SUBRETINAL SURGERY FOR PERIPAPILLARY SUBRETINAL NEOVASCULAR MEMBRANES

GREGG T. KOKAME, MD, SEIJO YAMAOKA, MD

Purpose: To report the results of surgical removal of extrafoveal peripapillary subretinal neovascular membranes (PSRNVMs) for elderly patients in whom visual acuity was threatened or affected by subretinal fluid, subretinal hemorrhage, subretinal exudate, or PSRNVM growth toward the fovea.

Methods: Retrospective review of six eyes of six patients undergoing subretinal surgical removal of PSRNVMs via pars plana vitrectomy.

Results: PSRNVMs were successfully removed in six eyes of six patients with initial preservation of foveal function. The preoperative Snellen visual acuity ranged from 20/40 to counting fingers, and the best postoperative visual acuity ranged from 20/25 to 20/40. The final visual acuity with a mean follow-up of 3 years (range, 6–63 months) was stable or improved in 83% (5 eyes) of cases, ranging from 20/25 to 20/80. Early recurrence of PSRNVM was noted only in 1 eye (17%) at 1 month after surgery and was successfully treated with laser photocoagulation. Late recurrence of choroidal neovascularization developed after 3 years in two eyes. Cataract developed in three of four phakic eyes.

Conclusion: PSRNVMs sparing the central fovea in elderly patients can be successfully removed surgically with initial preservation of foveal function and with a low rate of early recurrence.

RETINA 25:564–569, 2005

Peripapillary subretinal neovascular membranes (PSRNVMs) are a well-recognized, but relatively uncommon, cause of subretinal neovascularization.[1–3] Symptomatic PSRNVMs are often larger than neovascular complexes arising near the fovea and may lead to severe visual loss.[2–5] In a series of PSRNVMs in older patients by Kies and Bird,[3] vision did not spontaneously improve or recover in any patient once it was affected by subretinal fluid, subretinal hemorrhage, or extension of PSRNVM into the fovea. Of patients with PSRNVMs who initially presented with 20/40 or better vision, two thirds lost vision after 1 year.[2,3] In a study by Silvestri et al,[4] older patients with PSRNVMs were noted to have a uniformly poor prognosis and a high incidence of bilateral disease. They reported that 75% of untreated eyes in patients with PSRNVMs who were older than 70 years of age lost vision to a level of ≤3/60 in both eyes.

Macular laser is one treatment option for PSRNVMs. Bhatt et al[6] successfully treated a PSRNVM involving 180° of the temporal peripapillary retina with the krypton red laser without any change in vision or central field. However, other investigators reported a risk of papillomacular bundle damage and loss of central vision.[7–9] Macular Photocoagulation Study (MPS) Group[10,11] criteria for laser photocoagulation of PSRNVMs required that complete treatment spare at least 1.5 consecutive clock hours of temporal

From the Division of Ophthalmology, Department of Surgery, University of Hawaii School of Medicine, Honolulu, Hawaii; and The Retina Center at Pali Momi, an Affiliation of Hawaii Pacific Health, Aiea, Hawaii.

The authors do not have a proprietary interest in this study.

Reprint requests: Gregg T. Kokame, MD, The Retina Center at Pali Momi, 98–1079 Moanalua Road, Suite 470, Aiea, HI 96701.

peripapillary retina. However, laser treatment of PSRNVMs is also limited by the high recurrence rate[3,5] and the difficulty in assessing the true extent of the lesion by fluorescein angiography.[2,3]

Photodynamic therapy is another treatment option for subretinal neovascularization,[12,13] although most PSRNVMs (93%) are occult and poorly defined. In addition, in 73% of cases reported by Kies and Bird,[3] symptoms were attributed to subretinal fluid, hemorrhage, or exudate without extension of the PSRNVM into the fovea. Photodynamic therapy is currently used for subfoveal choroidal neovascular membranes including predominantly classic choroidal neovascularization (CNV) and small occult CNV lesions with recent loss of vision, CNV growth, or hemorrhage.[12,13] Treatment of extrafoveal CNV lesions is currently not covered by many insurance carriers. Other experimental techniques, such as transpupillary thermotherapy and pharmacologic agents, are also being assessed for their applicability with some encouraging results.[14–16]

Because of the poor visual prognosis of large PSRNVMs in elderly patients and the high recurrence rate with laser photocoagulation, subretinal surgery as described by Thomas et al[17] was utilized to remove PSRNVMs. This study reports the visual outcomes and surgical results after subretinal surgical removal of extrafoveal PSRNVMs in elderly patients with vision-threatening complications. In considering this procedure, we included patients who were losing vision or at risk for vision loss due to exudation, hemorrhage, or serous detachment adjacent to or into the fovea. However, the subretinal neovascular complex itself did not involve the fovea. This approach potentially limits damage to the papillomacular bundle and the foveal retinal pigment epithelium, while possibly allowing less recurrence due to more complete removal of the subretinal neovascular membrane with surgical excision.

Methods

This retrospective study included six eyes of six elderly patients (50 years of age or older) who underwent surgical removal of extrafoveal PSRNVMs via pars plana vitrectomy between May 1996 and June 2004 at The Retina Center at Pali Momi, an affiliation of Hawaii Pacific Health (Aiea, Hawaii). Indications for surgery were extrafoveal PSRNVMs with subretinal blood, subretinal fluid, or subretinal exudates encroaching toward or into the fovea. The Institutional Review Board of Hawaii Pacific Health approved the study.

The primary visual outcomes considered were preoperative and postoperative best-corrected Snellen visual acuities. Other factors evaluated for potential relationships to outcomes included patient age and sex; location of CNV by MPS criteria; type of CNV by MPS criteria; presence of subfoveal hemorrhage, fluid, or hard exudates; postoperative complications; and postoperative clinical and fluorescein angiographic status of lesions at follow-up visits (Fig. 1). Postoperative data and best-corrected Snellen visual acuity were evaluated with at least $\geq$6 months of follow-up.

All surgeries were performed by a single surgeon (G.T.K.), using a three-port pars plana vitrectomy technique as previously described by Thomas et al.[17] Initially, core vitrectomy was performed. A retinotomy was made to allow access to the PSRNVM using a subretinal infusion cannula or a subretinal pick. The subretinal membrane was gently elevated and then grasped using the Thomas subretinal forceps. The entire PSRNVM complex was gently peeled and removed completely through the retinotomy site with the intraocular pressure elevated to 120 mmHg to control bleeding. The infusion pressure was then gradually reduced slowly while watching for any subretinal bleeding. Finally, the eye was carefully examined 360° to evaluate for any peripheral retinal tears before air–fluid exchange. The patient was positioned face-down for 1 day to 2 days.

Results

The results of this study are summarized in Table 1. The mean age of the patients at the time of surgery was 72.7 years (range, 50–82 years). There were six patients (one man and five women). The mean duration of postoperative follow-up was 36 months (range, 6–63 months). Location of PSRNVMs was extrafoveal by MPS criteria in all cases, and none of the eyes had extension of the PSRNVM to closer than 800 μm from central fixation. The lesion types were found to be occult by MPS criteria in three eyes and minimally classic in two eyes. The lesion type in one eye was indeterminate, because there was a dense submacular hemorrhage. All patients had associated drusen, and none of the patients had presumed ocular histoplasmosis syndrome (POHS), angioid streaks, or serpiginous choroiditis.

Indications for surgery included serous detachment extending through the central fovea (three eyes), subretinal hemorrhage or exudate encroaching close to central fixation (two), and dense submacular hemorrhage thickly elevating the central fovea (one). The preoperative Snellen visual acuity ranged from 20/40 to counting fingers. The 6-month postoperative visual acuity ranged from 20/25 to 20/80. The postoperative

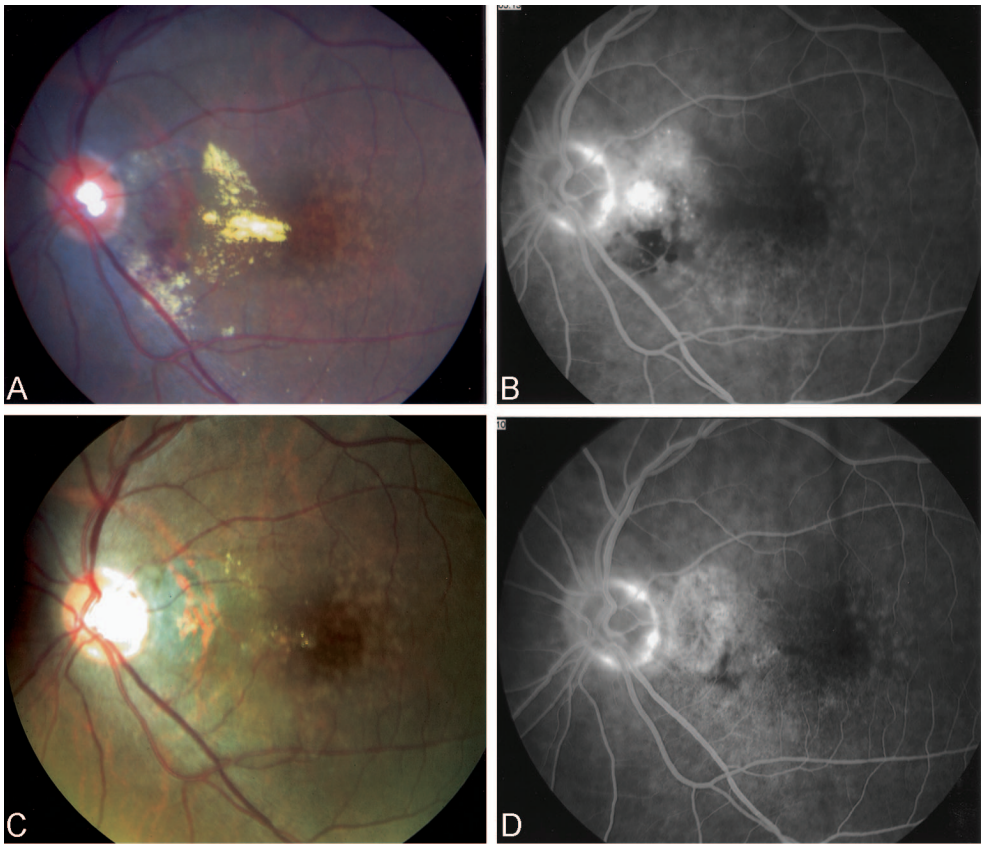

Fig. 1. Preoperative and postoperative photographs (Case 2). **A**, Preoperative photograph showing a peripapillary subretinal neovascular membrane involving the 1:30- to 5:00-o'clock margins of the optic nerve. Note the encroaching foveal exudates. **B**, Preoperative fluorescein angiogram (late phase) showing a peripapillary subretinal neovascular membrane sparing the fovea. Note the poorly defined borders and irregular hyperfluorescence. **C**, Photograph 9 months after surgery showing a localized peripapillary scar. Note the marked decrease in subretinal exudates. **D**, Postoperative fluorescein angiogram (late phase) showing an atrophic scar with no evidence of residual leakage or recurrent subretinal neovascularization.

best visual acuity ranged from 20/25 to 20/40 (at a mean of 7.3 months; range, 3–20 months). The final visual acuity ranged from 20/25 to 2/200. The final visual acuity improved ≥1 lines in 5 eyes (83%) and worsened 3 lines in 1 eye due to PSRNVM recurrence and geographic atrophy.

In all cases, no prior laser treatment or other treatments for the PSRNVM were performed before surgery. The subretinal membrane complex removed during surgery was often much larger than what was visible by fluorescein angiography. In most cases, subretinal surgery was performed without laser photocoagulation to the retinotomy site or long-acting intraocular gas. In one case (Case 5), an extramacular access retinotomy was utilized superior to the macula to remove a large PSRNVM. This extramacular retinotomy was treated with endolaser and sulfur hexafluoride gas. In Case 4, a retinotomy was made superotemporal to the fovea within the area of subretinal hemorrhage, and tissue plasminogen activator (25 μg/mL solution) was infused into the subretinal space through the retinotomy site. The tissue plasminogen activator was left in place for 30 minutes. After removal of the subretinal hemorrhage, the PSRNVM was visible; it was elevated in the subretinal space and attached to the disk margin. The PSRNVM was then gently peeled and removed from the subretinal space through the retinotomy site.

Preoperatively, there were two pseudophakic eyes and four phakic eyes. Postoperatively, three eyes (Cases 3, 4, and 6) developed a significant increase in cataract. Cataract extraction was performed on two eyes (Cases 4 and 6). Retinal detachment, retinal tear, epiretinal membrane, and cystoid macular edema were not noted. Early recurrence of CNV was noted in 1 eye (17%; Case 6) 1 month after surgery and was successfully treated with 1 laser photocoagulation for recurrent extrafoveal subretinal neovascularization. At 63 months of follow-up, there was no recurrence, and the final visual acuity was 20/25. Late recurrence of CNV ≥3 years after surgery was noted in 2 eyes: 1 at 44 months (Case 4) and 1 at 36 months (Case 5). One eye

Table 1. Summary of Patient Data

Patient No.	Sex	Age (yr)	Follow-up Duration (mo)	PSRNVM Location	PSRNVM Type	Indication(s) for Surgery	Preoperative Visual Acuity	6-mo Postoperative Visual Acuity	Postoperative Best Visual Acuity (mo)	Postoperative Final Visual Acuity	Complication(s)	Treatment(s)
1	F	76	6	Extrafoveal	Occult	Encroaching hemorrhage, exudate	20/50	20/25	20/25 (6)	20/25	—	—
2	F	77	9	Extrafoveal	Minimally classic	Encroaching exudate	20/40	20/30	20/30 (6)	20/30	—	—
3	F	80	20	Extrafoveal	Occult	Subfoveal serous detachment	20/100	20/40	20/40 (3)	20/50	Cataract	—
4	M	50	56	Extrafoveal	Indeterminate	Dense submacular hemorrhage	CF	20/80	20/30 (20)	20/80	Cataract, recurrent CNV (44 mo)	ECCE plus IOL PDT
5	F	82	62	Extrafoveal	Occult	Subfoveal serous detachment	20/100	20/40	20/40 (6)	2/200	Recurrent CNV (36 mo)	Argon laser
6	F	71	63	Extrafoveal	Minimally classic	Subfoveal serous detachment	20/400	20/50	20/25 (3)	20/25	Cataract, recurrent CNV (1 mo)	ECCE plus IOL argon laser

PSRNVM, peripapillary subretinal neovascular membrane; CF, counting fingers; CNV, choroidal neovascularization; ECCE, extracapsular cataract extraction; IOL, intraocular lens; PDT, photodynamic therapy.

(Case 4) underwent 3 subsequent photodynamic therapies for a subfoveal CNV recurrence that was not contiguous to the PSRNVM, and the final visual acuity at 56 months was 20/80. One eye (Case 5) underwent 3 thermal laser photocoagulations for recurrent extrafoveal subretinal neovascularization, but the final visual acuity decreased to 2/200 due to CNV recurrence and progressive geographic atrophy.

Discussion

Although numerous studies have evaluated outcomes and visual results of subfoveal subretinal neovascular membrane removal,[17,18] specific surgical series of resection of PSRNVMs are limited, especially involving elderly patients. Atebara et al[19] reported a retrospective review of 17 eyes that underwent resection of extensive peripapillary subretinal membranes associated with POHS in younger patients (mean age, 36 years). Fifty percent of eyes with subfoveal lesions had best-corrected visual acuity of 20/40 or better, and all 3 eyes with extrafoveal lesions had 20/20 vision. They suggested that surgical removal might provide visual benefit in selected cases of extensive peripapillary CNV due to POHS. Kertes[20] also reported favorable results for surgical excision of three massive extrafoveal and juxtafoveal PSRNVMs associated with POHS. Visual acuity improved in each patient from counting fingers, 20/400, and 20/25 preoperatively to 20/50, 20/20, and 20/20, respectively, with a mean follow-up of 41 months (range, 11–59 months).

However, for elderly patients older than 55 years of age, Bains et al[21] reported that surgical removal of PSRNVMs does not often yield significant visual improvement or stabilization. In 17 consecutive eyes of 17 patients who underwent PSRNVM resection associated with idiopathic, age-related macular degeneration, POHS, and inflammatory conditions, only 35% (6 of 17 eyes) of patients had stable or improved vision. Of the 17 PSRNVMs, 6 were extrafoveal, similar to the cases in our series. In this extrafoveal subgroup, vision was stable or improved in only 33% (2 of 6 eyes) of patients. However, of these six eyes, three developed postoperative cataract, and one developed CNV recurrence requiring repeated surgery. One of these six eyes did have significant vision improvement from 20/300 to 20/40.

In contrast, in our series of patients 50 years of age or older who had extrafoveal PSRNVMs removed in association with drusen, there was an 83% chance (5 of 6 eyes) of improvement in vision, supporting the hypothesis that foveal function can be preserved if the subretinal neovascular membrane is removed before it involves the fovea. Even in the one eye with vision

loss, there was initial improvement in vision before late CNV recurrence and geographic atrophy developed years later. All eyes in our series initially recovered 20/40 or better vision after subretinal surgical removal of the extrafoveal PSRNVM. In addition, subretinal hemorrhage, subretinal fluid, and subretinal exudates resolved after PSRNVM surgical removal.

Preoperative vision in our series was decreased or threatened by subretinal fluid, exudates, or hemorrhage extending toward or into the fovea, although the PSRNVM complex did not extend into the fovea. Kies and Bird[3] noted that vision loss associated with PSRNVM occurs without identifiable extension of the neovascular complex into the fovea in 73% of cases. In our cases, all of the PSRNVM complexes detected by fluorescein angiography were at least 800 μm from the center of the fovea, which may explain in part the better visual prognosis in our cases compared with the findings of Bains et al.[21]

The extrafoveal location of these PSRNVM lesions allows a better chance of preserving the foveal retinal pigment epithelium in older patients after subretinal surgery, because older patients usually have type I subretinal neovascularization in the classification system described by Gass.[22] Type I subretinal neovascularization tends to grow underneath the retinal pigment epithelium with multiple ingrowth sites. Subretinal surgical removal of type I subretinal neovascularization removes the retinal pigment epithelium with the PSRNVM. An atrophic retinal pigment epithelial scar was visible at the site of the PSRNVM removal in all of our cases, but the fovea was not involved in any of our cases. Surgical removal of subfoveal type I subretinal neovascularization is associated with a poor visual prognosis due to damage to the fovea by removal of the retinal pigment epithelium and secondary atrophy of the choriocapillaris.[17,18,21] Type II subretinal neovascularization extends through a focal defect in Bruch membrane and proliferates anterior to the retinal pigment epithelium. This type of CNV often occurs in POHS and younger patients. Theoretically, type II CNV can be extracted with preservation of the underlying retinal pigment epithelium and choriocapillaris. This may explain the favorable surgical results of PSRNVM removal associated with POHS in younger patients, even when the fovea is involved by the PSRNVM complex.[19,20]

With every treatment option for PSRNVM, there is a risk of recurrence. In our series, early recurrence was noted only in 1 eye (17%). Bains et al[21] also reported a similar risk of recurrence (24%) after surgical removal of extensive PSRNVMs in elderly patients. Although the current study is a small retrospective series, our early recurrence rate of 17% compares favorably with that of laser photocoagulation. Recurrence of PSRNVMs after initially successful photocoagulation occurred in 50% of cases reported by Kies and Bird.[3] The MPS Group[10] also reported that recurrence of subretinal neovascular membrane after extrafoveal laser treatment developed in 54% of age-related macular degeneration cases. Subretinal surgery may allow more complete removal of the subretinal neovascular membrane and decrease the risk of early recurrence. In our cases, the size of the removed subretinal complex at the time of surgery appeared larger than predicted by the fluorescein angiographic appearance. PSRNVMs tend to have occult patterns on angiograms with poorly defined borders, which make precise identification of the location of the PSRNVM difficult.[2,3] Kies and Bird[3] also reported that half of the recurrences arose from the area of laser treatment, while the other half occurred from a site outside the laser treatment at which no abnormality was present on the preoperative fluorescein angiogram. These findings may indicate that the original PSRNVMs were larger than seen on the preoperative angiogram.

In this small retrospective series, surgical removal of extrafoveal PSRNVMs resulted in a low risk of early recurrence and excellent initial vision with preservation of foveal function as well as the foveal retinal pigment epithelium. Surgical indications for PSRNVMs included serous detachment extending through the central fovea, subretinal hemorrhage or exudate encroaching close to or into the central fovea, and progressive growth of subretinal neovascularization toward the fovea. Subretinal surgery to remove extrafoveal PSRNVMs is a promising therapeutic option for elderly patients 50 years of age or older who have vision-threatening complications, and further studies are indicated. Other possible therapeutic options, such as transpupillary thermotherapy, photodynamic therapy, and antiangiogenic pharmacologic agents, are currently being assessed.[14–16]

Key words: subretinal surgery, peripapillary subretinal neovascular membranes, age-related macular degeneration, subretinal hemorrhage, subretinal fluid, subretinal exudates.

References

1. Jack RL. Peripapillary disciform degeneration of the retina, diagnosis and treatment. Ann Ophthalmol 1978;10:15–18, 21–24, 26–31.
2. Lopes PF, Green WR. Peripapillary subretinal neovascularization: a review. Retina 1992;12:147–171.
3. Kies JC, Bird AC. Juxtapapillary choroidal neovascularization in older patients. Am J Ophthalmol 1988;105:11–19.
4. Silvestri G, Archer DB, Johnston PB. Peripapillary subretinal

neovascular membranes: the natural history. Eye 1993;7: 398–402.
5. Flaxel CJ, Bird AC, Hamilton AM, Gregor ZJ. Partial laser ablation of massive peripapillary subretinal neovascularization. Ophthalmology 1996;103:1250–1259.
6. Bhatt NS, Al-Shirawi NM, Diamond JG. Krypton laser photocoagulation of peripapillary choroidal neovascular membrane. Ophthalmic Surg Lasers 1999;30:56–58.
7. Turcotte P, Maguire MG, Fine SL. Visual results after laser treatment for peripapillary choroidal neovascular membranes. Retina 1991;11:295–300.
8. Swartz M, Apple DJ, Creel D. Sudden severe visual loss associated with peripapillary burns during panretinal argon photocoagulation. Br J Ophthalmol 1983;67:517–519.
9. Bloom SM. Thermal papillitis after dye red photocoagulation of a peripapillary choroidal neovascular membrane. Retina 1990;10:261–264.
10. Macular Photocoagulation Study Group. Argon laser photocoagulation for neovascular maculopathy: five-year results from randomized clinical trials. Arch Ophthalmol 1991;109: 1109–1114.
11. Macular Photocoagulation Study Group. Argon laser photocoagulation for ocular histoplasmosis: results of a randomized clinical trial. Arch Ophthalmol 1983;101:1347–1357.
12. Treatment of Age-Related Macular Degeneration with Photodynamic Therapy and Verteporfin in Photodynamic Therapy Study Groups. Effect of lesion size, visual acuity, and lesion composition on visual acuity change with and without verteporfin therapy for choroidal neovascularization secondary to age-related macular degeneration: TAP and VIP report no. 1. Am J Ophthalmol 2003;136:407–418.
13. Verteporfin in Photodynamic Therapy Study Group. Verteporfin therapy of subfoveal choroidal neovascularization in age-related macular degeneration: two-year results of a randomized clinical trial including lesions with occult with no classic choroidal neovascularization—Verteporfin in Photodynamic Therapy report 2. Am J Ophthalmol 2001;131:541–560.
14. Chula TA, Danes RP, Harris A. Age-related macular degeneration: a review of experimental treatments. Surv Ophthalmol 1998;43:134–146.
15. Reichel E, Berrocal AM, Ip M, et al. Transpupillary thermotherapy of occult subfoveal choroidal neovascularization in patients with age-related macular degeneration. Ophthalmology 1999;106:1908–1914.
16. Eyetech Study Group. Anti-vascular endothelial growth factor therapy for subfoveal choroidal neovascularization secondary to age-related macular degeneration: phase II study results. Ophthalmology 2003;110:879–881.
17. Thomas MA, Dickinson JD, Melberg NS, et al. Visual results after surgical removal of subfoveal choroidal neovascular membranes. Ophthalmology 1994;101:1384–1396.
18. Submacular Surgery Trials Pilot Study Investigators. Submacular Surgery Trials randomized pilot trial of laser photocoagulation versus surgery for recurrent choroidal neovascularization secondary to age-related macular degeneration: I. Ophthalmic outcomes. Submacular Surgery Trials pilot study report number 1. Am J Ophthalmol 2000;130:387–407.
19. Atebara NH, Thomas MA, Holekamp NM, et al. Surgical removal of extensive peripapillary choroidal neovascularization associated with presumed ocular histoplasmosis syndrome. Ophthalmology 1998;105:1598–1605.
20. Kertes PJ. Massive peripapillary subretinal neovascularization. An indication for submacular surgery. Retina 2004;24: 219–225.
21. Bains HS, Patel MR, Singh H, Marcus DM. Surgical treatment of extensive peripapillary choroidal neovascularization in elderly patients. Retina 2003;23:469–474.
22. Gass JD. Biomicroscopic and histopathologic considerations regarding the feasibility of surgical excision of subfoveal neovascular membranes. Am J Ophthalmol 1994;118:285–298.