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Studies on Vitrectomy Cases Associated with Complicated Branch Retinal Vein Occlusion

Minoru Tanaka, Hisako Ninomiya, Yasuhiko Kobayashi and Hui Qiu

Department of Ophthalmology, Juntendo University Urayasu Hospital, Chiba, Japan

Purpose: To study the preoperative factors leading to vitrectomy, and to demonstrate the postoperative conditions causing the decreased visual acuity that results from branch retinal vein occlusion (BRVO).

Methods: In 113 patients (114 eyes) with BRVO, the following data were analyzed: age, general complications, distribution of occluding vessels, location of retinal breaks, classification of vitreoretinal pathology, and the number of cases, period from onset of BRVO to vitreous hemorrhage and from vitreous hemorrhage to vitrectomy, number of operations, relationship between posterior vitreous detachment (PVD) and number of operations, preoperative photocoagulations, pre- and postoperative visual acuity, and cases with poor visual outcome.

Results: The visual prognosis was much better in cases with vitreous hemorrhage only than in those with proliferative membrane and retinal detachment ($P = .0023$). Repeated surgeries were needed in the cases where there was only partial PVD ($P = .0029$). Macular disorders and optic nerve atrophy were the main causes of postoperative visual acuity < 0.1.

Conclusions: Early vitrectomy before development of vitreo retinal proliferation and retinal detachment, especially in cases where there is only partial PVD, seems to be essential for case management and treatment to attain better visual acuity for the patient. **Jpn J Ophthalmol 2001;45:397–402**

Key Words: Posterior vitreous detachment, retinal vein occlusion, vitrectomy, vitreous hemorrhage.

Introduction

Branch retinal vein occlusion (BRVO) is a disorder encountered relatively frequently in clinical practice,[1] and its natural course,[2,3] complications, and the results of multi-institutional surveys have been reported.[4–9] The therapeutic procedures, including timely photocoagulation, seem to be established. However, we sometimes encounter complicated cases that need vitreous surgery because of vitreous hemorrhage and retinal detachment due to inadequate therapy during the follow-up period in outpatient practice.

There are also reports of vitreous surgery for various complications of this disorder[10,11] in which important factors in the management of BRVO are inadequately reported.

The purpose of this article is to investigate the preoperative causative factors leading to vitrectomy, and to demonstrate the postoperative status affecting the decreased visual acuity caused by BRVO.

Materials and Methods

Of the 1,715 eyes that underwent vitreous surgery at the Department of Ophthalmology, Juntendo University Urayasu Hospital, between September 1984 and December 1997, the records of 113 patients (114 eyes or 7%) with BRVO were studied. The follow-up period ranged from 3 to 138 months. The patients, who consisted of 48 men and 65 women, ranged in age from 33 to 84 years (mean = 63 ± 9 years). Of these patients, those in whom fundus examination was impossible because of vitreous hemorrhage, and so diagnosis of BRVO could not be es-

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Correspondence and reprint requests to: Minoru TANAKA, MD, Department of Ophthalmology, Juntendo University Urayasu Hospital, 2-1-1 Tomioka, Urayasu-shi, Chiba-ken 279-0021, Japan

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tablished, the diagnosis of BRVO was made based on intraoperative findings. In patients with vitreous hemorrhage whose past histories were unclear, the possibility of rhegmatogenous vitreous hemorrhage and the presence or absence of diabetes mellitus were investigated by interviewing such patients to establish a preoperative diagnosis. However, there were many patients who underwent vitreous surgery without clarification of the above issues.

Eyes were evaluated with regard to presence or absence of generalized complications, distribution of occluded vessels, position of the retinal hole, classification of retinal and vitreous findings, the number of patients in each category of data, period from the onset of occlusion to vitreous hemorrhage, period from vitreous hemorrhage to surgery, number of operations, relationship between the presence or absence of posterior vitreous detachment (PVD) and the number of operations, use or nonuse of preoperative laser treatment, age and the number of operations, procedure of the first operation, cases of reoperation, distribution of postoperative visual acuity, patients with postoperative visual acuity of 0.1 or worse, and improvements in visual acuity. The Fisher test was employed for statistical analysis. Eyes were classified into four groups according to vitreous opacity and retinal findings. Namely, group 1 are the cases showing only vitreous opacity and hemorrhage; group 2, the cases showing proliferative membrane and vitreous opacity; group 3, the cases showing retinal detachment in addition to the group 1 findings; and group 4 are the cases with retinal detachment without vitreous opacity.

Results

Of the 113 patients, 75 (66%) had hypertension alone, 3 (3%) had diabetes mellitus alone, 4 (4%) had cerebral infarction, 8 (7%) had other diseases, and 5 (4%) had both hypertension and diabetes mellitus; 83 patients (74%) had hypertension and/or diabetes mellitus as a general condition.

When the distribution of occluded veins was evaluated in the 114 eyes, BRVO was observed on the upper temporal side in 78 eyes (68%), on the lower temporal side in 29 eyes (25%), on the upper and lower temporal side in 4 eyes (4%), and on the nasal side in 3 eyes (3%).

Of the 14 eyes in which the retinal holes could be confirmed during vitreous surgery, the retinal hole was near the proliferative membrane in 12 eyes, and near sheathed veins in the remaining 2 eyes. The presence of membranes was not observed near such veins. Moreover, newly formed vessels adjacent to the retinal hole were not observed.

Group 1 consisted of 79 eyes (69%), group 2 of 21 eyes (18%), group 3 of 11 eyes (10%), and group 4 of 3 eyes (3%). Retinal detachment was present in 14 eyes (group 3 + group 4, 12%).

Patient history was clearly known for 66 eyes. The period from the onset of BRVO to vitreous hemorrhage ranged from 2 months to 17 years (mean = 5 ± 4 years) in group 1; from 3 months to 20 years (mean = 4 ± 5 years) in group 2; from 6 months to 11 years in group 3; and was 10 years or more in group 4. In summary, the period from the onset of BRVO to vitreous hemorrhage ranged widely from 2 months to 20 years (mean = 5 ± 4 years) among the 66 eyes, but it was longer in patients who had developed retinal detachment or proliferative membrane. When the severity of vitreous hemorrhage was evaluated based on the degree of fundus visibility, it varied from initially mild to severe hemorrhage. Furthermore, rebleeding occurred in some patients before the initial hemorrhage was absorbed.

The period from vitreous hemorrhage to surgery increased as the condition advanced in groups 1, 2, and 3. The mean number of operations was also greater as the condition advanced. Group 4, which consisted of only 3 eyes, must be compared with groups 1–3 carefully; although the period until surgery was short, the disease resisted treatment, and the number of operations was 2.00 ± 1.00. In all groups combined, the mean period from vitreous hemorrhage to surgery was as long as 7.84 ± 14.52 months.

Of the 100 eyes that underwent ultrasound examination before operation, successful treatment was achieved by one operation in 58 (96%) of the 60 eyes in which PVD had been established. However, a lower rate of success was achieved by one operation in 30 (75%) of the 40 eyes in which there was only partial PVD. Three operations were performed in 1 eye (2%) with established PVD and in 5 eyes (13%) with partial PVD. Repeated operations were required in 10 (25%) of the 40 eyes with partial PVD. Therefore, a larger number of operations were required in eyes with partial PVD. Repeated operations were required in 2 (3%) of the 60 eyes with established PVD. The Fisher test demonstrated that there were significant differences between the two groups ($P = .0029$). When the relationship between the presence or absence of PVD and other clinical findings was evaluated, the mean age of patients with established PVD was 65 years, while that of patients with partial PVD was 63 years, and there was

no significant difference between the two groups. Moreover, when the period from the onset of occlusion to vitreous hemorrhage was evaluated in the 66 eyes with known past histories, the mean period was 5 ± 4 years in eyes with established PVD, while it was the same in eyes with partial PVD. When the use or nonuse of preoperative photocoagulation was evaluated, photocoagulation was performed in 18 eyes with established PVD, while photocoagulation was performed in 17 eyes with partial PVD. Ultrasound examination was performed preoperatively in all 12 eyes that underwent reoperation. Of the 6 eyes with vitreous hemorrhage that required reoperation, PVD had been established in 3 eyes, while PVD was partial in 3 eyes. Therefore, there was no significant difference between the two groups. Moreover, of the 6 eyes with retinal detachment, because PVD had been established in 3 eyes, and PVD was partial in 3 eyes, there was no significant difference between the two groups. Finally, the retinas could be attached in all cases.

Retinal photocoagulation as treatment for BRVO was performed before vitreous surgery in only 35 eyes (31%) and not performed in 79 eyes (69%). Of these 79 eyes, additional photocoagulation was performed in 76 eyes intraoperatively or postoperatively.

When age and the number of operations were compared, the patients who required three operations were about 10 years younger than those who required only one or two operations.

Vitrectomy included maximum possible removal of the vitreous gel, removal of the proliferative membrane if necessary, and coagulation of newly formed vessels budding in the vitreous body. Simple vitrectomy was performed in 38 eyes (33%), intraocular laser therapy was additionally performed in 60 eyes (53%) during surgery, and sulfur hexafluoride (SF_6) insufflation was also performed in the eyes complicated by retinal detachment. SF_6 gas tamponade or fluid–gas exchange was necessary in the initial operation in 16 eyes (14%). Cataract operation was performed simultaneously in 5 eyes to improve the intraoperative visibility.

Removal of vitreous opacity and retinal reattachment could be achieved by the first operation in many eyes. Of the 114 eyes, however, reoperation was needed in 6 eyes (5%) with rebleeding in the vitreous cavity and 6 eyes (5%) with retinal detachment. Rebleeding in the vitreous cavity was reduced in patients who received additional coagulation at the end of vitreous surgery compared with those treated before intraocular laser surgery was introduced in our clinic and who did not receive additional coagulation. Many patients who had recurrence of retinal detachment showed rapid progression of the retinal detachment. Furthermore, some of these patients needed repeated operations or silicone oil tamponade. The retina was finally attached in all patients.

The final visual acuity during the follow-up period was regarded as the postoperative visual acuity. The number of patients with visual acuity worse than 0.1 increased with the exacerbation of their condition from group 1 to group 4. Patients with visual acuity of 0.7 or better were more frequent in group 1, followed by groups 2 and 3 in descending order. When patients with postoperative corrected visual acuity of 0.1 or worse were compared with those with visual acuity after correction of 0.7 or better, the Fisher test demonstrated a significant difference between the two groups ($P = .0023$) (Table 1). The results are expressed by scattergrams in Figure 1.

In comparison of pre- and postoperative visual acuity, vision improved in many patients, especially in groups 1 and 2. Patients whose visual acuity improved to 0.7 or better totalled 27% in group 1 and 14% in group 2. However, in groups 3 and 4, those who showed no change in visual acuity and those who showed deterioration were more numerous than those who showed improvement. Of the 37 eyes with postoperative visual acuity of 0.1 or worse, 14 had macular disorders, and 5 had optic nerve atrophy. Futhermore, 9 eyes had premacular fibrous proliferation, 5 eyes showed proliferative vitreoretinopathy, and 4 eyes showed rebleeding in the vitreous cavity.

Discussion

Abe et al[10] reported vitreous hemorrhage in 60 (7.4%) of 810 eyes with BRVO. Although its fre-

Table 1. Postoperative Visual Acuity*

Visual Acuity	Group 1 (n=79)	Group 2 (n=21)	Group 3 (n=11)	Group 4 (n=3)	Total (*N*=114)
<0.1	21 (27)	8 (38)	7 (64)	1 (33)	37 (32)
0.1–0.3	16 (20)	6 (29)	1 (9)	2 (67)	25 (22)
0.4–0.6	21 (27)	4 (19)	2 (18)	0	27 (24)
0.7<	21 (27)†	3 (14)	1 (9)†	0	25 (22)

*Values are numbers of eyes. Values in parentheses are percentages.

†$P = .0023$

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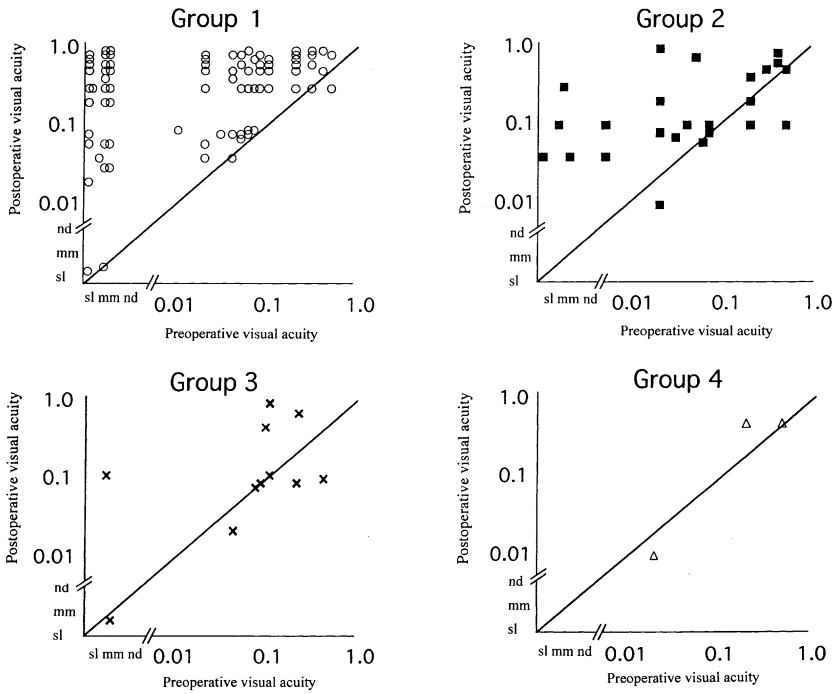

Figure 1. Pre- and postoperative visual acuity in the four groups in this study. Visual acuity improved in almost all cases, especially in groups 1 and 2. sl: sensus luminis, light perception; mm: motus manus, hand motion; nd: numerus digitorum, finger count.

quency in all BRVO patients is unknown in our study, it was observed in 7% of the patients in this study, being less frequent than proliferative diabetic retinopathy or retinal detachment. Although the surgical procedure for vitreous hemorrhage due to BRVO is relatively easy, there was some inadequacy in treatment during the follow-up period for many patients who had required vitreous surgery due to this disorder. Concerning the age of the patients, it was reported that the incidence of BRVO was 0.93 per 1,000 persons less than 65 years of age, while it was 5.36 per 1,000 persons 65 or older.[4] Therefore, BRVO initially occurred at the age of 65 years or later in more than half the patients. However, the mean age of our patients who required vitreous surgery due to BRVO was 63 years, and those who required three operations were approximately 10 years younger than those who were cured by one operation. Therefore, when the age of patients was clarified at the initial development of BRVO, it was considered to serve as reference data.

Hypertension and arteriosclerosis are considered to be some of the causes of BRVO,[13] and of the 113 patients who required vitreous surgery due to BRVO in our study, 75 (66%) were hypertensive, and 74% were hypertensive and/or diabetic. Therefore, hypertension and diabetes are important factors that require attention in the systemic management of BRVO.

The average period from the onset of BRVO to vitreous hemorrhage was as long as 5 years in our patients. Moreover, the possibility of exacerbation during a period of neglect due to apparent stability of symptoms after initial treatment or due to merely observation after hemorrhage must always be considered in treating BRVO. Furthermore, the period from the onset of vitreous hemorrhage to surgery was as long as 8 months, and the number of operations was generally greater in severe cases of BRVO, such as groups 3 and 4, because of intractability. These findings suggest the importance of early vitreous surgery with the intention to complete the treatment safely and consistently by one operation. Of the eyes preoperatively treated with photocoagulation, vitreous surgery was performed in 35 eyes (31%). However, of the eyes not preoperatively treated with photocoagulation, vitreous surgery was performed in a greater number. Therefore, the usefulness of photocoagulation before undergoing vitreous surgery is suggested.

The presence or absence of PVD is another important point in the follow-up. Whether there is

PVD or not is closely related to the postoperative visual acuity,[11] and there is the report that the frequency of partial vitreous detachment is significantly higher in patients with BRVO than in normal subjects.[12] In our patients, reoperation was performed less frequently in cases with established PVD, while the number of reoperations was higher in cases with partial PVD. Therefore, particularly careful observation is necessary in patients with BRVO and partial PVD. Moreover, ultrasound examination at the occurrence of hemorrhage and early operation in patients showing delayed natural absorption are considered to be vital in view of the possibility of exacerbation once hemorrhage occurs. When we evaluated the relationship between the presence or absence of PVD and other clinical findings, there were no significant differences. However, when numerous cases of BRVO were analyzed in this study, a significant difference was observed in the presence or absence of PVD. Therefore, further detailed evaluation is necessary in the future with regard to the range of PVD and the retinal-vitreous interface.

In our patients, retinal holes were observed in 14 eyes. They were near the proliferative membrane in 12 eyes and near the sheathed veins in 2 eyes. Joondepth et al[5] reported that retinal holes occurred near tissues containing neovascularization in 6 (22%) of 28 eyes, and they presented the hypothesis that traction of the retina by the vitreous body is a cause of retinal holes. That is, neovascularization occurs in the ischemic retina, vitreo-retinal adhesion is established, and traction is intensified to cause a hole. Moreover, Gutman et al[6] similarly suggested that holes are formed when PVD is established in the retina weakened by vein occlusion. On the other hand, Neumann[14] and Regenbogen et al[7] presented the theory of retinal degeneration due to circulatory disturbance. That is, circulatory disturbance of the retina induces circulatory disturbance of the inner layers of the retina and the choroid, and retinal holes are formed due to the thinning of the retina and the impairment of outer layers. However, according to our experience during surgery, traction was often applied to the site of the hole, so that we would be inclined to consider that the presence or absence of PVD is important. Pathohistological examination[14] demonstrated that vitreous hemorrhage occurs regardless of the presence or absence of PVD once neovascularization develops. Therefore, there would be no objection to the proposal that early BRVO is the foremost indication for photocoagulation. Ikuno et al[8,9] have reported on the types of retinal holes, the presence or absence of optic disc neovascularization, and the results of vitreous surgery. Their reports are considered to be significant in reducing the number of cases that require vitreous surgery due to BRVO.

To prevent the decrease of vision in patients with BRVO, prevention of neovascularization and management of macular edema are considered to be the final problems. Concerning the prevention of neovascularization, the Branch Vein Occlusion Study Group reported that scatter photocoagulation reduced retinal neovascularization from 40% to 20% in patients with BRVO, and vitreous hemorrhage from 60% to 30%.[15] Therefore, the timing of photocoagulation is important.

Vitreous surgery was indicated when the following symptoms were observed: in group 1, when bleeding reoccurs, and a thick blood clot remains in the inferior vitreous cavity even after blood is absorbed in the posterior pole, when there is a possibility of proliferative changes in the future, or when photocoagulation is impossible because the bleeding point is covered by hemorrhage; in group 2, when proliferative membrane was formed, and there was a possibility of retinal hole formation; and in groups 3 and 4, when detachment remained. Up to the present, suitable criteria have not yet been established. However, it was speculated that the timing of vitreous surgery is closely related to the presence or absence of PVD, as described above. Nitta et al[16] reported that 37% of sudden unilateral vitreous hemorrhage was caused by BRVO, and natural resorption of BRVO was poor. They also noted that the course of such vitreous hemorrhage was prolonged, because of rebleeding. Therefore, they recommended that BRVO patients undergo early surgery approximately 2 months after onset of hemorrhage when resorption of hemorrhage plateaued. Postoperative vision was significantly more satisfactory in our group 1 patients who underwent early vitrectomy. Therefore, we would like to emphasize the usefulness of early surgery to achieve better visual acuity for vitrectomy patients.

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