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Surgical posterior vitreous detachment combined with gas/air tamponade for treating macular edema associated with branch retinal vein occlusion: retinal tomography and visual outcome

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Abstract *Purpose:* To assess the effectiveness of surgical posterior vitreous detachment (PVD) together with gas/air tamponade in treating visual impairment from macular edema associated with branch retinal vein occlusion (BRVO–macular edema). *Methods:* A cohort study was conducted. To treat visual disturbance caused by BRVO–macular edema in 19 consecutive patients at a University Hospital, phacoemulsification, intraocular lens implantation, and vitrectomy were performed, together with gas/air tamponade. Patients were followed up postoperatively for 3–18 months. Foveal structure was defined using optical coherence tomography (OCT). Preoperative visual acuity, central retinal thickness, and interval between BRVO onset and operation were compared between patients with postoperative visual improvement and those without improvement. *Results:* Ten patients recovered normal or near-normal foveal configuration, while nine patients did not. Mean postoperative visual acuity in the former group of patients was significantly higher than in the latter. Mean foveal retinal thickness decreased significantly after the operation. The interval from onset of BRVO until operation was significantly shorter in patients with improved postoperative vision than in other patients, and patients operated on within 11 months had significantly increased postoperative visual acuity. *Conclusions:* Surgical PVD and gas/air tamponade appears effective in treating BRVO–macular edema, although relatively short duration from disease onset until operation is critical for improvement of vision. When a good postoperative foveal contour is seen, it seems to be associated with better visual outcome.

Introduction

Retinal vascular occlusive disorders such as vein occlusion or diabetic retinopathy may affect the foveal retina and induce macular edema [3, 10]. As macular edema affects central vision, a variety of treatments have been tried. Absence of posterior vitreous detachment (PVD) can contribute to occurrence of persistent macular edema in retinal vascular occlusion [9, 11, 12]. Surgical PVD may decrease foveal macular edema and improve vision in branch retinal vein occlusion (BRVO), although many other therapeutic approaches are possible [1, 7, 8].

Optical coherence tomography (OCT) reliably depicts retinal configuration [4, 13]. Hirakawa et al reported that OCT succeeded in detecting macular edema associated with retinal pigmentary degeneration, while fluorescein angiography (FAG) often failed [5]. Macular edema could be seen in OCT as intraretinal or subretinal accumulation of fluid [6].

In this study we evaluated the results of surgical PVD for macular edema associated with BRVO in consecutive cases without significant cataracts. We performed phacoemulsification with/without implantation of an intraocular lens (IOL), vitrectomy including induction of PVD,

Table 1 Summary of patients (*Duration* interval from onset of BRVO to operation, *PC* photocoagulation of the retina affected by BRVO, *BCVA* best-corrected visual acuity, *NS* not significant)

Case no.	Age (years)	Duration (months)	Retinal PC		LogMAR BCVA			Restoration of foveal contour
			Before op.	During op.	Follow up	Before op.	After op.	
1	71	3	+	–	18	0.30	0.16	+
2	61	4	+	+	15	1.00	1.00	+
3	63	8	+	–	17	0.52	0.30	+
4	47	2	+	+	10	0.52	0.16	+
5	72	2	+	+	12	0.52	0.40	+
6	49	3	+	+	13	0.70	0.52	+
7	63	1	+	+	11	1.00	0.30	+
8	53	20	+	+	4	1.00	0.52	+
9	79	17	+	+	6	1.00	0.52	–
10	31	2	+	+	8	0.70	0.22	+
11	53	1	–	–	8	0.52	0.40	+
12	73	24	+	–	6	1.00	1.00	–
13	58	24	–	–	7	0.30	0.30	–
14	73	4	+	+	5	1.00	1.00	–
15	65	12	+	–	5	0.40	0.70	–
16	76	14	+	+	5	0.52	0.70	–
17	89	15	+	–	5	0.40	0.40	–
18	52	38	+	+	5	0.22	0.70	–
19	68	12	+	+	5	0.70	0.70	–

and gas/air tamponade in 19 eyes of 19 patients with impaired vision from BRVO–macular edema.

Patients and methods

Patients

Nineteen eyes consecutively treated in 19 patients (male: female=8: 11) at our university hospital were included in this study (Table 1). Mean patient age (± SD) was 62.4±12.6 years (range 31–79 years). Estimated interval between onset of BRVO and operation was 11.3 months (range 1–38 months). Seventeen patients had received laser photocoagulation of the retina in the area of BRVO before operation. Two patients had diabetes mellitus without diabetic retinopathy. Hypertension was present in six patients. No potential impairment of vision from cataracts was evident prior to operation in any patient. Patients were followed up postoperatively for 3–18 months (mean ± SD 8.7±4.4).

Surgical procedure

Using local anesthesia, surgery was performed in all patients as follows: After PEA and implantation of a polymethylmethacrylate IOL (5.5 mm diameter), vitreous humor was removed by pars plana vitrectomy using a three-port system. The posterior vitreous face was removed from the retinal surface using a soft, tapered needle with suction at 300 mmHg, and then excised. Finally, after a fluid–air exchange procedure, the vitreous cavity was filled with 33% SF_6 gas in sterilized air or air alone (SF_6 16 cases; air alone 3 cases). The surgery was performed by S.S. in all patients. The mean duration of surgery was 42.9 min (± 9.2 min).

Analysis

Before surgery, and periodically afterwards, patients were examined. Examination included determination of best-corrected visual acuity (BCVA) [2], FAG and OCT. The OCT image of each patient was in the horizontal direction. Retinal thickness, including subretinal fluid accumulation, was measured at the central fovea by the latter procedure. Changes in retinal thickness at the central fovea and changes in BCVA were analyzed by paired *t*-tests. Mean preoperative BCVA, mean central retinal thickness, and mean interval from onset of BRVO to operation, were compared between patients with postoperative improvement of BCVA and those with no improvement.

Results

OCT images and foveal retinal thickness

By OCT, mean retinal thickness at the central fovea, including subretinal fluid accumulation, was significantly decreased following surgery (Table 2). Ten patients recovered a normal or near-normal foveal contour (Figs. 1, 2, 3), while nine patients did not (Fig. 4). FAG sometimes failed to detect macular edema that was evident by OCT (not illustrated). No statistically significant difference in preoperative central retinal thickness was evident between patients with and without visual improvement (366.6±177.0 µm vs 400.7±234.9 µm).

Visual outcome

Table 1 includes pre- and postoperative LogMAR BCVA in all patients. LogMAR BCVA over 1.0 was evaluated as 1.0 in this study. Postoperative BCVA upon follow up was higher than preoperative BCVA in ten patients, un-

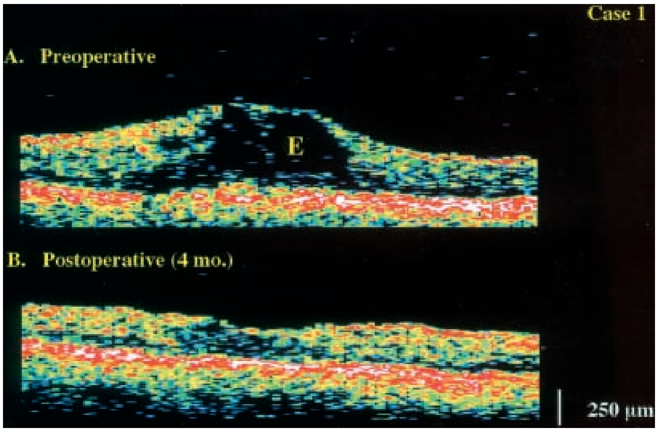

Fig. 1A,B Configuration of foveal retina **A** before and **B** after operation in case 1. Fluid accumulation (marked as E) beneath the foveal retina had decreased 4 months postoperatively

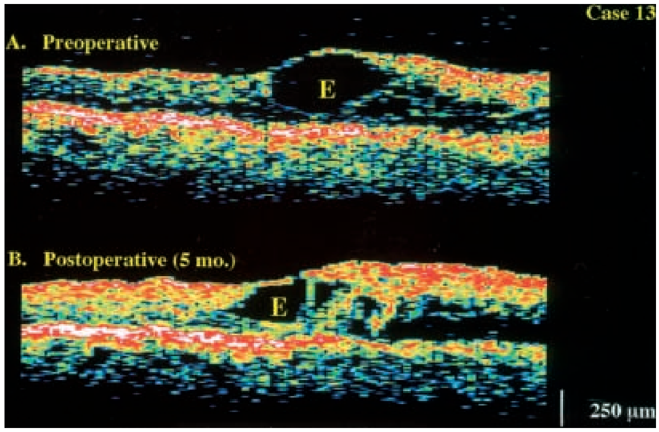

Fig. 4A,B. Configuration of foveal retina **A** before and **B** after operation in case 13. Fluid accumulation (marked as *E*) beneath the foveal retina had not decreased 3 months postoperatively

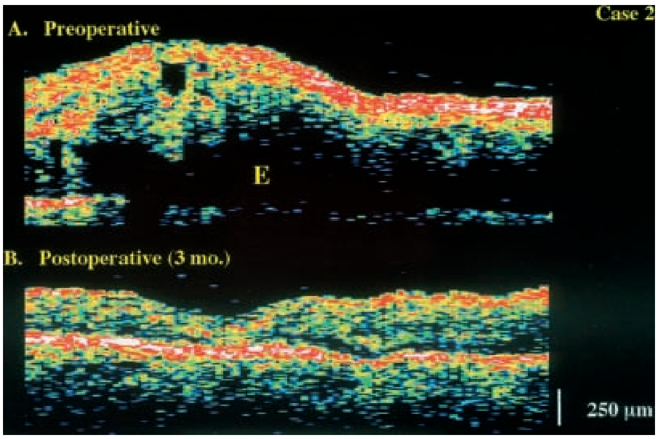

Fig. 2A,B Configuration of foveal retina **A** before and **B** after operation in case 2. Fluid accumulation (marked as *E*) beneath the foveal retina had decreased 3 months postoperatively

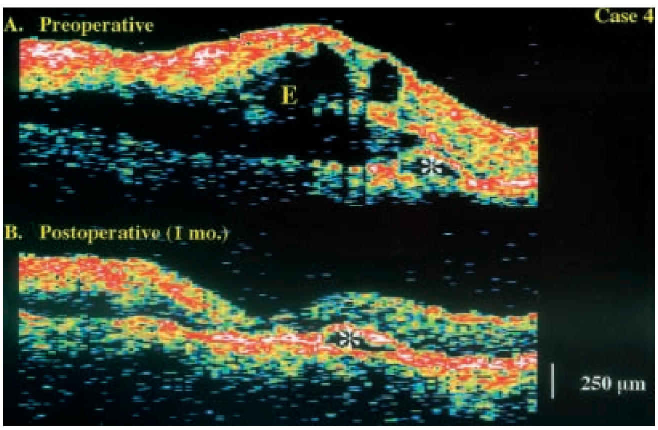

Fig. 3A,B Configuration of foveal retina **A** before and **B** after operation in case 4. Fluid accumulation (marked as *E*) beneath the foveal retina had decreased 1 month postoperatively. Pigment epithelial detachment (*asterisk*) did not change

Table 2 Retinal thickness at the central fovea, including subretinal fluid accumulation (µm, mean ± SD)

Preoperatively	Postoperatively	Statistical outcome
382.9±201.3	208.4±115.6	P<0.05 by paired *t*-test

Table 3 Mean LogMAR best-corrected visual acuity for all patients (mean ± SD)

Preoperatively	Postoperatively	Statistical outcome
0.658±0.277	0.526±0.27	NS by paired *t*-test

Table 4 Mean postoperative LogMAR best-corrected visual acuity (mean ± SD)

Patients recovered foveal shape	Patients not recovered foveal shape	Statistical outcome
0.40±0.25	0.67±0.23	P<0.05 by unpaired *t*-test

changed in six, and lower in three. There was no statistical difference of mean BCVA for all patients pre- and postoperatively (Table 3). Mean postoperative BCVA was significantly higher in patients recovering normal or near-normal foveal shape than in others (Table 4).

We also examined correlations between the estimated interval from the onset of BRVO until operation and postoperative visual improvement, as well as between preoperative BCVA and postoperative improvement. The preoperative interval was significantly longer in patients without visual improvement than in those with improvement (P <0.05 by unpaired *t*-test). No statistically significant difference in preoperative BCVA was found between patients with and without increased postoperative

Table 5 Mean LogMAR best-corrected visual acuity of patients operated on 11 months after the onset of disease (mean ± SD)

Preoperatively	Postoperatively	Statistical outcome
0.59±0.28	0.446±0.313	$P<0.025$ by paired *t*-test

BCVA. We therefore analyzed the change in BCVA after operation in patients who underwent surgery within 11 months after onset of BRVO. The surgery was found to statistically significantly improve the BCVA in the ten patients operated on within 11 months (Table 5).

Discussion

This study suggests that complete removal of the vitreous from the retinal surface in combination with gas/air tamponade was effective in reducing morphologically demonstrable macular edema, and that visual acuity improved postoperatively provided patients underwent surgery within 11 months after the onset of BRVO. The mean interval between onset of BRVO and operation was significantly longer in patients with no improvement of BCVA than in those with improvement. This difference indicates that longstanding macular edema may impair function of the central foveal retina. Further, when a good postoperative foveal contour is seen, it seems to be associated with better visual outcome; mean postoperative BCVA was significantly higher in patients who attained a normal or near-normal foveal configuration than those with unresolving macular edema postoperatively.

We employed a procedure using gas/air tamponade. Although the effectiveness of gas tamponade in promoting regression of macular edema following vitreous removal has not been completely established, Takahashi et al. recently reported that gas tamponade of the vitreous cavity can be effective in reducing macular edema in eyes with central retinal vein occlusion [14]. Further detailed prospective study is needed to examine the effectiveness of gas/air tamponade after surgical PVD in the treatment of macular edema associated with BRVO.

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