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Trocar Opening: A Novel Management Strategy for Silicone Oil Removal with Phacoemulsification and Iol Implantation

Xu Zhang, Yajie Pan and Zhengyu Song*

Department of Ophthalmology, Shanghai Shuguang Hospital, Shanghai University of Traditional Chinese Medicine, No. 185 Avenue of Pu'an, Huangpu District, Shanghai, 200021, China

***Corresponding author:** Dr. Zhengyu Song, Department of Ophthalmology, Shanghai Shuguang Hospital, Shanghai University of Traditional Chinese Medicine, No. 185 Avenue of Pu'an, Huangpu District, Shanghai, 200021, China, Tel: +86 02120256060; E-mail: rockersong@hotmail.com

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Abstract

Objective: To evaluate the efficacy and safety of a novel management strategy (Trocar opening) in silicone oil removal (SOR) in combination with phacoemulsification and IOL implantation.

Methods: There were 60 eyes of 60 patients with cataract and silicone oil-filled eyes enrolled in this study. All of the patients were divided into two groups: the patients in control group received 23G pars plana active SOR surgery with phacoemulsification and IOL implantation, while the patients in TO group received trocar opening methods during surgery. Best corrected visual acuity (BCVA), surgery time; intraocular pressure (IOP) and operative complications were observed in six months after surgery.

Results: There was no significant difference between the 2 groups for age, gender, preoperative, IOP or time of silicone oil stay. All patients were successfully completed their surgery. At 6 month after surgery, the mean BCVA improved from 1.34 ± 0.44 (control group) and 1.36 ± 0.42 (TO group) before surgery to 0.74 ± 0.36 (control group) and 0.77 ± 0.32 (TO group) after surgery (P<0.001), respectively, and there was no significant difference between the 2 groups. The mean SOR time was 6.9 ± 2.3 min in control group, while 4.8 ± 1.2 min in TO group (P=0.008). The mean cataract time was 8.4 ± 3.2 in control group, while 7.2 ± 2.6 min in TO group (P=0.013). The total operation time was 28.2 ± 8.5 min in control group, and 24.6 ± 6.4 min in TO group (P=0.035). Four eyes experienced posterior capsule rupture in control group, while none in TO group (P0.01). There was 1 eye occurred late recurrent retinal detachment 2 months after surgery in control group and 1 eye 4 mo in TO group. No other postoperative complication was observed such as vitreous hemorrhage, dislocated IOL, or endophthalmitis.

Conclusion: Our finding indicates that trocar opening is a simple, effective, time saving and safe method for SOR combined with phacoemulsification and IOL implantation.

Keywords: IOL implantation; Phacoemulsification; Posterior capsule rupture; Silicone oil removal; Vitrectomy; Hypotony; Retinal detachment

Introduction

Silicone oil filling in vitreous is a common method to withstand the retina and maintain the intraocular pressure (IOP) in posterior eye surgery (proliferative vitreoretinopathy, proliferative diabetic retinopathy, giant retinal tears and ocular trauma) [1]. However, there are several complications caused by silicone oil tamponade, such as silicone oil emulsification, secondary glaucoma, cataract, and corneal degeneration [2]. Therefore, it is suggested that the silicone oil should be removed as soon as its tamponade effect is no longer needed, and it is also recommended that a combined operation will be needed with cataract extraction and silicone oil removal (SOR) if the secondary cataract occurs [3].

Phacoemulsification in a vitrectomized eye is associated with a higher rate of posterior capsule rupture because of the hard nucleus [4]. And the buoyancy of silicone oil might lead to posterior capsule elevation and additional anterior chamber instability, which cause an increased risk of posterior capsule rupture [5]. The incidence of posterior capsule rupture during phacoemulsification in vitrectomized eyes or combined surgery has been reported between 1.4% and 10.1%, which is higher than normal phacoemulsification [5-7]. So in SOR combined with phacoemulsification, new managements are needed to reduce the incidence of posterior capsule rupture.

So in this study, we reported a new method, which was named as trocar opening, of SOR in combination with phacoemulsification and IOL implantation.

Materials and Methods

Patients selection

The study protocol has been approved by the institute's ethics committee on human research. After written informed consent was obtained, the research adhered to the tenets set forth in the Declaration of Helsinki. This consecutive case study was conducted from July 2017 to December 2017, there were 60 eyes of 60 patients were enrolled and underwent SOR in combination with phacoemulsification and IOL implantation. All patients accepted their previous 23G transconjunctival sutureless vitrectomy surgeries by the same surgeon. The indications for vitrectomy and silicone oil (Oxane®

5700; Bausch & Lomb, Rochester, NY, US) injection were limited to rhegmatogenous retinal detachment. The indication for SOR was the attachment of retina and the stability of silicone oil tamponade for at least 3 months. And the indication for phacoemulsification and IOL implantation was visual acuity impaired by cataract.

Data source

All patients were given exact measurements of keratometry, anterior chamber depth and axial length using IOL Master (IOL Master V1.1; Carl Zeiss Meditec, Jena, Germany). Ocular examination with best-corrected visual acuity (BCVA), applanation tonometry, slit-lamp biomicroscopy, and indirect fundus ophthalmoscopy was performed on all the patients at baseline, 1 d, 1 w, 1 months, 3 months, and 6 months postoperative visits. Main outcome measures were mean removal time, changes of BCVA and IOP, and intraoperative and postoperative complications. For statistical analysis, BCVA was converted to logarithm of the minimum angle of resolution (logMAR).

Surgical procedure

All patients were divided into 2 groups randomly: in control group (30 eyes), standard 23G active aspiration SOR with phacoemulsification and IOL implantation was performed; while in TO group (30 eyes), trocar opening method was used besides the same procedures in control group. All patients were under retrobulbar anesthesia with 2% lidocaine. 23G trocar-cannulas (Alcon Lab., Inc., Fort Worth, TX) were used to create two transconjunctival sclerotomies at the inferotemporal (intravitreous infusion) and superotemporal quadrants (SOR). The trocars were withdrawn with the microcannulas in situ, which were covered by microcannulas plugs in control group and remained open in TO group (trocar opening method). After that, a 3 mm width corneal incision was made and anterior capsulorhexis was performed. Hydrodissection of the lens nucleus was performed followed by phacoemulsification with irrigation and aspiration of the lens material using Alcon CONSTELLATION® Vision System (Alcon Lab., Inc., Fort Worth, TX). Then a soft foldable lens was injected in the capsular bag and the cornea incision was sealed by with 10/0 vicryl suture. Then the infusion tube was attached to the inferotemporal microcannulas and aspiration tube was attached to the superotemporal to have active SOR (with a negative pressure of 650 mmHg and IOP at 25 mmHg). When the remaining oil bubble was observed, the eyeball was tilted in order to place the oil bubble into the microcannula, which was helpful in complete removal of the silicone oil and prevention of sudden eyeball collapse. After completely SOR, wide angle viewing system was used to check the condition of the fundus. At the end of the surgery, all sclerotomy sites were sutured with 8/0 vicryl suture in order to prevent postoperative hypotony (Figure 1).

Statistical analysis

SPSS software (version 13.0 for Windows; SPSS Inc., IL, USA) was used for statistical analysis in this study. The data was presented as means ± SD. The results were analyzed by the analysis of variance. $P<0.05$ was considered to indicate significance.

Results

There were 60 eyes of 60 patients included in our study. The baseline demographics and characteristic of the patients were summarized in Table 1. There was no significant difference between the 2 groups for age, gender, preoperative IOP, or time of silicone oil stay.

All patients were successfully completed their surgery. The silicone oil was completely removed from all eyes. There was no significant residual oil in the anterior chamber or in the vitreous cavity in the last follow up after surgery. There was no serious intraoperative complications occurred, except 4 eyes occurred posterior capsule rupture in control group and IOLs were planted in sulcus, while none in TO group ($P<0.01$). There was 1 eye occurred late recurrent retinal detachment 2 months after surgery in control group and 1 eye 4 mo in TO group, which was because of PVR and re-operated with PPV and silicone oil tamponade once again, and none recurrence of retinal detachment occurred (during 6months follow-up). No other postoperative complication was observed such as vitreous hemorrhage, dislocated IOL, or endophthalmitis.

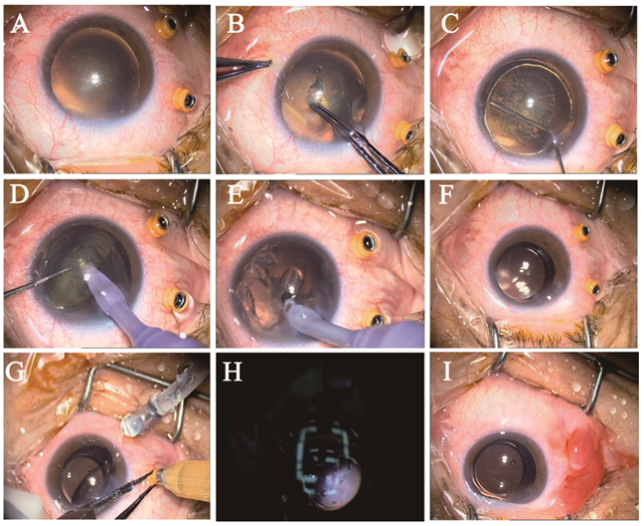

Figure 1: SOR with phacoemulsification IOL implantation using tracar opening method; (A) Unplugged microcannulas placement of the inferotemporal and superotemporal quadrants 3.5 mm from the corneoscleral limbus. (B) Continuous curvilinear capsulorhexis with silicone oil bubble was observed in the inferotemporal microcannula. (C) Hydrodissection of the lens nucleus with silicone oil bubble in the same place. (D) Phacoemulsification was performed with silicone oil bubble flow out of the inferotemporal and superotemporal microcannulas. (E) Irrigation and aspiration of the lens material with silicone oil bubble in the same place. (F) A soft foldable lens was injected in the capsular bag. (G) In 23G active aspiration SOR, the eyeball was tilted in order to place the oil bubble into the microcannula when the remaining oil bubble was observed. (H) Wide angle viewing system was used to check the fundus. (I) At the end of the surgery, all sclerotomy sites were sutured.

Mean surgical time was summarized in Table 2. There was significant difference between the 2 groups. Cataract time was defined as the interval between making of cornel incision and the seal of that incision. SOR time was defined as the interval between connection of infusion tube and the seal of the sclera incisions. Total time was defined as the interval between the patient on and off the operation table.

	Control Group	TO Group	P
Age (y)	52.2 ± 9.2	54.7 ± 8.4	0.687
Gender (male%)	46.7	53.3	0.154
Right Eye (%)	43.3	46.7	0.165
Pre-op IOP (mmHg)	16.7 ± 3.4	17.5 ± 3.7	0.435
Time of SO Stay (m)	5.4 ± 2.4	5.8 ± 1.8	0.562
BCVA (logMAR)	1.34 ± 0.44	1.36 ± 0.42	0.672

Table 1: Baseline demographic data and characteristics of the patients.

	Control Group	TO group	P
Cataract time (m)	8.4 ± 3.2	7.2 ± 2.6	0.013
SOR time (m)	6.9 ± 2.3	4.8 ± 1.2	0.008
Operation time (m)	28.2 ± 8.5	24.6 ± 6.4	0.035

Table 2: The comparison of mean cataract time, SOR time and mean operation time.

Mean IOP was summarized in Table 3. There was no significant difference between the 2 groups and no hypotony was occurred. Except the retinal redetachment, the remaining 60 eyes were improved with BCVA at the last follow up visit. The mean BCVA statistically improved from 1.34 ± 0.44 (control group) and 1.36 ± 0.42 (TO group) before surgery to 0.74 ± 0.36 (control group) and 0.77 ± 0.32 (TO group) after surgery (P<0.001), respectively, and there was no significant difference between the 2 groups.

post operation	Control Group(mmHg)	TO group(mmHg)	P
1 d	12.6 ± 4.5	13.5 ± 4.2	0.423
1 w	15.4 ± 3.8	15.5 ± 4.4	0.261
1 m	15.1 ± 2.6	14.8 ± 3.3	0.345
3 m	15.5 ± 3.6	14.9 ± 4.1	0.472
6 m	16.2 ± 3.7	15.7 ± 3.2	0.413

Table 3: The comparison of IOP.

Discussion

In this study, we reported a novel management strategy for SOR with phacoemulsification and IOL implantation, and found that method was simple, effective, time saving and safe.

It was described as a simple method, because only one step was needed, that was keeping the microcannulas unplugged during phacoemulsification and IOL implantation.

There were many methods to SOR: transpupillary or pars plana, active or passive, 20G or 23G or 25G. Transpupillary is a simple and less invasive technique, which with less trauma and better reserved of blood-aqueous barrier function [8,9], but has the theoretical risks to damage structures in the anterior chamber, and limits intravitreous performance when necessary [10]. The pars plana method is preferred, since it not only avoids irritation to the anterior segment, but also allows for sufficient examination of the retina [10]. For active suction, a 23G aspiration tubes is available, however, the cannula needs to enter into the vitreous cavity, through the trocar's microcannula, thus narrowing the tunnel's lumen. This kind of technique could lessen surgical trauma and decrease patients' discomfort, but it is quite time consuming for silicone oil of high viscosity [10-12]. Lin et al. [13] used a temporal head position with fluid-air exchange for the passive drainage, which requires patients to turn their heads during the surgery, so it is unsuitable for patients under general anesthesia. Larger sclerotomy may make removal quickly, but induces more surgical trauma and post-operative discomforts. Contrarily, smaller sclerotomy is less surgical trauma as well as less effective, especially for silicone oil of high viscosity [10]. So according to those findings, 23G pars plana active SOR is a relatively effective method.

To against the buoyancy of silicone oil, we introduced the new method of keeping the trocar opening during phacoemulsification and IOL plantation. That opening had two advantages: One could let silicone oil flow out of the opening trocar instead of directly elevating posterior capsule, then increase anterior chamber stability and decrease the possibility of posterior capsule rupture. In this study, none posterior capsule rupture was occurred in TO Group, while 4 in 30 eyes (13.3%) in the controls, which is almost as same incidence as other studies [5-7]. The other advantage was this method could decrease the remaining silicone oil volume when started to SOR, since silicone oil had been flown out during the entire phacoemulsification. So it can save the time of SOR. According to our results, the cataract time, SOR time and operation time was shorter in TO group than the controls.

Yildirim et al. [14] reported that the mean removal time through corneal tunnel incision was approximately [7]. 6-9 min for passive SOR. The mean time for passive removal of 1000 cSt silicone oil using 25G microcannulas was 7.3 min and for active removal using a specially designed 25G cannula of 1000 and 5000 cSt silicone oil were 3.3 min and 10.3 min, respectively [15,16]. The time taken for passive removal of 1000 cSt silicone oil using two 23-gauge microcannulas was 6.9 min, reported by Patwardhan et al. [17]. Song et al. [18] reported that the mean time for active removal of 5000 cSt silicone oil using a 23G microcannula was 6.8 min. By using an external vacuum pump, the mean silicone oil removal time was decreased to 7.12 ± 1.27 min for 5700 cSt silicone oil [19]. By 23G TSVS, Siyal et al. [20] observed 7.3 min for 1000 cSt passive SOR and 12 to 15 min 5000 cSt silicone oil. And in this study, the SOR time was 4.8 ± 1.2 min for 5700 cSt silicone oil, which means it is a time saving one.

The potential disadvantage of sutureless vitrectomy is postoperative wound leakage. O'Reilly et al. [21] reported transient hypotony in 10 of 39 eyes (25.6%). And Amato et al. [22] reported that 4 of 38 eyes (10.5%) required additional sutures intraoperatively and 2 of 38 eyes (5.3%) experienced postoperative hypotony. To prevent postoperative hypotony, we sutured all the sclerotomy sites, and got a safe result (no hypotony was observed). The incidence of retinal redetachment after SOR was 0.02-19.2% [9,23,24], and there was 4.8% in each group in this study, which indicated this new method did not increase the retinal redetachment incidence. Besides that, no other postoperative complication was observed such as vitreous hemorrhage, dislocated IOL, or endophthalmitis. According to those findings, the trocar opening is a safe method.

In conclusion, our finding indicates that trocar opening method is a simple, effective, time saving and safe method for SOR with phacoemulsification and IOL implantation.

There are some limitations of the current study, including relatively small population and short follow-up time. Future study with larger controlled cases and longer follow-up is warranted to further prove the efficacy and safety of this technique.

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