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Professional paper

The Effect of Vitrectomy with Silicone Oil Tamponade on Intraocular Pressure and Anterior Chamber Morphology

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A B S T R A C T

We measured the tamponading effect of silicone oil, saline and air after vitrectomy, on intraocular pressure and aqueous humor outflow in 85 patients with highly proliferative retina and vitreous changes. Silicone oil as retinal tamponading agent after vitrectomy was used in 45 patients, and saline or air in 39 patients. The mean intraocular pressure measured at one month after treatment was greatly elevated in patients with silicone oil tamponade as compared to those with saline or air tamponade. At 6 and 12 months examinations, mean intraocular pressures were compared in these two groups of patients. Gonioscopy revealed silicone oil emulsification and presence of emulsified bubbles in the anterior chamber in 22.22% of patients, and narrowing of the chamber angle in several patients with silicone oil tamponade. Intraocular pressure elevation following vitrectomy with silicone oil tamponade was found to be of transient rather than permanent nature, since it regressed after silicone oil removal. This transient elevation was due to silicone oil tendency to emulsify. Silicone oil bubbles changed the morphology of the anterior chamber angle and fine trabecular structures by creating a barrier to aqueous humor outflow.

Introduction

Pars plana vitrectomy with intravitreal silicone oil tamponade has been recognized as a successful mode of treatment in cases of complicated retinal detachments that led to blindness almost without exception before the introduction of this operative method in routine clinical practice[1–5]. For silicone tamponade we use silicone oil which, when introduced into the eye, serves as an eyeball stabilizer[6].

Elevated intraocular pressure (IOP) in early postoperative period and the onset

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of secondary glaucoma following vitrectomy with silicone tamponade, which persists even after the silicone oil is removed from the eye, compromise the operative treatment outcome, as no recovery of visual acuity is achieved in spite of good vitrectomy results in the posterior segment of the eye[7–9]. The incidence and etiopathogenesis of glaucoma developing after silicone oil tamponade is difficult to estimate from relevant literature data[7–9].

Early postoperative IOP elevation occurs in 7–48% of eyes, due to pupillary blockade, previous glaucoma, inflammation, or migration of silicone oil bubbles into the anterior chamber of the eye[9–11].

The purpose of this paper is to help explain, according to our own results, the incidence and mechanism of glaucoma onset as a complication of pars plana vitrectomy with silicone tamponade, with special reference to the effect of silicone oil tamponade on the anterior chamber morphology.

Patients and Methods

Presented are the results of vitrectomy surgical procedures performed in 84 patients at the Department of Ophthalmology, Zagreb University Hospital Center between September 1998 and January 1999.

Vitrectomy with silicone oil tamponade was performed in 45 (53.57%) patients (Group 1). Decision on the use of silicone oil depended on the size and site of retinal lesion, grade of proliferative vitreoretinopathy or diabetic proliferative retinopathy progression, and the need for inferior or posterior tamponade. Indications for the use of silicone oil were the advanced stage of proliferative vitreoretinopathy with retinal lesions and vitreous organization, as a result of retinal detachment and eye injury; and the advanced stage of proliferative retinopathy with hemophthalmus and vitreous organization.

Post-vitrectomy tamponade with air or saline was used in 39 (46.43%) patients with less pronounced proliferative alterations (Group 2). There were no cases of concurrent development of chronic glaucoma of either open or closed angle beside the underlying disease.

In Group 1 (45), patients were divided according to diagnosis as follows: proliferative diabetic retinopathy (20, 44.44%), proliferative vitreoretinopathy following retinal detachment (17, 37.78%), proliferative vitreoretinopathy due to eye injury (5, 11.11%), and proliferative vitreoretinopathy as a complication of uveitis (3, 6.67%).

In Group 2 (39), patients were divided according to diagnosis as follows: proliferative diabetic retinopathy (22, 56.41%), proliferative vitreoretinopathy due to eye injury (8, 20.51%), proliferative vitreoretinopathy following retinal detachment (6, 15.39%), and proliferative vitreoretinopathy as a complication of uveitis (3, 7.70%). Statistical analysis showed no significant difference between these two groups of patients.

All study patients were observed for 12 months after surgical procedure. In all patients, ophthalmologic examinations and IOP measurements were performed before treatment and at 1, 6 and 12 months after treatment. Gonioscopy (anterior chamber examination on a slit lamp by the use of Goldman's monomirror gonioscopic prism) was performed before surgery and at 1 and 6 months after surgery.

Statistical analysis

Two groups of patients were compared according to following variables:

- IOP values before, and at 1, 6 and 12 months after operation (comparisons

were made within each group and between the groups);

- gonioscopy findings before, and at 1 and 6 months after operation (within each group and between the groups).

Two methods of comparison were used:

- comparison of distribution irrespective of their numerical parameters (Kolmogorov-Smirnov test); and
- comparison of parameters (e.g., arithmetic mean, standard deviation).

For the assessment of gonioscopy findings statistical difference between two relative frequencies was determined.

Results

Intraocular pressure values in Group 1 and Group 2

Preoperative IOP values (mmHg) in two groups of patients are presented in Figure 1. In Group 1 and 2, mean IOP values were 14.86 ± 2.55 and 16.48 ± 3.80 mmHg, respectively. There was no statistically significant difference between the groups.

Figure 2 shows IOP values in two groups at one month after treatment. The mean IOP value was 21.22 ± 8.31 mmHg in Group 1, and 16.48 ± 4.81 mmHg in Group 2. Statistical analysis yielded a significant difference between mean IOP values of two groups of patients. Thus, at one month after treatment, the mean IOP was higher in Group 1 (patients with silicone oil tamponade) than in Group 2 (patients with air or saline tamponade).

IOP values of both groups at six months after treatment are presented in Figure 3. Silicone oil used for retinal tamponade was removed after a mean of 7.6 (range 4–12) weeks. The mean IOP value was 17.35 ± 5.23 in Group 1 and 16.64 ± 5.01 mmHg in Group 2, indicating a decrease compared to the values measured at one month after treatment in Group 1. In Group 2, however, the IOP values were stable and approximately equal to the values recorded at one month after treatment.

Figure 4 shows IOP values measured in two groups of patients at 12 months after surgery. The mean IOP value was 16.27 ± 4.25 mmHg in Group 1, and 14.90 ± 6.24 mmHg in Group 2.

Figure 5 shows the mean IOP patterns recorded in two groups of patients before, and 1, 6 and 12 months after surgery. Notable is the abrupt IOP elevation recorded in Group 1 at one month after surgery.

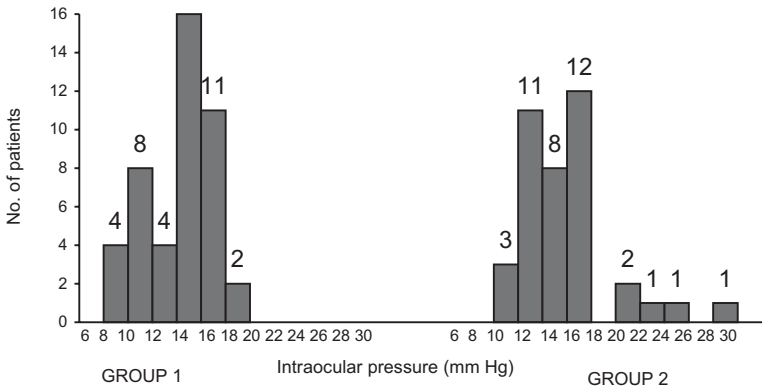

Fig. 1. Preoperative values of intraocular pressure in two groups of patients.

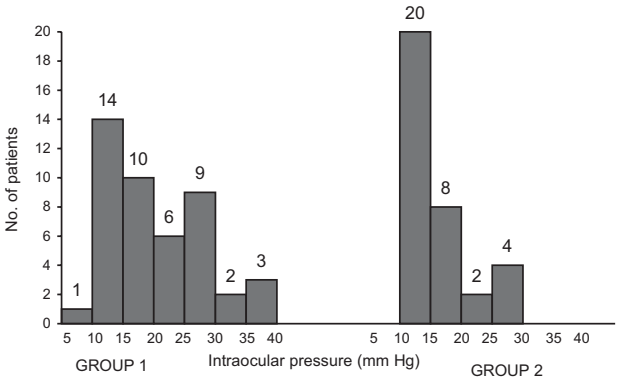

Fig. 2. Intraocular pressure values in two groups of patients at one month after treatment.

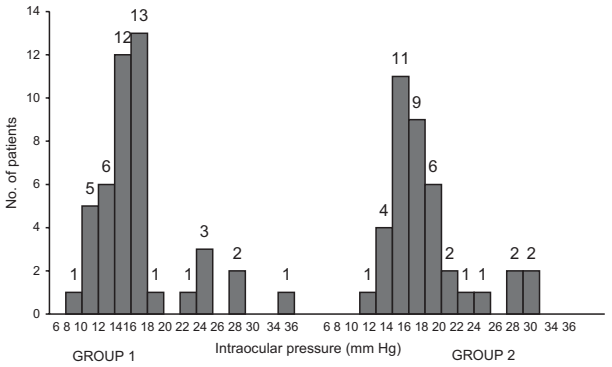

Fig. 3. Intraocular pressure values in two groups of patient at 6 months after treatment.

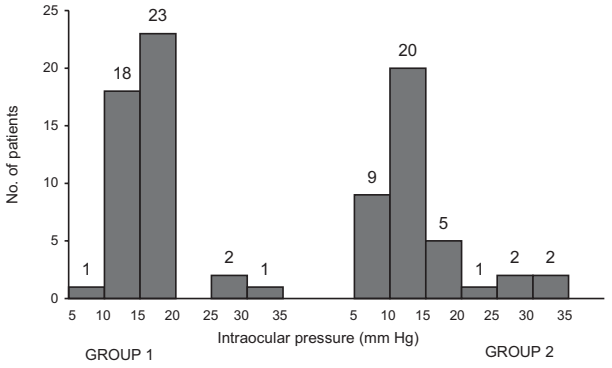

Fig. 4. Intraocular pressure values in two groups of patient at 12 months after treatment.

Gonioscopy alterations in Group 1 and 2

Preoperative gonioscopy findings of the degree of angle opening and possible presence of adhesions in two groups are presented in Figure 6. Open angle of the anterior chamber (opening 3) was present in a majority of patients from both groups, while narrow angle and adhesions were found in only few patients (patients with uveitis and eye injury, i.e. three patients from Group 1 and two patients from Group 2).

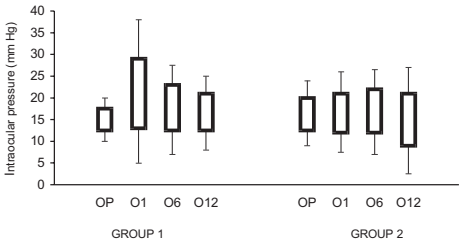

Fig. 5. Patterns of preoperative and postoperative mean intraocular pressure (IOP) values in two groups of patients. (OP – mean preoperative IOP, O1 – mean IOP at one month after treatment, O6 – mean IOP at 6 months after treatment, O12 – mean IOP at 12 months after treatment).

Figure 7 presents the findings of the degree of angle opening and possible adhesions in two groups at one month after surgery. In Group 1 the degree of angle opening changed in only two patients, while adhesions were present in four patients (*versus* three patients before surgery). It should be noted that in this group bubbles of emulsified silicone oil in the anterior chamber with open angle were found in ten (22.22%) patients. In Group 2, however, the gonioscopy performed one month after surgery showed no major alterations.

Figure 8 shows gonioscopy findings in two groups of patients six months after surgery. Group 1 showed no major difference in the degree of angle opening, except for two patients in whom the previously open angle had closed, i.e. findings corresponded to that obtained at one month after surgery. Adhesions in the anterior chamber angle were detected in eight (13.33%) patients. In two of them, adhesions caused obstruction of the aqueous outflow, whereas the remaining six patients had normal aqueous flow in spite of adhesions. Changes of the anterior

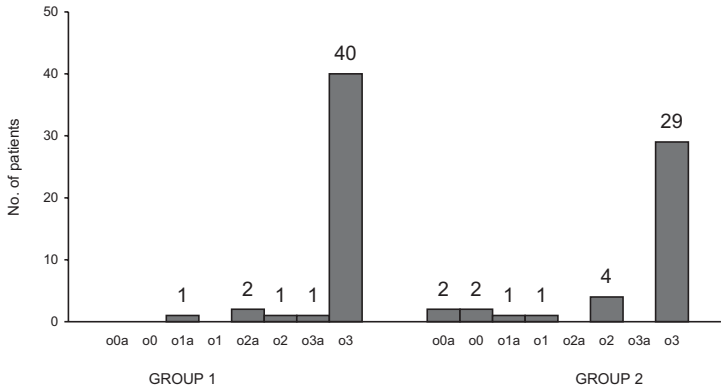

Fig. 6. Preoperative gonioscopy findings (the degree of angle opening and adhesions) of two groups of patients.

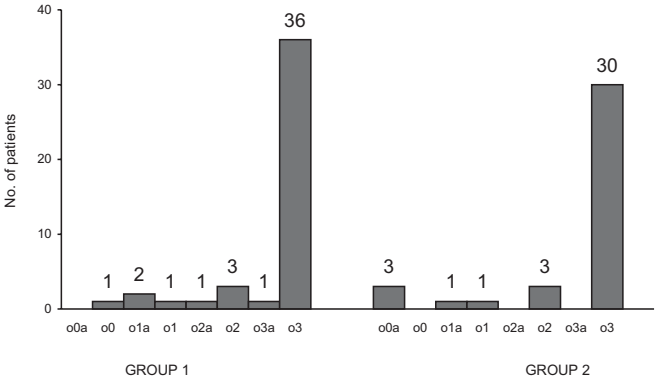

Fig. 7. Gonioscopy findings at one month after treatment (the degree of angle opening and adhesions) in two groups of patients. (o1–o3, the degree of angle opening, a – adhesions in the anterior chamber).

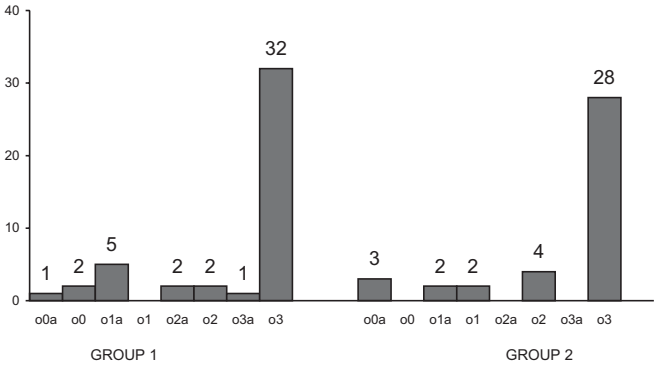

Fig. 8. Gonioscopy findings at six months after treatment (the degree of angle opening and adhesions) in two groups of patients. (o1–o3 – the degree of angle opening, a – adhesions in the anterior chamber).

chamber angle were postoperatively observed in five patients form Group 2, and included closure in three, and narrowing due to massive presence of adhesions in two patients. However, statistical analysis yielded no significant difference between the preoperative findings of the degree of angle opening and presence of adhesions in the anterior chamber angle in either group. There was no statistically significant difference in the degree of angle opening and presence of adhesions between patients with silicone oil tamponade (Group 1) and those with air or saline tamponade (Group 2).

Discussion and Conclusion

First observations of IOP elevations associated with silicone tamponade date back to the time when silicone oil was used as an instrument. In 1967, Watzke was first to record an increase in IOP upon intraocular silicone oil injection[12].

In a prospective study of 121 patients, a greater incidence of IOP elevation and secondary glaucoma was recorded during a three-year follow-up in patients with silicone oil tamponade as compared to those in whom the tamponade was removed[13]. This observation was thereafter confirmed in many studies[14,15]. Subsequent studies showed a correlation between the presence of emulsified oil bubbles in the anterior chamber and IOP elevation[16]. Other studies, however, noted the emulsified silicone oil bubbles in the anterior chamber after vitrectomy in 56%, and IOP elevation in not more than 10% of patients[17]. One study, which included 415 patients, showed that IOP elevation after vitrectomy with silicone oil tamponade most commonly occurred in the early postoperative period, and progressed into permanent secondary glaucoma in only 6% of patients[18]. Early postoperative glaucoma may occasionally develop due to pupillary obstruction caused by silicone oil bubbles or closure of lower Ando's iridectomy[19].

Our study showed that mean values of IOP measured at one month after surgery significantly exceed the preoperative values in patients with post-vitrectomy silicone oil tamponade. Their mean IOP values measured at one month after surgery were also higher than those recorded at that same time in patients with post-vitrectomy air or saline tamponade. The IOP measurements at 6 and 12 months after surgery, when silicone oil was removed from patients' eyes, showed that mean IOP values are similar in two groups of patients and do not differ much from the initial, preoperative values.

Gonioscopy was used to assess the potential effect of silicone oil tamponade on the morphology of the anterior segment of the eye, especially the angle of the anterior chamber. Preoperative examinations with monomirror Goldman's gonioscopy prism revealed a narrow chamber angle and presence of adhesions between the iris and the angle in several patients (three patients from Group 1 and two patients from group 2 with the diagnosis of uveitis and eye injury). All other patients had open angle of the anterior chamber (degree 2 and 3). One month after surgery, narrowing of the angle and adhesions were observed in four patients from Group 1, which was not considered a significant finding, as it did not differ significantly from the proportion of patients with narrowed angle in Group 2. These examinations revealed the emulsified oil bubbles scattered in a pearl-like fashion in the upper area of the angle at the trabecular level, which was recorded in ten (22.22%) patients from Group 1. Six months after surgery, upon silicone oil removal, bubbles disappeared, but the adhesions in the anterior chamber persisted in eight patients. In two of them, the adhesions transformed into thick fibrovascular membranes that obstructed aqueous humor outflow. The presence of silicone oil in the anterior chamber of the eye may exert a mechanical effect on aqueous outflow through the aqueous draining system, thus leading to IOP elevation. One theory suggests that silicone oil, transported by the aqueous, reaches the trabecular system, where it is phagocytized by macrophages, while the accumulation of macrophages within the trabecular space results in an increased resistance to aqueous outflow and IOP elevation[19]. Pathohistologic examination of enucleated eyes with silicone oil revealed silicone-filled vacuoles in corneal endothelial cells, anterior chamber cells, and trabecular system, along with elements indicating the presence of foreign body reaction against silicone oil[19,20].

According to the results, silicone oil tamponade caused a transient IOP elevation in the early postoperative period. The values of IOP returned to preoperative levels after the removal of silicone oil

from the eye. In some patients, the effects of silicone oil tamponade on the anterior segment morphology were the narrowing of the angle and the development of adhesions between the iris and anterior chamber angle structures, with consequential IOP elevation, however, this finding could not be taken as statistically significant. The occurrence of emulsified silicone oil bubbles in the anterior chamber of the eye, which caused mechanical obstruction to aqueous humor flow with consequential IOP elevation, was recorded in 22.22% of patients with silicone oil tamponade.

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UTJECAJ VITREKTOMIJE SA SILIKONSKOM TAMPONADOM NA OČNI TLAK I MORFOLOGIJU PREDNJE SOBICE

SAŽETAK

U radu su prikazani rezultati ispitivanja tamponirajućeg učinka silikonskog ulja, fiziološke otopine i zraka nakon vitrektomije u 85 bolesnika s visokim stupnjem proliferativne vitreoretinopatije. U 45 bolesnika za tamponadu je uporabljeno silikonsko ulje a u 39 bolesnika fiziološka otopina ili zrak. Srednja vrijednost očnog tlaka mjerenog jedan mjesec nakon zahvata bila je značajno povišena u bolesnika u kojih je tamponada izvedena silikonskim uljem, u usporedbi sa srednjom vrijednosti očnog tlaka u bolesnika u kojih je izvedena fiziološkom otopinom ili zrakom. Na kontrolnim pregledima 6 i 12 mjeseci nakon zahvata, srednja vrijednost očnog tlaka bila je podjednaka u

obje skupine bolesnika. Gonioskopskim pregledom nađeni su mjehurići emulzificiranog silikonskog ulja u prednjoj sobici oka u 22,22% bolesnika u kojih je provedena tamponada silikonskim uljem. Povišenje očnog tlaka nakon vitrektomije sa silikonskom tamponadom je prolazne naravi, jer se nakon vađenja silikonskog ulja iz oka vrijednosti očnog tlaka ne razlikuju značajno prema prijeoperacijskim vrijednostima, kao ni prema vrijednostima očnog tlaka u skupini bolesnika u kojih je tamponada izvedena fiziološkom otopinom ili zrakom. Emulzificirani mjehurići silikonskog ulja u prednjoj sobici oka nakon vitrektomije sa silikonskom tamponadom predstavljaju barijeru otjecanju očne vodice te dovode do prolaznog povećanja očnog tlaka.