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SCIENTIFIC REPORT

Results of high-density silicone oil as a tamponade agent in macular hole retinal detachment in patients with high myopia

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Background: To evaluate the use of high-density silicone oil (HDSO) as a tamponade agent for retinal detachment secondary to myopic macular hole.

Methods: 12 eyes of 12 patients with macular hole retinal detachment underwent pars plana vitrectomy, internal limiting membrane peeling and HDSO tamponade. No posturing was required postoperatively and HDSO was removed 3–4 months later. Outcome measures included macular hole closure and retinal attachment rates, best-corrected visual acuity (BCVA), and intraoperative and postoperative complications.

Results: The mean age of the patients was 67.8 years and the mean spherical equivalent refractive error was –13.4 diopters. After the removal of HDSO, 10 (83%) eyes had macular hole closure with retinal reattachment without any tamponade. One eye had retinal reattachment after re-operation and the other refused further surgery. At the last follow-up, the median BCVA improved from 20/800 to 20/600 ($p=0.046$). A transient increase in intraocular pressure was observed in 5 (42%) eyes and one eye each developed mild oil emulsification and transient peripheral choroidal detachment. None of the eyes was found to have severe intraocular inflammation post-operatively.

Conclusions: HDSO seemed to be an effective tamponade agent for myopic macular hole retinal detachment. Further prospective controlled studies seem warranted.

Retinal detachment with a macular hole occurs most commonly in highly myopic eyes, particularly in association with posterior staphyloma.^{1–3} The exact pathogenesis is uncertain but is thought to be due to tangential traction, posterior staphyloma and retinal pigment epithelium atrophy.^{2–6} Various procedures have been performed for macular hole retinal detachment and include pars plana vitrectomy with gas or silicone oil tamponade, macular buckling and scleral shortening.^{7–13} Removal of epiretinal membrane and internal limiting membrane (ILM) has also been performed to improve the success rate.^{4–6 14–16} However, despite these procedures, re-detachment may still develop and some eyes will require multiple surgeries to achieve reattachment.^{1–3 7–8} Loss of chorioretinal tissue and retinal pigment epithelium atrophy are some factors for the low reattachment rate. Poor compliance to face-down positioning after gas tamponade postoperatively may also potentially reduce the anatomical success rate.

Recently, high-density silicone oil (HDSO; Oxane HD, Bausch & Lomb, Rochester, New York, USA) was developed as a vitreous substitute for endotamponade in complicated retinal detachment, especially in cases with inferior proliferative vitreoretinopathy. HDSO is a mixture of silicone oil and partially fluorinated alkanes, and has a relative density of 1.03 g/cm³ and viscosity of 3800 cSt. Previous studies have demonstrated that HDSO resulted in high attachment rates in complicated retinal detachment and in persistent macular hole.^{17–19} The

heavier-than-water property of HDSO enabled it to tamponade the inferior and posterior retina effectively. Another advantage of HDSO is that patients can adopt a supine posture postoperatively.²⁰ In view of these beneficial properties, we performed a pilot study to evaluate HDSO as a tamponade agent in macular hole retinal detachment in patients with high myopia.

PATIENTS AND METHODS

This was a prospective pilot study in which patients with retinal detachment secondary to myopic macular hole and high myopia ≥ -6.0 D were recruited. Exclusion criteria included peripheral breaks connected to the macular hole retinal detachment, maculopathy secondary to age-related macular degeneration, a history of uveitis and allergy to silicone material. All surgeries were performed at Hong Kong Eye Hospital, Hong Kong, between December 2004 and January 2006. Informed consent was obtained from all patients and the protocol was approved by the ethics committee of the Kowloon Central Cluster of the Hospital Authority.

Preoperative investigations include best-corrected Snellen visual acuity (BCVA) testing, intraocular pressure measurement, axial length measurements, slit-lamp examination and indirect ophthalmoscopy. All surgeries were performed by two surgeons (BTOC, CYFY). Phacoemulsification with intraocular lens implantation was also performed in cases with visually significant cataract. All patients underwent standard three-port pars plana vitrectomy, followed by the removal of the posterior hyaloid. ILM peeling was then performed with either 0.15% trypan blue staining or triamcinolone acetonide, and specimens were sent for microscopic examination. Fluid/air exchange was performed, followed by air/HDSO exchange. Postoperatively, all patients adopted supine posture and were treated with a tapering course of 1% prednisolone acetate (Pred Forte, Alcon, Fort Worth, Texas, USA) and 0.5% levofloxacin (Cravit, Santen Osaka, Japan) eyes drops.

Patients were assessed on day 1, week 1, and months 1, 2 and 3 postoperatively. HDSO was removed 3–4 months postoperatively as recommended by the manufacturer, or earlier if complications arose. Surgical techniques of HDSO removal included pars plana sclerotomies with placement of infusion and active aspiration of HDSO using a soft 18 G cannula under endoillumination and microscopic visualisation. The globe was then re-filled with balanced salt solution or gas. Patients were followed on day 1, week 1, and months 1, 2 and 3, and then every 3 months after HDSO removal. Macular hole status was evaluated by slit-lamp biomicroscopy and in cases in which the hole status was doubtful, optical coherence tomography was performed for confirmation.

The main outcome measures include macular hole closure and retinal reattachment rates after HDSO removal and changes in BCVA. Other outcome measures included safety

Abbreviations: BCVA, best-corrected visual acuity; HDSO, high-density silicone oil; ILM, internal limiting membrane

parameters such as intraoperative or postoperative complications. Data were entered into a statistical software (SPSS V.11.5) for analysis.

RESULTS

A total of 12 eyes of 12 patients were recruited (table 1). The mean (SD) age was 67.8 (11.1) years (range 49–81 years). The mean (SD) spherical equivalent refractive error was −13.4 (5.3) D (range −6.0 to −21.0 D) and the mean (SD) axial length was 28.7 (1.7) mm (range 26.0–30.9 mm). The median preoperative BCVA was 20/800 (range 20/600 to finger counting).

Combined pars plana vitrectomy with phacoemulsification was performed in 7 of 10 phakic patients. ILM was successfully removed in all 12 eyes, in which 9 had trypan blue staining and 3 had triamcinolone-assisted ILM peeling. Histological examination confirmed the presence of ILM in all cases (fig 1). One eye developed a peripheral retinal break intraoperatively and was treated with endolaser photocoagulation.

Patients were followed for a mean of 12.1 months postoperatively (range 9–15 months). During the period of HDSO tamponade, all eyes had complete attachment of the retina and macular hole closure. In all, 5 (42%) eyes developed a transient increase in intraocular pressure (range 22–44 mm Hg) and all were controlled with topical drugs for glaucoma. Other complications included mild oil emulsification (one eye) and peripheral choroidal detachment, which resolved spontaneously (one eye). Severe intraocular inflammation including anterior chamber cells ≥ 2 or keratic precipitates were not observed in any eye. After tamponade of 3–4 months, HDSO was completely removed in all eyes. A total of 10 (83%) eyes had macular hole closure and complete retinal attachment after HDSO removal. One eye had reopening of macular hole and retinal re-detachment 2 weeks after HDSO removal, and re-operation with perfluorocarbon gas tamponade was performed, which resulted in macular hole closure and retinal reattachment. Another eye had reopening of macular hole with retinal and choroidal detachment 3 months after HDSO removal, but the patient declined further surgery. At the last follow-up, the median BCVA improved to 20/600 (range 20/200 to hand movements; Wilcoxon signed rank test, $p = 0.046$). In all, 11 (92%) eyes had macular hole closure and retinal reattachment without tamponade at the last follow-up, and all but one eye had stable or improved vision after surgery.

DISCUSSION

Our pilot study demonstrated that HDSO seemed to be an effective tamponade agent for myopic macular hole with retinal

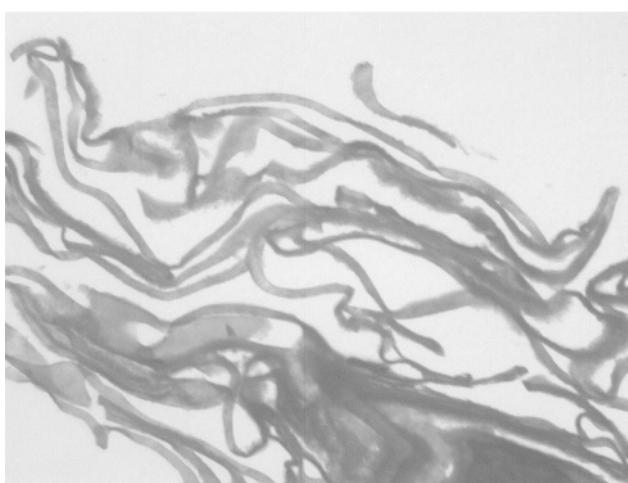


Figure 1 Light microscopy of the surgically removed specimen demonstrating the acellular internal limiting membrane (periodic acid Schiff stain, magnification $\times 400$).

detachment. After a mean follow-up of 12 months, 10 (83%) eyes had macular hole closure with retinal reattachment after one operation. There was also statistically significant improvement in the median BCVA. The results compared favourably with other surgical techniques for myopic macular hole retinal detachment. Ripandelli *et al*¹¹ reported that the retinal reattachment rates of following vitrectomy with gas tamponade and macular buckle were 73% and 93%, respectively. In another study by Chen *et al*,¹³ the primary retinal reattachment rate was only around 50–60% after vitrectomy and gas tamponade. The anatomical success rate in our study using HDSO therefore seemed to be comparable with previous studies and might be higher than gas tamponade. The heavier-than-water property of HDSO might enable more efficient tamponade on the retina. Moreover, with HDSO, patients can adopt a supine posture postoperatively and non-compliance to face-down positioning as in gas tamponade will not be an issue.²⁰ Another reason for the relatively high success rate in our study might be associated with ILM peeling. Kadonosono *et al*¹⁵ have shown that pars plana vitrectomy with ILM peeling, followed by gas tamponade for macular hole retinal detachment had a success rate of around 90%.

One of the concerns in using HDSO is the association with intraocular inflammation. In a case series reported by Theelen *et al*,¹⁸ in which 19 eyes underwent vitrectomy and HDSO tamponade for complicated retinal detachment, granulomatous

Table 1 Preoperative and postoperative details of the 12 patients recruited in the study

Patient number	Sex/age (years)/eye	Follow-up (months)	Refractive error (D)	Axial length (mm)	Symptom duration (months)	Preop lens status	Combined phaco + IOL	Preop visual acuity	Final visual acuity	Final macular hole status	Final retina status
1	F/49/R	15	−16.0	27.9	0.5	Phakic	No	20/800	20/600	Closed	Attached
2	F/73/R	10	−12.0	30.5	0.5	PCIOL	NA	20/800	20/600	Closed	Attached
3	F/80/R	15	−15.0	26.8	2	Phakic	Yes	20/800	20/600	Closed	Attached
4	M/61/L	12	−18.0	29.3	3	PCIOL	NA	20/600	20/600	Closed	Attached
5	F/62/L	15	−21.0	30.5	0.25	Phakic	Yes	20/800	20/800	Closed	Attached
6	M/74/R	12	−18.0	30.9	6	Phakic	Yes	FC	FC	Open	Detached
7	F/81/R	9	−7.0	26.0	4	Phakic	Yes	20/600	HM	Closed	Attached
8	F/55/R	12	−20.0	30.9	0.25	Phakic	No	20/800	20/600	Closed	Attached
9	L/70/L	12	−6.0	26.8	1	Phakic	Yes	20/600	20/200	Closed	Attached
10	M/55/R	12	−9.0	28.0	1	Phakic	No	20/800	20/200	Closed	Attached
11	M/72/L	12	−11.5	29.0	6	Phakic	Yes	20/800	20/600	Closed	Attached
12	M/81/L	9	−7.0	28.0	6	Phakic	Yes	20/600	20/200	Closed	Attached

F, female; FC, finger counting; HM, hand movements; IOL, intraocular lens; L, left; M, male; NA, not applicable; PCIOL, posterior chamber IOL; Preop, preoperative; phaco, phacoemulsification; R, right.

HDSO for macular hole retinal detachment

inflammation that did not respond to topical steroids was observed in 7 (37%) eyes. The inflammatory response completely resolved after HDSO removal. In our series, none of the patients were found to have such intraocular inflammation postoperatively. This might be owing to the exchange of perfluorocarbon liquids directly with HDSO in the study by Theelen *et al*¹⁸ and dispersion of the two substances might lead to additional adverse reactions. Our results are consistent with studies by Wolf *et al*¹⁷ and Rizzo *et al*,¹⁹ in which HDSO was found to be safe without adverse events including intraocular inflammation after tamponade of up to 3 months.

The main limitations of our study were the small number of cases and that combined cataract surgeries were not uniformly performed in all patients. Another limitation was the lack of optical coherence tomography evaluation in all patients to confirm the postoperative macular hole status. Also, despite the relatively high anatomical success rate, two eyes developed macular hole reopening with retinal detachment after HDSO removal. This might be related to insufficient tamponade duration as myopic macular hole might take longer to close. Therefore, further studies might consider prolonging the duration of HDSO tamponade in these cases.

In conclusion, our pilot study showed that HDSO seemed to be a promising vitreous substitute in retinal detachment secondary to myopic macular hole. The main advantage is the relatively high anatomical success rate with the lack of requirement for prone positioning postoperatively. The encouraging results suggest that a randomised controlled trial is warranted to compare its efficacy with other tamponade agents for macular hole retinal detachment.

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Competing interests: None.

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