Pak Armed Forces Med J 2007; 57(1): 49-55

COMPLICATIONS ASSOCIATED WITH THE USE OF 5000 – CENTISTOKE SILICON OIL AFTER VITREO – RETINAL SURGERY

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ABSTRACT

Purpose: The purpose of the study was to report and compare the complication rates associated with use of silicon oil after vitreo-retinal surgery.

Methods: This was a prospective hospital based study spanning over a period from January 2004 to June 2005. A total of 69 patients with different vitreo-retinal diseases were operated by a single surgeon using standard three ports pars plana vitrectomy technique and 5000–centistoke silicon oil. Depending upon the intra-operative situation, additional procedures were performed including use of an encircling band, relaxing retinotomy and use of perfluorocarbon liquids.

Results: The major post-operative complications observed were, development of cataract in 46 (85.18%) out of 54 patients, early post-operative raised intra-ocular pressure (IOP>25 mmHg) in 28 (40.57%) patients, keratopathy (including corneal edema, corneal abrasions and band keratopathy) in 15 (21.73%) patients, emulsification of silicon oil in 5 (7.26%) patients, glaucoma in 5 (7.26%) patients on final follow-up and ocular hyopotony in 1 (1.44%) patients. Retinal re-attachment in 35 (72.92%) and retinal re-detachment in 13 (27.08 %) patients. Visual out-come was, improved visual acuity in 45 (65.23%) patients, preserved (un-changed) in 10 (14.49%) patients and was reduced in 14 (20.28%) patients.

Conclusions: The use of silicon oil in vitreo-retinal surgery offers definite advantages however, its complications particularly cataract, glaucoma and kertopathy lead to worries about its use for prolonged retinal temponade.

Keywords: Silicon oil, complex retinal detachment, proliferative vitreo-retinal diseases, pars plana vitrectomy

INTRODUCTION

The use of silicon oil for treatment of retina detachment was first reported in 1962 [1]. The commercial production of medical grade silicone oil for ophthalmic use is almost not existing. Currently, most of the silicone oils used by the vitreo-retinal surgeons are of industrial origin. The purpose of silicone oil as a vitreous substitute is to provide short to long-term internal retinal tamponade in the management of complex retinal detachments, proliferative vitreo-retinopathy, diabetic retinopathy, giant retinal tear, viral retinitis and ocular trauma. Proliferative vitreo-retinopathy (PVR) is the commonest cause of recurrent retinal detachment [2]. In spite of complete vitrectomy, relieving of all tractions and careful peeling of membranes, recurrent traction in the vitreous base may cause formation of new breaks or elevation of retina leading to tractional or combined tractional-rhegmatogenous retinal detachment.

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Successful post-operative internal retinal tamponade has been achieved with silicone oil or gases like sulphurhexaflouride (SF6) and perflouropropane. However, silicone oil has the advantage of being a permanent internal tamponade agent. On the other hand the use of silicone oil is not without significant ocular complications [3] including early post-operative raised intrao-cular pressure, cataract formation, emulsification of silicone oil, keratopathy, glaucoma, epiretinal membrane formation and sub-retinal migration of oil. These complications are partly related to the duration of intra-ocular exposure to the silicone oil. Once a complication appears, removal of the silicone oil may not necessarily lead to its reversal. However, the reduction in vision due to silicone oil induced changes in refraction, often improves after removal of silicone oil. Unfortunately, sometimes removal of silicone oil may result in re-detachment of the retina [4]. This fear of recurrent retinal detachment and the resultant need for further surgery appears a common reason for late or not removing the silicone oil. As the retinal detachment rate does not appear to be influenced by the duration of intra-ocular silicon oil, it seems reasonable to remove the oil as early as possible to avoid or minimize its complications [5].

MATERIALS AND METHODS

This was a hospital based prospective study carried out in the vitreo-retinal clinic of Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan. All the patients in the vitreoretinal clinic were referred from the out-patient department of this hospital, where they were initially screened. The duration of the study was 18 months, from January 2004 to June 2005. Patients with pseudophakia, patients wth normal intra ocular pressure and patients with no history of vitreo-retinal surgery were included in this study. Of all these patients a complete pre-operative examination was carried out including taking of history, testing of visual acuity with Snellen's chart, E-chart, slit-lamp biomicropy, a detailed fundus examination with +78D lens and with indirect ophthalmoscopy, applanation tonometry and B-scan ultrasonography of eyes with opaque media.

The total number of patients who underwent standard three ports pars plana vitrectomy with silicone oil injection was 69. All these patients were operated by a single surgeon using 5000-Centistoke silicone oil in conjunction with standard three ports pars plana vitrectomy. Depending upon the intra-operative situation, additional procedures were performed including use of an encircling band, relaxing retinotomy and use of perfluorocarbon liquids. 42 patients were operated under local (retro-bulbar) anesthesia and remaining 27 patients were operated under general anesthesia. Post-operative instructions to maintain "face down position" for an average period of one week were given to all the patients. On the next day a complete post-operative examination of every patient was performed before discharging. The out-comes were assessed at 02 weeks, 06 months, 12 months and 18 months after surgery. We prepared a database for recording of relevant information on the patients. Data analysis was carried out using the EPI info programme version 6.02.

RESULTS

In this study we had a total of 69 patients, of them 37 (53.62%) were male and 32 (46.38%) were female, the age ranged from 15 to 74 years with the mean age of 47 years. The surgical indications were regmatogenous retinal detachment with PVR grade B and C in 19 (27.54%) patients, proliferalative diabetic retinopathy with non-resolving vitrous haemorrhage in 13 (18.84%) patients, proliferalative diabetic retinopathy with tractional retinal detachment in 11 (15.94%) patients, severe vasculitis with non-clearing vitreous haemorrage in 5 (7.25%) patients, vasculitis with tractional retinal detachment in 7 (10.14%) patients, gaint retinal tear with retinal detachment in 5 (7.25%) patients, intra-ocular foreign body with vitrous haemorrage

Table-1: Disease distribution of patients (n=69).

Disease	Number of Patients	Percentage
Rhegmatogenous RD with grade B, C - PVR	19	27.54
PDR with non resolving Vitreous Haemorrage	13	18.84
PDR with Tractional RD	11	15.94
Severe Vasculitus with non resolving Vitreous Haemorrage	05	07.25
Vasculitis with Tractional RD	07	10.13
Giant Retinal Tear with RD	05	07.25
Traumatic Vitreous Haemorrage with RD	04	05.80
IOFB with Vitreous Haemorrage	03	04.35
Persistant Exudative RD	02	02.90

RD = Retinal Detachment PVR = Proliferative Vitreo-Retinopathy IOFB = Intra Ocular Foreign Body

3 (4.35%) patients and persistant exudetive retinal detachment in 2 (2.90%) patients (table-1). The main complications included cataract in 46 (85.18%) out of 54 patients (table-3), early post-operative raised intra-ocular pressure in 28 (40.58%) patients, keratopathy in 15 (21.74%) patients, silicone oil emulsification in 5 (7.25%) patients and glaucoma in 5 (7.25%) patients on final follow-up. Other complications were single silicon oil buble in anterior chamber in 4 (5.8%) patients, sub-conjuctival silicone oil deposits in 3 (4.35%) patients, ocular hypotony in 1 (1.45%) patients and of course change in refraction in all the patients. Post-operative status of the retina showed retinal re-attachment in 35 (72.92%) patients and retinal re-detachment in 13 (27.08%) patients. Post-operative visual acuity was improved in 45 (65.22%) patients, preserved (un-changed) in 10 (14.49%) patients, decreased in 12 (17.39%) patients while 2 (2.90%) patients had no perception of light (table-4).

Table-2: Pre-operative status of the lens (n=69).

Status of lens	No. of Patients	Percentage
Clear lens	38	55.07
Early cataract	16	23.19
Pseudophakic	15	21.74

DISCUSSION

Silicone oil has become an essential component to facilitate re-attachment of retina in complex retinal detachments and to stabilize the post-operative retina in certain vitreo-retinal diseases [6]. Silicone oil assists in maintaining retinal re-attachment by a combination of effects, including tamponade of retinal breaks, flotation force, and its hydraulic space-occupying property. However, its use is not free of complications, if we get rewards on one end; we have to pay some penalties on the other.

Among the major compilations of silicone oil, early post-operative rise in intra-ocular pressure (IOP > 25 mm Hg) was very common (40.57%) (table-3). This was found in most of the patients with intra-ocular inflammations leading to formation of fibrin, pupillary membrane, and early posterior synichia, or patients with intra-ocular haemorrhage can block aqueous out-flow, especially when the patient lies in prone position [7] or at times in patients with unintentional over-filling of silicone oil. It was usually short-term and was managed by using pressure lowering medications and anti-inflammatory drugs with in two to six weeks. In an other study carried-out in Pakistan, similar results were obtained, the raised intra-ocular pressure was the most common complication of silicon oil (50%) in that study [8]. There was progression of pre-existing cataract and development of new lenticular opacities in 13 (24.07%) patients during first 06 months, this number raised to 31 (57.40%) and 46 (85.18%) after 12 months and 18 months respectively. This may be due to persistent contact of silicone oil with the posterior capsule causing disturbance in lens metabolism and as there is no vitreous, some

Table-3: Major post-operative complications associated with silicon oil.

Complication	Within 1st 6 months		From 7 months – 12 months		13 months – 18 months	
	Number	%age	Number	%age	Number	%age
Cataract	13	24.07	31	57.40	46	85.18
Keratopathy	06	08.69	12	17.41	15	21.73
Raised Intra- Ocular Pressure	28	40.57	00	00.00	00.00	00.00
Emulsification of Silicon Oil	02	02.89	03	04.34	05	07.26
Glaucoma	04	05.78	04	05.78	05	07.26
Single Silicon Oil Bubble in Anterior Chamber	04	05.78	04	05.78	04	05.78
Sub-Conjunctival Silicon Oil Deposits	03	02.89	03	02.89	03	02.89
Ocular Hypotony	00	00	01	01.44	01	01.44

Note: A single patient may have more than one complication

Table-4: Pre-operative and post-operative visual acuity (n=69).

Best Corrected Visual Acuity	No. of Pre- Operative Patients n(%)	No. of Post- Operative Patients n(%)
6/6 – 6/12	--	10 (14.49)
6/18 – 6/60	09 (13.04)	35 (50.74)
< 6/60 – 3/60	11 (15.94)	10 (14.49)
< 3/60 – PL + ve	49 (71.02)	12 (17.39)
NPL	--	02 (2.89)

nutrition that comes from vitreous also stops. AG Casswell and ZJ Gregora found similar results; they reported development of new lenticular opacities in 60% patients and 85% of pre-existing lens opacities progressed [9]. Other studies have shown 100% development of cataract after two years of silicon oil use. An other visually disabling complication is keratopathy, this is due to silicone oil in anterior chamber making constant contact with the corneal endothelium. We saw 6 (8.69%) cases in first 6 months, 12 (17.41%) cases in second 6 months and 15 (21.73%) cases after 18 months. In a study conducted by AG Casswell and ZJ Gregora they reported 326 (26%) patients of krathopathy out of 1248 patients [9]. These findings are slightly more than in our study, this seems to be due to their longer study period of 2 years. Emulsification of silicone oil was found in 5 (7.26%) cases on last follow-up visit. The clinical picture of emulsification is the break-down of the integrity of large silicon oil bubble into smaller bubbles (fish eggs). Post-operative emulsification of silicone oil is related to a number of factors including the absorption of water and other chemical substances and viscosity of silicon oil used. Low viscosity silicone oil emulsifies more than silicone oil with high viscosity. Ingrid U and Scott, in a recent study noted emulsification of 5000-centistoke silicon oil in 4% of their patients [10]. This observation is less than our observations of 7.26% patients. This may be due to their short follow-up period of one year. Glaucoma is a vision threatening complication of silicone oil, the late development of glaucoma in eyes with silicon oil is presumed to be secondary to the dispersion of small silicon oil bubbles, pigmented cells and silscon-laden macro-phages that may block the trabecular meshwork [11]. Other possible mechanisms include concomitant neovascular glaucoma, ghost cell glaucoma, uveitis and mechanical forward pushing of iris-lens diaphragm. In our study we found glaucoma in 5 (7.26%) patients on final follow-up. D H W Steel et al. had 10% cases of glaucoma [12]. Ocular hypotony is one of the dreaded complications of silicon oil. We faced one case (1.44%) of ocular hypotony after 14 months. This is probably due to ischaemia of the ciliary body, traction on the ciliary body from the adjacent cellar vitreous gel or it may be due to an inflammatory membrane covering the ciliary

processes followed later by fibro-cellolar proliferation. Azen SP, et al. found 11 (5.61%) out of 196 patients [13]. Single silicon oil bubble in anterior chamber is a complication causing visual disturbances and if not removed timely it leads to localized corneal endothelial opacity. In some patients it appears in the anterior chamber per-operatively but in most of the patients it presents post-operatively. A Castellarin et al had 1 (4.34%) eye out of 23 after vitrectomy with silicone oil [14]. We found 4 (5.78%) patients, of them 02 patients were of high myopia and the other 02 were pseudophakic with posterior capsular gape. Sub-conjunctival silicone oil deposit is a benign complication but cosmetically unacceptable to the patients. We had in 3 (4.34%) patients; this was due to incomplete wash-out of silicon oil per-operatively before conjunctival wound cloure. Federman JL and Schubert HD reported 3% patients with sub-conjunctival silicone oil deposits [15]. In this study retinal re-attachment was achieved in 35 (72.92%) patients after vitrectomy using silicon oil. However, a significant number of patients 13 (27.08%) had retinal re-detachment. This problem of retinal re-detachment was more in those patients who had not received encircling band (external tamponade) per-operatively. Scott IU et al in 2000 reported 48% retinal re-attachment after vitrectomy with silicone oil for complex vitreo-retinal diseases including giant retinal tear, proliferative vitreo-retinopathy, ocular trauma and proliferative diabetic retinopathy [16]. However, a Castellarin et al found reattachment in 74% of their patients [14]. In our study post-operative visual acuity was improved in 45 (65.23%) patients, preserved (un-changed) in 10 (14.49%) patients, while found decreased in 14 (20.28%) patients, of them 2 (2.89%) patients had no perception of light. The cause of loss of vision was retinal and optic nerve ischaema. The visual out-come was less in diabetic patients as compared to non-diabetic patients. In the study carried out by A Castellarin et al, they found visual acuity improved in 45%, was un-changed in 12%, decreased in 44% and 8.7% patients had no perception of light [14]. There was a significant change in refraction (hypermetropia of 05 to 06 diapoters) in all the patients (we excluded aphapakic patients), ultrasonography had marked imaging artifacts, therefore findings of both biometry and B-scan ultrasonography were non-reliable. Other reported complications of silicon oil use are sub-retinal migration of silicone oil, peri-silicon oil proliferation, tissue toxicity and migration of silicone oil into the brain tissues. Migration of silicone oil to sub-retinal space usually occurs in patients having retinal shortening with un-covered large tears (specially inferior tears) and poor external tamponade, and in patients with retinotomies. Peri-silicon oil proliferation may be due to entrapment of retina-derived angiogenic substances between the retinal surface and the silicon oil bubble [17]. Low molecular weight (less than 2500) components are common impurities in silicone oil. These are highly volatile; some of these components may diffuse as vaporized molecules into the surrounding tissue where they are thought to produce toxic effects. The vaporized molecules can also condense and become silicone oil droplets in areas of temperature change, such as near the iris or in the anterior chamber [18]. Exact mode of silicon oil migration to the central nervous system is not known, however it has been postulated that the oil may infiltrate the optic nerve after prolonged increased intra-ocular pressure (pseudoschnabel's cavernous optic atrophy). Once the oil has infiltrated the optic nerve, it may coalesce in the subarachnoid space and travel to the lateral ventricles. Alternatively, abnormalities of the optic nerve, such as an optic pit, can create a communication between the vitreous cavity and the subarachnoid space [19]. Although there is no evidence of damage arising from migration of silicone oil to the brain tissue, this may influence the clinicians decision regarding the necessity and timing of oil removal after successful tamponade has been attained. Furthermore, in patients who may have reasons for long-

standing silicon oil tamponade, in these cases aggressive treatment of elevated intra-ocular pressures should be initiated.

CONCLUSIONS

- There were significant number of complications which included early post-operative raised intraocular pressure, clinically significant cataract, band keratopathy and glaucoma in order of decreasing incidence.
- Comparison with the national and international studies showed almost similar results.
- The visual out-come after vitrectomy with silicon oil was less in diabetic patients as compared to non-diabetics.
- Careful post-operative handling and timely removal of silicon oil is necessary to avoid the initiation or worsening of its associated complications.
- Silicon oil has been commonly used for more than four decades, but published data on out-comes of such surgery is limited. There is need for further study about the physicochemical characteristics of silicon oil and potential benefits and harmful effects of its use.

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