ORIGINAL ARTICLE

Retinal Tamponade with Silicone Oil – Long Term Results

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SUMMARY

Aim: The aim of this study is to evaluate the frequency and efficacy of silicone oil (SO) retinal tamponade in various retinal diseases. The incidence of silicone oil tamponade according to individual indications, incidence of complications and duration of tamponade were evaluated in the study.
Material and Methods : A retrospective study included 510 eyes that were operated on pars plana vitrectomy (PPV) from January 2010 to December 2012. In our group we evaluated 241 men and 189 women, age 4-84 years, mean 62 years . Follow-up period was 12 to 48 months, an average of 27.5 months . We evaluated 253 eyes with diabetic retinopathy, 201 eyes with regmatogenous retinal detachment, 34 eyes with endophthalmitis and 22 eyes after the injury.
Results: In 253 diabetic retinopathy eyes (DR) silicone oil tamponade was indicated in 56 eyes (22.1 %). Silicone oil removal was done on 22 eyes (39.3 %), the average length of SO tamponade was 9.7 months. After SO removal BCVA (best corrected visual acuity) 0,1 and worse had 12 eyes (54,6 %), 0,2 – 0,4 had 5 eyes (22,7 %) and 0,5 or better had 5 eyes (22,7 %). Permanent SO tamponade was left in 34 diabetic retinopathy eyes (60.7 %). Secondary glaucoma (SG) was present in 40 eyes (71.5 %). In 201 retinal detachment (RD) eyes silicone oil tamponade was used in 76 eyes (37.8 %). Secondary glaucoma was present in 31 eyes (40.8 %). Silicone oil was successfully removed in 40 eyes (52.6 %), the average length of tamponade was 9.2 months. In this group BCVA 0,1 and worse had 22 eyes (55,0 %), 0,2 – 0,4 had 15 eyes (37,5 %) and 0,5 or better had 3 eyes (7,5 %). 36 eyes (47,4 %) RD eyes had permanent silicone oil tamponade. In a group of 34 eyes with endophthalmitis SO tamponade was used in 16 eyes (47 %). Secondary glaucoma was present in 3 eyes (18.8 %). Silicone oil removal we did in 11 eyes (68.8 %), the average length of SO tamponade was 5.5 months. After SO removal BCVA 0,1 and worse had 3 eyes (27,2 %), 0,2 – 0,4 had 4 eyes (36,4 %) and 0,5 or better had 4 eyes (36,4 %). 5 eyes (31.2 %) with endophthalmitis had permanent SO tamponade. Out of 22 eyes with eye injuries SO tamponade was used in 14 eyes (63.6 %). 5 eyes (35.7 %) had secondary glaucoma. In 9 eyes (64.3 %) silicone oil was removed, the average length of tamponade was 9.1 months. In this group BCVA 0,1 and worse had 6 eyes (66,7 %), 0,2–0,4 had 1 eye (11,1 %) and 0,5 or better had 2 eyes (22,2 %). Permanent silicone oil tamponade had 5 eyes (35,7 %). In group of 56 phakic eyes (100 %) with silicone oil tamponade we followed cataract progression. 26 eyes (40 %) had cataract surgery in 6 month follow up, 47 eyes (72.3 %) in 1 year follow up and 57 eyes (87.7 %) had cataract surgery in 3 years follow up.
Conclusion: Silicone oil tamponade is the method of choice for long-term and stable retinal tamponade, which is important for good functional outcomes of the surgical intervention. The silicone oil tamponade of the retina is nowadays irreplaceable, despite of its potential risks and complications.

Key words: keratoconus, corneal cross-linking, riboflavin, UVA irradiation, maximum curvature of the cornea, effectivity of the treatment

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INTRODUCTION

Silicone oil is applied to the vitreous cavity, with the aim of ensuring long--term and stable retinal tamponade (15). In the majority of cases this concerns complicated findings, for which temporary gas tamponade is insufficient. We indicate SO tamponade in the case of retinal detachment for numerous, large or enormous ruptures (14), for proliferative vitreoretinopathy (PVR), severe myopia with macular hole (16) or for repeat operations on retinal detachment (11). In the case of diabetic retinopathy, we most frequently use SO on advanced tractional or combined retinal detachment, or recurrences of haemophthalmos. Further indications are traumas with retinal crack or retinal detachment (3), endophthalmitis (4), CMV retinitis, acute retinal necrosis, complications in age related macular degeneration (ARMD), tumours, retinopathy of prematurity, vein occlusions, Coats' disease and others (2). We consider tamponade with silicone oil during PPV also upon complicated findings in the

sole functioning eye or in the case of severely ill patients and patients with mobility problems.
The silicone oil used in ophthalmology is highly biocompatible. From a chemical perspective it concerns 100% polydimethylsiloxane (purified), its density is 0.97-0.98 g/cm3 (it is therefore lighter than water), refractive index 1.40, surface tension on the interface with water 40 dyn/cm2. Silicone oil is available in various viscosities: 1000, 1300, 2000, 5000, 5500 cs (centistokes). A separate group comprises heavy silicone oils, which we do not use due to their limited indications and complications.
The most frequent complications upon retinal tamponade with silicone oil are cataract and secondary glaucoma. We analyse our results and a comparison thereof with those of other authors in further detail in the discussion. In the case of secondary glaucoma, we achieved sufficient compensation of IOP (intraocular pressure) in the majority of eyes by means of local therapy, upon surgical treatment in our workplace we give priority to cyclodestructive surgery due to the risks and complications of filtering operations on the eye with simultaneous tamponade with silicone oil.
As a consequence of its higher refractive index in comparison with water or the vitreous body, silicone oil causes a refractive shift. Upon aphakia it causes a reduction of hypermetropia, in phakic or pseudophakic eyes it causes a shift to hypermetropia. In the case of severe myopia it reduces myopic correction.
A highly unpleasant complication of SO tamponade is its subretinal or subchoroidal penetration, mostly as a consequence of PVR, scarring of the retina or choroidea upon findings of complicated retinal detachment or in the case of traumas. In the case of penetration of SO beneath the conjunctiva, which is very difficult to remove, infiltration of the Tenon's capsule occurs, resulting in chronic inflammation. For this reason, in the case of sutureless PPV techniques we consider it safer to suture all wounds upon the use of SO tamponade, thus averting this complication. In rare cases, penetration of SO may occur into the conjunctiva via a glaucoma drained implant (10).
A less frequent complication of long-term SO tamponade is zonular keratopathy, which probably occurs as a consequence of impaired trophic function of the anterior segment in severely afflicted eyes which would otherwise probably atrophy without SO (1).
The causes of deterioration of central visual acuity following evacuation of SO are sometimes not entirely clear. Phototoxicity of the light used in PPV, toxicity of SO with regard to the retina and also the effect of the enlarged image during SO tamponade, which is lost after evacuation, may play a role in this process (7).

MATERIAL AND METHOD

A retrospective study incorporated 510 eyes of 430 patients, who were operated on using the technique of pars plana vitrectomy (PPV) from January 2010 to December 2012 (36 months). The study sample comprised 241 men and 189 women, aged 4 – 84 years, average 62 years. The observation period was 12 – 48 months, average 27.5 months. We evaluated 4 sub-groups within the study: 253 eyes with diabetic retinopathy, 201 eyes with rhegmatogenous retinal detachment, 34 eyes with endophthalmitis and 22 eyes following trauma. With regard to the small number of patients, we did not evaluate SO tamponade statistically in other indications. In addition to the above-stated disorders, 6 eyes were indicated for SO tamponade during the observation period with uveitis, 2 eyes with wet form ARMD, 1 eye with intraocular tumour, 1 eye with retinopathy of prematurity, 1 eye with Coats' disease and 1 eye with central retinal vein occlusion.
In the study we evaluated the indications, frequency, anatomical and functional results of retinal tamponade with silicone oil (SO) in the case of various ocular pathologies, as well as the incidence of secondary glaucoma and its solution.
BCVA was evaluated on Snellen's optotypes in all eyes at the end of the observation period.
In the study we also evaluated the incidence and progression of cataracts as a consequence of tamponade with silicone oil and the necessity of surgical solution thereof.

RESULTS

In the sub-group of 253 eyes (100%) with diabetic retinopathy (DR), tamponade with silicone oil was indicated in 56 eyes (22.1%). Silicone oil was evacuated in 22 eyes (39.3%), the average length of tamponade was 9.7 months. In the sub-group of eyes with diabetic retinopathy, permanent SO tamponade was left in 34 eyes (60.7%). Out of 22 eyes following successful evacuation of SO we attained BCVA of 0.1 and worse in 12 eyes (54.6%), 0.2 – 0.4 in 5 eyes (22.7%) and 0.5 and better in 5 eyes (22.7%). Out of 34 eyes with retained permanent SO tamponade we attained BCVA of 0.1 and worse in 33 eyes (97.1%), and 0.2 – 0.4 in only 1 eye (2.9%). We recorded secondary glaucoma as a consequence of SO tamponade in 30 eyes (53.6%), and recorded decompensation of pre-existing secondary neovascular glaucoma in 10 eyes (17.9%). Secondary glaucoma was present in the sub-group of eyes with DR and with applied SO in as many as 40 eyes (71.5%)! Of these, 37 eyes (92.5%) were compensated in local therapy, in 3 eyes (7.5%) a cyclocryo application operation was performed with a good effect.
In the sub-group of 201 eyes (100%) with rhegmatogenous retinal detachment (RRD), primary SO tamponade was indicated in 51 eyes (25.4%), and secondary SO tamponade was indicated in 25 eyes (12.4%) following previous unsuccessful PPV with expansive gas tamponade. Altogether SO tamponade was used on 76 eyes (37.8%) with RRD. Silicone oil was successfully evacuated in 40 eyes (52.6%). The average length of tamponade was 9.2 months. In 7 eyes (15% of eyes following evacuation of

Table 1

Indication	SO	Secondary	Glaucoma	Permanent tamponade	Successful evacuation of SO
DR	n = 253	56 (22.1%)	40 (71.5%)	34 (60.7%)	22 (39.3%)
Rhegmatogenous RD	n = 201	76 (37.8%)	31 (40.8%)	36 (47.4%)	40 (52.6%)
Endophthalmitis	n = 34	16 (47%)	3 (18.8%)	5 (31.2%)	11 (68.8%)
Traumas	n = 22	14 (63.6%)	5 (35.7%)	5 (35.7%)	9 (64.3%)

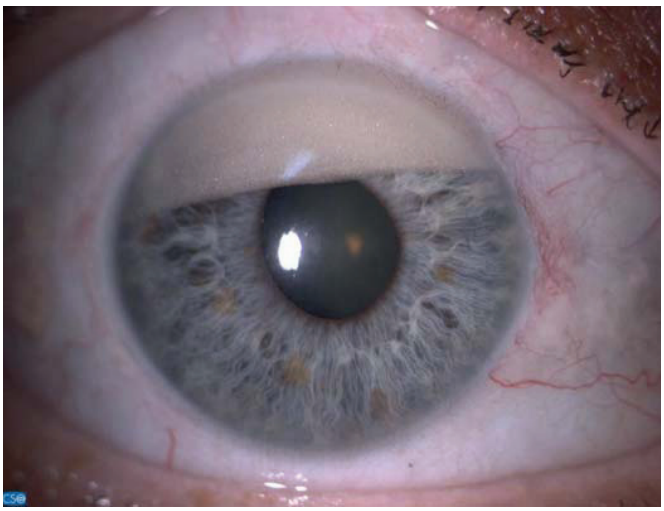

Fig. 1 Emulsification of SO in anterior chamber

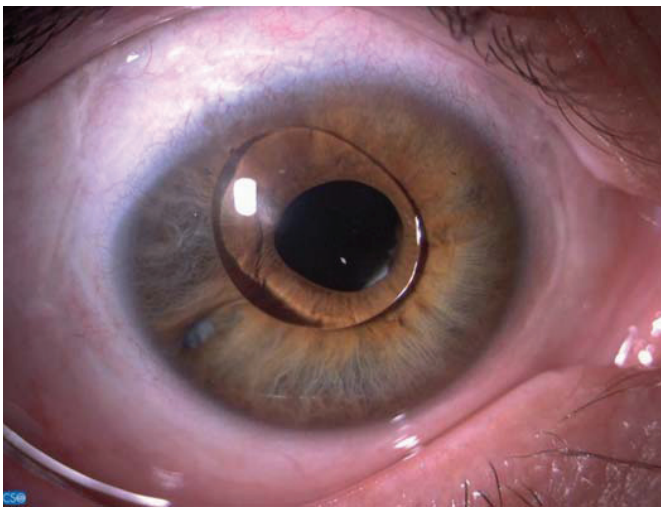

Fig. 2 Silicone oil in anterior chamber

SO), silicone oil was re-applied due to the recurrence of retinal detachment in our sub-group. Permanent retinal tamponade using SO was retained in 36 eyes (47.4%). Out of 40 eyes following successful evacuation of SO we attained BCVA of 0.1 and worse in 22 eyes (55.0%), 0.2 – 0.4 in 15 eyes (37.5%) and 0.5 and better in 3 eyes (7.5%). Out of 36 eyes with retained permanent SO tamponade we attained BCVA of 0.1 and worse in 32 eyes (88.9%), and 0.2 – 0.4 in only 4 eyes (11.1%). We recorded secondary glaucoma in 31 eyes (40.8%) with SO tamponade for RRD. In 29 eyes (93.5%), IOP was compensated local therapy, in 2 eyes (6.5%) we proceeded during SO tamponade to transscleral cyclophotocoagulation by diode laser, with a good effect.

In the sub-group of 34 eyes (100%) with endophthalmitis, SO tamponade during PPV was indicated in 16 eyes (47%). Silicone oil was evacuated in 11 eyes (68.8%), the average length of tamponade was 5.5 months. Permanent SO tamponade was left in 5 eyes (31.2%) with endophthalmitis. Out of 11 eyes following successful evacuation of SO we attained BCVA of 0.1 and worse in 3 eyes (27.2%), 0.2 – 0.4 in 4 eyes (36.4%) and 0.5 and better in 4 eyes (36.4%). Out of 5 eyes with retained permanent SO tamponade we attained BCVA of 0.1 and worse in 5 eyes (100%). We recorded secondary glaucoma as a consequence of SO tamponade in 3 eyes (18.8%), in all IOP was compensated in local therapy.

In the sub-group of 22 eyes (100%) with ocular trauma, SO tamponade was indicated in 14 eyes (63.6%). We performed evacuation of silicone oil in 9 eyes (64.3%), the average length of tamponade was 9.1 months. Permanent SO tamponade was left in 5 eyes (35.7%). Out of 9 eyes following evacuation of SO we attained BCVA of 0.1 and worse in 6 eyes (66.7%), 0.2 – 0.4 in 1 eye (11.1%) and 0.5 and better in 2 eyes (22.2%). Out of 5 eyes with retained permanent SO tamponade we attained BCVA of 0.1 and worse in 5 eyes (100%). We recorded secondary glaucoma in 5 eyes (35.7%), in all eyes IOP was compensated in local therapy.

An overview and comparison of the evaluated results is presented in table 1.

In the total group of 162 eyes (100%) with SO tamponade, 15 eyes (9.3%) were aphakic, 66 eyes (40.7%) pseudophakic and 81 eyes (50%) phakic. During the primary operation we conducted combined cataract surgery with PPV on 16 eyes (19.8%). In the observation period we evaluated the incidence of cataract with the need for surgery by the technique of phacoemulsification with or without the implantation of an artificial IOL (intraocular lens) in the group of 65 phakic eyes (100%). Within six months 26 eyes were operated on (40%), within 1 year 47 eyes (72.3%) were operated on, within 3 years 57 eyes (87.7%). Of these, 32 eyes (49.2%) were operated on for cataract during tamponade with silicone oil, in 5 eyes (7.7%) surgery was performed without the implantation of an IOL.

DISCUSSION

The most frequent complication of retinal tamponade with silicone oil is cataract, the incidence of which changes depending on the age of the patient, associated general illnesses and ocular pathologies, and naturally also the length of SO tamponade. In our study sample we observed a progression of cataract within 1 year in 72.3% of eyes, within 3 years in as many as 87.7% of eyes. This data is even higher than the published results of other authors (5), who describe the presence of a cataract in 50% within 5 years following PPV, in diabetics in up to 80%. From this it is evident that the presence of silicone oil tamponade has a significant influence on the metabolism of the lens. In the era of modern phacoemulsification, cataracts do not represent a more serious technical problem. However, in the postoperative period a progression of secondary fibrosis occurs, with a thickening of the posterior capsule of the lens. As a result, upon the subsequent evacuation of SO it is usually necessary to perform posterior capsulectomy. For the above reasons, the optimal solution is combined surgery of the anterior and posterior segment of the eye with implantation of a posterior chamber lens into the capsule and subsequent PPV. However, we attempt to avoid this in patients with preserved accommodation.

From our perspective, the most serious complication of retinal tamponade with silicone oil is secondary glaucoma (17), which frequently requires combined local therapy, sometimes we also embark upon surgical correction of raised intraocular pressure. This is most frequently caused by emulsifications of SO (fig. 1), which clog the trabecular meshwork and thereby cause outflow of the fluid

from the anterior chamber. From the perspective of long-term tamponade it appears to be more appropriate to use silicone oil with a higher viscosity (5000-5500cs) (18). In our groups, its incidence was 18.8-71.5%, which corresponds to the data from the literature (8). Most frequently (71.5%) this was in eyes with diabetic retinopathy, where secondary neovascular glaucoma plays an important role (19).

Closed-angle secondary glaucoma may occur as a consequence of pupillary block, which is preceded by basal iridectomy at 6 o' clock ("Japanese"). Silicone oil in the anterior chamber (fig. 2) can cause blockage of the outflow of the intraocular fluid in the chamber angle, as a result it is necessary to evacuate the silicone oil from the anterior chamber perioperatively or postoperatively using fluid or viscoelastic material (12).

In the sub-group of eyes with rhegmatogenous retinal detachment, silicone oil was successfully evacuated in 40 eyes (52.6%). In the Silicone Oil Study, SO was successfully evacuated in 45% of cases (9). In our study sample, silicone oil was re-applied in 7 eyes (15% of eyes following evacuation of SO) due to recurrence of retinal detachment. This data corresponds with the data of other authors in the literature, who have referred to the necessity of reoperation of retinal detachment following evacuation of SO in 15-25% of eyes (6, 13). It is evident that the percentage success rate of evacuation of SO upon RRD remains comparable, but it is necessary to note that we choose SO tamponade today in the case of more complicated findings of retinal detachment, whilst we resolve simpler findings with the aid of expansive gas tamponade.

In the sub-group with endophthalmitis we successfully evacuated SO in 11 eyes (68.8%). In a similar group of patients, the authors Dotřelová et al. (4) explanted silicone oil after 4.6 months in 40.9% eyes. We believe that we achieved better results thanks to timely surgical intervention, which thereby improves the prognosis with regard to anatomical and function aspects.

We achieved similar results in comparison with other authors (3) also in the case of ocular traumas (3). Doležalová et al. in their study referred to successful evacuation of SO in two eyes out of four (50%) following PPV for severe perforating ocular trauma.

CONCLUSION

Retinal tamponade with silicone oil is irreplaceable, despite the potential risks and complications in vitreoretinal surgery. The anatomic success rate following evacuation of the silicone oil provides the preconditions for a successful functional result. Thanks to advances in the technical possibilities of PPV and timely surgical intervention, the proportion of successful evacuations of SO is increasing (68.8% in the sub-group of eyes with endophthalmitis). In primary pars plana vitrectomy we always attempt to avoid retinal tamponade with silicone oil, which is possible thanks to retinal tamponade with expansive gases. Primary SO tamponade is thus indicated later for more complicated findings in the posterior segment of the eye. Thanks to expansion gases, the absolute number of patients with permanent retinal tamponade with SO has been reduced. The decision on the type of tamponade always depends on the individual case, the finding on the ocular fundus and also on the anterior segment of the eye, as well as on the preferences and experiences of the vitreoretinal surgeon. In our workplace SO tamponade is indicated most frequently in the case of PPV for trauma – in 63.6% of eyes. We recorded secondary glaucoma upon SO tamponade following PPV for diabetic retinopathy – in 71.5% of eyes. On average, we embark upon evacuation of SO after 5.5 to 9.7 months. The anatomical success rate of evacuation was 39.3% - 68.8%, which corresponds with the published results of other authors (9). Permanent retinal tamponade using SO was retained in our patients in 31.2% - 60.7% of cases, most frequently following PPV for diabetic retinopathy.

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