Vision-related quality of life and visual function following vitrectomy for proliferative diabetic retinopathy

Fumiki Okamoto, MD, Yoshifumi Okamoto, MD, Shinichi Fukuda, MD, Takahiro Hiraoka, MD, Tetsuro Oshika, MD.

Department of Ophthalmology, Institute of Clinical Medicine, University of Tsukuba, Ibaraki, Japan.

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Correspondence to Fumiki Okamoto, MD, Department of Ophthalmology, Institute of Clinical Medicine, University of Tsukuba, 1-1-1 Tennoudai, Tsukuba, Ibaraki, 305-8575 Japan. E-mail: Fumiki-o@md.tsukuba.ac.jp FAX: +81-29-853-3148

Diabetic retinopathy is one of the most common causes of blindness in industrialized countries.[1] It can lead to severe visual loss by causing retinal detachment, macular edema, vitreous hemorrhage, and neovascular glaucoma. Pars plana vitrectomy is known to be effective in preserving and restoring visual function in patients with proliferative diabetic retinopathy (PDR).[2–6] Despite the large body of published material regarding the visual outcome of vitrectomy for PDR, the impact of this surgical intervention on patients' quality of life (QOL) has not been reported in literature.

In ophthalmology, traditional objective clinical outcome measures such as visual acuity are increasingly being complemented with assessment of patients' perception of their visual function and quality of life. The National Eye Institute 25-Item Visual Function Questionnaire (VFQ-25) is a vision-related QOL (VR-QOL) instrument designed to assess patients' perception of their visual function and QOL.[7] Prior studies have reported the influence of vitrectomy on VR-QOL in patients with macular hole,[8–10] epiretinal membrane,[11] and age-related macular degeneration.[12,13] The purpose of this study was to evaluate the VR-QOL and visual function following vitrectomy for PDR by using VFQ-25.

Methods

We analyzed 51 eyes of 51 patients with PDR who were scheduled to undergo pars plana vitrectomy. Their age averaged 55.8 ± 12.1 years (mean ± SD), and there were 21 males and 30 females. Forty-six eyes of 46 age-matched subjects served as normal controls. The current study was a prospective, interventional, consecutive, comparative case series, and was conducted in accordance with the Declaration of Helsinki, and the study protocol was approved by the Institutional Review Committee of Tsukuba University Hospital. Prior to inclusion in the study, all patients provided written informed consent after the nature of the study was explained to them.

The surgery was performed in our clinic by an experienced vitreoretinal surgeon from June 2005 through September 2006. The indications for vitrectomy included recurrent or persistent nonclearing vitreous hemorrhage (11 eyes), traction or combined traction/rhegmatogenous retinal detachment (17 eyes), and adherent posterior hyaloid causing excessive macular traction (23 eyes). Exclusion criteria included patients with previous history of ocular surgery and ophthalmic disorders, except for mild refractive errors and mild cataract. Patients who had underwent vitrectomy for bilateral eyes within at least three months were also excluded. The presence and severity of cataract were graded using the lens opacities classification system III (LOCS III) reference standards.[14] The following preoperative information was obtained for each patient: age, gender, duration of diabetes mellitus (DM), serum HbA1c, and fasting plasma glucose. Data on the patients' characteristics are presented in Table 1.

LogMAR best-corrected visual acuity (BCVA), letter contrast sensitivity, and the severity of metamorphopsia were obtained preoperatively and at 3 months postoperatively. Letter contrast sensitivity was measured using the CSV-1000LV chart (Vector Vision, Columbus, Ohio). Metamorphopsia was evaluated using M-CHARTS (Inami Co., Tokyo, Japan), which enable quantitative evaluation of the degree of metamorphopsia in patients with macular diseases.[15,16]

Surgical procedures

All surgeries were performed by a single surgeon (F.O.) under sub-Tenon local anesthesia. The crystalline lens was removed by phacoemulsification and intraocular lens implantation when required, following by 20-gauge three-port pars plana vitrectomy. Using contact lenses, posterior hyaloid separation and removal of the posterior vitreous membrane were performed, and then bimanual delamination, en bloc dissection, and segmentation techniques were used to remove proliferative tissues. Membrane dissection and segmentation were performed when necessary to eliminate all tangential tractions. Peripheral vitrectomy and panretinal endophotocoagulation were routinely performed. Air-fluid exchange was performed when an iatrogenic retinal tear and/or rhegmatogenous retinal detachment were identified intraoperatively.

Questionnaire (VFQ-25)

The patients were requested to answer VFQ-25 preoperatively and 3 months postoperatively to assess VR-QOL. Preoperative VFQ-25 was examined the day before or two days before operation. The research staff explained the questionnaire to the patients, verbally administered instruction, and provided assistance when required. The completed questionnaires were reviewed for missing data by the research staff. Prior to surgery, all the missing items were incorporated by the subjects themselves.

The VFQ-25 comprises 25 items wherein patients are expected to assess the level of difficulty of particular visual symptoms or day-to-day activities. Each item is assigned to one of the 12 subscales, namely, general health, general vision, ocular pain, near activities, distance activities, social functioning, mental health, role difficulties, dependency, driving, color vision, and peripheral vision. The subscales are scored on a 0 to 100-point scale, where 100 indicates the highest possible function or the minimal subjective impairment. The VFQ-25 composite score is calculated as the unweighted average response to all items, excluding the questions regarding general health.

The VFQ-25 used in this study was a Japanese version, with modifications to suit the Japanese culture and way of life. The modified NEI VFQ-25 questionnaire has been assessed for reliability and validity, and it has been proven to accurately measure VR-QOL in Japanese individuals.[17]

Statistical analysis

The mean scores and standard deviations were calculated for each VFQ-25 subscale result as well as for the VFQ-25 composite score in patients with PDR and normal controls. A Mann-Whitney *U* test was performed to compare each subscale score and composite score between the PDR patients and normal controls. The Wilcoxon signed-ranks test was used for variables that were present both pre- and postoperatively. The relationships of the questionnaire scores with visual acuity, contrast sensitivity, metamorphopsia, age, duration of DM, serum HbA1c, and fasting plasma glucose were examined by the Spearman rank correlation test. To correlate visual acuity with the questionnaire score, the Snellen visual acuity was converted to its logMAR equivalent. Approximations for

visual acuity worse than 20/400 were as follows: counter fingers, 20/2000; hand motions, 20/4000; and light perception, 20/8000.[18,19] All tests of association were considered statistically significant if $P < 0.05$. The analyses were carried out using StatView (version 5.0, SAS Inc., Cary, NC).

Results

The logMAR BCVA ranged from 2.30 to 0.00 preoperatively (mean, 1.24; median, 1.30) and from 2.60 to -0.08 postoperatively (mean, 0.46; median, 0.30). The vitrectomy significantly improved visual acuity ($p < 0.0001$), with 39 patients (75.0%) gaining 2 or more ETDRS lines. No change was observed in 9 eyes (17.3%), and vision decreased by 1 or more lines in 4 patients (7.6%). The postoperative reduction in visual acuity was attributed to neovascular glaucoma (2 patients) and optic disc atrophy (2 patients). These patients did not have neovasucular glaucoma and optic disc atrophy preoperatively. The mean letter contrast sensitivity significantly improved from 7.5 preoperatively to 15.0 postoperatively ($p < 0.001$).

All patients underwent PDR surgery for their worse-seeing eye. The logMAR BCVA in the fellow eye ranged from 1.20 to 0.00 (mean, 0.62; median, 0.60).

Preoperative and postoperative mean logMAR BCVA on the type of PDR were vitreous hemorrhage (pre 1.34, post 0.25), tractional retinal detachment (pre 1.31, post 0.24), and excessive macular traction (pre 1.22, post 0.74). Further, preoperative and postoperative mean VFQ-25 composite scores on the type of PDR were vitreous hemorrhage (pre 51.2, post 62.3), tractional retinal detachment (pre 61.1, post 70.3), and excessive macular traction (pre 55.2, post 59.4).

The results of VFQ-25 questionnaire pre- and postoperatively are shown in table 2. The preoperative VFQ-25 composite score was significantly lower in the PDR patients than in the normal controls ($p < 0.0001$). The preoperative subscales were significantly lower in the PDR patients than in the normal controls, except for ocular pain ($p < 0.0001$). Vitrectomy significantly improved VFQ-25 composite score ($p < 0.005$) and subscales such as general vision, near activities, distance activities, social functioning, mental health, role difficulties, driving, and peripheral vision. However, postoperative VFQ-25 composite score still remained significantly lower in the PDR patients than in the normal controls ($p < 0.0001$).

The preoperative VFQ-25 composite score exhibited significant correlation with the preoperative logMAR BCVA in the better-seeing eye but not in the worse-seeing eye (Figure 1). Significant correlation was also observed between the preoperative VFQ-25 composite score and letter contrast sensitivity (Figure 1). The preoperative VFQ-25 composite score did not correlate with age ($r = 0.138$, $p = 0.496$), duration of DM ($r = 0.122$, $p = 0.523$), serum HbA1c ($r = 0.136$, $p = 0.400$), and fasting plasma glucose ($r = 0.051$, $p = 0.750$). At 3 months postoperatively, the VFQ-25 composite score exhibited significant correlation with the logMAR BCVA in the worse-seeing eye as well as the better-seeing eye (Figure 2). Similar significant correlation was observed between the VFQ-25 composite score and letter contrast sensitivity (Figure 2). However, there was no significant relationship between the postoperative VFQ-25 composite score and

the severity of metamorphopsia (r = -0.390, p = 0.081). Further, there was no significant correlation between changes in VFQ-25 composite score by surgery and changes in logMAR BCVA (r = -0.212, p = 0.148) and letter contrast sensitivity (r = 0.307, p = 0.093).

Discussion

In the present study, VFQ-25 composite score and all subscale scores, except for color vision, were significantly reduced in patients with PDR, indicating that those patients were suffering from a wide range of functional vision difficulties as compared to the normal controls. The preoperative VFQ-25 composite score significantly correlated with visual acuity and contrast sensitivity in the better-seeing eye. Postoperatively, VFQ-25 composite score significantly correlated with the condition of the worse-seeing eye as well as the better-seeing eye. Previous studies reported that VR-QOL significantly improved following vitreous for age-related macular degeneration,[12,13] macular hole,[8–10] and epiretinal membrane peeling.[11] The current study represents the first report that VR-QOL significantly improved following vitreous surgery for PDR. In patients with macular hole,[8] 4 of 12 subscales improved significantly with surgery, such as general vision, near activities, mental health, and role difficulties. Vitrectomy for epiretinal membrane significantly improved 2 of 12 subscales, including general vision and distance activities.[11] Vitrectomy for PDR significantly improved 8 of 12 subscales (general vision, near activities, distance activities, social functioning, mental health, role difficulties, driving, and peripheral vision) in this case series. Based on these previous and current findings, it is suggested that vitrectomy for PDR offers greater subjective improvement in VR-QOL than that for other macular disorders.

The preoperative VFQ-25 composite score significantly correlated with preoperative visual acuity and contrast sensitivity in the better-seeing eye. These results are consistent with several previous reports. Miskala et al investigated VR-QOL in patients with subfoveal choroidal neovascularization by using the VFQ-25, and demonstrated that changes in the overall and subscale scores were linearly related to changes in visual acuity of the better-seeing eye but are not associated with changes in the worse-seeing eye.[12] Deramo et al investigated VR-QOL in patients with unilateral central retinal vein occlusion and observed that VFQ-25 responses significantly correlated with visual acuity in the better-seeing eye.[19] In other studies, VFQ-25 responses significantly correlated with binocular visual acuity in patients with macular hole and epiretinal membrane.[8,11] In our study, VR-QOL was significantly associated with contrast sensitivity as well as visual acuity in the better-seeing eye.

Interestingly, postoperative VFQ-25 composite score significantly correlated with postoperative visual acuity and contrast sensitivity in both the worse-seeing and better-seeing eyes. Until now, there has been no previous report that showed significant relationship between VR-QOL and visual function of the worse-seeing eye in patients with vitreoretinal diseases. In PDR, however, bilateral eyes are usually affected to a rather similar extent, while other vitreoretinal diseases such as macular hole and epiretinal membrane are generally unilateral. In our study, mean visual acuity in the better-seeing eye was considerably deteriorated (0.62

logMAR BCVA), and the difference between the better-seeing and worse-seeing eyes was small. This seems to be the reason why VFQ-25 score correlated with the visual function not only in the better-seeing eye but also in the worse-seeing eye.

In several studies investigated quality of life outcomes following ocular surgery, only week or absent correlation between increase in quality of life and improvement of visual acuity was observed. [10,20] In this study, there was no significant correlation between changes in VFQ-25 composite score and changes in visual acuity. This finding suggests visual acuity is only one aspect of visual function, which explains why despite increased visual acuity and letter contrast sensitivity in several cases VFQ-25 values decrease in our series.

There was no association between the severity of metamorphopsia and VFQ-25 composite score. This observation is consistent with the results of previous studies in patients with macular hole and epiretinal membrane.[8,11] Thus, it seems that visual acuity and contrast sensitivity are more suitable indicators for patients' VR-QOL than the degree of metamorphopsia.

This study has certain limitations, including small sample size and short-term follow-up. The VFQ-25 score in patients with macular hole was more improved at 1 year postoperatively than at 3 months postoperatively.[11] Thus, longer-term investigations of patients after vitrectomy for PDR might give somehow different results regarding VR-QOL and visual function. Future studies with a larger sample size and longer follow-up will further facilitate our understanding of the relation between VR-QOL and visual function in patients undergoing vitrectomy for PDR.

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Figure legends

Figure 1. Preoperative National Eye Institute 25-Item Visual Function Questionnaire (VFQ-25) composite score vs. preoperative logMAR best-corrected visual acuity (BCVA) and preoperative letter contrast sensitivity in patients with proliferative diabetic retinopathy.
(Top left) VFQ-25 composite score vs. logMAR BCVA in the better-seeing eye: r = -0.446, $p < 0.001$. (Top right) VFQ-25 composite score vs. logMAR BCVA in the worse-seeing eye: r = -0.354, $p = 0.072$. (Bottom left) VFQ-25 composite score vs. letter contrast sensitivity in the better-seeing eye: r = 0.407, $p = 0.016$. (Bottom right) VFQ-25 composite score vs. letter contrast sensitivity in the worse-seeing eye: r = 0.255, $p < 0.153$.

Figure 2. Postoperative National Eye Institute 25-Item Visual Function Questionnaire (VFQ-25) composite score vs. postoperative logMAR best-corrected visual acuity (BCVA) and postoperative letter contrast sensitivity in patients with proliferative diabetic retinopathy.
(Top left) VFQ-25 composite score vs. logMAR BCVA in the better-seeing eye: r = –0.520, $p < 0.0001$. (Top right) VFQ-25 composite score vs. logMAR BCVA in the worse-seeing eye: r = –0.632, $p < 0.0001$. (Bottom left) VFQ-25 composite score vs. letter contrast sensitivity in the better-seeing eye: r = 0.323, $p = 0.041$. (Bottom right) VFQ-25 composite score vs. letter contrast sensitivity in the worse-seeing eye: r = 0.374, $p = 0.014$.