**Objective:** To establish a communication between an obstructed retinal vein and the choroid by means of laser in eyes with nonischemic central or branch vein occlusion.

**Methods:** Retrospective review identified eyes with nonischemic central or branch vein occlusion, and with decreasing or persistently decreased visual acuity of 20/100 or worse for 4 months or more before treatment, that received 1 or more sessions of laser photocoagulation to create a chorioretinal anastomosis.

**Results:** Of 24 eyes with central vein occlusion, an anastomosis formed in 9 (38%) within 2 months after treatment, with visual improvement of 1 to 3 lines in 2 (33%) of 6 and no improvement in 1 (16%). No permanent, vision-limiting complications occurred during a mean follow-up of 13 months after the first treatment session or 8 months after the last session.

**Conclusions:** Laser photocoagulation of a retinal vein and Bruch’s membrane may create a chorioretinal anastomosis in some eyes with a nonischemic vein occlusion. Progression to an ischemic status may possibly be prevented with successful anastomosis formation. Marked visual improvement may occur. Treatment techniques to create reliably an anastomosis with subsequent visual improvement, while minimizing potential complications, continue to evolve.


**R**ETINAL VEIN occlusion is a common cause of visual loss. Until recently, treatment options for affected eyes have been directed at management of sequelae of the venous occlusion, including macular edema and neovascularization, by grid or scatter-type photocoagulation, and have not been aimed at reestablishing the venous outflow of the retina. A chorioretinal anastomosis between a retinal vein and the choroid may bypass the occluded vein and relieve the venous obstruction. This may decrease the conversion rate of a nonischemic vein occlusion to an ischemic status and lessen macular edema with concurrent improvement in visual acuity.

Attempts to create a chorioretinal venous anastomosis by means of laser photocoagulation have been successful in some eyes. Of 24 eyes with a nonischemic central retinal vein occlusion (CVO) treated in this fashion by McAllister and Constable, 8 (33%) developed an anastomosis within 7 weeks after treatment coincident with some visual improvement; 3 (12%) of 24 had marked visual improvement of 6 lines or more. None of these 8 eyes progressed to an ischemic status. In the Central Vein Occlusion Study, one third of eyes with perfused CVO progressed to a nonperfused status during follow-up, occurring most frequently in the first 4 months. Creating an anastomosis in eyes with branch retinal vein occlusion (BVO) has not been reported.

We describe 30 eyes of 30 patients with a nonischemic vein occlusion (24 with CVO and 6 with BVO) who underwent laser photocoagulation during 1 or more treatment sessions in an attempt to create a chorioretinal anastomosis.
Nine (38%) of the 24 treated eyes developed a chorioretinal anastomosis within 8 weeks after treatment. Of these 9 eyes, the mean duration of decreasing or persistently decreased visual acuity to a level of 20/100 or worse because of perfused macular edema before the first treatment was 9 months. One eye (11%) had received grid laser photocoagulation for cystoid macular edema at least 4 months before the first anastomosis attempt, whereas 1 (11%) had the grid treatment at the same time as the first anastomosis attempt. The grid treatment did not result in improved visual acuity in either eye. None of the 9 eyes demonstrated progression to an ischemic status during a mean follow-up of 11 months after the first treatment session. Of the 15 eyes (62%) that did not develop an anastomosis, an ischemic status developed in 3 (20%) during a mean follow-up of 14 months after the first treatment session.

Eighteen treatment sessions, in an attempt to create a chorioretinal anastomosis, were completed for the 9 patients who developed an anastomosis, with a mean of 2 treatment sessions per patient (range, 1-4 sessions) (Table 2). Of the 18 sessions, only the last treatment session for each of the 9 eyes (9 sessions) resulted in a successful anastomosis. For the 3 eyes that required only 1 treatment session to create an anastomosis, the mean follow-up was 9 months. For the 4 eyes that required a second treatment session to create an anastomosis, the mean follow-up after the second session was 3 months. For the 1 eye that required a third treatment session to create an anastomosis, the follow-up after the third session was 4 months. For the 1 eye that required a fourth treatment session to create an anastomosis, the follow-up after the fourth session was 4 months.

Of the 9 sessions that resulted in an anastomosis in these 9 eyes, the laser photocoagulation treatment parameters varied. Of the 9 sessions, 3.0 W of argon blue-green (using a 50-µm spot size and 0.1-second duration) resulted in anastomosis formation in 8 of these sessions (89%). In the remaining 1 session for 1 eye, 700
mW of dye yellow at 50 µm and 0.1-second duration produced a chorioretinal anastomosis.

Of the 9 eyes that developed an anastomosis (Figure 1), 2 had marked and prompt visual improvement of 6 or more lines (2 of 24 [8%]), 5 had some visual improvement of 1 to 3 lines (5 of 24 [21%]), and 2 (2 of 24 [8%]) had no visual improvement within 8 weeks after the treatment session that led to anastomosis formation, which may have resulted from the presence of foveal retinal pigment epithelial hyperpigmentation, before treatment, associated with chronic cystoid macular edema.

For descriptive purposes only, the ophthalmoscopic appearance of the chorioretinal anastomosis was categorized into 1 of 3 groups, based on the diameters of the central and peripheral venous segments emanating from the anastomotic site. One group (Figure 2) consisted of those anastomoses where the central venous segment had a relatively larger diameter than the relatively smaller diameter of the peripheral venous segment. Five of the 9 eyes that developed an anastomosis had this configuration. Another group consisted of those anastomoses where the central venous segment was relatively smaller in caliber than the peripheral venous segment, in fact, the central segment was markedly narrowed and even absent ophthalmoscopically in 1 eye (Figure 3). Four of the 9 eyes that developed an anastomosis had this configuration. In the 1 eye that developed 2 chorioretinal anastomoses (case 1 below), the ophthalmoscopic appearance of one of the anastomoses may be categorized into a third group in which the central segment is of the same caliber as the peripheral segment.

No permanent, vision-limiting complications were encountered in any of the 24 eyes during a mean follow-up of 13 months after the first treatment session or 7 months after the most recent treatment session. No eye developed segmental retinal ischemia or choroidovitreal neovascularization in this series.

![Table 1. Pretreatment Characteristics in Eyes With Nonischemic CVO*](image)

**Characteristics** | **All Eyes** | **Anastomosis** | **No Anastomosis**
---|---|---|---
Mean age, y | 72 | 75 | 68
White race | 22 (92) | 13 (87) | 9 (100)
Male sex | 13 (54) | 7 (46) | 6 (67)
Perfused CME | 24 (100) | 15 (100) | 9 (100)
VA ≤20/100 | 24 (100) | 15 (100) | 9 (100)
At diagnosis | 18 (75) | 12 (80) | 6 (67)
When treated | 23/48 (48) | 11/30 (37) | 12/18 (67)
Mean duration of VA | 12 12 10 | 12 12 10 | 12 12 10
≤20/100 before Rx, mo | 12 (50) | 6 (40) | 6 (67)

* CVO indicates central retinal vein occlusion; CME, cystoid macular edema; Dx, diagnosis; Rx, treatment; and VA, visual acuity. Unless indicated otherwise, data are given as number (percentage).

![Table 2. Treatment and Posttreatment Characteristics in Eyes With Nonischemic CVO*](image)

**Characteristics** | **All Eyes** | **Anastomosis** | **No Anastomosis**
---|---|---|---
Mean No. of treatment sessions | 2 | 2 | 2
Mean follow-up, mo | 13 | 14 | 11
After 1st Rx | 7 | 8 | 5
After last Rx | 3 | 4 | 1
- W blue-green laser | 23/48 (48) | 11/30 (37) | 12/18 (67)
Anastomosis formation | 9 (38) | 0 (0) | 9 (100)
VA improvement ≥6 lines | 2 (8) | 0 (0) | 2 (22)
Progressed to nonperfusion | 3 (12) | 9 (20) | 0 (0)

* CVO indicates central retinal vein occlusion; Rx, treatment; and VA, visual acuity. Unless indicated otherwise, data are given as number (percentage).

![Figure 1. Visual acuity (VA) at first treatment session to create an anastomosis vs final visual acuity in eyes with nonischemic central retinal vein occlusion. Points above the line represent deterioration in visual acuity; points below the line, improvement; and points on the line, unchanged. HM indicates hand motions; CF, counting fingers.](image)

![Figure 3. Eight eyes (33%) did not develop any complications. Of the 16 eyes (67%) that developed a complication of treatment, the severity varied, and 2 of the 16 eyes developed more than 1 complication. A transient vitreous hemorrhage occurred in 10 eyes (10 of 24 eyes [42%]) at the time of treatment, 9 of which had received only Nd:YAG laser photocoagulation at 1 or more treatment sites. The hemorrhage was mild in all 10 eyes immediately after treatment and had cleared in all eyes at the 2-month follow-up visit; no eyes were examined before the 2-month follow-up visit. Localized choroidal neovascularization developed in 5 eyes (5 of 24 eyes [21%]) and did not affect visual acuity or require treatment in any instance at the most recent follow-up. Pre-retinal fibrosis developed in 3 eyes (3 of 24 eyes [12%]). A vitrectomy was performed in 1 of these 3 eyes to release a secondary, small, localized traction retinal detachment. No eye developed segmental retinal ischemia or choroidovitreal neovascularization in this series.](image)
BRANCH RETINAL VEIN OCCLUSION

Pretreatment characteristics of the 6 eyes of 6 patients with a nonischemic BVO are outlined in Table 4, with subgroup analysis of the eyes that developed an anastomosis and those that did not.

Three (50%) of the 6 treated eyes developed a chorioretinal anastomosis within 8 weeks after treatment. Of the 3 eyes with an anastomosis, the mean duration of decreasing or persistently decreased visual acuity to a level of 20/100 or worse because of perfused macular edema before the first treatment was 13 months. Two of these eyes (67%) had received grid laser photocoagulation for cystoid macular edema at least 4 months before the first anastomosis attempt. The grid treatment did not lead to improvement in visual acuity in either eye. None of the 6 eyes demonstrated progression to an ischemic status during a mean follow-up of 13 months after the last treatment session.

Of the 3 eyes that developed an anastomosis, each had received only 1 treatment session (Table 5). Follow-up for the 3 eyes was 11 months (range, 4-16 months) after the first and only treatment session. Laser photoocoagulation treatment parameters varied. At 2 (67%) of the 3 sessions, the argon blue-green wavelength using 3.0 W of power at 50 µm and 0.1-second duration was used. At the remaining 1 session for 1 eye (33%), 1.0 W of argon green at 50 µm and 0.1-second duration was used.

Of the 3 eyes (50%) that developed an anastomosis, 2 had some visual improvement of 1 to 3 lines (2 of 6 [33%]), and 1 had no visual improvement (Figure 4), which may have been caused, in part, by the presence of foveal pigment associated with chronic cystoid macular edema. In all cases, both the central and peripheral venous segments appeared to dip down into the choroid. The central venous segment was relatively smaller in caliber than the peripheral segment in all 3 cases.
REPORT OF CASES

CASE 1

A 53-year-old healthy white man came to The Wilmer Retinal Vascular Center in March 1995 with a 12-month history of a nonischemic CVO in the right eye. Corrected visual acuity was 20/100 OD and 20/20 OS, and results of pupillary, intraocular pressure, and slitlamp examinations were normal. No neovascularization of the iris or angle was present. Ophthalmoscopy of the right eye disclosed disc edema, cystoid macular edema, mild venous tortuosity, and rare intraretinal hemorrhage (Figure 5, A). Fluorescein angiography confirmed the nonischemic nature of the CVO (Figure 5, B) with cystic parafoveal fluorescein leakage in the late-phase frames (Figure 5, C). Ophthalmoscopy of the left eye was normal.

Laser photocoagulation with the argon blue-green wavelength, 3.0 W, 50-µm spot size, and 0.1-second duration was applied about 2 disc diameters superonasal and inferonasal to the optic nerve. One spot was placed in each location overlying the retinal vein to puncture the retinal vein and, hopefully, subjacent Bruch membrane with the 1 spot (Figure 5, D and E). Inferonasally, treatment was applied to the retinal vein where an underlying choroidal vessel was noted (Figure 5, A and E). No bleeding was encountered.

Seven weeks later, visual acuity had improved to 20/30 OD with subjective visual improvement. Ophthalmoscopy disclosed resolution of the disc edema with lessened macular edema and venous tortuosity (Figure 5, F). A chorioretinal anastomosis was noted ophthalmoscopically at both treatment sites. The presence of an anastomosis was suggested at each site by the ophthalmoscopic appearance of the central and peripheral segments of the treated retinal vein dipping down into the choroid. Superonasally, the central venous segment had a relatively wider diameter than the peripheral segment of the same vein (Figure 5, F). Inferonasally, both the central and peripheral segments of the retinal vein were of approximately the same caliber (Figure 5, F). Fluorescein angiography disclosed earlier venous filling in the central venous segment compared with the peripheral venous segment at both treatment sites (Figure 5, G). Trilaminar venous flow was not observed.
Figure 5. A, On initial examination, ophthalmoscopy confirmed the 12-month history of a nonischemic central retinal vein occlusion with disc edema, cystoid macular edema with some intraretinal hemorrhage, mild venous tortuosity, and rare intraretinal hemorrhage. Note the choroidal vessel (arrow) (compare with E). B, Fluorescein angiography confirmed the nonischemic status of the occlusion. Note the patchy choroidal filling inferonasal to the optic nerve head (arrow) (compare with I). C, Cystic parafoveal fluorescein leakage (arrow) was present in the late-phase frames. Fluorescein leakage at the disc margin was also present. D and E, One application of laser photocoagulation was placed overlying the retinal vein in an attempt to puncture Bruch's membrane and the retinal vein with 1 spot at each treatment site. E, Inferonasally, treatment was placed around the retinal vein where an underlying choroidal vessel was noted (compare with A, F). Seven weeks after treatment, the disc edema and macula improved (compare with A). In some areas, the venous tortuosity had also improved. A chorioretinal anastomosis was noted ophthalmoscopically at both treatment sites (arrows). Superonasally, the central venous segment had a relatively larger diameter than the peripheral venous segment; both dipped down toward the choroid. Minimal fibrosis was present at the treatment site. Inferonasally, the central venous segment was of the same diameter as the peripheral venous segment; both dipped down toward the choroid. G, Fluorescein angiography disclosed earlier venous filling within the central venous segment (straight arrow) compared with the peripheral venous segment (curved arrows) at both treatment sites. H, Seven months after treatment, further resolution of the venous tortuosity and disc hyperemia had occurred (compare with A). The morphological configuration of the inferonasal anastomosis had changed during follow-up (large arrow) (compare with F). The nearby choroidal vessel, noted before treatment (see A), had an enlarged diameter, suggesting increased flow within it. I, Fluorescein angiography of the inferonasal anastomosis demonstrated both the central and peripheral (straight arrows) venous segments joining into a common venous trunk that dipped down toward the choroid through a venous loop (curved arrow). The more prominent filling within the venous loop, compared with each venous trunk, may be attributed to the larger volume of blood filling the loop, supplied from 2 trunks. Patchy choroidal filling, which was present in this area before treatment (compare with B), was again noted. J, Although parafoveal fluorescein leakage remained in the late-phase frames (arrow), the macula was less cystic and thickened.

Seven months after treatment, visual acuity was 20/25 OD. Further resolution of the cystoid macular edema and venous tortuosity had occurred (Figure 5, H). The morphological configuration of the inferonasal anastomosis had changed (Figure 5, H and I). Fluorescein angiography demonstrated both the central and peripheral venous segments joining into a common venous trunk that dipped down toward the choroid through a venous loop (Figure 5, I). Although parafoveal fluorescein leakage remained in the late-phase frames, the macula was less cystic and thickened (Figure 5, J). No complications occurred.

CASE 2

A 56-year-old white man with systemic hypertension came to The Wilmer Retinal Vascular Center in November 1994 with an 11-month history of a nonischemic CVO in the right eye. Corrected visual acuity was 20/60 OD and 20/20 OS. Results of pupillary, intraocular pressure, and slit lamp examinations were normal. No neovascularization of the iris or angle was present. Ophthalmoscopy of the right eye disclosed disc congestion, marked macular edema with central cyst formation, mild venous tortuosity and engorgement, and rare intraretinal hemorrhage. Fluorescein angiography confirmed the nonischemic nature of the CVO and demonstrated parafoveal dye leakage in the late-phase frames. Ophthalmoscopy of the left eye was normal. Grid laser photocoagulation was applied to the superior sector of the cystoid macular edema in the right eye, by means of argon green, 50 µm, 0.1-second duration, and 100 mW of power, without complication.

Four months later, the visual acuity had decreased to 20/100 OD. Ophthalmoscopy was essentially unchanged (Figure 6, A). Fluorescein angiography disclosed a nonischemic CVO with marked dye leakage accumulating parafoveally in a cystic pattern in the late-phase frames (Figure 6, B). In an attempt to create a chorioretinal anastomosis, 700 mW of dye yellow laser with a 50-µm spot size and 0.1-second duration was used to puncture first Bruch's membrane and then the adjacent retinal vein in 8 locations for a total of 16 bursts, 2 at each treatment site. One of the chosen treatment sites was where the superonasal vein appeared to dip down into the neurosensory retina (Figure 6, A).

Two months after treatment, the visual acuity had improved to 20/50 OD with marked subjective improvement. The disc congestion, venous tortuosity, and cystoid macular edema had improved. A chorioretinal anastomosis was present superonasally (Figure 6, C) and was suggested by the ophthalmoscopic appearance of the central and peripheral segments of the treated retinal vein dipping down into the choroid. The central segment had a relatively wider diameter than the peripheral segment. An anastomosis did not develop at any of the 7 other treatment sites. Fluorescein angiography demonstrated laminar venous flow in the central, wider vein compared with relatively less laminar flow in the peripheral, narrower vein (Figure 6, D). Trilaminar venous flow was not observed. Although parafoveal fluorescein accumulation was present in the late phase of the angiogram, the macula was less cystic and thickened (Figure 6, E). Indocyanine green angiography (Figure 6, F) suggested drainage from the anastomosis into a choroidal vessel, presumably a choroidal vein; however, given the other prominent choroidal vessels in the vicinity, the finding was only suggestive.

Nineteen months after treatment, the visual acuity was 20/25 OD. The ophthalmoscopic and angiographic appearance of the superonasal anastomosis remained unchanged. No complications occurred.

Instead of managing the consequences of the vein occlusion such as macular edema and neovascularization by grid or scatter-type photocoagulation,1-4 treatment modalities have recently been aimed at restoring venous flow by bypassing the occlusion altogether.5 The concept of creating a chorioretinal anastomosis between a retinal vein and the choroid was initially introduced almost 50 years ago by Verhoeff8 when he described such an anastomosis that developed after diathermy. During the following 40 years, the idea resurfaced within the literature several times5-12 and was most recently popularized as a potential therapeutic modality for eyes with a nonischemic CVO by bypassing the occluded vein, thereby relieving the obstruction. The rationale for attempting to reestablish venous outflow after creating a chorioretinal anastomosis has been to alter the natural course6-7 by improving visual acuity, as associated macular edema de-
creases, and by decreasing the conversion rate of the vein occlusion to an ischemic status.

Performing a retinal vein bypass in eyes with an ischemic vein occlusion has not been widely attempted, because reestablishing venous outflow in these eyes would not likely lead to either reperfusion of the areas of retinal capillary dropout or improved visual acuity. However, if the parafoveal and perifoveal areas remain nonischemic in an eye with an otherwise largely ischemic CVO, there may be some visual benefit from improved venous outflow and lessened macular edema. Reperfusion of the remaining retinal capillaries may also lessen the risk of developing rubeosis. Since ischemic eyes might be more likely to develop the fibrovascular complications from attempting to create a laser-induced chorioretinal anastomosis (I. L. McAllister, FRACO, oral communication, 1997), such as choroidovitreal neovascularization, further

Figure 6. A, Four months after initial examination, ophthalmoscopy demonstrated no change in the disc congestion and mild venous tortuosity. Despite the superior grid treatment, the cystic macular edema remained with a large, central cyst (large arrow). Note the short segment of the superonasal retinal vein that appears to disappear into the retina and then immediately reappear (small arrow) (compare with Q). B, Fluorescein angiography demonstrated cystic parafoveal fluorescein accumulation in the late-phase frames. C, About 2 months after treatment, a chorioretinal anastomosis had formed superonasally (arrow) (compare with A). D, Fluorescein angiography demonstrated laminar venous flow in the larger-diameter central vein (straight arrow) compared with less laminar flow in the narrower peripheral vein (curved arrow) in this angiographic frame. E, Two months after treatment, parafoveal fluorescein dye leakage remained, but it was less cystic and thickened. Although the disc remained hyperfluorescent, the associated dye leakage had lessened. F, Indocyanine green angiography suggested drainage from the anastomosis into a choroidal vessel (arrows), presumably a choroidal vein.
investment is needed before this treatment approach is recommended for ischemic eyes.

Laser parameters and treatment techniques for reproducible anastomosis formation in eyes with nonischemic vein occlusion have not yet been determined. It is not clear from our study why an anastomosis developed in only 9 (38%) of 24 eyes with CVO and only 3 (50%) of 6 eyes with BVO. Ophthalmoscopic determination of whether the retinal vessel or Bruch’s membrane was definitely punctured by the laser application may be impossible. Perhaps 1 wavelength, such as argon blue-green, argon green, dye yellow, or Nd:YAG, is superior to the others, or perhaps using 1 in combination with another may prove to be preferable.

The necessary power to successfully produce an anastomosis is also unknown. Of the 12 eyes that developed an anastomosis, 10 (83%) had been treated with the relatively high power of 3.0 W with the use of the argon blue-green wavelength at the session that led to anastomosis formation. Of the remaining 2 eyes, 1 was treated with 700 mW of dye yellow and the other with 1.0 W of argon green.

Factors other than power and wavelength may possibly determine whether or not an anastomosis will form, such as whether an underlying choroidal vein is near to the treated area (Figure 5, A and E), whether a segment of the pretreatment retinal vein dips into the neurosensory retina at the treatment site (Figure 6, A and C), the age of the patient, the presence of collateral vessels on the optic nerve head, media clarity to facilitate treatment, and the degree of intravascular pressure elevation in the obstructed vein, among others. However, if creation of an anastomosis is attempted earlier in the course of the occlusive process, perhaps when the intravascular pressure is most elevated, the outcome may be clouded by the natural course; a control population would be necessary.

It may be that some eyes respond to the injury of laser photocoagulation with anastomosis formation, whereas others react with a fibrovascular response involving much smaller vessels.16,17 It has also not yet been determined whether puncture of both the retinal vein and Bruch’s membrane is necessary for anastomosis formation; it may be that puncture of only 1 of these structures, such as Bruch’s membrane, is sufficient. However, puncture of Bruch’s membrane first, followed immediately by puncture of the adjacent vein, or puncture of both the retinal vein and subjacent Bruch’s membrane with 1 spot, may be preferable. Further investigation is necessary.

The ophthalmoscopic and angiographic criteria necessary to determine the presence of a chorioretinal anastomosis have not been well described. “Trilaminar venous flow” has been suggestive of anastomosis formation; however, this was not observed in our patients. Unfortunately, analyses of the fluorescein angiograms in our 30 patients did not help to determine whether blood was preferentially flowing into the anastomosis. In our study, the primary criterion used to determine whether a chorioretinal anastomosis had formed during follow-up was the ophthalmoscopic appearance of the central and/or peripheral segment of the treated retinal vein dipping down into the choroid at a treatment site.

In our series of 30 eyes, an anastomosis formed in 12 eyes (40%): 9 (38%) of 24 with nonischemic CVO and 3 (50%) of 6 with nonischemic BVO. Even when an anastomosis was produced from the laser application, however, it led to marked visual improvement (≥6 lines) only in 2 eyes (8%) with nonischemic CVO. In these 2 eyes, it is unlikely that the visual improvement reflected the natural course of the CVO since, in both cases, decreased vision had been present for about 1 year, with prompt (within 8 weeks) and marked visual benefit and obvious decompression of the venous tree after creation of the laser-induced anastomosis. The fact that only 2 eyes with an anastomosis had marked visual improvement, compared with 10 eyes with an anastomosis that did not have marked visual improvement, may result from a variety of factors that may include pretreatment visual acuity, pretreatment presence of foveal pigment or degeneration, the presence or absence of previous extensive grid laser photocoagulation, ophthalmoscopic type of chorioretinal anastomosis that formed (see the “Results” section; Figures 2, 3, and 5, F), and other presently unrecognized factors.

Among the 12 eyes that developed an anastomosis, a relative difference in venous caliber between the central and peripheral venous segments at the anastomotic site was observed. Whether this observation is related to the amount of blood flow within the venous segment and, consequently, the effectiveness of the anastomosis is not known. Nevertheless, we categorized the ophthalmoscopic appearance of the chorioretinal anastomosis into 3 groups, based on the diameters of the central and peripheral venous segments emanating from the anastomotic site; there may be no consistent relationship between venous caliber and functional success of an anastomosis. The implications of these observations require further investigation.

Although there were no permanent, vision-limiting complications in our series of 30 eyes, we remain concerned about the development of such complications after this procedure, and we are therefore presently willing to treat only those eyes whose visual acuity is 20/100 or worse and who have been followed up for at least 4 months with decreased or decreasing visual acuity. Potential treatment complications include longstanding, vision-limiting hemorrhage, periretinal fibrosis with or without associated traction and/or rhegmatogenous retinal detachment, choroidal neovascularization, segmental retinal ischemia, and choroidovitreal neovascularization.18

Laser perforation of a retinal vein and underlying or adjacent Bruch membrane may successfully create a chorioretinal anastomosis in some eyes and may offer improved visual status and perhaps a decreased risk of progression to an ischemic status in eyes with a nonischemic CVO or BVO. The precise treatment variables and technique to reliably create an anastomosis, while minimizing potential complications, continue to evolve.
REFERENCES


Notes From Our Ophthalmic Heritage

Arinaventura Cavaliert (1598-1647), the distinguished professor mathematics at Bologna, was the first to furnish a formula solving the problem, how to find the focal distance for parallel rays of light for any convex or concave lens. This formula, which appeared in Cavaliert’s “Exercit Geomet” (Bonacci. 1647) was this:

\[
F = \frac{2r_1 r_2}{r_1 + r_2}
\]

Here, \(r_1\) is the radius of the spherical surface which is toward the parallel rays; \(r_2\) the radius of the remaining surface. The ratio of refraction is assumed to be (from air to glass) 3:2.