

RESEARCH ARTICLE

## CORRELATION BETWEEN DURATION OF USING SILICONE OIL TAMPONADE AND INCREASED INTRAOCULAR PRESSURE

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### ABSTRACT

**Background:** Silicone oil is an artificial liquid that functions as a tamponade agent in vitreoretinal surgery. One disadvantage of using silicone oil is that it needs advanced procedures for oil evacuation because it is not absorbed spontaneously by the retina. This evacuation is recommended as soon as the retina heals to prevent complications such as pupil block and glaucoma secondary to silicone oil (SO) emulsification and causing increased intraocular pressure (IOP). The recommended time for SO evacuation is the first 3-6 months after surgery.

**Objective:** To determine the relationship between increased IOP and duration of use of tamponade SO.

**Method:** This study used a *cross-sectional* design by taking secondary data on retinal detachment history patients who underwent silicone oil evacuation at KMJA Hospital Jakarta from January 2019 to November 2021.

**Results:** Respondents were 39 patients with an age range of 23-69 years and 71.8% were male. The average duration of use of SO is 9 months. In weeks 3-4 after the SO evacuation, data on the number of eyes with high IOP have obtained from as many as 9 eyes and 6 of them had used tamponade SO for more than 6 months with a p-value of 0.153.

**Conclusions:** There was no significant association between the duration of SO tamponade use and increased IOP after SO evacuation.

**Keywords:** Long use of tamponade SO, increased intraocular pressure, emulsification SO.

### INTRODUCTION

Polydimethylsiloxanes (PDMS) or commonly known as silicone oil is an artificial liquid that functions as a tamponade agent in vitreoretinal surgery, especially regarding the handling of retinal detachment in the eyeball. Silicon oil is injected into the vitreous cavity with the aim of restoring intraocular pressure and providing intraocular tamponade. The surface tension of the tamponade agent must be able to prevent the migration of fluid into the subretinal space. Silicon oil has higher stability compared to gas but has a lower density than water. Silicon oil will form bubbles inside the vitreous cavity. High interfacial voltage is effective in closing gaps in the retina and preventing further expansion of the retinal layer separated from the choroid pigment layer. Silicon oil is not like a gas that evaporates over time, therefore it can be a tamponade agent over a longer period of time and minimize the anatomical target of intraocular tamponade insertion.<sup>1,2</sup>

SO tamponade has better anatomical and functional results than *sulfur hexafluoride* (SF6) gas tamponade in

advanced complex retinal detachment repair. SO enables faster visual rehabilitation in the postoperative period, and reduces the need for a facedown position in patients with neck or back disorders and at altitudes such as air travel. Silicone oil is able to reduce the risk of neovascular glaucoma by separating proangiogenic factors as well as reducing recurrent vitreous bleeding in patients with proliferative diabetic retinopathy.<sup>3,4</sup>

One indication of SO tamponade in vitreoretinal surgery is retinal detachment with *proliferative vitreoretinopathy* (PVR), retinitis in diabetic severe retinopathy caused by viruses and ocular trauma. Other indications are patients who will travel by plane immediately after surgery so that it is not possible to tamponade with gas or air because there will be an increase in gas volume in higher areas or altitudes, difficult to perform postoperative face-down positions such as pediatric patients and patients who have spinal problems or patients who need the best sharp vision immediately after surgery.<sup>1</sup>

One of the biggest disadvantages of using tamponade SO is that it requires a second procedure for oil evacuation

because it is not absorbed spontaneously by the retina or has contact with the retina lower than gas. This evacuation action is recommended to be done as soon as possible after the retina heals to prevent SO-related complications. Indeed, there is not much evidence to show that prolonged use of tamponade SO will significantly increase the risk of post-evacuation complications.<sup>3</sup>

Complications after tamponade SO that often occur include increased intraocular pressure (IOP) caused by pupil block or secondary glaucoma after tamponade SO insertion. Increased intraocular pressure as a complication of vitrectomy procedures with tamponade SO may resolve after SO evacuation is performed. Emulsification is defined as two immiscible liquids where the droplets of one liquid (dispersed liquid) are spread in a continuum of another liquid (continuous liquid) so that there is resistance between the two media which causes SO droplets to move to the other medium because of the difference surface tension. Emulsification of SO can occur anywhere from a few weeks to several years postoperatively.<sup>1,3,5</sup> There are in vivo studies that report that SO emulsification starts from 5 to 24 months with an average of 13.2 months from the first SO installation.<sup>6-8</sup>

Prevention of emulsification of SO post vitrectomy is evacuation at 3-6 months after the first operation. The indication of removal of this SO is after adhesion of the neural layer of the retina with the retinal pigment layer and this adhesion or attachment process can occur at 2 months after tamponade insertion. Also in vitreoretinal surgery, the laser scar is formed within 1 month and silicone oil tamponade serves as a barrier to retinal tissue as long as the laser scar has not yet formed. The recommended SO evacuation time is within 3-6 months after vitrectomy, this is because of the consideration that all processes have taken place or anatomical targets have been achieved. There is no fixed time from experts considering the healing process is different for each individual.<sup>1,3,9</sup>

Based on the description above, the researcher found a phenomenon to conduct research to determine the

relationship between increased IOP and duration of use of tamponade SO.

## METHODS

This type of research is observational analytics using the cross sectional method with the aim of determining the relationship between the duration of SO use and the increase in IOP after SO evacuation. Intraocular pressure was measured using a non-contact airpuff tonometer and taken within 3-4 weeks after SO evacuation. This study excluded patients with a history of glaucoma, ocular hypertension, and patients with incomplete data. Data was taken from the medical records of patients with a history of retinal detachment who underwent SO tamponade evacuation surgery from January 2019 to November 2021 and the operation was performed by an ophthalmologist at KMJA Hospital Jakarta, South Jakarta.

The sampling technique is by *consecutive sampling*. The total number of patients with a history of retinal detachment at KMJA Hospital Jakarta during the period January 2019 to November 2021 was 70 medical records and those who met the inclusion and exclusion criteria were 39 data. The data was analyzed by *Gamma* Correlation test using IBM SPSS version 25 statistical data processing software. This study uses a 95% confidence interval with a  $\alpha$  value of 5% so that if the p value is  $< 0.05$ , the results of statistical calculations show that there is a significant relationship between the duration of SO use and the increase in IOP after SO evacuation.

## ETHICAL APPROVAL

This study has obtained permission for research ethics from the Health Research Ethics Committee (KEPK) of the Faculty of Medicine UIN Syarif Hidayatullah Jakarta number B-049/F12/KEPK/TL.00/10/2022

## RESULTS

**Table 1. Distribution of Demographics**

Respondent Characteristics	Category	Frequency (N)	Percentage (%)
Age	12-25 Years (Teenager)	1	2.6
	26-45 Years (Adult)	14	35.9
	46-64 Years (Elderly)	23	59
	> 65 Years (Old)	1	2,6
Gender	Male	28	71.8
	Female	11	28.2

**Table 2 Duration of using SO tamponade Categories**

Description	Category	Frequency (N)	Percentage (%)
Duration of Using SO Tamponade	3-6 Months	16	41
	> 6 Months	23	59

**Table 3 Crosstabs of duration of using SO tamponade with IOP Post-Evacuation SO Categories**

Description	Category	Duration of Using SO Tamponade		
		3-6 Month	> 6 Month	Total
Categories IOP Post-Evacuation SO in Weeks 3-4	Normal (10-21mmHg)	13	13	26
	Low (<10mmHg)	0	4	4
	High (>21mmHg)	3	6	9
	<b>Total</b>	16	23	39

## DISCUSSION

### Demographics

There were 39 patients with an age range of 23-69 years. the majority of patients were in the age group 46-64 years (elderly), namely 23 people (59%) and the average age obtained was 47 years. The respondents were predominantly male, where there were 28 eyes (71.8%) of male patients. (Tabel1) Based on these results, it can be concluded that more male patients with a history of retinal detachment underwent OS tamponade evacuation compared to women and the majority of respondents were elderly.

### Duration of using SO

In Table 2, there were 16 patients (41%) who evacuated SO tamponade within 3-6 months after SO installation in the previous vitrectomy surgery and as many as 23 patients (59%) evacuated SO above 6 months from installation in the first operation with the longest being 24 months after.

This study had more patients with SO use longer than 6 months compared to those who used it according to the recommended time limit and the average length of time to use SO as tamponade in this research is 9 months. This is in accordance with a study entitled "*Silicone Oil Removal: Post-operative Complications*" by Reda Issa et al (2020) that the average use of tamponade SO is for 9.46 months.<sup>3</sup>

Based on the book "*Vitreoretinal Surgical Techniques*" and several research journals, SO evacuation is generally recommended within 3-6 months after installation, because in that time frame it is believed that the anatomical target has been achieved, namely the neural layer of the retina with the

retinal pigment layer has been reattached. Removal of the SO within the recommended time can minimize the occurrence of complications from the installation of the SO as intraocular tamponade such as emulsification.<sup>2,10-12</sup>

### Correlation between duration of using SO with the increased IOP Post-Evacuation SO

IOP data after SO evacuation at weeks 3 and 4 on Table 3 showed the number of eyes with high IOP as many as 9 eyes and 6 of them had used SO tamponade for more than 6 months. High intraocular pressure after SO evacuation is often caused by SO emulsification due to tamponade SO over the recommended time. In this study, 59% of patients used silicone oil tamponade for more than 6 months as mentioned in Table 2. Based on the *Gamma* Correlation Test that has been carried out, a p value of 0.153 is obtained, which means that there is no significant correlation between the length of use of tamponade SO and the increase in IOP that occurs after SO evacuation. This insignificant result could not be separated from the limitations that have been made by researchers, such as the population only coming from one eye clinic at a hospital and the time span that has been determined in data collection. But the correlation value obtained was 0.436, which means that the strength of the relationship between the duration of SO use and the increase in IOP after SO evacuation is sufficient.

Emulsification of SO is the most frequent complication of using SO as tamponade. A study entitled "*Anatomical Results and Complications After Silicone Oil Removal*" stated in his study there were 21 cases of eyes that underwent emulsification (21.42%) and 17 of them were those who used SO for more than 6 months. 13 The mechanism of

emulsification of SO is still not fully understood, but the widely accepted hypothesis is that SO forms small droplets that separate from the main bubble of SO due to shear forces induced by *saccadic eye movement*. Shear forces are generated between the surface of the SO with the aqueous humor due to the relative movement between the oil, the *aqueous*, and the wall of the eye. This leads to rupture of SO molecules from the main SO bubble and forms SO droplets. SO droplets can penetrate following water circulation to various intraocular parts such as subretinal *space*, anterior oculi camera, trabeculum *meshwork*, and cornea which can ultimately cause toxic retina, keratopathy, or glaucoma.<sup>1-3</sup>

Emulsification that occurs in *meshwork* trabeculae then causes interference in the form of obstruction and *scarring*, so there will be an increase in IOP. *Aqueous humor* is constantly being produced and reabsorbed. The balance between the two processes is very important in order to set the total volume and IOP to stay within normal limits. Conditions such as obstruction such as the meshwork trabeculae which physiologically play a role in 90% *outflow* of aqueous humor, can cause retention of aqueous humor fluid so that IOP increases.<sup>14-16</sup>

## CONCLUSION

There was no significant relationship between the duration of use of tamponade SO and increased IOP after SO evacuation.

For other researchers who are interested in continuing the research that the author has conducted, it is recommended to expand the population so that more samples are obtained so that it is hoped that they can better describe the results of the relationship between IOP increase and the duration of SO tamponade use.

## CONFLICT OF INTEREST

No conflicts of interest

## ACKNOWLEDGMENTS

Not applicable

## FUNDING SOURCES

No funding was received

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