ORIGINAL

Results of submacular surgery to remove diabetic submacular hard exudates

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Abstract : Purpose : To evaluate outcomes of submacular surgery to remove massive submacular hard exudates with diabetic macular edema. Design : Retrospective, noncomparative, interventional consecutive case series. Participants : Fifty-six eyes of 40 patients with massive submacular hard exudates with diabetic macular edema. Intervention : Submacular surgery was performed to remove massive submacular hard exudates. Main Outcome Measures : Preoperative and postoperative visual acuities and clinical findings. All patients were followed for more than 1 year postoperatively. Results : The macular hard exudates underlying the fovea almost disappeared, and macular edema remarkably reduced following surgery. Visual acuities ranged from 0.01 to 0.3 before surgery, and from 0.04 to 1.0 after surgery. Visual acuity improved by two lines or more in 45 eyes (80.4%), remained unchanged in 8 eyes (14.3%) and worsened in 3 eyes (5.3%). Visual acuity improved to 0.3 or more in 24 eyes (42.9%). Better postoperative visual acuity (0.3 or better) was related to hemoglobin A1C (HbA1C) and the size of hard exudates. Conclusions : Results showed the efficacy of submacular surgery to remove massive hard exudates with diabetic macular edema, and outcomes were satisfactory. J. Med. Invest. 55 : 211-215, August, 2008

Keywords **:** *diabetic macular edema, hard exudates, vitrectomy, submacular surgery*

INTRODUCTION

Progress in development of vitreous surgery has allowed vitrectomy to be performed to treat diabetic macular edema. Efficacy of such a treatment was discussed in many reports, and the procedure is now almost well established (1-3). However, massive hard exudates with diabetic macular edema are still difficult to manage, and good visual prognosis cannot be expected using ordinary vitrectomy (4, 5). Submacular hard exudates can be removed by vitrectomy through a transretinal approach. However, information regarding vitreoretinal surgery for removing massive hard exudates is minimal, and only small case series exist (6-8). In contrast to previous reports, our present case series consisted of 56 eyes from 40 patients. We evaluated outcomes of our vitreous surgery to remove massive hard exudates with diabetic macular edema.

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PATIENTS AND METHODS

Patients

A consecutive series of 40 patients with massive diabetic macular hard exudates who underwent sub-

macular surgery were retrospectively reviewed. Fifty-six eyes of 40 consecutive patients with massive diabetic macular hard exudates underlying the fovea were entered into this study. All patients underwent initial vitreous surgery to remove massive hard exudates, at the Tokushima University Hospital between April 1996 and February 2002. All surgical procedures were performed by one surgeon (TN). Informed consent was obtained from each patient before surgery. Twenty-four patients were treated in one eye, and the residual 16 patients were treated in both eyes. Patients included 20 women (26 eyes), and 20 men (30 eyes) ranging from 44 to 75 years old (mean age ±SD, 58.9 ±8.5 years old). All patients had received panretinal photocoagulation in the affected eyes.

Preoperative records included age, gender, affected eye, duration of symptoms, visual acuity in decimal, fundus findings, size of exudates (greatest diameter) and hemoglobin A1C (HbA1C) obtained within 3 months before surgery. Postoperative records included visual acuity, fundus findings, duration of follow-up and postoperative complications. All patients were followed for more than 1 year postoperatively.

Surgical Techniques

Surgical procedures were almost the same as those for vitreous surgery for age-related macular degeneration (9, 10). A standard three-port pars plana vitrectomy (PPV) was performed, and the posterior adherent cortical vitreous was removed from the retina when posterior vitreous detachment was not present preoperatively. A small retinotomy was performed at the easiest point to access the hard exudates. Subretinal infusion through the retinotomy hole was done to create macular detachment, and the hard exudates were removed using a subretinal forceps, and washed out by careful subretinal infusion. After removal of the hard exudates, a fluid-gas exchange with air or perfluoropropane gas was performed to remove the subretinal fluid, and the retina was re-attached. Surgery-combined pars plana lensectomy with intraocular lens implantation was performed in 40 eyes. Four eyes were previously operated for cataract. Lenses were kept in 12 eyes.

Statistical Analyses

All statistical procedures were performed using the SPSS 13.0 for Windows software (SPSS Japan Inc., Tokyo, Japan). At time of surgery, age, preoperative duration, visual acuity, size of exudates and HbA1C were recorded for each eye. All eyes were classified into 2 groups according to postoperative best visual acuity : group A, postoperative best visual acuity of 0.3 or better ; and group B, postoperative best visual acuity worse than 0.3. A comparative statistical analysis was done among these 2 groups.

RESULTS

Twenty women (26 eyes) and 20 men (30 eyes) were included in this study. Their age ranged from 44 to 75 years old (mean age ±SD, 58.9 ±8.5). The follow-up period ranged from 12 to 91 months (mean ±SD, 43.6 ±22.3). All patients had type 2 diabetes mellitus (DM). Posterior vitreous detachment was not observed in 54 (96.4%) of 56 eyes during vitrectomy. One eye needed a second surgery. After the first surgery, hard exudates accumulated again. We performed a second surgery for the affected eye 6 months later, to remove the hard exudates and an epiretinal membrane. In all patients, macular hard exudates in the fovea almost disappeared, and macular edema was remarkably reduced after surgery. Representative cases are shown in Figures 1 and 2.

Characteristics of patients are summarized in Table 1. Preoperative duration after onset of blurred vision ranged from 2.0 to 48.0 months (mean ±SD, 10.4 ±7.3), including that in 43 eyes (76.8%) of 12.0 months or less. Hemoglobin A1C (HbA1C) obtained within 3 months before surgery ranged from 5.1 to 12.3% (mean ±SD, 7.1 ±1.3). Preoperative decimal visual acuity ranged from 0.01 to 0.3 (mean ±SD, 0.105 ±0.069), and 40 of 56 eyes (71.4%) were 0.1 or less. Postoperative best visual acuity ranged from 0.04 to 1.0, and it was 0.3 or better in 24 of 56 eyes (42.9%). Postoperative best visual acuity improved by 2 lines or better in 45 eyes (80.4%), remained unchanged in 8 eyes (14.3%), and deteriorated in 3 eyes (5.3%) ($P<0.0001$, using a Student's t-test for paired data, Figure 3). Follow-up period to resume the best visual acuity ranged from 1.0 to 65.5 months (mean ±SD, 12.9 ±11.5). Postoperative final visual acuity improved by 2 lines or better in 39 eyes (69.7%), remained unchanged in 11 eyes (19.6%), and deteriorated in 6 eyes (10.7%) ($P=0.0016$, using a Student's t-test for paired data, Figure 4).

Characteristics of the 2 groups are summarized in Table 2. For postoperative best visual acuity re-

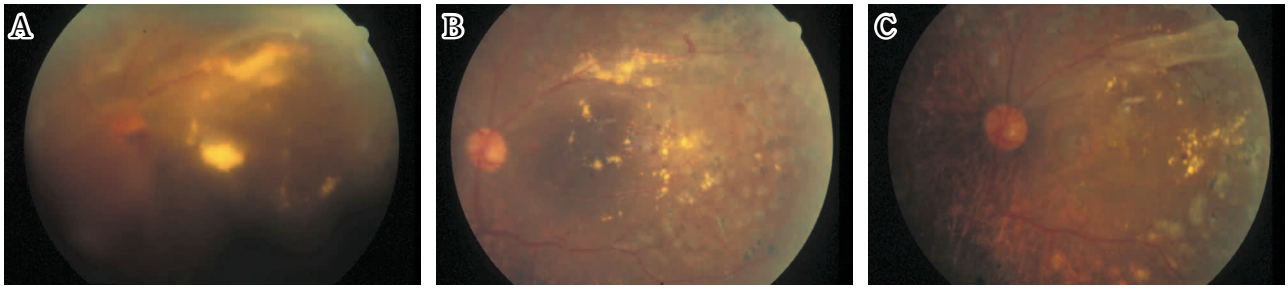

Figure 1. A, A 51-year-old female before surgery. A preoperative fundus appearance of massive macular hard exudates. The preoperative visual acuity was 0.01. B, Five months after surgery, macular hard exudates have almost disappeared and visual acuity improved to 0.4. C, Twenty-seven months after surgery, macular hard exudates disappeared and visual acuity improved to 1.0.

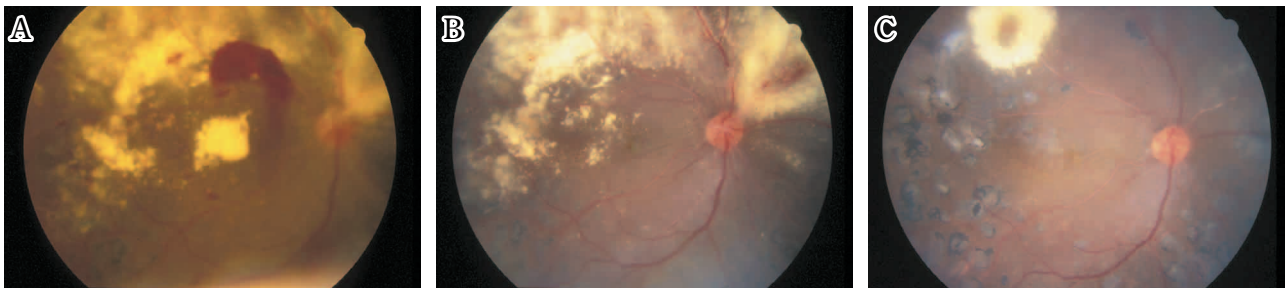

Figure 2. A, A 57-year-old female before surgery. A preoperative fundus appearance of massive macular hard exudates. The preoperative visual acuity was 0.1. B, Four months after surgery, macular hard exudates almost disappeared and visual acuity improved to 0.6. C, Sixty-five months after surgery, macular hard exudates disappeared and visual acuity improved to 1.0.

Table 1. Characteristics of Patients

No. of patients	40
Unilateral	24
Bilateral	16
No. of eyes	56
Sex	
Female	20 (26 eyes)
Male	20 (30 eyes)
Age (yrs)	
Range	44 - 75
Mean	58.9
SD	8.5
Preoperative Duration (mos)	
Range	2 - 48
Mean	10.4
SD	7.3
HbA1C (%)	
Range	5.1 - 12.3
Mean	7.1
SD	1.3
Preoperative VA	
Range	0.01 - 0.3
Mean	0.105
SD	0.069

SD=standard deviation
VA=visual acuity

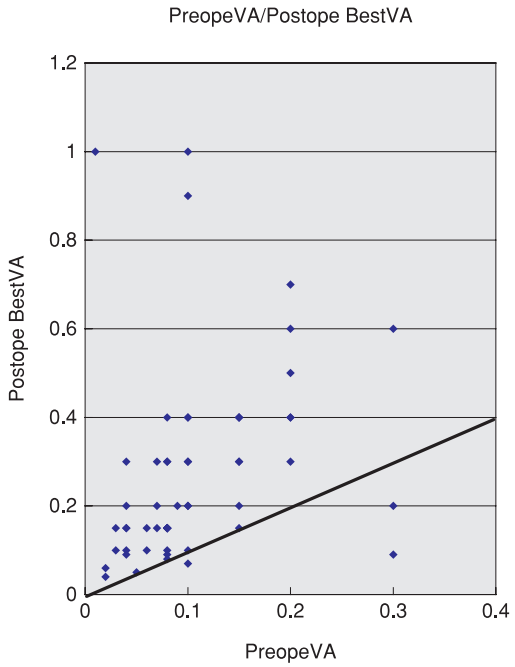

Figure 3. Scattergram of preoperative visual acuity and postoperative best visual acuity.
Postoperative best visual acuity improved 2 lines or better in 45 eyes (80.4%), remained unchanged in 8 eyes (14.3%) and deteriorated in 3 eyes (5.3%) ($p < 0.0001$).

sults, the better postoperative visual acuity (0.3 or better) was related to HbA1C (P=0.004 using a Student's t-test), and to size of hard exudates (P=0.026 using a Student's t-test).

Complications related to surgery were observed in 14 eyes. Retinal tear formed in 7 of 56 eyes (12.5%).

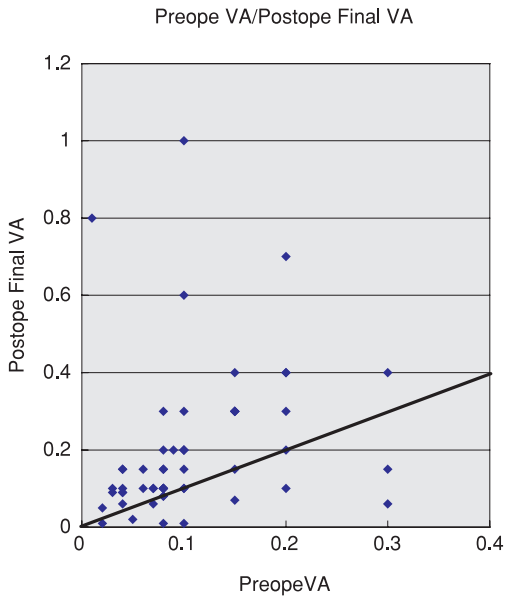

Figure 4. Scattergram of preoperative visual acuity and postoperative final visual acuity.
Postoperative final visual acuity improved 2 lines or better in 39 eyes (69.7%), remained unchanged in 11 eyes (19.6%) and deteriorated in 6 eyes (10.7%) (p = 0.0016).

Table 2. Characteristics of Groups

	Group A (VA≧0.3)	Group B (VA<0.3)
No. of eyes	24	32
Age (yrs)		
Range	47 - 75	44 - 74
Mean	57.7	59.8
SD	8.1	8.8
HbA1C (%)*		
Range	5.2 - 8.5	5.1 - 12.3
Mean	6.50	7.47
SD	0.86	1.38
Preoperative Duration (mos)		
Range	2 - 24	2 - 48
Mean	8.6	11.8
SD	5.03	8.79
Size of Exudate (DD)*		
Range	0.5 - 1.5	0.3 - 3.5
Mean	0.86	1.32
SD	0.34	0.94
Duration for Absorption (mos)		
Range	3 - 19.4	2 - 19.2
Mean	7.03	8.91
SD	3.91	4.61

VA = visual acuity
SD = standard deviation
DD= disc diameter

A macular hole was made during the creation of macular detachment in 3 eyes. An increase in lens nuclear sclerosis was observed in 4 eyes of phakic patients postoperatively. All these complications did not cause any serious problems because of our proper procedures during surgery.

DISCUSSION

Vitrectomy has been performed for diabetic macular edema. Efficacy of such a treatment was discussed in many reports, and the standard procedure is now almost well established (1-3). However, massive hard exudates with diabetic macular edema are still difficult to manage and good visual prognosis cannot be expected using ordinary vitrectomy (4, 5). In previous cases of diabetic macular edema, hard exudates remained and visual prognosis was not good after vitrectomy. Following recent advances in vitreous surgery, hard exudates can now be removed using a transretinal approach, just like in vitreous surgery for age-related macular degeneration (9, 10). Therefore, we believed that this procedure might be useful for cases of diabetic macular edema and used this technique in 56 eyes after getting informed consent from appropriate patients. However, previous information on vitreoretinal surgery for removing massive hard exudates is minimal and only small case series have been reported (6-8), including at the most 10 cases. In contrast to previous reports including only small numbers, our series consisted of 56 eyes of 40 patients.

In this series, 40 eyes (71%) had a preoperative visual acuity of 0.1 or less. Postoperatively, 24 eyes (43%) had a best visual acuity of 0.3 or better. Seven eyes (13%) had a postoperative best visual acuity of 0.5 or better. In other reports (6-8), visual outcome was not as good as ours and number of cases was smaller than ours.

Several factors might have created favorable surgical outcomes in our patients undergoing removal of subfoveal massive hard exudates. Firstly, preoperative durations of symptoms were relatively short, and were 12 months or shorter in 43 eyes (77%). It is difficult to determine the optimal period of observation time before removal of the massive hard exudates. However, in order to obtain better surgical outcomes, we should attempt to perform submacular surgery at the beginning of accumulation of the hard exudates under the fovea. Therefore, we can prevent irreversible retinal damage caused by hard exudates. Secondly, in our procedure, the subretinal space was washed with an infusion solution after submacular hard exudates were removed. Using this procedure, vascular endothelial growth factor (VEGF) or some cytokines playing a key role in the pathogenesis of diabetic macular edema are washed out from the subretinal space. VEGF is be-

lieved to be an important factor to create hard exudates and it has been detected in excised specimens of diabetic macular hard exudates using immunohistochemical staining (6). Thirdly, we tried to remove hard exudates as gently as we could, with great delicacy. Most of the hard exudates were washed out with the infusion solution to prevent damaging the neural retina and the pigment epithelium. Hard exudates are known to exist in the outer plexiform layer of the retina. However, in cases with massive hard exudates, they form in the subretinal space. Therefore, we could wash out most of them using the infusion solution.

Statistical results showed that good visual prognosis (0.3 or better) was related to HbA1C and to the size of the hard exudates. Some reports suggested a correlation between glycemic control and diabetic retinopathy (11, 12). One study reported a correlation between persistent clinically significant macular edema (CSME) and elevated HbA1C, and that persistent CSME occurred more frequently when HbA1C was greater than 7.5% (13). In our report, mean HbA1C was 7.47% in the worse visual prognosis (less than 0.3) group. This suggested the importance of glycemic control in the management of DM. Good visual prognosis also correlates with size of hard exudates, since size of hard exudates may correspond to severity of macular edema and retinopathy.

Since the advent of nuclear cataract following vitrectomy within a few years, we performed lensectomy combined with intraocular lense implantation at the time of our submacular surgery in 39 eyes (70%).

Our surgical outcomes showed that submacular surgery was effective and safe in removing macular hard exudates from diabetic patients.

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