Clinical Study

Combined Idiopathic Macular Hole Vitrectomy with Phacoemulsification without Face-Down Positioning

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Received 12 August 2011; Accepted 11 December 2011

Academic Editor: Denise Hug

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Purpose. To evaluate the outcome of combined vitrectomy with phacoemulsification without postoperative face-down positioning for idiopathic macular holes (MHs).

Methods. We studied 42 eyes of 42 cases followed up for 6 months postoperatively. MH closure rate and preoperative and postoperative visual acuity (VA) were evaluated.

Main Outcome Measures. MH closure rate and VA were evaluated after combined vitrectomy with phacoemulsification without postoperative face-down positioning.

Results. Of the 42 holes, 40 (95.2%) were initially closed, and the final closure rate was 100%. Compared with preoperative VA, the mean VA was significantly improved at 1 month and the improvement was maintained for at least 6 months postoperatively.

Conclusions. Combined vitrectomy with phacoemulsification without postoperative face-down positioning produced favorable anatomic and functional results for MH repair. Improvement in VA can be expected for up to at least 6 months postoperatively.

1. Introduction

Since 1991, stage 2, 3, and 4 idiopathic macular holes (MHs) have benefited from effective treatment as described by Kelly and Wendel [1]. The surgical procedure comprises pars plana vitrectomy, without cataract surgery, removal of adherent cortical vitreous, stripping of epiretinal membranes, total fluid-air exchange, and SF₆ gas tamponade, with strict occiput-up postoperative positioning for at least 1 week. This face-down positioning is uncomfortable, and extended periods of such positioning can also prolong immobilization, leading to ulnar nerve neuropathy [2] and pressure sores [3]. Tornambe et al. [4] first challenged the necessity of face-down positioning in MH surgery in 1997. In their study phakic eyes underwent combined cataract extraction with posterior chamber intraocular lens (IOL) insertion using 15% C₃F₆ gas and no internal limiting membrane (ILM) peeling, and the primary closure rate was 79%.

We previously reported the results of a pilot study of 21 eyes of 21 patients that underwent vitrectomy with ILM removal, and SF₆ gas tamponade without postoperative face-down positioning for MH [5]. The surgical procedure involved cataract extraction and IOL implantation in all phakic eyes (20 of 21 eyes). We present herein the results of a larger number of cases with a longer postoperative followup.

2. Patients and Methods

This retrospective case series included 42 eyes of 42 patients undergoing combined vitrectomy with phacoemulsification performed by a single surgeon (F. Y.), without postoperative face-down positioning. The procedures were performed at the Department of Ophthalmology, Toho University Ohashi Medical Center, from September 2006 to February 2011. Patients whose MH duration was longer than 6 months or unknown who had secondary MH, such as that due to trauma, chronic cystoid macular edema, or high myopia, and patients with clear lenses or pseudophakia were excluded from the study. After the risks and benefits of combined vitrectomy with phacoemulsification without postoperative face-down positioning had been thoroughly explained, written informed consent was obtained from all patients. The informed consent process and the corresponding consent forms were approved by the ethics review committee of Toho University Ohashi Medical Center. Institutional Review Board/Ethics
Committee approval was obtained. All procedures conformed to the tenets set forth in the Declaration of Helsinki.

MH was diagnosed by stereoscopic biomicroscopy and optical coherence tomography (OCT) and graded according to the Gass classification [6]. Of the 42 patients, 32 (76.2%) were women and 10 (23.8%) men, with mean age of 64.4 years (range, 52–79). Among the 42 eyes, 7 (16.7%) had stage 2, 27 (64.3%) stage 3, and 8 (19.0%) stage 4 MH. Mean MH size was 0.33 disc diameters (range, 0.2–0.6). MH had been present for an average of 2.5 months (range, 1–6 months). All 42 eyes were phakic.

The surgical procedure involved cataract extraction and IOL implantation before standard 20 G or 25 G three-port vitrectomy. No posterior capsule rupture or anterior capsule tear occurred during surgery. Core vitrectomy was followed by surgical creation of a posterior hyaloid detachment in eyes with either stage 2 or 3 MH. Indocyanine green (ICG) diluted to a concentration of 0.125% was used to aid ILM peeling. The ILM was peeled beyond a radius of 1 disc diameter to a concentration of 0.125% was used to aid ILM peeling.

Results

Of the 42 patients, 32 (76.2%) had stage 2, 27 (64.3%) stage 3, and 8 (19.0%) stage 4 MH. Indocyanine green (ICG) diluted to a concentration of 0.125% was used to aid ILM peeling. The ILM was peeled beyond a radius of 1 disc diameter to a concentration of 0.125% was used to aid ILM peeling.

The methods and results of various studies of combined vitrectomy with phacoemulsification without postoperative face-down positioning are summarized in Table 2. Vitrectomy in phakic elderly patients results in the development of nuclear sclerotic lens opacity [11] and large

4. Discussion

Guillaubey et al. [7] compared results between a face-down position and a seated positioning after MH surgery. They speculated that the mechanism of MH repair with the patient seated is as follows. Intraocular gas tamponade has two main properties: surface tension and buoyancy. Buoyancy is related to density and surface tension is related to the viscosity of the tamponade product. The surface tension represents contact among the entire interface with the retina. The buoyant force is maximal at the apex of the bubble, depending on gravity and tamponade product depth. After MH surgery, the buoyant force is of minor significance because the most important feature of the bubble is its surface tension, which leads to closure of the hole by keeping its edge dry, independent of buoyancy. Thus, with a sufficient volume of intraocular gas, the position of the eye after intraocular tamponade should not influence surface tension around the MH.

We hypothesized that it does not matter whether the patient is seated or otherwise without face-down positioning, that is, that positioning strategy is not relevant because the mechanism of MH repair is the same regardless of the postoperative position of the patient.

In 2001, Simcock and Scalia [8] reported a 90% success rate phacovitrectomy without prone posture for stage 2 and stage 3 MH using 20% C3F8 gas and no ILM removal. In 2008, Madgula and Costen [9] reported on 31 eyes with combined phacovitrectomy for MH using 16% C3F8 gas with ILM peeling without prone posturing. Primary anatomical closure of MH was achieved in 96.7% eyes. In 2010, Heath and Rahman [10] reported a 92.5% success rate of 23-gauge vitrectomy with phacoemulsification without face-down posturing, using 16% C3F8 gas with ILM peeling.

In the present series, surgery was performed with ILM peeling, 20% SF6 gas tamponade, and no face-down positioning and the anatomical success rate was 95.2% with a single operation and 100% with a single additional surgery. These findings suggest that combined vitrectomy with phacoemulsification without postoperative face-down positioning and 20% SF6 gas may be as effective for achieving hole closure as C3F8 gas. Patients can return earlier to their usual activities after surgery with SF6 gas because this gas is absorbed more quickly than C3F8 gas.

The methods and results of various studies of combined vitrectomy with phacoemulsification without postoperative face-down positioning are summarized in Table 2.
Table 1: Patient data.

| Patient | Age (years) | Eye | Symptom duration (months) | Pre operative VA (log MAR) | Post operative VA (log MAR) | Hole stage | Hole size (DD) | MH status | Confirmed time (days) |
|---------|-------------|-----|----------------------------|----------------------------|----------------------------|------------|----------------|-----------|----------------------|
| 1       | F 62        | R   | 1                          | 1                          | 0.2                        | 2          | 0.2            | Closed    | 8                    |
| 2       | F 75        | L   | 1                          | 0.5                        | 0.2                        | 3          | 0.2            | Closed    | 8                    |
| 3       | F 70        | R   | 1                          | 0.4                        | 0                          | 2          | 0.25           | Closed    | 4                    |
| 4       | F 62        | R   | 2                          | 1                          | 0.7                        | 3          | 0.3            | Closed    | 8                    |
| 5       | F 55        | L   | 1                          | 0.5                        | 0.2                        | 2          | 0.2            | Closed    | 7                    |
| 6       | F 73        | L   | 1                          | 1                          | 0.2                        | 4          | 0.5            | Closed    | 7                    |
| 7       | M 63        | L   | 1                          | 0.4                        | 0                          | 3          | 0.25           | Closed    | 9                    |
| 8       | F 69        | R   | 3                          | 0.5                        | 0.3                        | 2          | 0.3            | Closed    | 7                    |
| 9       | F 53        | R   | 5                          | 1                          | 0.5                        | 3          | 0.6            | Closed    | 7                    |
| 10      | F 68        | L   | 2                          | 1                          | 0.7                        | 3          | 0.5            | Closed    | 9                    |
| 11      | F 63        | L   | 5                          | 0.5                        | 0.2                        | 3          | 0.5            | Open      | 4                    |
| 12      | F 58        | L   | 1                          | 0.5                        | 0                          | 2          | 0.2            | Closed    | 6                    |
| 13      | F 64        | L   | 2                          | 0.3                        | 0.5                        | 3          | 0.4            | Closed    | 5                    |
| 14      | F 61        | R   | 2                          | 0.7                        | 0.5                        | 3          | 0.5            | Closed    | 6                    |
| 15      | F 65        | L   | 2                          | 0.3                        | 0.4                        | 3          | 0.3            | Closed    | 5                    |
| 16      | F 63        | R   | 2                          | 0.5                        | 0.2                        | 4          | 0.25           | Closed    | 8                    |
| 17      | F 64        | L   | 2                          | 1                          | 0.7                        | 4          | 0.5            | Open      | 6                    |
| 18      | F 59        | R   | 4                          | 0.5                        | 0.4                        | 4          | 0.3            | Closed    | 7                    |
| 19      | M 67        | L   | 6                          | 0.7                        | 0.4                        | 3          | 0.4            | Closed    | 8                    |
| 20      | M 70        | L   | 3                          | 0.4                        | 0.4                        | 3          | 0.2            | Closed    | 9                    |
| 21      | F 57        | L   | 6                          | 0.3                        | 0                          | 4          | 0.5            | Closed    | 9                    |
| 22      | F 59        | R   | 3                          | 0.3                        | 0.1                        | 3          | 0.3            | Closed    | 8                    |
| 23      | F 68        | L   | 5                          | 0.7                        | 0.3                        | 3          | 0.4            | Closed    | 6                    |
| 24      | M 60        | R   | 2                          | 0.7                        | 0.3                        | 2          | 0.2            | Closed    | 10                   |
| 25      | M 65        | L   | 2                          | 0.7                        | 0                          | 3          | 0.2            | Closed    | 5                    |
| 26      | M 68        | R   | 1                          | 0.6                        | 0.7                        | 3          | 0.4            | Closed    | 11                   |
| 27      | F 56        | R   | 4                          | 0.2                        | 0                          | 4          | 0.3            | Closed    | 7                    |
| 28      | M 58        | R   | 3                          | 0.7                        | 0.1                        | 3          | 0.3            | Closed    | 8                    |
| 29      | F 72        | L   | 1                          | 0.6                        | 0.4                        | 3          | 0.3            | Closed    | 7                    |
| 30      | F 52        | L   | 4                          | 0.4                        | 0.1                        | 3          | 0.3            | Closed    | 8                    |
| 31      | F 65        | R   | 1                          | 0.7                        | 0.2                        | 4          | 0.2            | Closed    | 8                    |
| 32      | F 76        | R   | 3                          | 0.7                        | 0.2                        | 3          | 0.3            | Closed    | 9                    |
| 33      | M 72        | L   | 1                          | 0.7                        | 0.7                        | 3          | 0.3            | Closed    | 10                   |
| 34      | M 60        | R   | 2                          | 1                          | 0.5                        | 3          | 0.5            | Closed    | 11                   |
| 35      | F 70        | R   | 1                          | 0.4                        | −0.1                       | 3          | 0.2            | Closed    | 8                    |
| 36      | M 66        | R   | 2                          | 1                          | 0.3                        | 3          | 0.2            | Closed    | 7                    |
| 37      | F 62        | R   | 2                          | 0.5                        | 0.1                        | 4          | 0.3            | Closed    | 8                    |
| 38      | F 65        | L   | 5                          | 1                          | 0.4                        | 3          | 0.3            | Closed    | 6                    |
| 39      | F 66        | R   | 1                          | 1                          | 0.3                        | 3          | 0.2            | Closed    | 8                    |
| 40      | F 54        | L   | 2                          | 0.2                        | 0.2                        | 3          | 0.2            | Closed    | 8                    |
| 41      | F 79        | R   | 1                          | 0.7                        | 0.2                        | 2          | 0.3            | Closed    | 10                   |
| 42      | F 69        | L   | 6                          | 1                          | 0.4                        | 3          | 0.6            | Closed    | 9                    |

M: male, F: female, L: left, R: right, VA: visual acuity, log MAR: logarithm of minimum angle of resolution, DD: disc diameter, MH: idiopathic macular hole, MH status: MH status after first surgery, confirmed time: time at which MH closure or non-closure was confirmed postoperatively.

long-acting gas to fill in the vitreous cavity can induce a more immediate “gas” cataract. All elderly phakic patients undergoing MH surgery will therefore develop cataracts. Combined vitrectomy with phacoemulsification has many advantages for both the patient and surgeon [12–14]. The patient does not need to return for additional surgical procedures and the surgeon does not need to perform a technically difficult operation. This is due to the lack of vitreous support which may result in unstable anterior chamber depth and variable pupil size during cataract surgery [15]. In patients
with clear lenses, vitrectomy without phacoemulsification with postoperative face-down positioning for a few days was performed so that they did not develop cataracts.

In this study, iatrogenic retinal tears occurred intraoperatively in 14 (33.3%) eyes, and 3 (7.1%) of these patients had postoperative rhegmatogenous retinal detachment. This rate appears to be higher, but Hotta et al. [16] reported that patient with peripheral retinal breaks or retinal detachment had significantly shorter duration of MH symptoms (3.2 months) than those without these complications (10.0 months). In the present series, MH had been present for an average of 2.5 months (range, 1–6 months). We plan to find between iatrogenic retinal tears or rhegmatogenous retinal detachment and duration of MH in the near future.

Combined vitrectomy with phacoemulsification, ILM removal and SF₆ gas tamponade followed by no face-down positioning achieved favorable anatomical and functional results. These surgical methods may spare patients the potentially unnecessary inconvenience of postoperative face-down positioning.

The limitations of our study include the lack of a concurrent control group and the fact that a single vitreoretinal surgeon performed all procedures. Therefore, there are no data to compare the results between different surgical procedures or between surgeons for evaluating the accuracy of the success rate.

In conclusion, in 42 eyes of 42 patients, combined vitrectomy with phacoemulsification, ILM peeling, and SF₆ gas tamponade for MH without postoperative face-down positioning achieved favorable anatomical and functional results. These surgical methods may spare patients the potentially unnecessary inconvenience of postoperative face-down positioning.

**Conflict of Interests**

No conflicting relationship exists for any authors. The authors have no proprietary or commercial interest in any materials discussed in this paper.

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**Table 2: Methods and results of studies of combined vitrectomy with phacoemulsification without postoperative face-down positioning.**

| Study | Year | Gas used | ILM peeling | Hole stage (no. of eyes) | Primary (final) success rate | Followup (months) |
|-------|------|----------|-------------|--------------------------|-----------------------------|------------------|
| Tornambe et al. [4] | 1997 | 15% C₂F₆ | No | 2, 3, and 4 (33) | 79% (85%) | 6–40 |
| Simcock and Scalia [8] | 2001 | 20% C₂F₆ | No | 2 and 3 (20) | 90% | 3–36 |
| Madgula and Costen [9] | 2008 | 16% C₂F₆ | Yes | 2, 3, and 4 (31) | 96.7% (100%) | 10 |
| Heath and Rahman [10] | 2010 | 16% C₂F₆ | Yes | 3 and 4 (40) | 92.5% | 2–12 |
| Present study | | 20% SF₆ | Yes | 2, 3, and 4 (42) | 95.2% (100%) | 6 |