Laser Chorioretinal Venous Anastomosis for Progressive Nonischemic Central Retinal Vein Occlusion

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The use of high or medium-intensity lasers to create an anastomotic connection between a retinal vein and a choroidal vein for the treatment of nonischemic central retinal vein occlusion (CRVO) has shown encouraging results. We established communication between an obstructed retinal vein and the choroid using a modified laser application in the eye of a 17-year-old boy with progressive nonischemic CRVO with macular edema and achieved excellent anatomic and visual results. The macular edema totally resolved and visual acuity significantly improved from 6/60 to 6/6. *(Chang Gung Med J 2005;28:866-71)*

Key words: central retinal vein occlusion (CRVO), chorioretinal venous anastomosis.

The use of a high-intensity laser to create an anastomotic connection between a retinal vein and a choroidal vein for the treatment of nonischemic central retinal vein occlusion (CRVO) has shown encouraging results.[1-5] This technique potentially offers a means of permanently bypassing the site of obstruction to the venous outflow, which is thought to occur in the region of the lamina cribrosa.[6] However, this technique frequently causes serious complications, including vitreous hemorrhage, preretinal fibrosis, choroidal neovascularization, segmental retinal ischemia, and choriovitreal neovascularization.[1-4,7-9] In order to improve results and decrease the number of complications, a modified technique was proposed using a medium-high intensity laser.[10] In this study, we found excellent results in adapting the modified technique to create anastomosis between the retinal venous and choroidal venous circulation in a patient with nonischemic CRVO with macular edema who showed progressive vision loss.

CASE REPORT

A healthy 17-year-old young man presented with a 2-week history of progressive loss of vision in his left eye. When he was first seen, his visual acuity was 6/20 OS, and the right eye appeared to be normal. Fluorescein angiography revealed stasis retinopathy and mild macular edema (Fig. 1 A and B). No other abnormalities were found on systemic hematological survey. During the week after his first visit, his vision deteriorated to 6/60 and retinal hemorrhage and macular edema significantly increased. Fluorescein angiography revealed a nonischemic CRVO with macular edema (Fig. 1 C and D). In addition, an electroretinograhic examination with retinal ischemic monitor software (LKC Technologies, Inc) revealed relatively low amplitude and prolonged latency. A chorioretinal venous anastomosis was performed with topical anesthesia, a fundus contact lens, and a slit-lamp delivery system, using a Coherent Novus Omni laser instrument. Three treatment sites were selected over superonasal, inferotemporal and inferonasal branches of the retinal vein adjacent to the engorged first-order or second-order venous tributaries, avoiding direct treatment through the intraretinal hemorrhage. The immediate peripapillary area and the horizontal meridian were avoided to minimize the risk of dam-

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Received: Nov. 5, 2004; Accepted: Jan. 25, 2005
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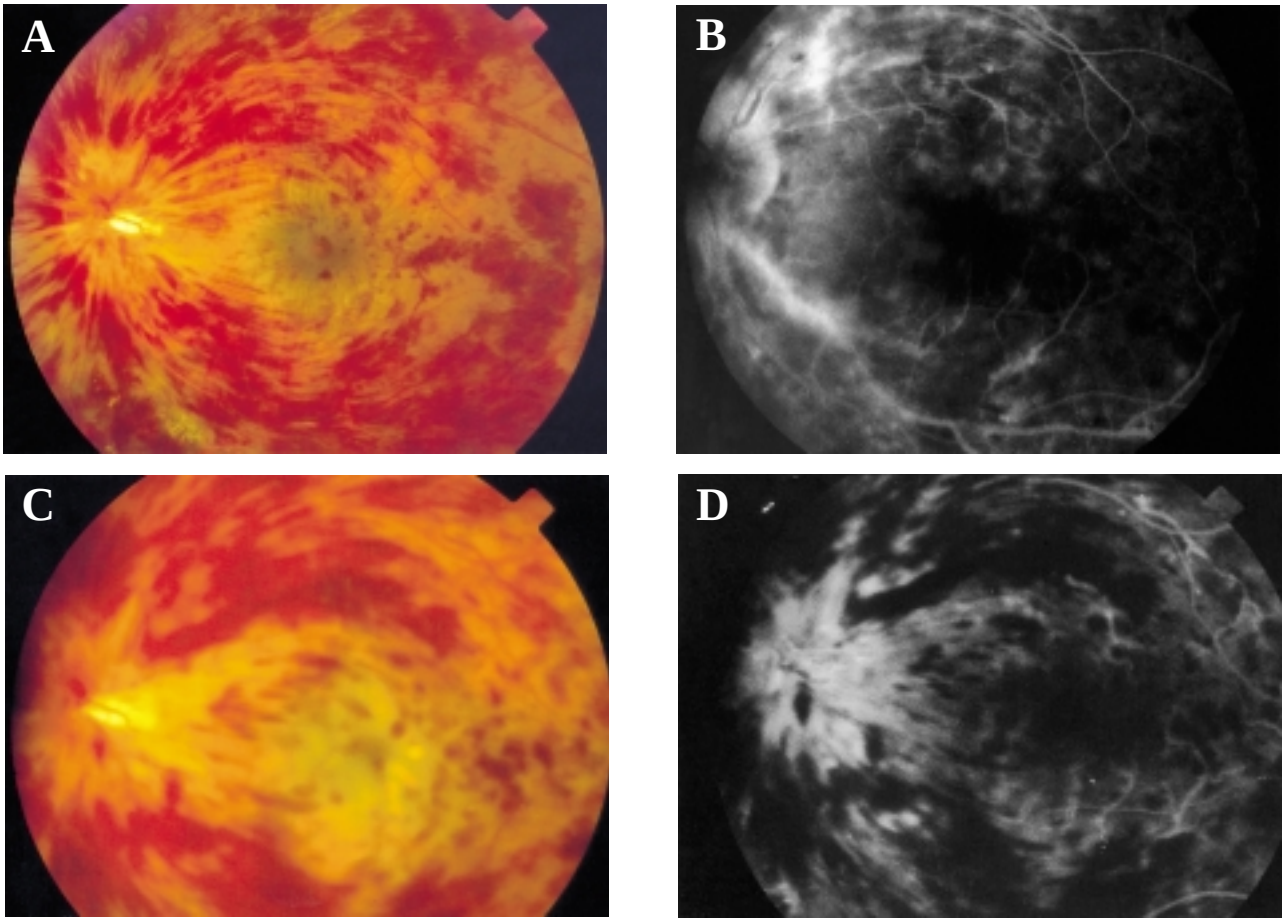

Fig. 1 Sixty-degree fundus photograph of a patient with a nonischemic CRVO showing stasis retinopathy with mild macular edema reducing visual acuity to 6/20 (A). Fluorescein angiogram showing retinal hemorrhage blocked fluorescein with mild disc dye leakage (B). One week later, retinal hemorrhage progressed with moderate macular edema deteriorating visual acuity to 6/60 (C). Fluorescein angiogram showing more severe retinal hemorrhage blocked fluorescein, disc dye leakage and macular dye leakage (D).

aging a branch of the posterior ciliary arterial circulation. Treatments were applied adjacent to the selected vein, not on the vein or at the edge of the vein. Long duration, medium-intensity laser application with small laser photocoagulation spots was applied to a focal area at the selected site using a krypton red laser (647 nm) at a power setting of 1W with a spot size of 50 μm and a duration 0.4 seconds. One or two burns were placed into the focal site to reach the end point of a visible choroidal vacuole, implying Bruch's membrane rupture.

Four weeks after the procedure our patient's vision had improved to 6/12 with reduced retinal hemorrhage and some resolution of the macular edema. The sites of the previous laser application showed two probable anastomoses. At 8 weeks after the procedure, his vision had returned to 6/6, retinal hemorrhage had significantly decreased and the macular edema had resolved. Two well-developed chorioretinal venous anastomoses were visible at the superotemporal and inferonasal sites of the laser application. The anastomoses were confirmed by fluorescein angiography, which demonstrated preferential filling of the inferonasal and superotemporal veins with venous laminae flowing toward anastomosis sites (Fig. 2). At the time of this report, this patient had been followed-up for 12 months and had maintained a visual acuity of 6/6 with no untoward

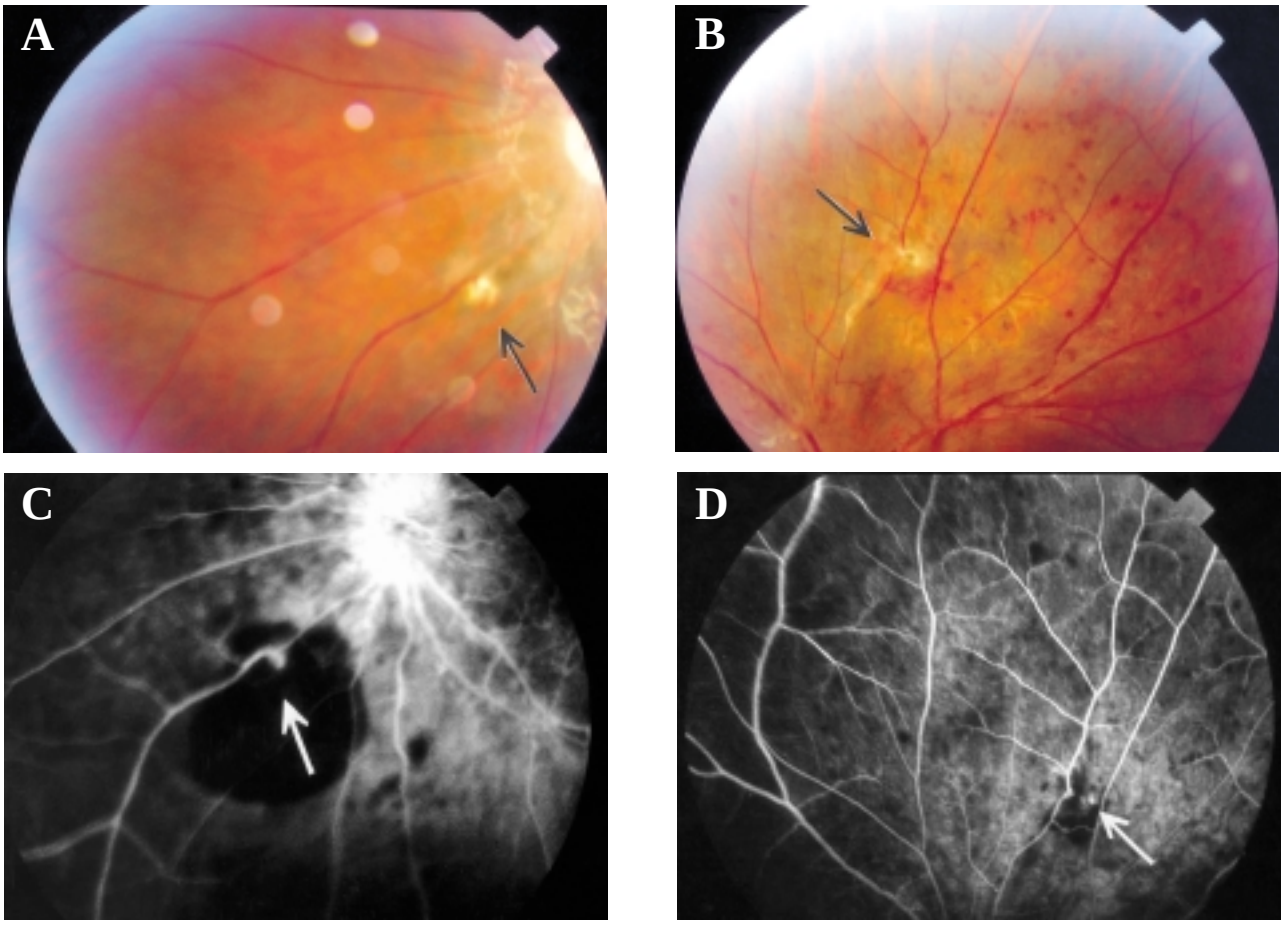

Fig. 2 Sixty-degree fundus photograph of a patient with nonischemic CRVO 2 months after successful anastomosis creation. The successful anastomosis sites are seen off the inferonasal and superotemporal veins (arrows) (A and B). Sixty-degree fluorescein angiogram showing preferential filling of the inferonasal and superotemporal veins with venous laminae flowing toward anastomosis sites (arrows) (C and D).

complications arising from the anastomosis.

DISCUSSION

CRVO is a common retinal vascular disorder that is frequently associated with severe loss of vision. Obstruction in the central retinal vein may produce a clinical picture of an ischemic or nonischemic CRVO. In the ischemic form, retinal capillary nonperfusion occurs with retinal ischemia and cell death, leading to loss of vision with no prospect of recovery. In the nonischemic form, there are variable degrees of venous stasis; however, the capillary circulation of the retina remains largely intact. The degrees of vision loss vary with the extent of extravasation of blood and retinal edema. Progression from nonischemic to ischemic CRVO occurs in 9.5% to 20% of cases.[11-13] There is still no definite method for preventing the progression from nonischemic to ischemic CRVO. Patients who initially have nonischemic CRVO with poor visual acuity and macular edema may be at greater risk for disease progression.[12] To treat this condition effectively requires recognition that venous outflow is obstructed at the level of the lamina cribrosa and that the obstruction has to be relieved or bypassed.[6] Some attempts at treating CRVO were not based on a scientific understanding of this condition and, therefore, did not prove to be effective.[14,15] The concept of creating a therapeutic anastomosis between the retina

and choroid as a means of treating retinal vascular occlusive disease was raised by researchers several years ago but was achieved only recently with the use of high energy laser photocoagulation.[15-17]

Laser-induced chorioretinal venous anastomosis was proposed by McAllister and Constable as a candidate therapy for nonischemic CRVO to provide an alternative drainage route for the obstructed circulation.[1] The authors described focal application of high-intensity green wavelength laser photocoagulation to a tributary retinal vein with the intention of puncturing both the vein wall and the underlying Bruch's membrane. In a later modification of this technique, the Bruch's membrane was selectively punctured first, followed by puncture of the vessel wall using a neodymium:yttrium-aluminum-garnet laser when required.[4] Researchers of several case series have reported successful anastomosis formation in 38% to 63% of treated eyes with demonstration of the reversal of retinal venous congestion and variable improvement in visual acuity.[1-4,18] However, because there have been no reports of a technique which consistently creates functioning anastomosis to improve vision and prevent ischemia, this treatment remains unproven. In addition, frequent, serious complications have been reported after using this technique, including high-energy laser induced vitreous hemorrhage, preretinal fibrosis, choroidal neovascularization, segmental retinal ischemia, and choriovitreal neovascularization.[1-4,7-9] Total occlusion of the distal portion of the venous tributary can also be a complication of this treatment. This is potentially serious because it may increase retinal ischemia. For this reason, patients treated with this technique require careful follow-up and, if there is evidence of retinal ischemia, need urgent pan-retinal photocoagulation to the affected area to reduce the risk of neovascular complications.[4]

To limit the complications of the treatment, Leonard et al.[10] proposed a modified technique of laser chorioretinal venous anastomosis which intentionally avoids vein wall rupture and uses medium-intensity, longer duration laser application. In their study, at least one patent anastomosis eventually developed in 100% of cases and visual acuity improved in 84% of cases. The only complication was localized preretinal fibrosis in 26% of cases and there were no vascular complications.[10]

In our study, we used the modified technique proposed by Leonard et al.[10] in a patient who had nonischemic CRVO with worsening visual acuity and macular edema. Treatment sites were selected adjacent to his engorged first-order or second-order venous tributaries, avoiding direct treatment through the intraretinal hemorrhage. The immediate peripapillary area and the horizontal meridian were avoided to minimize the risk of damaging a branch of the posterior ciliary arterial circulation. Treatment was also far enough from the macular area to minimize any tractional effects that may have resulted from scarring induced by laser photocoagulation.[1,19] Treatments were applied adjacent to the selected vein since puncturing the vein wall was not required to form a functioning anastomosis and puncturing the adjacent Bruch's membrane alone was sufficient.[10]

Anastomosis was successfully created using this technique with macular edema resolution, significant visual improvement and no vascular complications were noted. We used long-duration medium-intensity laser applications with a small spot size to favor thermal diffusion and homeostasis at the treatment site to rupture only the underlying Bruch's membrane. Using this method, we avoided deliberate puncture of the engorged venous tributary with a high-intensity laser. The anastomosis resulted in uniform reversal of retinal venous engorgement in all quadrants. The results of this study showed that successful laser anastomosis using a modified laser application between the retina and choroid circulation was associated with a reversal of nonischemic CRVO with progressive macular edema and results in improvement in vision with few complications.

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雷射脈絡膜網膜靜脈聯結治療漸進惡化非缺血性中心網膜靜脈阻塞

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在網膜靜脈與脈絡膜靜脈之間，使用高或中強度能量雷射製造脈絡膜網膜靜脈聯結，來治療非缺血性中心網膜靜脈阻塞已有令人鼓舞的成果呈現．我們以改良的雷射治療方式，來治療一位罹患漸進惡化非缺血性中心網膜靜脈阻塞合併黃斑部水腫的十七歲男性，得到良好的解剖結構與視力結果。術後不僅黃斑部水腫完全吸收，而且視力由零點壹進步到壹點零。(長庚醫誌 2005;28:866-71)

關鍵字：非缺血性中心網膜靜脈阻塞，脈絡膜網膜靜脈聯結。

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受文日期：民國93年11月5日；接受刊載：民國94年1月25日
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