Radial Optic Neurotomy for CRVO

Surgical decompression of the optic nerve head resulted in improved anatomical and visual results in most patients in a series.

BY E. MITCHEL OPREMCAK, MD

Central retinal vein occlusion (CRVO) is a common retinal vascular condition, the second leading cause of permanent retinal vascular blindness.[1,2] It can result in unilateral loss of vision due to intraretinal hemorrhage, edema and retinal ischemia, and there is no established effective treatment. Grid laser photocoagulation has been shown to decrease edema in CRVO but not to improve visual acuity in patients with CRVO and persistent macular edema.[3] Chorioretinal anastomosis with high-intensity laser photocoagulation achieved anatomical success in one-third of eyes and was associated with clinical improvement, but it carries a high complication rate, including hemorrhages and other undesirable sequelae.[4]

It has been suggested that the anatomy of the optic disc may contribute to the pathogenesis of CRVO.[5] The optic nerve head is the site where the optic nerve fibers, the central retinal vein, and the central retinal artery all enter or exit the eye through the confined space of the lamina cribrosa. The scleral outlet at the optic nerve head, with a diameter of 1.5 mm, is surrounded by a nonelastic scleral ring. The optic nerve, which is myelinated before it enters the eye, loses its myelin sheath at this point in order to pass through the opening.

The "bottleneck" of nerve and vascular tissue at this crucial anatomic point may result in a compression syndrome, analogous to carpal tunnel syndrome, in which pressure exerted by the confined space results in tissue ischemia and dysfunction.[5] Compression of nerve and vessels within this space may play a role in the pathogenesis of CRVO. A surgical technique that relieves the neurovascular pressure at this point could be a viable approach to therapy for CRVO.

RADIAL OPTIC NEUROTOMY TECHNIQUE

The surgical technique of radial optic neurotomy (RON) was developed with the goal of opening this space and relieving pressure on the central retinal vein in CRVO.

In the procedure, after pars plana vitrectomy, the intraocular pressure (IOP) is momentarily elevated. A specially designed microvitreoretinal blade is positioned at the edge of the optic disc and directed posteriorly into the optic nerve, incising the lamina cribrosa and adjacent sclera (Figure 1). One or, rarely, two stab incisions are made, with no lateral movement of the blade. The surgeon takes care to ensure that the edge of the incision borders on but does not touch the central retinal vessels. Often an immediate opening of the optic disc can be observed. The blade is withdrawn, and any small hemorrhages at the site are controlled by elevation of IOP and gentle tamponade with the vitrectomy cutter.

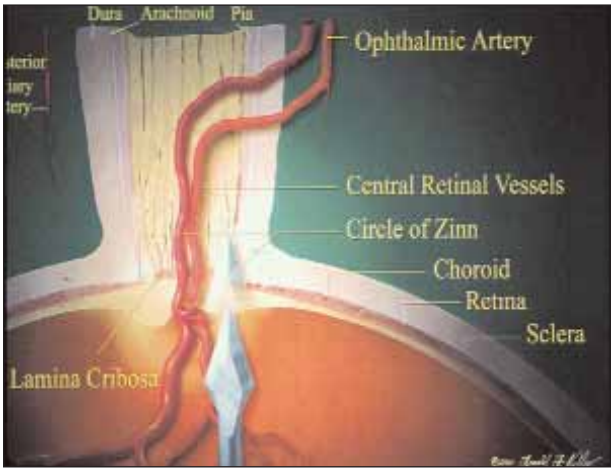

Figure 1. In the radial optic neurotomy procedure, a specially designed microvitreoretinal blade is positioned at the edge of the optic disc and directed posteriorly into the optic nerve, incising the lamina cribrosa and adjacent sclera.

CLINICAL RESULTS

Results with the RON technique in a retrospective series of 11 patients[5] and a prospective series of 117 patients[6] have previously been reported. In addition, a prospective

series in which intravitreal injection of triamcinolone acetonide was added to RON has also been described.[7]

The nonrandomized series of 117 patients included those who were older than 40 years and had a CRVO with presenting Snellen visual acuity of 20/200 or worse. Most patients were male (67%), were older than 50 years (97%), and had visual acuity of count fingers or worse (69%). All had intraretinal hemorrhage, venous dilation, disc edema and macular edema. CRVO was classified as perfused in 64 (55%), nonperfused in 28 (24%), and indeterminate in 15 (13%). Nonperfusion was defined as 10 disc areas or more of ischemia on fluorescein angiography. Eight patients had predominantly macular edema, and two had preoperative vitreous hemorrhage.

Six of the 117 patients in the series were lost to follow-up, and the remaining 111 had follow-up of at least 3 months, with a mean of 9 months (range, 3–32 months).

Despite a high incidence of bilateral disease (19%), patients underwent RON in one eye only, whichever eye had the more recent onset of CRVO.

All patients in the series had RON performed by this author. Anatomic improvement was noted in 95% of patients, appearing as early as 1 week postop, but with more dramatic improvement at 2 to 3 months postop and continuing improvement over many months. Events indicative of anatomic improvement included resolution of disc edema, retinal hemorrhage and edema, and venous engorgement. Five patients showed no improvement or worsening of disease. Eleven patients received sub-Tenon's injection of triamcinolone for cystoid macular edema persisting more than 3 months after surgery.

Postoperative best corrected visual acuity was equal to preop or improved in 94% of patients. In most patients (71%), visual acuity improved, with an average gain of 2.5 Snellen lines. Two or more lines of improvement were seen in 53% of patients, three or more lines in 41%, four or more in 25%, and six or more in 14%. Postop visual acuity was equal to preop in 23% and worse in 6%.

Intraoperative complications included hemorrhages at the RON site in 18% of patients, which in all cases were controlled with elevated IOP and gentle tamponade. No patients had lacerations of central retinal vessels. No patients had vitreous hemorrhage at the day 1 postoperative exam, and five had vitreous hemorrhage at the 1 week exam, three of which occurred in patients taking warfarin sodium (Coumadin, Bristol-Myers Squibb). No endophthalmitis, retinal detachment, or proliferative vitreoretinopathy was seen.

Age and duration of CRVO appeared to influence the visual outcome of RON; there was a trend for worse outcomes in older patients and those with longer duration of CRVO. Absence of preoperative afferent pupillary defect was associated with greater gain in lines of vision.

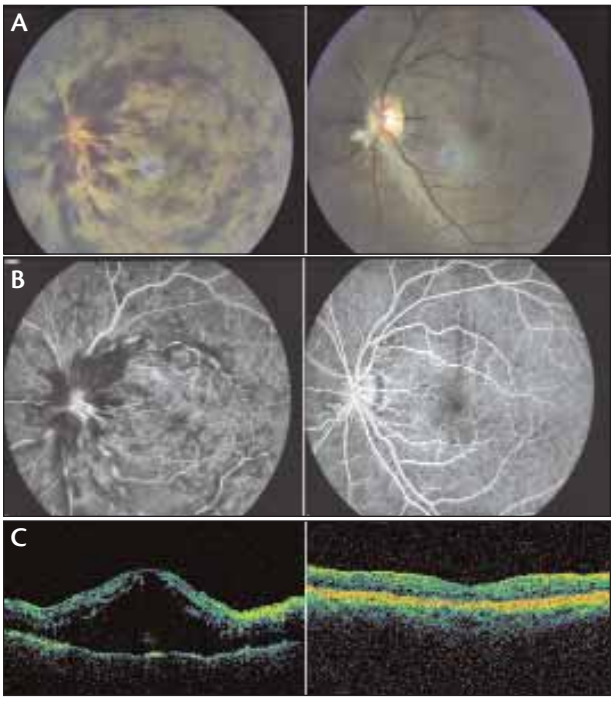

Figure 2. Case example of a 78-year-old white male whose visual acuity improved from 20/400 preoperatively to 20/30 after RON with intravitreal triamcinolone injection. Before and after color fundus photographs (A). Before and after fluorescein angiograms (B). Before and after optical coherence tomographies (C).

Perfused CRVO was also associated with greater gain.

The presence of anterior segment neovascularization, either present preoperatively (15%) or developing after surgery (6%) was associated with poor visual outcome.

RON WITH TRIAMCINOLONE INJECTION

In some patients in the series described above, late macular pigmentation and persistent cystoid macular edema (CME) were associated with poor visual outcome. Intraocular injection of triamcinolone has been reported to be effective in treating macular edema in conditions including diabetes, CME, and CRVO.[8-11]

The ability of adjunctive intraocular triamcinolone injection to improve results of RON was assessed in a consecutive series of 63 patients with CRVO.[7] This series was sequential with the series described above.

Selection criteria and surgical technique for RON in this series were similar to those described above. At the conclusion of the RON procedure, 4 mg of triamcinolone in 0.1 mL was injected through the pars plana with a 27-gauge needle.

The results of RON with triamcinolone injection were compared to those with RON alone. Patients' initial visual acuity and demographics were similar between the two

series. Prevalence of hypertension and diabetes were similar. There were more males in the RON-alone group than in the group receiving intravitreal triamcinolone. Mean follow-up was slightly longer in the series receiving intravitreal triamcinolone, at 11 months vs 9 months in the RON-alone series. There were fewer patients with perfused CRVO (35%) and more classified as indeterminate (30%) in the RON-plus-injection series.

Radial optic neurotomy with injection of triamcinolone resulted in anatomic resolution of CRVO in 93% of patients, similar to the 95% seen with RON alone.

There were no significant differences in visual acuity results between the two series. A case example of a 78-year-old white male with bilateral CRVO whose visual acuity improved from 20/400 preoperatively to 20/30 after RON with injection of triamcinolone is shown in Figure 2.

Complications were comparable between the two series. Fewer intraoperative hemorrhages were noted in the RON-plus-injection series (8%) vs the RON-alone series (18%). Intraocular pressure elevation above 21 mm Hg was noted in 25% of patients in the RON-plus-injection series, all of which were controlled with topical medications. Postoperative endophthalmitis occurred in one patient.

A reduction in the incidence of macular pigmentation or CME was not seen with the addition of the steroid injection. Macular pigmentation occurred in 28% in the RON-plus injection group vs 22% in the RON-alone group, and CME developed in 17% in both groups.

In this series, a single adjunctive dose of triamcinolone at the time of RON did not appear to convey benefit in long-term anatomic or visual outcomes or to reduce the incidence of persistent CME or macular pigmentation. Vitrectomy shortens the half-life of intraocular drugs, including triamcinolone,[8] so use of the drug in this setting may have reduced the effect of the steroid. The authors' early impression of a beneficial effect of injection did not persist beyond 2 or 3 months.

CONCLUSIONS

In all vascular surgery, whether cardiovascular, neurosurgical, or the new field of retinal vascular surgery, the main goals are to restore blood flow to nonperfused tissues; to manage secondary tissue damage, including retinal edema, hemorrhage and nonviable tissue; to identify and address post-perfusion complications (post-perfusion retinopathy); and to support the remaining viable tissues throughout the postoperative period. We have applied these principles to the treatment of branch retinal vein occlusion via arteriovenous crossing sheathotomy, to retinal artery occlusions via translumenal Nd:YAG embolysis/embolectomy, and to CRVO via RON.

The anatomic and visual results of RON in both of the series described above compare favorably with the natural history of patients with CRVO and visual acuity of 20/200 or worse.[2] The use of intravitreal triamcinolone seems to elevate the risk of postoperative complications. Patient selection and physician expectations are important issues. An ideal candidate for RON would be a patient with reversible pathology including disc edema, venous dilatation, and extensive retinal hemorrhage and edema. Patients with end-stage CRVO without significant edema and hemorrhage or those with severe anterior segment neovascularization and glaucoma would not be expected to do well with RON. The surgeon and patient must be aware that it takes several months for such extensive hemorrhage and edema to clear once the retinal blood flow has been restored after RON. During this time, the patient may report subjective improvement of visual acuity, and adjunctive therapies may be used to support the remaining healthy tissues.

We have recently completed a study of 88 consecutive patients employing RON with pneumatic displacement of the subretinal fluid and macular edema via an air bubble. This maneuver rapidly diminishes macular swelling, reduces secondary macular pigmentation and improves final visual acuity. Future studies are looking at the potential benefit of macular cyst puncture to assist with the resolution of refractory CME following RON. Although further study is warranted, RON appears to be an effective technique to relieve optic nerve head compression in patients with risk of severe permanent visual loss due to CRVO. ■

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