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Research Article

Persistent Intraocular Pressure Elevation after Silicon Oil Removal in Patients with Post-Pars Plana Vitrectomy

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ABSTRACT

Background: It is well-known that silicon oil (SO) injection into the vitreous cavity after pars plana vitrectomy is usually associated with high intraocular pressure.
Objectives: To determine the influence of silicon oil (SO) removal on IOP level after pars plana vitrectomy for spontaneous rhegmatogenous retinal detachment (RRD)
Subjects and Methods: A prospective study was conducted at Ibn Al-Haitham eye teaching hospital, Baghdad- Iraq. Intraocular pressure (IOP) was measured pre and post SO removal in patients who have underwent retinal detachment surgery with SO injection of 1000 centistokes (cSt) viscosity. Baseline IOP was measured for all the patient before the SO removal. Follow-up was performed at 1, 4, and 8 weeks after SO removal. IOP was measured by Goldman applanation tonometer. Patients with IOP > 21 mm Hg at 8 weeks post-operatively with or without anti-glaucoma mediations were considered as persistent IOP elevation after SO removal.
Result: Sixty eyes of 60 patients were included. Twenty eyes had persistent IOP elevation after SO removal on first week postoperative. It decreased to 14 eyes on 4th week after SO removal and further decreased to 12 eyes on 8th week af-ter SO removal. The percentage of persistent IOP elevation following SO removal was about 20% on 8th week of SO removal.
Conclusion: Persistent IOP elevation sometimes happens after SO removal. Therefore, removing SO does not simply treat the elevated IOP happened during SO injection. Patients after SO removal should be followed up for IOP for several weeks and should be treated medically or surgically as required.

Introduction

Silicone oil (SO) implantation is an important part of advanced retinal detach-ment surgeries, and it has many indications as in advanced diabetic retinopathy, ocular trauma, and viral retinitis. (1-3)

SO has specific physical characteristics. It is a polymer that has low specific gravity, and therefore it is buoyant. It is inert, nontoxic and optically clear with refractive index of (1.403). It provides a prolonged tamponade in comparison with intraocular gases with lower incidence of postoperative hypotony. (4,5)

Scott et al, compared SO of different viscosities in the treatment retinal detach-ment and concluded that anatomical, visual outcomes, and complication rates were similar regardless of SO viscosities. (6)

In-vitro studies suggested that the higher the viscosity of SO, the greater the stability and safety when endotamponade stayed for more than 6 months.(7)

SO remains the preferred tamponading agent for retina surgeons for decades. However there are many complications related to its use. These include development of cataract in phakic eyes, band keratopathy especially if there is endothelial touch, elevation of intraocular pressure, anterior chamber inflammation, and anterior dislocation or sub-retinal migration of the oil. (8-13)

The early elevation of IOP after SO injection is usually caused by inflammation in anterior chamber or aqueous flow obstruction secondary to choroidal effusion or both. Late-onset elevation is caused by blockage of the trabecular meshwork by emulsified SO in anterior chamber. (13)

IOP elevation is the most important complication of SO injection. This study fo-cuses on this complication of SO injection.

Subjects and Methods

This prospective study includes patients who were scheduled for pars plana vitrectomy and SO injection due to spontaneous rhegmatogenous retinal detachment in Ibn Al-Haytham Eye Teaching Hospital in Baghdad, Iraq between June 2019 and June of 2020. The study was approved by Al-Kindy College of medicine and written informed consent was obtained from all patients.

Patients were assessed preoperatively for visual acuity, refraction, IOP measurement and dilated fundus examination. IOP measurement was done by Goldman applanation tonometry.

Patients with history of glaucoma, diabetes mellitus, previous cataract surgery, previous vitreo- retinal surgery and intraocular inflammation were excluded.

All surgeries were performed by single consultant vitreoretinal specialist surgeo. under local peribulbar anesthesia. All surgeries performed within one or two weeks from presentation. Triamcinolone acetonide was injected in twelve cases to ease the visualization of vitreoretinal adhesions. Core vitrectomy and posteri-or hyaloid separation with peripheral vitreous shaving was performed in all cas-es. Retinal breaks were identified and surrounded by laser retinopexy. Heavy perfluorocarbon liquid was used to flatten the macula. Three hundred sixty de-gree laser retinopexy was performed. Heavy liquid was aspirated and complete fluid-air exchange was performed. Silicone oil (1000 cSt) was injected to get a near-complete fill then the infusion cannula was removed. The sclerotomies were sutured with 7/0 vicryl.

Dexamethasone eye drops 0.1% and ciprofloxacin eye drops 0.3% were pre-scribed six times daily for 2 weeks for all the patients after surgery.

Follow up visits were scheduled at 1st day, 1st week, 4th week, 8th week and pos-SO removal. In all the scheduled follow-up visits, visual acuity, refraction, IOP measurement, and dilated fundus examination were performed.

Duration of endotamponade last for 3 to 6 months. SO was then removed with or without performing phacoemulsification surgery. Thirty of the included eye needed phaocemuslificaiton surgery. SO removal was performed by the same surgeon who performed the pars plana vitrectomy and SO implantation at the same hospital.

Patients with IOP more 21 mm Hg after SO removal which persisted through 8th week postoperative, with or without anti-glaucoma medications, were considered persistent raised IOP.

Results

Sixty eyes of 60 patients were included in this study. Forty were male and 20 were female. Their ages ranged from 10 years to 69 years with a mean of 46.5 y±9.5. Patients demographics were shown in table 1. Pre-vitrectomy IOP was 15.2 mmHg ±2.5. IOP during SO endotamponade was 22.57 ±14.26 mmHg. This was reduced to 19.4±7.4 mmHg at 1st week post-SO removal (p= 0.15). It was further reduced to 17.8 ±5.7 mmHg at 4th week post-SO removal (p=0.04). At 8th week post-SO removal, the IOP reduced to16.7±4.6 mmHg (p=0.017). Table 2 shows mean IOP during various times of the study and its statistical significance. At 1st week post-SO removal, 33.3% have IOP more than 21 mm Hg. This was reduced to 23.3% at 4th week, and was further reduced to 20% at 8th week. There was no gender predilection among patients with persistent IOP elevation at 8th week post-SO removal (p= 0.15).

Table 1: Patient Demographics

	Number	**MEAN±SD**	**Frequency (N%)**
Age		47±9.5	
Gender	Male 40 Female 20		66.7% 33.3%
RRD (spontaneous)	60 PVR grade A: 35 grade B:25		100%
Laterality	OD 43 OS 17		71.7% 28.3%
macula	On 20 Off 40		33.3% 66.7%
Lens status	Phakic 60		100%
IOP during SO endotamponade		22.75±14.26	
Emulsified silicon at time of removal	20/60		33%
Mean IOP at 1st week post op.		19.4±7.4	
Mean IOP at 4th postoperative week		17.8±5.7	
Mean IOP at 8th postoperative week		16.73±4.6	
Re-detachment after SO removal	4		6%

Table 2: Mean Levels of IOP of Sample during Various Times of Study

Time	Mean	standard deviation	Mean difference from preoerative level	t	p-value
Pre-operative	22.57	14.265	0	0	0
1st week postoperative	19.40	7.440	3.167 ± 11.856	1.463	0.154
4th week postoperative	17.80	5.762	4.767 ± 12.522	2.085	0.046
8th week postoperative	16.73	4.668	5.833 ± 12.619	2.532	0.017

Table 2 also shows the relationship between IOP pre-operative and during different times after SO removal. Re-detachment rate after SO removal in the cur-rent study was 6%. The highest percentage of IOP elevation was noticed in 10-19 years group (50%) followed by 40-49 years group (37.5%).

Discussion

SO, injection is an important step for long term tamponade in complex retinal detachment surgeries. IOP elevation is a common complication after SO for endo-tamponade. (14)

The percentage of IOP elevation with SO endotamponade varies in the literature, It ranges from 2.2 to 56%.(15,16) Emulsification of SO is one of the most common causes of late-onset glaucoma. Emulsification is the separation of tiny globules of SO from the original large bubble. SO (1000 cSt), which is most commonly used, has low viscosity with high degradation rate and easy injection into the globe and easy removal. While SO (5000 cSt) has high viscosity with low degradation but with difficult injection and removal. In-vitro studies showed that the higher viscosity of the SO, the better the long term stability effect. This is due to lower emulsification rate. (17,18) In the current study, SO (1000 cSt) was exclusively used because it was the only available SO at the hospital during the study time .

Many authors believe that all eyes with SO will eventually develop emulsification, and when this occurs, tiny oil globules gain access to the anterior chamber despite the fact that the bulk of the SO remains in the posterior segment. The tiny globules may lodge in the trabecular meshwork. They cause damage to the endothelial cells of trabecular meshwork or cause peripheral anterior synechiae. These two factors will eventually lead to raised IOP. In aphakic eyes pupillary block may occur if an inferior iridectomy is not performed.(19) Copious irrigation of emulsified SO droplets from the anterior chamber might influence IOP control and lead to normal IOP in 90% of cases according to Ichhpujani et al.(20)

Emulsification is affected by purity and viscosity of SO. But even with highly pu-rified SO, a life table analysis showed that only 30% of anterior chambers were free of emulsified SO by gonioscopy by 3 years after surgery. Emulsification of SO is regarded as a risk factor of persistent high IOP after SO removal in the lit-erature. (21) Our current study is in agreement with this conclusion as emulsification was found in 75% of fcases of persistent IOP elevation after SO removal (9 out of 12).

There are conflicting results in the literature on the influence of SO removal on IOP post-SO removal. Falkner CI et al, reported significant decline in IOP after SO removal.(22) While Moisseive et al did not find such a decline in IOP after SO removal.(23)

In current study the mean IOP during SO endotamponade was 22.75 ±14.26 mm Hg, which reduced to 16.7± 4.6 at 8th week post-SO removal. This finding was in agreement with Falkner et al study.

One of the complications of SO removal is the post-operative transient hypotony. In our study, this was reported in 1% of the cases. All the cases improved with topical or systemic steroids. The reported incidence of hypotony in literature varied from 5 to 40% of the cases.(24,25) The percentage of hypotony in our study is lower than what is reported in the literature which might be due to the fact that 23 gauge vitrectomy probe was used exclusively in all the cases.

Rate of persistent ocular hypertension after SO removal in the literature was re-ported to be 9-16%.(26,27) In one study persistant IOP elevation was 13% after SO removal.(28) While persistant IOP elevation in our study at 8th week post-SO removal was 20%. This difference is probably due to difference in patients char-acteristics. They included open globe injury, traction RD and RRD. While in our study only RRD was included. Another reason is the fact that IOP more 24 mmHg was taken as a cutoff value for definition of ocular hypertension. While we took IOP more than 22 mmHg as cutoff value. The mean duration of endo-tamponade was also different. It was an average of 9.4 months for the other study, while for the 4.5 months for our study.

When the of IOP elevation stratified according to the age group, the higher rate was reported in patients below 50 years of age. The peak was in 10-19 years of age group. Pillai etal reported that younger than 50 years of age are at twice risk of developing high IOP during the SO endotamponade.(29) This might be explained by the tendency towards aggressive inflammatory response and hence highest incidence of trabeculitis.

Higher physical activity in younger age group causes emulsification of SO during endotamponade. And this might be the reason for higher risk of persistent IOP elevation after SO removal.

In one study, 16% of patients were required IOP lowering medication after SO removal. The rate of glaucoma surgery after SO removal was 2%.(30) It reached unto 7% in other studies.

Glaucoma surgery especially filtration surgery after SO removal is often complicated and has limited success rate due to conjunctival scarring from the previous retinal surgery. Glaucoma implants may be a better option.(31)

The limitations of this study are its sample size, the study was not controlled and it was not masked or randomized. The duration of follow up after SO removal was only 8 weeks. Longer follow-up is required.

Conclusion

SO removal is the best way to reduce IOP in case of high IOP during SO endo-tamponade, however persistent IOP elevation after SO removal is stills an issue. The SO removal itself is not without complications and include about 25% risk of re-detachment in RRD. This is in addition to early hypotony risk.

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Conflict of Interest
No conflict of interest

References

[1] Heidenkummer HP, Kampik AN, Thierfelder SÖ. Experimental evaluation of in vitro stability of purified polydimethylsiloxanes (silicone oil) in viscosity ranges from 1000 to 5000 centistokes. Retina (Philadelphia, Pa.). 1992 Jan 1;12(3 Suppl):S28-32.

[2] Branisteanu DC, Moraru AD, Maranduca MA, Branisteanu DE, Stoleriu G, Branisteanu CI, Balta F. Intraocular pressure changes during and after sili-cone oil endotamponade. Experimental and Therapeutic Medicine. 2020 Dec 1;20(6):1.-

[3] Abu-Yaghi NE, Abu Gharbieh YA, Al-Amer AM, AlRyalat SA, Nawaiseh MB, Darweesh MJ, Alkukhun LR, Abed AM, Saleh OA, Ababneh OH. Character-istics, fates and complications of long-term silicone oil tamponade after pars plana vitrectomy. BMC ophthalmology. 2020 Dec;20(1):1.-

[4] Borowicz D, Nowomiejska K, Nowakowska D, Brzozowska A, Toro MD, Avi-tabile T, Jünemann AG, Rejdak R. Functional and morphological results of treatment of macula-on and macula-off rhegmatogenous retinal detachment with pars plana vitrectomy and sulfur hexafluoride gas tamponade. BMC ophthalmology. 2019 Dec;19(1):1-8.

[5] Scott IU, Flynn HW, Murray TG, Smiddy WE, Davis JL, Feuer WJ. Outcomes of complex retinal detachment repair using 1000-vs 5000-centistoke silicone oil. Archives of ophthalmology. 2005 Apr 1;123(4):473-8.

[6] Heidenkummer HP, Kampik A, Thierfelder S. Emulsification of silicone oils with specific physicochemical characteristics. Graefe's archive for clinical and experimental ophthalmology. 1991 Jan;229(1):88-94.

[7] Barca F, Caporossi T, Rizzo S. Silicone oil: different physical proprieties and clinical applications. BioMed research international. 2014 Jun 11;2014.

[8] Miller JB, Papakostas TD, Vavvas DG. Complications of emulsified silicone oil after retinal detachment repair. InSeminars in ophthalmology 2014 Sep 1 (Vol. 29, No. 5-6, pp. 312-318). Taylor & Francis.

[9] Feng H, Adelman RA. Cataract formation following vitreoretinal procedures. Clinical ophthalmology (Auckland, NZ). 2014;8:1957.

[10] Enders P, Schick T, Schaub F, Kemper C, Fauser S. Risk of multiple recur-ring retinal detachment after primary rhegmatogenous retinal detachment re-pair. Retina. 2017 May 1;37(5):930-5.

[11] Farrahi F, Feghhi M, Ostadian F, Alivand A. Pars plana vitrectomy and sili-cone oil injection in phakic and pseudophakic eyes; corneal endothelial changes. Journal of Ophthalmic & Vision Research. 2014 Jul;9(3):310.

[12] Rahman A, Hussain M, Hassan MF, Bhatti MN, Qazi AM. Comparison of raised IOP after pars plana vitrectomy (PPV) using 1000 CSt and 5000 CSt silicone oil in rhegmatogenous retinal detachment. Pakistan Journal of Oph-thalmology. 2011 Mar 31;27.(١)

[13] Barr CC, Lai MY, Lean JS, Linton KL, Trese M, Abrams G, Ryan SJ, Azen SP, Silicone Study Group. Postoperative intraocular pressure abnormalities in the silicone study: silicone study report 4. Ophthalmology. 1993 Nov 1;100(11):1629-35.

[14] Theelen T, Tilanus MA, Klevering BJ. Intraocular inflammation following en-dotamponade with high-density silicone oil. Graefe's Archive for Clinical and Experimental Ophthalmology. 2004 Jul;242(7):617-20.

[15] Honavar SG, Goyal M, Majji AB, Sen PK, Naduvilath T, Dandona L. Glauco-ma after pars plana vitrectomy and silicone oil injection for complicated reti-nal detachments. Ophthalmology. 1999 Jan 1;106(1):169-77.

[16] Petersen J, Ritzau-Tondrow U. Chronic glaucoma following silicone oil im-plantation: a comparison of 2 oils of differing viscosity. Fortschritte der Oph-thalmologie: Zeitschrift der Deutschen Ophthalmologischen Gesellschaft. 1988;85(6):632-4.

[17] Ciobotaru OR, Lupu MN, Rebegea L, Ciobotaru OC, Duca OM, Tatu AL, Voinescu CD, Stoleriu G, Earar K, Miulescu M. Dexamethasone-chemical structure and mechanisms of action in prophylaxis of postoperative side ef-fects. Rev Chim (Bucharest). 2019 Mar 1;70(3):843-7.

[18] 18 .Brănişteanu DC, Moraru A, Bîlha A. Anatomical results and complica-tions after silicone oil removal. Romanian journal of ophthalmology. 2017 Oct;61(4):261.

[19] Ichhpujani P, Jindal A, Jay Katz L. Silicone oil induced glaucoma: a review. Graefe's Archive for Clinical and Experimental Ophthalmology. 2009 Dec;247(12):1585-93.

[20] Ozaki H, Huang J, Uchio E. Intraocular pressure abnormalities following sili-cone oil injection for complicated retinal detachments. Investigative Oph-thalmology & Visual Science. 2013 Jun 16;54(15):2855.-

[21] Falkner CI, Binder S, Kruger A. Outcome after silicone oil removal. British journal of ophthalmology. 2001 Nov 1;85(11):1324-7.

[22] Moisseiev JO, Barak AD, Manaim TO, Treister GI. Removal of silicone oil in the management of glaucoma in eyes with emulsified silicone. Retina (Phil-adelphia, Pa.). 1993 Jan 1;13(4):290-5.

[23] Jonas JB, Knorr HL, Rank RM, Budde WM. Intraocular pressure and silicone oil endotamponade. Journal of glaucoma. 2001 Apr 1;10(2):102-8.

[24] 24.Song ZM, Chen D, Ke ZS, Wang RH, Wang QM, Lu F, Qu J. A new ap-proach for active removal of 5,000 centistokes silicone oil through 23-gauge cannula. Retina. 2010 Sep 1;30(8):1302-7.

[25] Al-Wadani SF, Abouammoh MA, Abu El-Asrar AM. Visual and anatomical outcomes after silicone oil removal in patients with complex retinal detach-ment. International ophthalmology. 2014 Jun;34(3):549-56.

[26] Moisseiev E, Ohana O, Gershovitch L, Barak A. Visual prognosis and com-plications following silicone oil removal. European journal of ophthalmology. 2013 Mar;23(2):236-41.

[27] Issa R, Xia T, Zarbin MA, Bhagat N. Silicone oil removal: post-operative com-plications. Eye. 2020 Mar;34(3):537-43.

[28] Pillai GS, Varkey R, Unnikrishnan UG, Radhakrishnan N. Incidence and risk factors for intraocular pressure rise after transconjunctival vitrectomy. Indian journal of ophthalmology. 2020 May;68(5):812.

[29] Bhoot M, Agarwal A, Dubey S, Pegu J, Gandhi M. Silicone oil induced glau-coma. The Official Scientific Journal of Delhi Ophthalmological Society. 2018 Aug 3;29(1):9-13.

[30] Narang P, Agarwal A. Single-pass four-throw technique for pupilloplasty. Eu-ropean Journal of Ophthalmology. 2017 Jun 26;27(4):506-8.

[31] Jonas JB, Knorr HL, Rank RM, Budde WM. Retinal redetachment after removal of intraocular silicone oil tamponade. British journal of ophthalmology. 2001 Oct 1;85(10):1203-7.

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