European Journal of Ophthalmology / Vol. 18 no. 5, 2008 / pp. 680-684

Silicone oil in the surgical treatment of traumatic endophthalmitis

H. YAN, Y. LU, J. YU, J. HAN, J. ZHANG, S. CHEN, Y. XU

Department of Ophthalmology, Tianjin Medical University General Hospital, Tianjin - China

PURPOSE. *To explore the effects of vitrectomy combined with silicone oil injection in the treatment of traumatic endophthalmitis without retinal detachment, and analyze the relative factors.*

METHODS. *Eighteen eyes of 18 patients with traumatic endophthalmitis and without retinal detachment received the treatment of vitrectomy combined with silicone oil filling. Silicone oil removal combined with intraocular lens implantations were performed in all eyes 6 months postoperatively. The visual acuity was measured by logMAR values. Preoperative visual acuity ranged from light perception to 0.1. The mean preoperative intraocular pressure was 9 mmHg with a range from 5 to 25 mmHg. Follow-up ranged from 6 to 43 months with a mean of 18 months.*

RESULTS. *The postoperative visual acuity ranged from light perception to 0.8 at the last follow-up examination. The visual acuity increased in 15 eyes (83%), and was stable in 3 eyes (17%). The mean postoperative intraocular pressure was 17 mmHg with a range from 10 to 20 mmHg, and was significantly higher than preoperatively ($p<0.05$). There was no retinal detachment or ocular atrophy. Postoperative complications mainly included fibrosis exudates in the anterior chamber (18 eyes) and temporary intraocular pressure elevation (3 eyes).*

CONCLUSIONS. *Under treatment with systemic antibiotics, vitrectomy combined with silicone oil filling may be a reasonable alternative to standard endophthalmitis treatment using intravitreal antibiotics. (Eur J Ophthalmol 2008; 18: 680-4)*

KEY WORDS. *Vitrectomy, Silicone oil, Endophthalmitis*

Accepted: April 2, 2008

INTRODUCTION

Traumatic endophthalmitis is a common serious complication after ocular penetrating injury. Visual loss, even ocular atrophy, will occur if the traumatic endophthalmitis is not treated in time (1). Ocular atrophy caused by recurrent retinal detachment or incomplete treatment of endophthalmitis is noticed in some patients postoperatively (2, 3). Silicone oil has been used in the repair of complex retinal detachments associated with cytomegalovirus retinitis, proliferative diabetic retinopathy, giant retinal tear, proliferative vitreoretinopathy, and ocular trauma in adult and pediatric patients, and had antimicrobial activity against endophthalmitis-causing agents when the microorganisms were suspended within the silicone oil in in vitro conditions (4-6). In this study, we report the results of silicone oil used in the surgical treatment of endophthalmitis without retinal detachment in a small case series.

METHODS

Patients

Eighteen eyes of 18 patients who had undergone vitrectomy combined with silicone oil injection for the treatment of traumatic endophthalmitis without retinal detachment in our hospital from 2000 to 2004 were involved. Sixteen

1120-6721/680-05$25.00/0

patients were male and two were female with a mean age of 34 years (range, 2 to 43 years). Ocular penetrating injury occurred in 5 eyes, and intraocular foreign body in 13 eyes, which included metal foreign body in 10 eyes and stone foreign body in 3 eyes. Preoperative visual acuity ranged from light perception to 0.1. The mean preoperative intraocular pressure was 9 mmHg with a range from 5 to 25 mmHg. No retinal detachments were noticed in the eyes preoperatively. Follow-up ranged from 6 to 43 months with a mean of 18 months.

All patients had symptoms of pain and decrease of vision. No retinal vessel could be seen with indirect ophthalmoscope, and no red reflex was found. The corneas were almost clear in all patients. All patients underwent systemic and topical antibiotic treatment, which was started before their referral to our clinic. Informed consent was obtained from all patients.

Pre- and postoperative examinations

The pre- and postoperative examinations mainly included visual acuity, slip-lamp examination, indirect ophthalmoscope, B-scan, electrophysiology (electroretinography, visual evoked potentials), intraocular pressure (applanation tonometry), and orbit computed tomography. Visual acuity was measured by logMAR values. No wave was shown in electroretinography in any injured eye.

Surgical procedures of vitrectomy

Retrobulbar and peribulbar injection of lidocaine made the eyes akinesis. The infusion canula was created at first, then phacoemulsification through sclera tunnel and posterior capsule resection were performed in all eyes.

An initial undiluted vitreous specimen was obtained after placing sclerotomies but before turning on the infusion fluid. The vitreous cutter was introduced into the midvitreous cavity and 0.2 to 0.5 mL vitreous gel was excised and aspirated into the syringe using manual suction with a high cutting rate. Once a sample was obtained, the infusion was turned on and the vitrectomy procedure was continued. The samples were cultured on blood agar, chocolate agar, Sabouraud agar, and thioglycolate broth.

In eyes with intraocular foreign body, inflammatory vitreous around the intraocular foreign body was resected first, to expose the foreign body. If the short diameter of foreign body was shorter than 3 mm, the foreign body was removed through the enlarged sclerotomy site. Otherwise the foreign body was taken out through corneal limbus incision. After inflammatory vitreous was completely resected, the pus on the surface of retina was drained by back flush needle. Air–fluid exchange, silicone oil injection, and peripheral iridectomy were conducted before the sclerotomies were closed.

Topical cycloplegic (1% atropine sulphate) and topical corticosteroid (1% prednisolone acetate) were administered three times a day for 7 days postoperatively. Systemic corticosteroids (30 mg prednisolone once a day for 7 days) were administered orally for 7 days. The patients were maintained on treatment with intravenous ofloxacin 100 mg twice a day for 7 days and ofloxacin eyedrops were continued three times a day for 2 weeks. No intravitreal antibiotics were used pre- and postoperatively. The postoperative examinations were performed on day 1, day 3, day 5, and day 7 postoperatively.

Surgical procedure of silicone oil removal

After anesthesia, the sclerotomy site of infusion canula was created. The silicone oil was drained through the vitrectomy site under the infusion pressure. The intraocular lens was implanted with ciliary sulcus fixation. All the patients were given anti-inflammatory treatment regularly after operation. In our study silicone oil removal and IOL implantation were conducted in all eyes 6 months postoperatively.

Statistical method

Paired Student *t* test was used to analyze the changes of pre- and postoperative intraocular pressure. Chi square test was applied to compare the changes of pre- and postoperative VA.

RESULTS

The clinical features, which included visual acuity, hypopyon, traumatic cataract, intraocular foreign body, and other associated pathology, are listed in Table I.

Visual acuity

The visual acuity ranged from light perception to 0.8 at the last follow-up examination. The visual acuity increased in 15 eyes (83%) and was stable in 3 eyes (17%).

TABLE I - EFFECTS OF SILICONE OIL ON THE SURGICAL TREATMENT OF TRAUMATIC ENDOPHTHALMITIS WITHOUT RETINAL DETACHMENT

Case no.	Causes of injury	Characteristics of injury	VA		Complications	Follow-up (mo)
			Preop	Postop		
1	Penetrating injury at limbus	Hypopyon, traumatic cataract, vitreous empyemata, anterior chamber, vitreous hemorrhage	LP	HM	Fibrosis exudates in anterior chamber, temporary intraocular hypertension	7
2	Penetrating injury at sclera	Hypopyon, traumatic cataract, vitreous empyemata, vitreous hemorrhage	CF	0.3	Fibrosis exudates in anterior chamber, temporary intraocular hypertension	11
3	Penetrating injury at sclera	Hypopyon, traumatic cataract, vitreous empyemata, vitreous hemorrhage	HM	0.5	Fibrosis exudates in anterior chamber, temporary intraocular hypertension	8
4	Penetrating injury at limbus	Hypopyon, traumatic cataract, vitreous empyemata, anterior chamber,	HM	HM	Fibrosis exudates in anterior chamber vitreous hemorrhage	13
5	Penetrating injury at sclera	Hypopyon, traumatic cataract, vitreous empyemata, vitreous hemorrhage	LP	0.1	Fibrosis exudates in anterior chamber	10
6	IFB (stone) through sclera	Hypopyon, traumatic cataract, vitreous empyemata, vitreous hemorrhage	0.02	0.6	Fibrosis exudates in anterior chamber	21
7	IFB (stone) through cornea	Hypopyon, traumatic cataract, vitreous empyemata	LP	0.06	Fibrosis exudates in anterior chamber	17
8	IFB (stone) through cornea	Hypopyon, traumatic cataract, vitreous empyemata	0.04	0.8	Fibrosis exudates in anterior chamber	31
9	IFB (metal) through sclera	Hypopyon, traumatic cataract, vitreous empyemata	LP	HM	Fibrosis exudates in anterior chamber	32
10	IFB (metal) through cornea	Hypopyon, traumatic cataract, vitreous empyemata	0.1	0.7	Fibrosis exudates in anterior chamber	43
11	IFB (metal) through limbus	Hypopyon, traumatic cataract, vitreous empyemata, anterior chamber hemorrhage	HM	0.04	Fibrosis exudates in anterior chamber	6
12	IFB (metal) through sclera	Hypopyon, traumatic cataract, vitreous empyemata, vitreous hemorrhage	LP	LP	Fibrosis exudates in anterior chamber	17
13	IFB (metal) through sclera	Hypopyon, traumatic cataract, vitreous empyemata	CF	0.06	Fibrosis exudates in anterior chamber	14
14	IFB (metal) through limbus	Hypopyon, traumatic cataract, vitreous empyemata	LP	0.02	Fibrosis exudates in anterior chamber	29
15	IFB (metal) through cornea	Hypopyon, traumatic cataract, vitreous empyemata	CF	0.1	Fibrosis exudates in anterior chamber	19
16	IFB (metal) through sclera	Hypopyon, traumatic cataract, vitreous empyemata, vitreous hemorrhage	HM	0.08	Fibrosis exudates in anterior chamber	23
17	IFB (metal) through cornea	Hypopyon, traumatic cataract, vitreous empyemata	0.06	0.3	Fibrosis exudates in anterior chamber	11
18	IFB (metal) through cornea	Hypopyon, traumatic cataract, vitreous empyemata, anterior chamber hemorrhage	LP	LP	Fibrosis exudates in anterior chamber	12

VA = Visual acuity; LP = Light perception; HM = Hand movement; CF = Counting fingers; IFB = Intraocular foreign body

Anatomic outcome

Retinas completely remained attached in all eyes (100%) after silicone oil removal.

Intraocular pressure

The mean postoperative intraocular pressure was 17 mmHg (range, 10 to 20 mmHg), significantly higher than preoperatively ($p<0.05$). None of the patients showed silicone oil related intraocular pressure elevation before the silicone oil removal.

Microorganisms cultures

The microorganisms that were isolated from vitreous aspiration were *Staphylococcus epidermidis* in five cases and *Staphylococcus aureus* in three cases. The remaining cases were culture negative. Although the microorganism culture results of vitreous were negative in the remaining 10 cases, the clinical features, which included ocular pain, hypopyon, traumatic cataract, and vitreous empyemata, supported the diagnosis of endophthalmitis. A previous study showed that the positive result of microorganisms culture of vitreous in endophthalmitis cases was only 70.8% (7). Therefore, we treated the endophthalmitis with intravenous ofloxacin in cases with negative microorganism culture result of vitreous and diagnosed by clinical features.

Postoperative complications

Inflammatory exudates in anterior chamber had been noticed in all eyes (100%) postoperatively, and were gradually decreased 3 days postoperatively by a continuous subconjunctival injection of a mixture of dexamethasone and gentamicin. A temporary intraocular pressure elevation related to inflammatory reaction in three eyes was controlled by 20% mannitol 250 mL intravenously once a day and 2% timolol twice a day. No ocular atrophy had been noticed postoperatively.

DISCUSSION

Endophthalmitis is a serious complication after ocular injury and intraocular operation (1). Despite recent advances in the management of endophthalmitis, final visual prognosis depends on the virulence of microorganisms, host resistance, and the time between the onset of disease and the initiation of therapy. In traumatic endophthalmitis the bacterial toxic damage effect to neuroepithelial layer of retina, vitreous body, and ciliary body causes visual acuity decrease and even ocular atrophy. Vitrectomy for endophthalmitis offers several theoretical advantages, including removal of the infecting organisms and their toxins, removal of the vitreous membranes that could lead to subsequent detachment of the retina, clearing of vitreous opacities, collection of abundant material for culture, and possibly better distribution of intravitreal antibiotics (8). In our study vitrectomy combined with silicone oil injection controlled the traumatic endophthalmitis, improved the visual acuity, and prevented ocular atrophy.

After ocular penetrating injury, bacteria enter into the eye through traumatic perforating tract. Since the vitreous body and lens are good bacteria culture media, the bacteria reproduce quickly, and aggravate the damage to retina, vitreous body, and ciliary body. According to our previous clinical experiences, although widespread vitrectomy had been performed in traumatic endophthalmitis without retinal detachment, a small quantity of bacteria remained and the ora serrata and ciliary body were seriously damaged, which finally led to retinal detachment and ocular atrophy in some patients during follow-up examinations. We thought although the inflammatory vitreous body was resected and lavement was performed, the remnant inflammatory cells continued to damage the retina and ciliary body. It especially caused the latent dissociation of ora serrata and resulted in retinal detachment.

Silicone oil, a long-acting retinal tamponading agent, is useful for the treatment of complex retinal detachments associated with advanced proliferative retinopathy (9). It was shown that silicone oil exerts an antibacterial and antifungal effect in a fairly nonspecific fashion in in vitro conditions (4). The possible mechanisms of antimicrobial activity of silicone oil are nutritional deprivation and toxicity, and mediating an autoimmune reaction after the eyes are filled with silicone oil (10, 11). We aimed at the benefit from the retinal tamponading effect and antimicrobial activity of silicone oil in cases that required the use of retinal tamponade for the cause of potential ora serrata dissolve and subsequent retinal detachment associated with endophthalmitis. Our cases responded well to the use of silicone oil in regard to the suppression of inflammation and preventing retinal detachment and ocular atrophy. Additional treatment using systemic steroids and, if necessary, silicone oil could improve the functional outcome in some cases of endophthalmitis requiring vitrectomy.

Vitrectomy combined with silicone oil injection can improve visual acuity in eyes with traumatic endophthalmitis without retinal detachment. Low initial visual acuity was shown to be associated with poor visual outcome in endophthalmitis. In vitrectomy not only the resection of the turbid vitreous body and the clearance of endophthalmitis focus but also silicone oil injection can avoid inflammatory cells' damage to retina and ciliary body. Therefore, the visual acuity can be improved. Even though the visual acuity dose not improve obviously, the attached retina and silicone oil injection can avoid ocular atrophy. Dotrelová et al (12) reported that vitrectomy combined with implantation of silicone oil was used for endophthalmitis without retinal detachment, and visual acuity improved in 72.7% of eyes, was unchanged in 9.1% of eyes, and deteriorated in 18.2% of eyes. In all injured eyes, 86.4% remained anatomically retina attached. Bali et al (11) used the same surgical procedure to treat serious endophthalmitis. The results indicated that visual acuity was better in the silicone oil group than that in the non silicone oil group. These results suggested that silicone oil tamponade might be beneficial in the treatment strategy of severe endophthalmitis. Bartz-Schmidt et al's (2) and Azad et al's (13) clinical results also confirmed that vitrectomy combined with silicone oil tamponade was valuable for the treatment of serious endophthalmitis. In our study, visual acuity improvement was noticed in 15 eyes (83%) postoperatively. The retina remained attached in all eyes (100%) after silicone oil removal. No ocular atrophy was noticed.

In short, under treatment with systemic antibiotics, vitrectomy combined with silicone oil filling may be a reasonable alternative treatment to standard endophthalmitis treatment using intravitreal antibiotics, and can prevent visual loss and ocular atrophy caused by the serious damage of retina and ciliary body. The long-term curative effect needs to be evaluated.

The authors do not have a significant financial interest or other relationship with any product manufacturer or provider of services discussed in this article.

Reprint requests to:
Hua Yan, MD
Department of Ophthalmology
Tianjin Medical University General Hospital
No. 154, Anshan Road
Tianjin China, 300052
phuayan2000@yahoo.com

REFERENCES

1. Schiedler V, Scott IU, Flynn HW Jr, Davis JL, Benz MS, Miller D. Culture-proven endogenous endophthalmitis: clinical features and visual acuity outcomes. Am J Ophthalmol 2004; 137: 725-31.
2. Bartz-Schmidt KU, Bermig J, Kirchhof B, et al. Prognostic factors associated with the visual outcome after vitrectomy for endophthalmitis. Graefes Arch Clin Exp Ophthalmol 1996; 234 (Suppl): S51-8.
3. Kaynak S, Oner FH, Koçak N, Cingil G. Surgical management of postoperative endophthalmitis: comparison of 2 techniques. J Cataract Refract Surg 2003; 29: 966-9.
4. Azen SP, Scott IU, Flynn HW, et al. Silicone oil in the repair of complex retinal detachments: a prospective observational multicenter study. Ophthalmology 1998; 105: 1587-97.
5. Scott IU, Flynn HW Jr, Azen SP, Lai MY, Schwartz S, Trese MT. Silicone oil in the repair of pediatric complex retinal detachments: a prospective, observational multicenter study. Ophthalmology 1997; 106: 1399-407; discussion 1407-8.
6. Ozdamar A, Aras C, Ozturk R, Akin E, Karacorlu M, Ercikan C. In-vitro antimicrobial activity of silicone oil against endophthalmitis causing agents. Retina 1999; 19: 122-6.
7. Eser I, Kapran Z, Altan T, Eren H, Yilmaz OF. The use of blood culture bottles in endophthalmitis. Retina 2007; 27: 971-3.
8. Endophthalmitis Vitrectomy Study Group. Results of Endophthalmitis Vitrectomy Study. A randomized trial of immediate vitrectomy and intravenous antibiotics for the treatment of postoperative bacterial endophthalmitis. Arch Ophthalmol 1995; 113: 1479-96.
9. Azen SP, McCuen BW, Stern W, et al. Vitrectomy with silicone oil or perfluoropropane gas in the eyes with severe proliferative vitreoretinopathy. Silicone Study Report 3. Retina 1993; 13: 279-84.
10. Aras C, Ozdamar A, Karacorlu M, Ozkan S. Silicone oil in the surgical treatment of endophthalmitis associated with retinal detachment. Int Ophthalmol 2001; 24: 147-50.
11. Bali E, Huyghe P, Caspers L, Libert J. Vitrectomy and silicone oil in the treatment of acute endophthalmitis. Preliminary results. Bull Soc Belge Ophtalmol 2003; 288: 9-14.
12. Dotrelová D, Dvorák J, Kalvodová B, Stepánková J. Pars plana vitrectomy and primary implantation of silicone oil in the treatment of acute exogenous endophthalmitis in eyes without retinal detachment. Cesk Slov Oftalmol 2003; 59: 146-52.
13. Azad R, Ravi K, Talwar D, Rajpal, Kumar N. Pars plana vitrectomy with or without silicone oil endotamponade in post-traumatic endophthalmitis. Graefes Arch Clin Exp Ophthalmol 2003; 241: 478-83.