

The Effect of the Use of Vent Cannula on Intraocular Pressure in the Early Postoperative Period in Silicone Oil Tamponade Application Due to Rhegmatogenous Retinal Detachment

Kamil Yavuzer¹ , Mehmet Çıtırık²

ABSTRACT

Purpose: To compare the effects of the evaluation of adequate silicone oil injection by the infusion cannula or vent cannula at the end of the surgery on the intraocular pressure (IOP) in patients who underwent silicone oil tamponade due to rhegmatogenous retinal detachment (RRD).

Materials and Methods: We evaluated two different groups which underwent 5000 cSt silicone tamponade at the end of vitreoretinal surgery performed for RRD. There were 28 eyes (from 28 patients) in the group 1. In this group, the sufficient silicone oil in the vitreous was controlled by onset of silicone oil drainage from the infusion cannula at the end of the surgery and the injection process was terminated. There were 27 eyes (from 27 patients) in the group 2. In this group, silicone oil injection was terminated with the onset of silicone drainage in the vent cannula. Postoperative IOP controls were performed using a pneumotonometer.

Results: In group 1, the mean IOP was 20.25 ± 8.22 mmHg in group 1 and IOP was > 21 mm Hg in 10 patients (35.71%) on day 1 after surgery. In group 2, the mean IOP was 17.26 ± 6.11 mmHg and IOP was >21 mmHg in 4 patients (14.81%). There was a significant difference in IOP measured on day 1 after surgery between the two groups ($p = 0.018$). On week 1 after surgery, the mean IOP of the patients was 15.50 ± 4.16 mmHg in group 1 and 15.00 ± 4.33 mmHg in group 2 ($p = 0.858$). On month 1, mean IOP was 14.39 ± 3.70 mmHg in group 1 and 13.85 ± 3.98 mmHg in group 2 ($p = 0.935$).

Conclusion: The vent cannula, which has been introduced into vitreoretinal surgery in recent years, is advantageous in terms of IOP control in the early postoperative period and it provided better results when compared to follow-up with the onset of silicone drainage from infusion cannula.

Keywords: Infusion cannula, retinal detachment, silicone oil, vent cannula, vitreoretinal surgery.

INTRODUCTION

Silicone oil is a polymer consisted for siloxane (-Si-O-) repeats $[R_2-Si-O]_n$ and partially inner in chemical manner. The hydrophobic, clear fluid, which is generally termed as silicone oil, is technically hydrocarbon not oil¹. The silicone oil was first used for ocular surgery in an animal model in 1962 and has shown a significant development since its first application². In the ophthalmology practice, introduction of silicone oils with different physical characteristics ensure convenience to ophthalmologists³⁻⁷. Although it serves an intraocular tamponade, it has adverse

effects such as cataract, glaucoma, keratopathy, retinal toxicity or proliferative effects, particularly at long-term⁷.

Unlike gas tamponade, silicone oil is used as long-term endotamponade. Currently, 1000 centistoke (cSt) and 5000 cSt poly-dimethyl-ethyl-siloxane silicone oils are used most commonly in ophthalmology practice. The centistoke is a viscosity unit and represents resistance of fluid against deforming horizontal and vertical forces¹. In fact, there is no difference in power of tamponade between 1000 cSt and 5000 cSt silicone oils; however, high-viscosity

1- Assistant Prof., University of Health Sciences, Van Training and Research Hospital, Ophthalmology Clinic, Van, Turkey

2- Associate Prof., University of Health Sciences, Ankara Uluçanlar Eye Training and Research Hospital, Ankara, Turkey

Received: 22.09.2020

Accepted: 30.11.2020

Ret-Vit 2021; 30:227-232

DOI: 10.37845/ret.vit.2021.30.40

Correspondence Address:

Kamil Yavuzer

University of Health Sciences, Van Training and Research Hospital, Ophthalmology Clinic, Van, Turkey

Phone: +90 506 325 1336

E-mail: dr.kamilyavuzer@hotmail.com

silicone oil is less emulsified when compared low-viscosity silicone oil⁸. Due to avoidance complications such as early emulsification and glaucoma, 5000 cSt silicone oil is preferred in case of long-term tamponade. The intraocular pressure (IOP) elevation at early postoperative period is attributed to excessive amount of silicone oil injected, formation of pupillary block by passage of oil to anterior chamber, episcleral pressure elevation and inflammation caused by silicone oil. In particular, IOP elevation on postoperative day 1 results from mechanical effect of silicone given at excessive amount⁹. Thus, silicone amount injected should be well-adjusted. Most vitreoretinal surgeons monitor sufficient amount of silicone injection by silicone filling to infusion cannula during surgery. A vent cannula is present for monitoring sufficient amount of silicone injection in some vitreoretinal surgery pack.

In this study, the patients underwent silicone tamponade for rhegmatogenous retinal detachment (RRD) were assessed. The silicone oil injection was assessed using two different methods, infusion cannula and vent cannula, at the end of surgery. It was aimed to compare these methods on IOP after surgery.

MATERIAL and METHOD

This retrospective study was approved by Ethics Committee of Van Training and Research Hospital (2020/18) and conducted in accordance to tenets of Helsinki Declaration. We screened patients files from retina unit of Ulucanlar Eye Training and Research Hospital of Health Sciences University. Two groups were constructed from files screened. Group 1 included 28 eyes of 28 patients in which sufficient amount of silicone injection was monitored by infusion cannula during surgery. Group 2 included 27 eyes of 27 patients in which sufficient amount of silicone injection was monitored by vent cannula during surgery. All files were selected among pseudophakic patients underwent surgery for RRD. The patients underwent vitreoretinal surgery for other causes, those underwent anterior segment surgery during vitreoretinal surgery, those with glaucoma or uveitis before surgery, those on anti-glaucomatous agents for IOP elevation before surgery, those received intravitreal tamponade other than 5000 cSt and those with phakic, aphakic or intraocular lens luxation were excluded.

Before surgery 4 cc of 20 mg/mL lidocaine (Jetokain, Adeka, Turkey) was administered from inferior temporal region of orbital rim via retrobulbar manner for anesthesia and akinesia. All surgical interventions were performed by same experienced surgeon (M.Ç.). Four 25 gauge (G) trocar was inserted initially and an infusion cannula was

placed to inferotemporal trocar at 12 O'clock direction. Following core vitrectomy, perfluorodecalin (Merdecalin Perfluoro Decalin, Meran Tıp) was given to vitreal space and peripheral vitrectomy was initiated. The vitreous sink and vitreous base surrounding rupture was trimmed and spiral laser was applied around rupture. After air-fluid exchange, vitreal space was filled with 5000 cSt silicone oil (Mersilicon, Silicone Oil 5000 cSt Vial, Meran Tıp). In group1, sufficient amount of silicone injection was performed by releasing distal tip and monitoring filling of infusion cannula (Figure 1). In group 2, a vent cannula was inserted through a trocar and sufficient amount of silicone injection was monitored by observing silicone drainage from vent cannula (Figure 2). Postoperative IOP measurements were performed using pneumotonometer (Topcon Computerized Tonometer, Topcon Corporation, Japan). IOP elevation was confirmed by Goldmann applanation tonometry in cases with IOP measurement >21 mmHg.

Statistical Analysis

Data were analyzed using SPSS version 18.0 (SPSS Inc, Chicago, Illinois, USA). Shapiro-Wilk test was used to assess normal distribution. Parameters from groups were compared using independent samples t test. A p value <0.05 was considered as statistically significant.

FINDINGS

Mean age was 50.50±11.36 years (34-77 years) in group 1 and 51.30±9.36 years (37-73 years) in group 2. No significant difference was detected in age between groups (p=0.369). There were 21 men (75%) and 7 women (25%) in group 1 whereas 19 men (70.37% and 8 women (29.63%) in group 2. No significant difference was detected in gender distribution between groups (p=0.635). Mean follow-up was 6.68±1.87 months in group 1 and 6.89±1.70 in group, indicating no significant difference between groups (p=0.513). No significant difference was detected in duration of silicone oil administration between groups (p=0.785). Table 1 presents data and statistical analyses regarding patient characteristics.

In group 1, the mean IOP was 20.25 ± 8.22 mmHg in group 1 and IOP was > 21 mm Hg in 10 patients (35.71%) on day 1 after surgery. In group 2, the mean IOP was 17.26 ± 6.11 mmHg and IOP was >21 mmHg in 4 patients (14.81%). It was found that IOP elevation was significantly more common in group 1 on day 1 after surgery (p=0.018). Brinzolamide plus timolol (Azarga, Novartis) combination was prescribed to patients with IOP elevation. In control visit on week 1, IOP was elevated in 3 patients from group

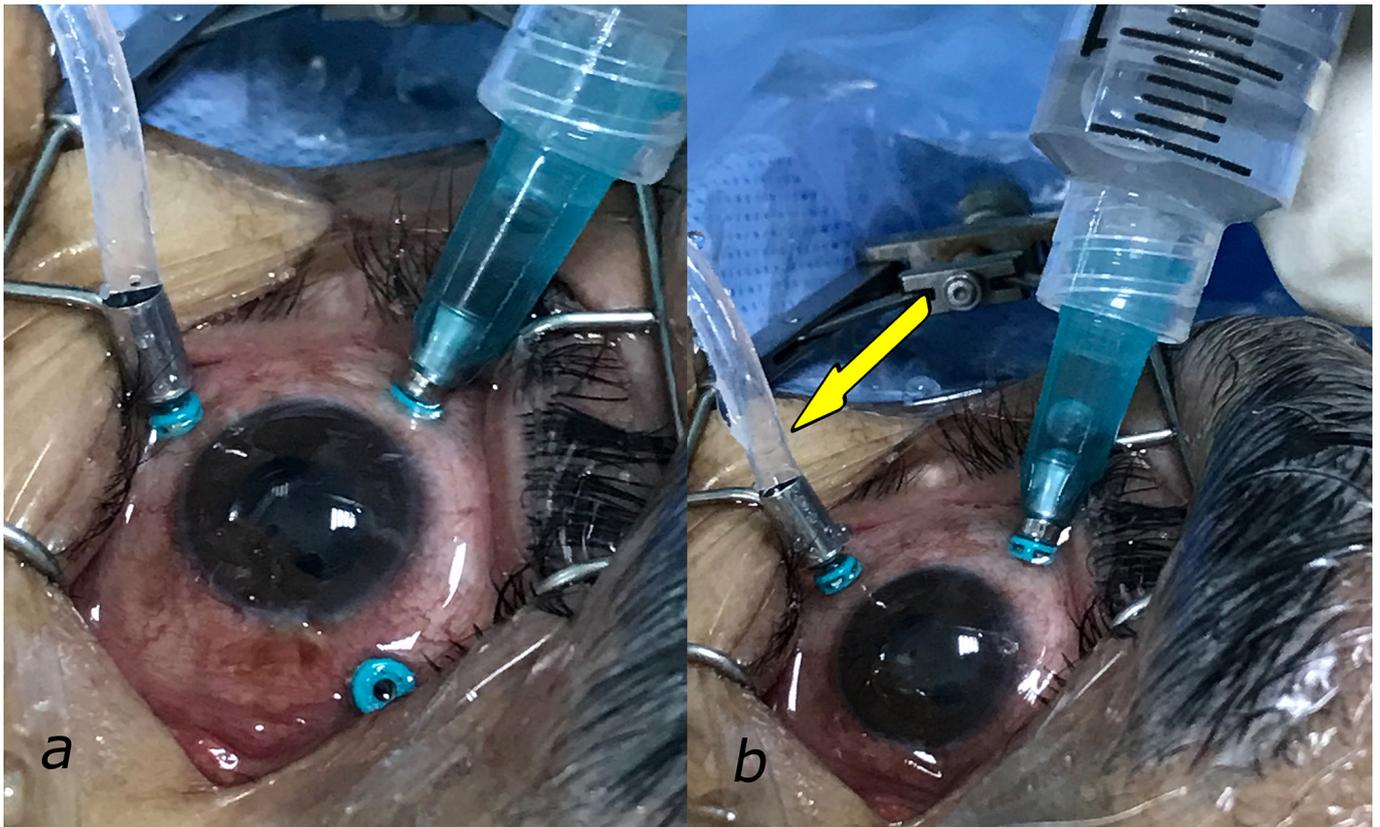


Figure 1: a) Empty infusion cannula b) Infusion cannula with silicone oil filling. Yellow arrow indicates level of silicone oil.

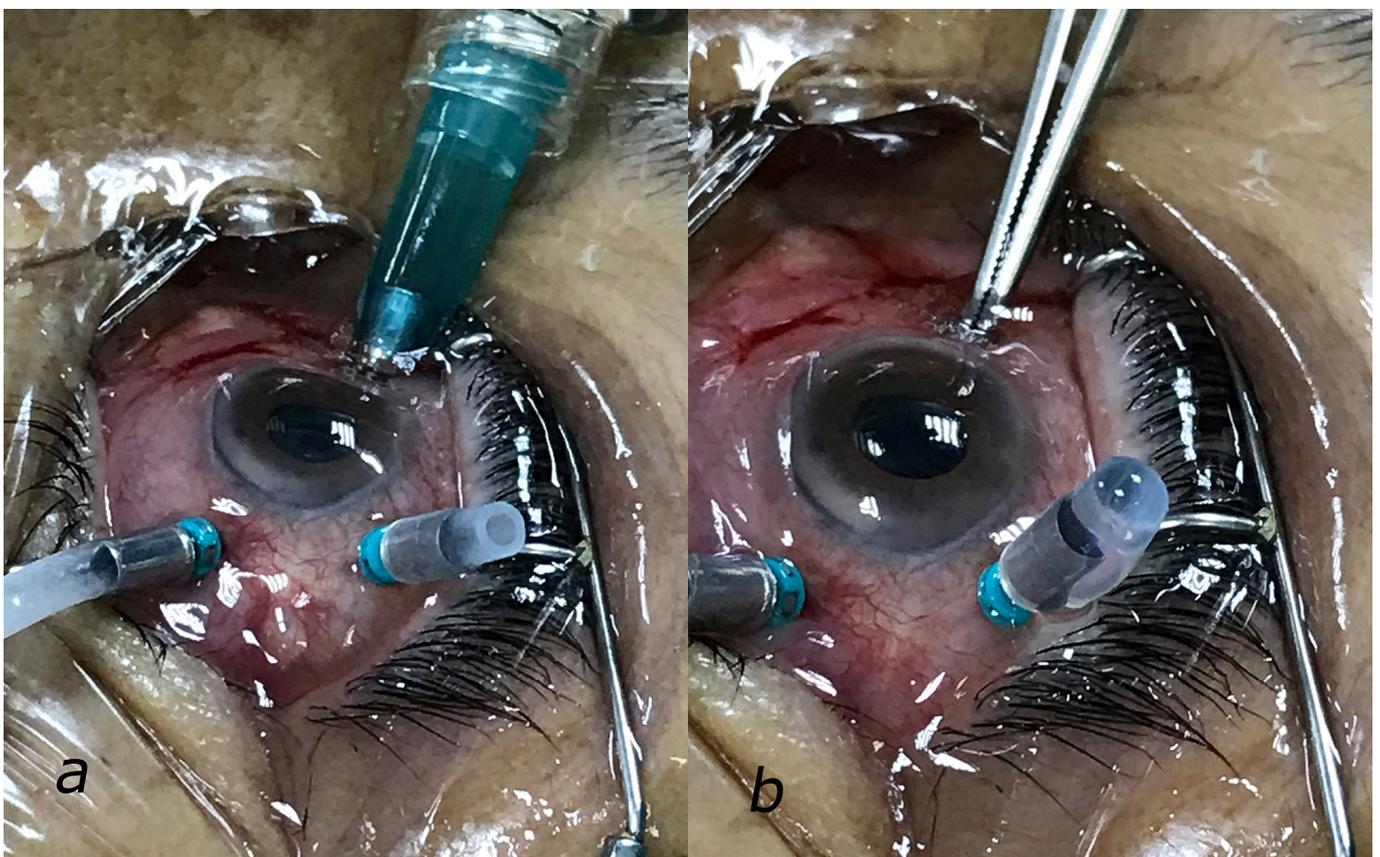


Figure 2: a) Empty vent cannula b) Direct drainage of silicone oil in vent cannula.

Table 1: Distribution and statistical analysis of patients characteristic in the groups.

Patient characteristics	Group 1 (n=28. ± SD)	Group 2 (n=27. ± SD)	p value
Age (year)	50.50 ± 11.36	51.30 ± 9.36	0.369
Gender (M/F)	21/7	19/8	0.453
High myopia (n)	7	6	0.635
Follow-up duration (month)	6.68 ± 1.87	6.89 ± 1.70	0.513

M: Male, F: Female, SD: Standard Deviation.

1 and 2 patients from group 2. On week 1 after surgery, the mean IOP of the patients was 15.50 ± 4.16 mmHg in group 1 and 15.00 ± 4.33 mmHg in group 2 (p = 0.858). Another anti-glaucomatous agent (Brimonidine, Alphagan, Allergan) was added to treatment in patients with persisted IOP elevation. On month 1, there were one patient with IOP elevation in two groups each. mean IOP was 14.39 ± 3.70 mmHg in group 1 and 13.85 ± 3.98 mmHg in group 2 (p = 0.935). Different anti-glaucomatous agents (Latanaprost,

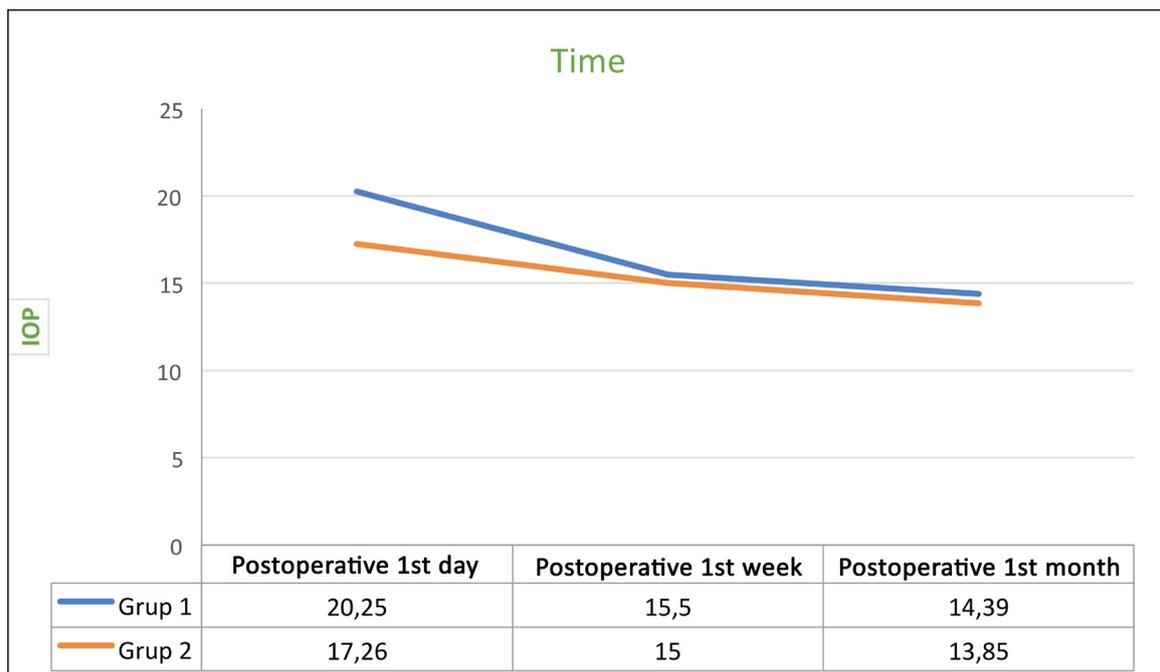
Xalatan, Pfizer) were added to patients with IOP elevation. IOP was under control in subsequent control visit and no surgical intervention was required. Table 2 and Graphic 1 present postoperative IOP values in the patient groups.

Of the patients with IOP elevation on postoperative day 1, there was a small silicone drop in anterior chamber in 2 patients in group 1 and in one patients in group 2. No emulsified silicone particle was detected in any patient. All

Table 2: IOP measurements at postoperative control visits in the groups.

Postoperative IOP measurements	Group 1 (n=28. ± SD)	Group 2 (n=27. ± SD)	p value
Day 1 (mmHg)	20.25 ± 8.22	17.26 ± 6.11	0.018
Week 1 (mmHg)	15.50 ± 4.16	15.00 ± 4.33	0.858
Month 1 (mmHg)	14.39 ± 3.70	13.85 ± 3.98	0.935

IOP: Intraocular pressure, SD: standard deviation.



Graphic 1: IOP change over time in both groups.

cases were controlled by topical anti-glaucomatous agents. When patients with postoperative IOP elevation were considered, it was seen that IOP elevation was present in 4 (57.14%) of 7 patients with high myopia in group 1 and 2 (33.33%) of 6 patients in group 2.

DISCUSSION

The injection of excessive amounts of silicone oil is one of the most important causes of silicone oil-related IOP elevation at early postoperative period¹⁰. This makes monitoring sufficient amount of silicone oil injection important during surgery. A vent cannula is present in some vitreoretinal surgery packs in order to facilitate silicone oil monitoring. The vent cannula is added to in the trocar pack of 23 G, 25 G and 27 G vitreoretinal surgery packs (Consellation Vitrectomy Pack, Alcon Labs., USA). It inactivates valve system of trocar. In this study, we investigated which system is superior for monitoring sufficient amount of silicone oil injection during surgery and their effects on postoperative IOP in eyes underwent surgery with endotamponade (5000 cSt silicone) due to RRD.

The elevated IOP is a potential risk factor for optic nerve injury and significant rates of IOP elevation is reported at early postoperative period after ocular surgery using various techniques¹¹. It is known that retina has ability of auto-regulation which may reduce perfusion pressure during IOP elevation and the auto-regulation provides protection against temporary IOP elevation¹². Although short periods of IOP elevation isn't considered to be associated with permanent optic nerve injury, it has been emphasized that auto-regulation is attenuated and leads permanent loss of vision even after short-term IOP elevation following vitrectomy using gas or silicone oil tamponade^{12,13}. In a study by Framme et al., it was reported that IOP elevation above 40 mmHg at early postoperative period after vitrectomy was mainly observed in eyes given silicone oil as tamponade¹². Authors reported that IOP elevation incidence was 24.3% three hours after surgery and reached up to 44.6% 48 hours after surgery in eyes given silicone oil. In our study, IOP was present at early postoperative period in 14 (25.45%) of 55 eyes underwent vitrectomy with silicone oil tamponade. It was 35.71 in the group in which infusion cannula was used to monitor sufficient amount of silicone injection during surgery whereas 14.81% in the group in which vent cannula was used for monitorization. These findings showed why silicone injection monitorization can be performed better without leading IOP elevation. It should be suggested that optic nerve injury which may develop at early postoperative period can be avoided by vent cannula.

In our study, IOP elevation rate was higher in eyes with high myopia than those without in both groups. In a population-based, cross-sectional study (The Blue Mountains Eye Study) on 3654 Australian, the myopia was found to be independent risk factor for glaucoma and ocular hypertension. In the study, it was suggested that myopic eyes cause predisposition to primary open-angle glaucoma because of genetics and anatomic structure. Although IOP elevation rate was higher among patients with high myopia, it was relatively lower in the group in which sufficient amount of silicone injection was monitored using vent cannula. This finding indicates that better monitorization for sufficient amount of silicone oil can be achieved using vent cannula.

In eyes given silicone oil tamponade, mechanisms underlying glaucoma include pupillary block, synechial angle closure, rubeosis iridis, migration of emulsified or non-emulsified silicone oil to anterior chamber and idiopathic open-angle glaucoma¹⁵. It is difficult to true cause of early IOP Elevation after intravitreal silicone oil injection. In our study, silicone oil migration to anterior chamber was observed in 2 patients with IOP elevation in group 1 and one patient in group 2.

In two patients, topical anti-glaucomatous agents failed to control IOP within a month and additional agent was needed. The IOP elevation or glaucoma rates vary from 2.2% on month to 56% on month 8; lower rates have been reported in more recent studies as result of advances in surgical techniques and equipments¹⁵. In our study, we observed lower IOP elevation rate with vent cannula in vitreoretinal surgery.

Although promising data were obtained in our study, failure to identify definitive cause of early IOP elevation is a factor that limits our results. Both groups included patients with high myopia to achieve standardization for amount of silicone oil given and there was no significant difference between groups regarding high myopia rate. However, we did not measure the volume of silicone oil given during surgery, which is another limitation of our study. Since silicone oil is mobile within eye, prophylactic low iridectomy is recommended in aphakic eyes in order to prevent pupillary block¹⁶. Although glaucoma due to pupillary block angle closure is a well-defined entity after silicone oil injection, it occurs rarely in phakic and pseudophakic eyes since zonule-lens barrier prevents silicone oil migration. However, presence of zonular weakness may lead predisposition to silicone oil migration and pupillary block development¹⁵. In our study, we had no data regarding zonule weakness of defect although patients

included were pseudophakic. In addition, we did not assess long-term outcomes in the patients since we aimed to compare two different methods for monitoring sufficient amount of silicone oil injection during surgery.

In conclusion, we addressed the effects of vent cannula, introduced lately in vitreoretinal surgery practice, on early postoperative IOP elevation and observed that it provided better results when compared to infusion cannula. Advances in technology offer lower complication rate and less undesired effects.

REFERENCES

1. İlhan Ç, Çıtırık M. Regmatojen Retina Dekolmanı Cerrahisinde Kullanılan Silikon Yağları ve Özellikleri. *Güncel Retina*. 2019;3: 176-80.
2. Cibis PA, Becker B, Okun E, et al. The use of liquid silicone in retinal detachment surgery. *Arch Ophthalmol*. 1962; 68: 590-9.
3. Siqueira RC, Gil AD, Canamary F, et al. Pars plana vitrectomy and silicone oil tamponade for acute endophthalmitis treatment. *Arq Bras Oftalmol*. 2009; 72: 28-32.
4. Loo A, Fitt AW, Ramchandani M, et al. Pars plana vitrectomy with silicone oil in the management of combined rhegmatogenous retinal and choroidal detachment. *Eye (Lond)*. 2001; 15: 612-5.
5. Williams RL, Kearns VR, Lo AC, et al. Novel heavy tamponade for vitreoretinal surgery. *Invest Ophthalmol Vis Sci*. 2013; 54: 7284-92.
6. Ranjan R, Manayath GJ, Avadhani U, et al. Rapid macular hole formation and closure in a vitrectomized eye following rhegmatogenous retinal detachment repair. *Oman J Ophthalmol*. 2018; 11: 71-4.
7. Çıtırık M, Batman C, Zilelioğlu O. Vitreoretinal Cerrahide Silikon Yağı Kullanımı. *Ret-Vit*. 2006; 14: 321-8.
8. Heidenkummer HP, Kampik A, Thierfelder S. Emulsification of silicone oils with specific physicochemical characteristics. *Graefes Arch Clin Exp Ophthalmol*. 1991; 29: 88-94.
9. Gedde SJ. Management of glaucoma after retinal detachment surgery. *Curr Opin Ophthalmol*. 2002; 13: 103-9.
10. Çakır M, Pekel G, Ağca A, Çekiç O, Bayraktar Ş, Yılmaz ÖF. Komplike retina dekolmanlarında pars plana vitrektomi ile birlikte 5000 cs silikon yağı kullanımı. *Ret-Vit*. 2008; 16:45-9.
11. Tranos P, Bhar G, Little B. Postoperative intraocular pressure spikes: the need to treat. *Eye (Lond)*. 2004; 18: 673-9.
12. Framme C, Klotz S, Wolf-Schnurrbusch UE, et al. Intraocular pressure changes following 20G pars-plana vitrectomy. *Acta Ophthalmol*. 2012; 90: 744-9.
13. Pillunat LE, Anderson DR, Knighton RW, et al. Autoregulation of human optic nerve head circulation in response to increased intraocular pressure. *Exp Eye Res*. 1997;64:737-44.
14. Mitchell P, Hourihan F, Sandbach J, et al. The relationship between glaucoma and myopia: the Blue Mountains Eye Study. *Ophthalmology*. 1999;106: 2010-5.
15. Kornmann HL, Gedde SJ. Glaucoma management after vitreoretinal surgeries. *Curr Opin Ophthalmol*. 2016; 27: 125-31.
16. Mota SEH, Castañeda-Diez R, Zavala-Martínez MT. Transfixion technique for the treatment of silicone oil pupillary block glaucoma refractory to Nd-YAG iridotomy. *Cir Cir*. 2019; 87: 215-8.