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SHORT COMMUNICATION

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Intraocular inflammation following endotamponade with high-density silicone oil

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Abstract *Background:* The use of a mixture of silicone oil and partially fluorinated alkanes (high-density silicone oil) has recently been suggested as intraocular tamponade in complicated retinal detachment of the inferior quadrants. We describe a series of patients who developed a clinical picture resembling anterior granulomatous uveitis following endotamponade with high-density silicone oil. *Methods:* We evaluated 19 eyes of 18 patients who underwent pars plana vitrectomy and intraocular tamponade with high-density silicone oil (Oxane HD®). The indication for this type of intraocular tamponade was limited to cases with complicated retinal detachment of the inferior quadrants. Oxane HD® was removed after a mean period of 3 months. *Results:* One to eight weeks following vitrectomy with high-density silicone oil, an intraocular inflammation was observed in 7 of 19 eyes (37%). These eyes presented with keratic precipitates (KP), pigmented clumps in the inferior part of the anterior chamber and increased anterior chamber cellular reaction. This inflammatory response did not react to topical steroids. In addition to KP a considerable amount of cellular precipitation was noted on the surface of the oil bubble. Strikingly, the intraocular inflammatory signs completely resolved following removal of the high-density silicone oil. *Conclusions:* An inflammatory response, resembling granulomatous uveitis, occurs in a significant number of patients after high-density silicone oil endotamponade. It is likely that this vitreous substitute is an immunogenic agent, given the complete resolution of the inflammation after removal of the high-density silicone oil. The routine use of this newly developed silicone oil should therefore await the outcome of additional controlled clinical trials.

Introduction

Silicone oil has become a well-accepted intraocular tamponade in cases of proliferative vitreoretinopathy (PVR). Although the tolerance for intraocular silicone oil is generally good, a number of side effects have been reported, including keratopathy, elevated intraocular pressure, ocular hypotony, emulsification, cataract formation, iritis and endophthalmitis [6]. In selected cases the relative density of silicone oil to water is of importance. The lower density of standard silicone oil may cause an insufficient tamponade of the inferior quadrants, resulting in persistent or recurrent retinal detachment in that particular area [12].

Recently, Wolf et al. evaluated a new type of high-density silicone oil [16]. The relative density of this silicone oil is 1.02 g/cm^3 (at 22°C), which makes it slightly heavier than water and particularly suitable for complicated inferior retinal detachments. The aforementioned study reported a good intraocular tolerance for this type of silicone oil without specific side effects.

Over the past year we have used high-density silicone oil in selected cases. In this study we report a peculiar side effect, seen in several patients, that resembles a uveitic reaction of the granulomatous type.

Patients and methods

Nineteen eyes of eighteen patients were included in this prospective, interventional case series from 1 April 2003 to 31 August 2003. The indications for the use of high-density silicone oil included inferior PVR and large retinal tears in the inferior quadrants. Further details of the preoperative retinal situation are summarized in Table 1. After thorough explanation of the risks and benefits of high-density silicone oil, informed consent was obtained from each patient before surgery. One patient was under 18 years old and informed consent was obtained from his parents.

Following retrobulbar anaesthesia with 5 ml of mepivacaine HCl 2%, the eye was prepared with watery iodine 0.1% solution to obtain sterile conditions. After sterile draping a sterile lid speculum was placed in the eye and a standard three-port pars plana vitrectomy was performed. Special attention was given to thorough removal of the peripheral vitreous. Retinal traction was relieved by removal of all epiretinal membranes, and relaxing retinotomies were performed when indicated. After adequate mobilization had been achieved, the retina was reattached with the use of perfluorocarbon liquid (Dk-line®; Bausch & Lomb, Waterford, Ireland). After endolaser coagulation the perfluorocarbon liquid was replaced by high-density silicone oil (Oxane HD®; Bausch & Lomb). To prevent a pupillary block, we performed a peripheral iridectomy at the 12 o'clock position in all aphakic eyes. The wounds were sutured with monofile polyglactin 9-0 sutures (Vicryl®; Ethicon, Norderstedt, Germany), and all eyes were patched with an antibiotic-steroid ointment for 24 h. Postoperatively every patient received antibiotic–steroid eye drops four times a day, which was decreased weekly by one drop daily. Patients were routinely monitored at day 1 and at 1 week, 4 weeks, 2 months and 3 months after surgery.

Removal of the high-density silicone oil was performed 1–4 months (average 2 months) after surgery. After a three-port vitrectomy set-up, Oxane HD® was actively aspirated and exchanged for balanced salt solution using a panoramic view surgical lens and endoillumination. When possible, keratic precipitates (KP), emulsified oil remnants and pigment clumps were removed by use of a fluted needle. The mean follow-up period after removal of high-density silicone oil was 3 months (range 2–4 months).

Results

Details of patient's age, gender, lens situation and indication for the use of high-density silicone oil are depicted in Table 1. The follow-up in these patients ranged from 2 to 4 months after removal of high-density silicone oil, with an average of 3 months. Seven eyes (37%) operated with Oxane HD® endotamponade presented with KP and pigmented clumps of presumed cellular origin, which occurred within 1–8 weeks (mean 4 weeks) postoperatively. The endothelial precipitates had a brownish, mutton-fat appearance and were localized in the inferior parts of the corneal endothelium (Fig. 1). Also, an increased inflammatory reaction, represented by intensified flare and cells in the anterior segment, was present in affected patients. This inflammation did not resolve with topical steroids. None of these patients had a history of uveitis. In the remaining 12 eyes no inflammatory response was noted and the corneal endothelium did not show cellular precipitates.

Migration of high-density silicone oil to the anterior chamber was observed in two eyes. A uveitic reaction was

Table 1 Preoperative data of patients undergoing pars plana vitrectomy and endotamponade with high-density silicone oil (Oxane HD®). *IOL* Pseudophakic eye, *PDR* proliferative diabetic retinopathy, *PVR* retinal detachment due to proliferative vitreoretinopathy (classification according to the Retina Society, 1991 [8]), *RRD* rhegmatogenous retinal detachment, *VRS* vitreoretinal surgery

Eye no.	Patient no.	Gender	Age (years)	Eye	Lens situation	Indications for Oxane HD®	Number of previous VRS
1	1	M	85	OS	IOL	PVR CP 1 inferior	0
2	2	F	51	OS	IOL	PVR CP 1 inferior	1
3	3	M	67	OS	IOL	PVR CP 6 inferior	1
4	4	M	55	OS	IOL	RRD, retinal tears inferior	1
5	5	M	72	OD	IOL	RRD, retinal tears inferior	0
6	6	F	64	OS	IOL	Inferior defects in PDR	0
7	7	F	66	OS	IOL	PVR CP 6 inferior	
8	8	F	56	OS	IOL	PVR CP 3 inferior	1
9	9	M	67	OS	Phakic	RRD, retinal tears inferior	1
10	10	M	60	OS	IOL	RRD, retinal tears inferior	1
11	11	M	72	OS	IOL	Large posterior retinotomy	0
12	12	F	62	OD	IOL	PVR CP 1 inferior	1
13	13	M	59	OD	IOL	PVR CP 1 inferior	0
14	14	M	50	OS	IOL	PVR CP 2 inferior	1
15	15	M	11	OD	Aphakic	PVR CP 7 inferior	3
16	15	M	11	OS	Aphakic	PVR CP 7 inferior	3
17	16	M	53	OS	Aphakic	PVR CP 2 inferior	1
18	17	M	73	OD	IOL	PVR CP 2, defects inferior	1
19	18	M	69	OD	IOL	PVR CP 3 inferior	1

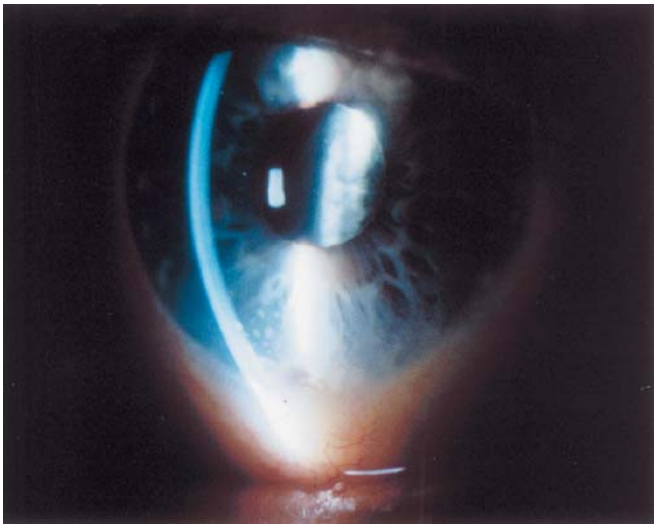

Fig. 1 Slit-lamp photograph of an eye with inflammatory response to high-density silicone oil. Besides the presence of keratic precipitates, dark-brown clumps are evident in the inferior part of the anterior chamber

not present in these eyes. Anterior peripheral synechiae and an increase in intraocular pressure were not observed in any of the 19 eyes. We noticed inferior emulsification droplets with the tamponade present in 2 of the 19 eyes. Only one of these two eyes belonged to the inflammation group.

By January 2004 Oxane HD® had been removed in 17 of the 19 eyes and at that time the retina was reattached in all eyes. During removal, some single emulsification droplets could be observed in all study eyes and these droplets were removed by repeated fluid–air exchange. In two eyes the retina redetached due to recurrent PVR, and silicone oil of high viscosity (5,000 cSt) was injected. In the seven eyes with inflammatory response cellular precipitates were visible not only on the corneal endothelium but also on the surface of the oil bubble, as observed during removal of Oxane HD®. All signs of inflammatory reaction, including KP, resolved following removal of Oxane HD® without the need for additional anti-inflammatory therapy.

Discussion

Silicone oil is an excellent tool in the surgical treatment of complicated retinal detachment [2]. Nevertheless, because the density of regular silicone oil is lower than water, the tamponade of the inferior parts of the retina may be inadequate in preventing redetachment in complex cases where pathology is located inferiorly [12]. In such cases the combination of open retinal breaks and an aqueous environment with inflammatory and cell-growth-stimulating factors will contribute to the development of PVR. To circumvent this problem, various agents with higher density have been used to tamponade the detached retina. However, several reports mention an increase in postoperative intraocular inflammation and even retinal necrosis associated with the use of high-density fluorosilicone oils as well as semifluorinated alkanes such as F_6H_8 and their oligomers [3, 4, 5, 7, 10, 11, 14]. Besides, non-inflammatory protein precipitates and droplet formation have been reported with in-vitro use of perfluorocarbons [15]. The widespread use of these vitreous substitutes in a clinical setting has therefore not been recommended.

Recently a mixture of silicone oil and partially fluorinated alkane, which is similar to the previously evaluated F_6H_8, has been introduced as high-density vitreous substitute in complicated retinal detachments of the inferior quadrants. To date, only one study has evaluated the benefits and potential complications of this type of vitreous substitute in retinal detachment surgery [16]. The authors described good intraocular tolerance with side effects similar to those of conventional silicone oil and reported anatomic success in 25 of their 33 study eyes (75%).

In the present paper we describe seven eyes that developed a clinical picture resembling granulomatous uveitis after high-density silicone oil injection. We consider this an important side effect, given the relative high proportion of eyes (37%) that developed this inflammatory response. Since we have not noted such a reaction in eyes with conventional silicone oil tamponade, and since removal of Oxane HD® resulted in resolution of the inflammation, we believe that the high-density silicone oil was the cause of this side effect. Recently it has been demonstrated that immunoglobulins and complement fractions are present on the surface of fluorosilicone oil and in the stroma of ocular tissues in eyes filled with these vitreous substitutes [13]. Immune complex deposition and accumulation of insoluble antigens can cause granulomatous, T-lymphocyte-mediated (type IV) inflammation. Also, complement activation due to antigen–antibody complexes or artificial surfaces can cause chemotaxis of leucocytes, increased vascular permeability and acute inflammation [1]. Since we observed KP as well as increased flare and cell count our findings suggest an immunologic reaction possibly of both cellular (T-mediated) and plasma (complement) origin. The swift resolution of the uveitic reaction after removal of the high-density silicone oil also suggests an immunologic reaction.

In our study we replaced perfluorocarbon liquids directly by high-density silicone oil to decrease the risk of intraoperative redetachment. Due to the close chemical relationship of the two substances dispersion at the borderline may lead to additional intraocular adverse reactions. One might therefore consider replacing the perfluorocarbon with air prior to the infusion of Oxane

HD®. This would avoid direct contact between perfluorocarbon and Oxane HD®, thus preventing unpredictable side effects due to an undesirable interaction between these two compounds.

The use of Oxane HD® as intraocular tamponade in complicated retinal detachment is effective in terms of anatomic success. Nevertheless, the presence of this type of high-density silicone oil provoked an inflammatory response in a significant proportion of our patients. At the moment it cannot be predicted whether this granulomatous uveitis will have an adverse effect on the anatomical or functional outcome. We would therefore advocate additional controlled clinical trials to evaluate these potential harmful side effects before high-density silicone oil is routinely used as temporary vitreous substitute in patients with retinal detachments.

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