Ischemic Optic Neuropathy Post Silicon Oil Removal

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ABSTRACT

Objectives: To study the risk of ischemic optic neuropathy following silicon oil removal.

Methods: A prospective analytic study that was conducted on patients who underwent silicon oil removal at King Hussein Medical Center during a one year period from February 2015 till January 2016. Patients were examined by neuro-ophthalmologists prior to surgery. Optic nerve function and appearance were assessed. Any patient with pre existing optic neuropathy was excluded from the study. Procedure was done using local anaesthesia for all patients by vitreoretinal surgeon. The duration of surgery and maximum bottle height during the procedure, and the viscosity of silicon oil used whether 1000 or 5000 centistokes were recorded. Optic nerve function and appearance were evaluated after silicon oil removal for a period of 3 months after surgery.

Results: One hundred and sixty- two patients were enrolled. Mean age was 57.4 years with males slightly outnumbering females. Thirty- eight patients were excluded due to presence of pre existing optic neuropathy. The indications for silicon oil injection were proliferative diabetic retinopathy, rhegmatogenous retinal detachment, trauma, macular hole and combined. Sixteen patients developed optic neuropathy after silicon oil removal. Statistical significance was seen in patients with 5000 centistokes silicon oil, bottle height of infusion line exceeding 50 cm, and retained silicon oil for more than 12 months.

Conclusion: Silicon oil removal can lead to ischemic optic neuropathy. It is important to take precautions during the procedure in order to prevent this complication.

Keywords: Optic Neuropathy, Removal, Silicon oil.

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Introduction

Silicone oil (polydimethylsiloxane) is a synthetic polymer used in vitreoretinal surgeries due to its ocular tamponade effect and optical clarity.[1, 2] The main indication is proliferative diabetic retinopathy causing tractional retinal detachment and/or proliferative vitreoretinopathy. Other indications are rhegmatogenous retinal detachment, trauma, high myopia, retinal holes and infectious conditions such as syphilis and CMV retinitis.[3-6] There are two types of silicon oil used at King Hussein Medical Center according to their viscosities, the 1000 centistokes (cs) and the 5000 cs. The higher the viscosity of silicon oil, the lower the tendency to emulsify.[7] In clinical practice both 1000 cs and 5000 cs silicon has no clinically significant difference in emulsification.[8] It is recommended for silicone oil to be removed as soon as retinal condition permits, otherwise complications can occur like cataract, glaucoma, and keratopathy.[2, 9, 10] Glaucoma can be the cause of optic nerve involvement due to various causes. It could be caused by pupillary block, silicon oil over filling or due to silicon oil emulsification and migration into anterior chamber angle.[7] The procedure of silicon oil

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removal is not free of complications. Retinal re-detachment can occur. Vision loss was also reported after silicon oil removal.[11]

In this study, we aimed to evaluate the risk of ischemic optic neuropathy following silicon oil removal in relation to certain factors and how to prevent it.

Methods

A prospective analytic study that was conducted at King Hussein Medical Center during a one year period from February 2015 till January 2016. All patients who underwent silicon oil removal were evaluated. Patients were examined by neuro-ophthalmologists prior to surgical procedure. Ocular examination included Snellen's chart visual acuity, applanation tonometry, anterior segment and fundus examination post mydriasis. Optic nerve function and appearance were assessed. Fluorescein angiography (FFA) and optical coherent tomography (OCT) were done when indicated. Humphry's 24-2 was done in patients with visual acuity of more than 3/60. Any patient with pre existing optic neuropathy was excluded from the study. Procedure was done using retro-bulbar local anaesthesia for all patients by vitreoretinal surgeon. The duration of surgery, maximum bottle height during surgery and viscosity of silicon oil used whether 1000 or 5000 centistokes were recorded. Optic nerve function and appearance were evaluated after silicon oil removal for a period of 3 months after surgery. Duration of procedure, bottle height during procedure, viscosity of silicon oil used and duration of silicon oil retained in the eye were investigated in relation to occurrence of optic nerve involvement. *P-Value* was used to measure statistical significant and was considered to be significant if less than 0.05.

Results

One- hundred and sixty- two patients were enrolled. Mean age was 57.4 years with males slightly outnumbering females (1.1:1) of the total 162 patients. Thirty- eight patients (23.5%) were excluded from the study due to presence of pre- existing optic neuropathy. The main indication for silicon oil injection for the remaining 124 patients was proliferative diabetic retinopathy (86 patients, 69.4%), rhegmatogenous retinal detachment (17, 13.7%), trauma (3, 0.02%), macular hole (2, 0.02%) and combined (16, 12.9%) that includes more than one of these conditions and other causes such as high myopia. All patients with proliferative diabetic retinopathy has laser treatment. Sixty- five patients had silicon oil 5000 cs and 59 patients had silicon oil 1000 cs. Duration of procedure ranged from 31.3 minutes to 69.2 minutes (mean 48.7 minutes). Maximum bottle height used was 54 cm. Emulsified silicon oil was seen in 28 patients. The majority of patients had silicon oil retained for 6 to 12 months, Table I. Sixteen patients (12.9%) developed optic neuropathy after silicon oil removal. Table II shows the distribution of patients according to risk factors evaluated. Statistical significance (*p-value* < 0.05) was seen in patients with 5000 centistokes silicon oil, bottle height of infusion line exceeding 50 cm and retained silicon for more than 12 months.

Table I: Distribution of whole population according to factors evaluated

Factor		Number of patients	Percentage
Viscosity of silicon	5000 cs	65	52.4%
	1000 cs	59	47.6%
Duration of surgery	Less than 30 min	9	7.3%
	30 to 60 min	107	86.3%
	More than 60 min	8	6.5%
Bottle height	Less than 30 cm	4	3.2%
	30 to 50 cm	99	79.8%
	More than 50 cm	21	16.9%
Duration for silicon oil retained	Less than 6 months	8	6.5%
	6 months to 12 months	94	75.8%
	More than 12 months	22	17.7%

Table II: Distribution of patients with ischemic optic neuropathy in relation with factors evaluated

Factor		Number of patients	P-value
Viscosity of silicon	5000 cs	13	$0.01 < p < 0.025$
	1000 cs	3	
Duration of surgery	Less than 30 min	2	$0.05 < p < 0.1$
	30 to 60 min	12	$0.1 < p < 0.9$
	More than 60 min	2	$0.1 < p < 0.9$
Bottle height	Less than 30 cm	1	$0.1 < p < 0.9$
	30 to 50 cm	5	$0.05 < p < 0.1$
	More than 50 cm	10	< 0.001
Duration for silicon oil retained	Less than 6 months	2	$0.1 < p < 0.9$
	6 months to 12 months	5	$0.1 < p < 0.9$
	More than 12 months	9	< 0.001

Discussion

Silicon oil is commonly used in vitreoretinal procedures in order to tamponade the retina and keep it attached.[12] The duration of how long it should be retained depends on retinal status, breaks and traction. Silicon oil has the advantage of being optically clear enabling the physician to examine the retina after its injection with ease.[13, 14] However, if it is left for long period it can cause many complications.[15] It can cause cataract in phakic patients, emulsify into the vitreous cavity making its removal difficult and migrating into anterior chamber causing increased intraocular pressure and corneal damage.[16, 17] Optic nerve damage in vitrectomized patients with silicon oil is multi- factorial in our opinion. Patients with advanced proliferative retinopathy usually have a vulnerable nerve or disc at risk to develop ischemic optic neuropathy due to disease itself or previous laser treatment. Prolonged increased intraocular pressure may also cause optic nerve damage. The use of retro- bulbar local anaesthesia may be a cause of optic nerve insult. We did not find any correlation in literature for silicon oil itself to have an adverse effect on optic nerve. In this study, we tried to investigate the procedure of silicon oil removal as causing optic neuropathy. Difficulties we encountered were the presence of multiple factors affecting optic nerve as the primary disease itself, previous laser treatment and high intraocular pressure. The risk factors we evaluated were the type of silicon used, the duration of surgery, bottle height during surgery and how long was silicon oil retained inside the eye. The other difficulty we encountered was how to assess optic nerve function especially in patients with poor visual acuity where color vision and visual field testing are not informative. In such patients we depended on optic disc appearance before and after surgery and on the presence of relative afferent pupillary defect. Optic nerve function was assessed by Snellen's visual acuity, pupillary light reaction, optic disc appearance, color vision and visual field testing. Mean visual acuity (Snellen's fraction) was 0.08 before surgery and 0.15 after surgery. The 16 patient with ischemic optic neuropathy has mean visual acuity of 0.03. The development of ischemic optic neuropathy was not related to high intraocular pressure or glaucoma. All patients with preexisting glaucoma were already excluded from the study as they were known to have optic nerve involvement. Mean intraocular pressure before surgery was 14.8 mmHg and 16.1 mmHg. None of the patients in our study developed glaucoma. Regarding the viscosity of silicon used, sixty- five patients had 5000 cs silicon oil compared to 59 patients with 1000 cs silicon oil Table 1. The majority of patients with optic neuropathy (13 out of 16 patients had 5000 cs silicon oil (statistically significant, Table II. There was no statistical difference for occurrence of optic neuropathy regarding the duration of surgery in our series. We think the bottle height of the infusion port during the procedure is a major culprit causing optic nerve damage. Only one patient with optic

nerve damage was seen when the bottle height did not exceed 30 cm. On the other hand 10 patients had damage with bottle height exceeding 50 cm. This is not surprising as higher bottle height can cause higher pressure inside the vitreous cavity. Direct prolonged mechanical pressure related bottle height can cause optic nerve damage regardless of the presence and type of silicon oil. The other factor we found to be statistically significant was retained silicon oil for more than 12 months. We have two possible explanations for this. Firstly, the prolonged retained silicon oil especially if emulsified may directly affect the nerve and secondly the procedure of its removal would be more difficult. Emulsification occurred only in 2 patients. Both of them, 1000 cs silicon was used. Intraocular pressure was normal and only one of them developed optic neuropathy. None of our patients was aphakic. Although the number of patients in our study was not large, we wanted to share our observation that ischemic optic neuropathy occurs post silicon oil removal. The risk of silicon oil removal on the integrity of the optic nerve still remains doubtful and more research is warranted. We aim to extend our study for longer duration and to extend the follow up period of the patients. Ten of the 16 patients who developed ischemic optic neuropathy had the insult in the first two weeks after surgery. The other 6 patients developed it before the end of the first month. Since all our patients developed optic neuropathy in the first month we believe that the insult is directly related to the procedure. In conclusion and in order to prevent optic nerve damage during silicon oil removal in patients who are already at risk of developing optic neuropathy, we recommend to use low bottle height during surgery, remove silicon as early as retinal condition permits especially if the viscosity of silicon oil injected is 5000 centistokes.

Conclusion: Silicon oil removal can lead to ischemic optic neuropathy. It is important to take precautions during the procedure in order to prevent this complication.

References

1. **Kreiner CF.** Chemical and physical aspects of clinically applied silicones. *Dev Ophthalmol* 1987; 14:11–19.
2. **Ichhpujani P, Jindal A, Kat LJ, Arch G.** Silicone oil induced glaucoma: A review. *Clin Exp Ophthalmol* 2009; 247:1585–1593.
3. **Lim JI, Enger C, Haller JA, Campocharo PA, *et al.*** Improved visual results after surgical repair of cytomegalovirus-related retinal detachments. *Ophthalmology* 1994; 101: 264–269.
4. **Cazabon S, Groenewald C, Pearce IA, Wong D**. Visual loss following removal of intraocular silicone oil. *Br J Ophthalmol* 2005; 89:799–802.
5. **Nadal J, Verdaguer P, Canut MI**. "Treatment of retinal detachment secondary to macular hole in high myopia: vitrectomy with dissection of the inner limiting membrane to the edge of the staphyloma and long-term tamponade," *Retina* 2012; 32: 1525–1530.
6. **Barca F, Caporossi T, Rizzo S.** Silicone Oil: Different Physical Proprieties and Clinical Applications. *BioMed Res Int* 2014; 2014; 502143. doi: 10.1155/2014/502143.
7. **Scott IU, Flynn HW, Murray TJ, Smiddy WE, *et al.*** "Outcomes of complex retinal detachment repair using 1000- versus 5000-centistoke silicone oil," *Archives of Ophthalmology* 2005; 123: 473–478.
8. **Falkner CI, Binder S, Kruge A.** Outcome after silicone oil removal. *Br J Ophthalmol* 2001; 85: 1324–1327.
9. **Prazeres J, Magalhães O, Lucatto FA, Navarro RM, *et al***. Heavy Silicone Oil as a Long-Term Endo-tamponade Agent for Complicated Retinal Detachments. *BioMed Research International Volume* 2014, Article ID
10. **Flaxel CJ, Mitchell SM, Aylward GW.** Visual outcome after silicone oil removal and recurrent retinal detachment repair. *Eye* 2000; 14: 834-838.
11. **Ortisi E, Avitabile T, Bonfiglio V**. "Surgical management of retinal detachment because of macular hole in highly myopic eyes," *Retina* 2012; 32: 1704–1718.
12. **Wei Y, Li Y, Chen F,** "Vitrectomy treatment of retinal detachments related to choroidal coloboma involving the disk," *Retina* 2014; 34: 1091–1095.
13. **Kapur R, Birnbaum AD, Goldstein D, Tessler HH, *et al***. "Treating uveitis-associated hypotony with pars plana vitrectomy and silicone oil injection," *Retina* 2010; 30: 140–145.
14. **Tan HS, Dell'Omo R, Mura M.** Silicone oil removal after rhegmatogenous retinal

detachment: comparing techniques. *Eye* 2012; 26: 444–447.
15. **Laganowski HC, Leaver PK.** Silicone Oil in the Aphakic Eye: The Influence of a Six o'clock Peripheral Iridectomy. *Eye* 1989; 3: 338-348.
16. **Heimann H, Stappler T, Wong D**. Heavy tamponade 1: a review of indications, use, and complications. *Eye* 2008; 22: 1342–1359.