitors, and enucleation. An important aspect of the management of NVG involves the discovery of vessel proliferation and the performance of preventive treatments to impede further progression. The mainstream of early NVG treatments are panretinal photocoagulation and adjuvant anterior chamber angle photocoagulation.⁵-⁷ The delivery of panretinal photocoagulation improves the state of retinal ischemia, which causes vessel proliferation, and thus inhibits progression of the disease.

The use of an endoscopic laser allows visualization of anatomical structures that are not visible with conventional microscopes, such as the peripheral retina, pars plana, ciliary body and the posterior part of the iris. Furthermore, the endoscopic laser is not hindered by visual obstacles such as cornea opacity, miosis, cataract and intraocular gas, thus making it suitable for panretinal photocoagulation of the entire retina.⁸ We attempted to reveal the therapeutic results of vitrectomy and aggressive endoscopic laser photocoagulation extending to the extreme periphery in NVG.

MATERIALS AND METHODS

The subjects consisted of seven NVG patients (eight eyes) who received vitrectomy and aggressive retinal photocoagulation. The diagnosis of NVG was made upon noting the presence of vessel growth on the iris and anterior chamber angle with an intraocular pressure (IOP) of more than 21 mmHg. All patients were retrospectively studied for systemic diseases, preoperative panretinal photocoagulation, operative procedure, change of vision and IOP. All patients underwent preoperative and postoperative slit lamp, gonioscopy, and fundus examinations.

All patients were treated with vitrectomy and endoscopic laser photocoagulation. We were unable to observe the entire retina without the aid of an endoscope. The endoscope imaging unit we used was the FV-2000EF (TDH company, Tokyo, Japan) with the illumination source and image input system.
located in the front and the monitor and S-VHS connectors located in the back. Additional systems included an Argon laser unit (Novus 2000, Coherent, CA, USA), monitor (Sony PVM-1943MD, Tokyo, Japan), and S-VHS video recording unit (Victor HR-X7, Tokyo, Japan). A standard vitrectomy was performed through three sclerotomy sites through the pars plana, while panretinal photocoagulation was performed by endoscopic laser. The laser photocoagulation was delivered to all visible sites by endoscope (Fig. 1). The average number of laser burns delivered was 1,515, with a coagulation time of 0.1 to 0.2 seconds and energy of 150 to 500 mW. In addition, extracapsular cataract extraction (ECCE) (two eyes), ciliary body coagulation (one eye), and glaucoma valve insertion (one eye) were performed.

RESULTS

The subjects were four males (four eyes) and three females (four eyes), ranging in age between 40 and 60 years with the average age being 54.3 years. The follow-up period ranged from 4 to 15 months and averaged 9.5 months. The past medical histories revealed six patients having diabetes mellitus and one having combined hypertension. The duration of diabetes mellitus averaged 10 years, ranging from 1 to 20 years, and all patients had proliferative diabetic retinopathy. One patient had central retinal vein occlusion and two diabetes mellitus patients had received cataract surgery. The patients had received panretinal photocoagulation prior to development of NVG. The conditions thought to have provoked the onset of NVG included proliferative diabetic retinopathy in seven eyes and central retinal vein occlusion in one eye. To control preoperative intraocular pressure, Diamox® 1,000 mg/day and Mikelan were administered in six eyes, Diamox® 1,000 mg/day in one eye, and Mikelan® in one eye. However, the IOP measurements were all above 21 mmHg. Preoperative vision was hand motion in four eyes, finger counting.

Fig. 1. Endoscopic views during operation.
A. Ora serrata and pars plana (asterisk)
B. The endophotocoagulation around the retina (asterisk)
C. Ciliary body (asterisk)
D. The endophotocoagulation on the ciliary body (arrows).
Table 1. Patient Data and Results of Endoscopic Laser Photocoagulation for NVG

<table>
<thead>
<tr>
<th>Patient No</th>
<th>Sex/Age</th>
<th>Primary disease</th>
<th>Preoperative Laser (mmHg)</th>
<th>Vision</th>
<th>IOP</th>
<th>Procedures</th>
<th>Intraoperative No. of laser</th>
<th>NVI</th>
<th>Vision</th>
<th>IOP (1 wk)</th>
<th>IOP (last)</th>
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<tr>
<td>1</td>
<td>F/51</td>
<td>DM</td>
<td>Yes</td>
<td>FC</td>
<td>50</td>
<td>TPPV, Seton</td>
<td>1,822</td>
<td>regressed</td>
<td>LP-</td>
<td>5</td>
<td>18</td>
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<tr>
<td>2</td>
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<td>DM</td>
<td>Yes</td>
<td>FC</td>
<td>40</td>
<td>TPPV, ECCE, E</td>
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<td>25</td>
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<td>3</td>
<td>M/40</td>
<td>CRVO</td>
<td>Yes</td>
<td>HM</td>
<td>23</td>
<td>TPPV</td>
<td>1,190</td>
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<td>20/200</td>
<td>12</td>
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<td>31</td>
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<td>HM</td>
<td>32</td>
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<tr>
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<td>15/200</td>
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<td>1,206</td>
<td>regressed</td>
<td>20/200</td>
<td>18</td>
<td>23</td>
</tr>
</tbody>
</table>

NVG, neovascular glaucoma; NVI, neovascularization of iris; IOP, intraocular pressure; DM, diabetes mellitus; CRVO, central retinal vein obstruction; TPPV, trans pars plana vitrectomy; Seton, seton’s procedure (valve implantation); ECCE, extracapsular cataract extraction; E, membranectomy; cyclo, cyclophotocoagulation; PI, Peripheral iridectomy; LP, light perception; HM, hand motion; FC, finger counting.

in three eyes, and 15/200 in one eye. All eyes presented iris neovascularization, and among these eyes, partial anterior chamber closure was observed in two eyes (numbers 1 and 5). A seton procedure was added in one case and cyclophotocoagulation was combined in the case of number 5.

There were no intraoperative complications, although in two eyes, postoperative cornea abrasion and recurrent cornea erosions occurred. New vessels of the iris and anterior chamber disappeared or stabilized after surgery in seven eyes, while there was progression in one eye. The average IOP 1 week after surgery was 20 mmHg, and the average IOP at final OPD follow-up was 25 mmHg. The IOP 1 week after surgery decreased in all the eyes, although one eye had an angle closure of 35 mmHg. During the final follow-up, seven eyes maintained an IOP of less than 25 mmHg. In order to control IOP, the eyes received antiglaucoma eye drops. Preoperative vision improved in four eyes, showed no change in one eye, and decreased to no light perception in three eyes (Table 1).

DISCUSSION

NVG may be divided into three stages, including neovascularization of the iris, early glaucoma and endstage glaucoma. Accordingly, the treatment is largely divided into the prevention of new vessel progression and treatment of increased IOP. The preventive treatment is mandatory in neovascularization of the iris, while treatment of increased IOP is directed at the glaucoma. The preventive treatment modalities involving the destruction of the ischemic retina are panretinal photocoagulation and panretinal cryotherapy. It has been reported that the destruction of the ischemic retina eliminates the production of angiogenic factors, thus preventing new vessel growth in the retina, iris and ciliary body, and leading to the degeneration of existing new vessels. However, it is not effective in cases of peripheral iris adhesion. Van Meurs et al. reported that rubecosis in peripheral retinal detachment disappeared after removal of a detached peripheral retina. When we destroy the ischemic retina to regress rubecosis, the peripheral retina should be included.

We performed laser photocoagulation on the entire retina, averaging 1,515 burns with the aid of an endoscope. We were able to achieve complete photocoagulation of the retinal periphery. The results showed a regression or stabilization of new vessels in seven eyes, while in one eye the new vessel growth became exacerbated. In cases 1 and 2, even when the new vessels of the iris had disappeared, the visual acuity decreased to no light perception. We cannot explain the exact reason for the vision loss, but we suspect aggressive laser treatment may have destroyed the peripheral vision. It is uncertain how many laser burns are effective in order to regress the neovascularization of the iris. The appropriate number of
laser burns on the ciliary body as well as on the retina is a problem to be solved in the near future.

Endoscopic cyclophotocoagulation was reported to be effective in enhancing intraocular pressure control in patients with glaucoma. In the case of number 5, an endstage glaucoma that had a posterior chamber intraocular lens, ciliary body photocoagulation was performed while being visualized in addition to retinal photocoagulation. Approximately 100° of the contiguous ciliary processes were treated. The clinical end point of each burn was a whitening of the ciliary process tissue. The result showed that even in the case of endstage NVG, extensive retinal photocoagulation coupled with cyclophotocoagulation with endoscopic laser might become an alternative treatment modality. The exacerbation and lack of prevention occurred in eye number 6, being in the NVG stage with anterior angle closure and a final IOP of 45 mmHg. The vision decreased to no light perception. Eye number 1 received glaucoma valve insertion and presented a low IOP during the early postoperative period and a relatively low IOP thereafter, although it is questionable if this was due to panretinal photocoagulation.

In our cases, there were two incidences where NVG followed cataract operation in patients with proliferative diabetic retinopathy. In both these cases, the posterior capsule was ruptured. This may be explained by the crossing over of the angiogenic factors into the anterior chamber uninhibited by the ruptured posterior capsule, causing iris neovascularization and glaucoma. These results are similar to the studies of Poliner et al., which investigated the occurrence of NVG after ICCE and ECCE. Poliner reported an 8.9% incidence of NVG after ICCE, an 11.8% incidence in patients who received ECCE with a posterior capsule rupture, and no incidence of neovascular glaucoma in cases of ECCE where the posterior capsule was preserved. Therefore, careful consideration must be taken to preserve the posterior capsule in patients receiving cataract operation who have retinal ischemic diseases.

The 18 or 20-gauge laser endoscopy is capable of performing the three tasks of observation, illumination, and photocoagulation. The endoscopy allows the visualization of structures such as the peripheral retina, pars plana, ciliary body, and iris. It is not limited by obstructive factors (corneal opacity, miosis, cataract, intraocular gas) and does not require technical skills involving scleral indentation. Peripheral retinal photocoagulation is facilitated by endoscopic viewing. However, stereopsis is not capable by laser endoscopy, and since the surgery is performed via a monitor, some difficulty exists before proficiency is achieved.

In the past, NVG was destined for enucleation. However, with the discovery of the role of retinal ischemia in the production of angiogenic factors, treatment has been directed to deliver panretinal photocoagulation in the early stage in order to prevent progression of the disease. Therefore, it is necessary to check for the presence of neovascularization in patients with retinal ischemia during follow-up and to perform preventive measures before anterior chamber angle closure occurs. Nevertheless, it is difficult to perform complete classical panretinal photocoagulation in early stage NVG, particularly with accompanying anterior ocular opacities. On the other hand, laser endoscopy allows the complete treatment of the peripheral retina without regard to anterior ocular opacities. Thus, it is an excellent method of early NVG treatment.

REFERENCES