The Effect of Early Postoperative Prone Posturing in the Operating Room and Delayed Prone Posturing in the Service on Postoperative Success in Macular Hole Surgery: A Retrospective Cross-sectional Study

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ABSTRACT

Purpose: It was aimed to determine whether there is a difference between the anatomical and visual surgical results of patients underwent surgery for a macular hole who were immediately placed in the prone position in the operating room at the end of the surgery, or placed in the delayed prone position after transfer to the inpatient service.

Materials and Methods: This retrospective observational study included 85 patients who had surgery for macular hole using 25 Gauge vitrectomy system. At the end of surgery, 12% C3F8 or 15% SF6 gas tamponade were used. We compared 42 patients (Group 1) who were placed in the prone position immediately and 43 patients who were placed in the prone position after an average of 15 minutes (12-18 minutes) (Group 2). The best corrected visual acuity (BCVA) at preoperative and postoperative 3 months were compared and anatomical success rates were determined. Descriptive analyses, Chi-square, Kruskal-Wallis and Mann-Whitney U tests were used.

Results: Anatomical success rate was 95.2% in Group 1 and 93.1% in Group 2. There was no significant difference in anatomical success and BCVA results between the patients who immediately placed in the prone position in the operating room and the patients who were placed in the delayed prone position ($p>0.05$). There was no statistically significant difference between type of tamponade material used and the BCVA on postoperative month 3 ($p>0.05$).

Conclusion: This suggests that the rigidity in the prone position is not absolute and the cumulative effect in the early postoperative period is important.

Keywords: Gas tamponade, Macular hole, Prone position, Visual acuity.

INTRODUCTION

The incidence of primary macular hole has been reported as 7.9: 100,000.[1] Although there is no consensus on optimal duration of prone position, it was reported as one week in preliminary studies.[2] However, in recent studies, it was shown that minimum one-week prone positioning has no superiority to minimum 3-days prone positioning.[3] Thus, minimum 3-days prone positioning procedure is frequently preferred today. However, the lack knowledge how much time the patients spend out of prone positioning makes patient compliance and success unclear. It is though that duration of prone position and amount of gas expanded increase likelihood closure or macular hole.[4] The surgical success rate was reported as 79% in patients with incompliance to prone position.[5] Thus, the surgeon should emphasize the importance of compliance to prone position in the recovery. Strict adherence to prone positioning and maintaining dryness of macular hole region are highly important in the recovery of macular hole.[6]

Although it is controversial how duration of positioning after surgery is important, it is generally considered that long-term prone positioning have favorable effect on outcomes. Sato et al. emphasized that macular hole was completely closed after 3-days prone positioning and that

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there was no cumulative effect and strict adherence at initial period was important.[7] Macular hole can be defined as vitrectomy, peeling or peeling plus reversing inner limiting membrane and intravitreal tamponade application. Many surgeons prefer intravitreal perfluoropropane gas (C_3F_8) or sulfur hexafluoride gas (SF_6) as tamponade at the end of procedure. Some surgeons prefer silicone oil as tamponade as they think that strict adherence to prone positioning is difficult; however, most surgeons do not prefer silicone oil as there is a need for second surgery for removing silicone oil. Although complete intravitreal fluid-gas exchange is performed at the end of surgery, there is minimal residual intraocular fluid and it is assumed that recovery process will be influenced negatively due to fluid-hole interaction if prone positioning recommendations are not adhered. A bridge is formed between margins of hole and pigment epithelium by glial cells while hole is recovering. The bridging process is impaired if fluid contacts with the region.

Given the controversy on this issue, it was aimed to determine whether there is a difference between the anatomical and visual surgical results of patients underwent surgery for a macular hole who were immediately placed in the prone position in the operating room at the end of the surgery or those placed in the delayed prone position after transfer to inpatient ward at sitting position in our study. Given the lack of consensus about duration and rigidity of prone positioning, a question has arisen whether time to prone positioning have influence on surgical outcomes. In our study, it was aimed to assess whether 15-minutes of transfer time has influence on outcomes and importance of rigidity in prone positioning.

MATERIALS AND METHODS

This retrospective, observational study was designed in accordance to tenets of Helsinki Declaration. The study was approved by Ankara Health Research and Application Center of Health Sciences University. The study included patients with macular hole who presented to Retina Unit of Ankara Ulucanlar Eye Research and Application Center of Health Sciences University between January, 2020 and December, 2021 and had indication for surgery. The diagnosis of macular hole was made using biomicroscopic fundus examination optical coherence tomography (OCT) after comprehensive ophthalmological examination.

We screened patient files in the retina unit and extracted data regarding age, gender, diagnoses, best-corrected visual acuity (logMAR) at preoperative period and on postoperative month 3, anatomical success on month 3 by OCT, tamponade material used and time to prone positioning. In all patients, 5-days prone positioning was recommended at postoperative period.

The study included patients with primary macular hole who had no history of previous ocular surgery, corneal disease or scar; no cataract according to LOCS classification; no ocular comorbidity and no history of ocular trauma. Overall, 85 eyes of 85 patients with primary macular hole on OCT regardless of stage according to International Vitreomacular Traction Study (stage 2, 3, 4) were included to the study. Only patients with primary macular hole were included to the study and those with traumatic macular hole were excluded. All patients included had stage 3 or 4 macular hole with width ranging from 400-600 µm. Patients with macular hole>600 µm were excluded since routine surgery was not feasible.

In the study, 42 patients (group 1) who were immediately placed to prone position in operating room and 43 patients (group 2) who were placed prone position at inpatient ward with 15-minutes delay (12-18 minutes; including transfer time) were compared. Of the patients with indication of vitrectomy due to macular hole, those in group 1 were operated by a single, experienced surgeon (MYT) while those in group 2 were operated by another experienced surgeon (MC) using Constellation Vitrectomy® (Alcon, Fort Worth, Texas, USA) 25 gauge vitrectomy system (Both surgeons had experience of vitrectomy more than annual 10,000 cases over 15-years period). For akinesia and anesthesia, Atkinson needle with 4 cc lidocaine (20 mg/mL) plus epinephrine (0.0125 mg/mL were injected at one-third lateral to inferior eyelid via retrobulbar route in patients undergoing vitreoretinal surgery. After sterile preparation, vitrectomy plus peeling of inner limiting membrane plus tamponade were administered as surgical procedure in all patients. Triamcinolone acetate was used for vitreous clearance during vitrectomy while Brilliant blue (ILM Blue; Dorc International, Zuidland, The Netherlands) was used during peeling of inner limiting membrane. At the end of surgery, 12% C_3F_8 or 15% SF_6 were preferred as tamponade.

Statistical analyses were performed using SPSS version 23.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics are presented as min-max, mean, standard deviation, count and percent (%). Normality of distribution was assessed using Shapiro-Wilk test. Data were analyzed using Chi-square test, Mann Whitney U test and Kruskal-Wallis test. A p value<0.05 was considered as statistically significant.

FINDINGS

Table 1 presents baseline demographic characteristics of the patients who were immediately placed prone position

Table 1: *Preoperative demographic data of groups according to time to prone positioning*		
	Group 1	Group 2
Number of eyes	42	43
Gender		
Male	18	18
Female	24	25
Age. years. mean± standard deviation. range	59.8 ±2.27 (18-78)	65.1 ±1.70 (24-79)
Side		
Right	31	30
Left	11	13

after surgery and transferred to ward at prone position (group 1) and those who were placed to prone position after transfer to ward at sitting position (group 2). In group 2, transfer time to ward was calculated and determined as 15 minutes (12-18 minutes) in average.

In the study, we assessed 42 eyes of 42 patients in the group 1 and 43 eyes of 43 patients in the group 2. Mean and median ages were 59.8 ±2.27 years (18-78 years and 65 years in the group 1 and 65.1±1.70 years (24-79 years) and 67 years in the group 2, respectively. There were 18 men and 24 women in the group 1 while 18 men and 25 women in the group 2. There was no significant difference in age and gender between group 1 and 2 ($p>0.05$).

In the group 1, 28 of 42 cases were pseudophakic while 14 were phakic. In the group 2, 30 of 43 cases were pseudophakic while 13 were phakic. Given the advanced age and postoperative cataract progression, phacoemulsification plus intraocular lens implantation was performed in all phakic patients. There was no significant difference between groups.

Table 2 presents distribution of tamponade used across groups. Overall, C_3F_8 were used in 62 patients while SF_6 were used in 23 patients. There was no significant difference between groups regarding tamponade used ($p>0.05$). The C_3F_8 was given in 30 cases in the group 1 while 32 cases in the group 2, indicating no significant difference. The SF_6 was given in 12 cases in the group 1 while 11 cases in the group 2, indicating no significant difference.

On postoperative month 3, it was found that idiopathic macular hole was closed in 94.1% of all patients. It was seen that anatomical success was achieved in 40 (95.2%) of 42 patients in the group 1 and 40 (93.1%) of 40 patients in the group 2. Overall, there was anatomical failure in 5 patients.

Table 3 presents BCVA values on month 3 in both groups.

Table 2: *Time to prone positioning and best corrected visual acuity (BCVA) after surgery*		
	Preoperative BCVA (logMAR) (Mean ± Standard deviation)	Postoperative BCVA (logMAR) (Mean ± Standard deviation)
Group 1	1.18 ±0.31	0.55 ±0.38
Group 2	1.19 ±0.27	0.60 ±0.43

Table 3: *Tamponade materials used in groups according to time to prone positioning after surgery*					
			Time to prone positioning		Total
			Group 1	Group 2	
	C3F8	(n)	30	32	62
		(%)	71.4%	74.4%	72.9%
	SF6	(n)	12	11	23
		(%)	28.6%	25.6%	27.1%
Total		(n)	42	43	85
		(%)	100.0%	100.0%	100.0%

The baseline BCVA was 1.18±0.31 logMAR in the group 1 and 1.19±0.27 logMAR in the group 2. There was no significant difference in baseline BCVA between groups (p>0.05). On month 3, mean BCVA was 0.55±0.38 logMAR in the group 1 and 0.60±0.43 logMAR in the group 2, indicating no significant difference (p=0.567).

Postoperative findings were assessed on month 3. There was type 1 closure in 90 cases and type 2 closure in 5 cases. There was U-type closure in 18 cases, V-type closure in 12 cases, W-type closure in 10 cases an type 2 closure in 2 cases in the group 1 whereas U-type closure in 16 cases, V-type closure in 14 cases, W-type closure in 10 cases and type 2 closure in 3 cases in the group 2, indicating no significant difference between groups. There was ellipsoid zone and external limiting membrane defects particularly in V-type closure. The visual acuity was associated with closure pattern. Type 1 and U-type closure showed best postoperative visual acuity. It was found that the postoperative visual acuity was better in patients with better baseline visual acuity and macular hole diameter of 400-500 µm.

Table 4 presents type of tamponade used and mean BCVA values (logMAR). There was no significant difference in baseline visual acuity between groups stratified by tamponade used (p>0.05). No significant difference was detected in visual acuity on postoperative month 3 according to tamponade used (p>0.05).

DISCUSSION

In the meta-analysis including 227 patients, Hu et al. (2016) found that macular hole was closed in lesser extent in patients with incompliance to prone positioning.[8] In another meta-analysis including 358 patients (2019), it was found that closure rate was higher in patients strictly adhered to prone positioning.[9] Again, in another meta-analysis including 640 patients, Tsai et al. (2021) found that anatomical closure rate in macular hole >400 µm was significantly higher in patients adhering to prone positioning; however, authors found no significant difference regarding visual acuity.[10] There are other studies reporting that anatomical and visual outcomes are not in correlated.[11] Although anatomical defect is closed by closure of tip of macular hole after surgery, losses in ellipsoid zone and photoreceptor outer zone on OCT may hamper improvement in visual acuity.

There is no consensus about duration of prone positioning after macular hole surgery. There is a meta-analysis reporting that 3-days prone positioning is sufficient in macular hole >400 µm[9]; however, there is another meta-analysis reporting that duration of prone positioning should be 5 days in macular hole >400 µm.[10] In the study by Madi et al., it was reported that optimal duration should be 5 days.[12] In a study including limited number of patients, it was reported that 6-days prone positioning sufficient in macular hole>400 µm.[13] It was reported that presence of macular hole >400 µm is an unfavorable risk factor for closure.[14] It was reported that surgical success was low in cases with incompliance to postoperative prone positioning and those in which silicone oil was used.[5,15] Although patients are informed about importance of prone positioning, it is impossible to collect objective data regarding compliance to prone positioning in routine practice. In elderly patients, compliance is lower due to comorbid diseases and articular problems. In the literature, one study was performed by designing a device to collect objective data; in the study, it was found that the patients were at real prone position in less than one-half of time considered as compliant by patients.[16] However, the device has failed to gain popularity since 2002. No objective assessment was performed in majority of studies evaluating efficacy of positioning after macular hole surgery. In our study, all patients were recommended to maintain prone positioning for 5 days after surgery.

In our study, no significant difference was observed in anatomical and visual surgical outcomes between patients who were placed to prone position immediately after surgery at operating room and those who placed to prone position after transfer to inpatient ward at sitting position. In our study, the fact that there was no significant difference in anatomical success and visual acuity on postoperative month 3 suggests that cumulative prone positioning was the factor effective in success. In the literature, there is a general outcome of success although there are varying success rates with whether or not prone positioning was

Table 4: Tamponade materials used and best-corrected visual acuity (BCVA)

	Preoperative BCVA (logMAR) (Mean ± Standard deviation)	Postoperative BCVA (logMAR) (Mean ± Standard deviation)
C3F8	1.18 ±0.30	0.57 ±0.42
SF6	1.13 ±0.18	0.54 ±0.34

employed and duration of prone positioning. Given this, it can be concluded that cumulative effect at early postoperative period is important and that a strict positioning is not possible and warranted even Ovalı et al. reported that anatomic success could be achieved at the end of day.[17]

In our study, secondary conclusion is that tamponade materials used had no superiority to each other. Modi et al. reported that there was no difference in anatomical and visual outcomes between C_3F_8 and SF_6 regardless of macular hole stage but less cataract and ocular hypertension were observed less commonly with SF_6.[18] Casini et al. also reported similar results.[19] No significant difference was observed in surgical success silicone oil and C_3F_8.[20]

This study has some limitations including lack of objective assessment of duration of prone positioning and subgroup analysis by stratifying size of macular hole.

CONCLUSION

No significant difference was found in anatomical success and visual acuity on month 3 between group 1 and 2. Tamponade materials used had no superiority to each other regarding visual acuity.

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