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Comparison of 2 modified methods for the active removal of silicone oil with a 23-gauge transconjunctival vitrectomy system

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Abstract

To report and compare 2 modified approaches for the active removal of silicone oil (ROSO) with a 23-gauge transconjunctival vitrectomy system.

This prospective single blinded study was conducted from January 2015 to December 2016. Eighty-nine eyes of 86 patients who underwent silicone oil removal were enrolled. Patients were randomly divided into either group A or B. In group A, the fluid–air exchange tube was connected to a 1 mL syringe with the plunger removed and the tip was dilated with a hemostat so that it fit into the cap of the 23-gauge cannula to form a seal for oil drainage. In group B, the tip of the syringe was closely attached to the cap of the 23-gauge cannula by a tube adaptor, which was salvaged from a used silicone oil inject and aspirate pack and sterilized. Main outcome measures were time required for silicone oil removal, silicone oil residual, intraoperative and postoperative complications including hypotony, bleeding, and retinal redetachment.

The mean time required was 6.08 ± 0.31 minutes and 6.11 ± 0.31 minutes for groups A and B, respectively. No silicone oil residual, severe hypotony, recurrence of retinal detachment, or impairment of visual acuity were observed in either group. Conjunctival injection and hyperemia were slightly more severe in group A, but spontaneously resolved in 2 to 3 days.

Both methods described in this paper were demonstrated to be safe, effective, and cost-effective for the ROSO. The syringe dilation method caused more severe conjuntival irritation, thus we suggest using the tube adaptor method for hospitals equipped with cold sterilization equipment.

Abbreviations: BCVA = best corrected visual acuity, IOP = intraocular pressure, PPV = pars plana vitrectomy, ROSO = removal of silicone oil.

Keywords: 23-gauge vitrectomy system, active removal, silicone oil

1. Introduction

A silicone oil tamponade is widely used for complex cases such as retinal detachment and proliferative vitreoretinopathy during a pars plana vitrectomy (PPV). As a temporary internal tamponade for retinal reattachment, the silicone oil should not remain longer than required, in order to avoid silicone oil-related complications such as cataract, secondary glaucoma, and keratopathy.[1] Several techniques have been developed for the removal of silicone oil (ROSO) including an anterior approach through the corneal limbus and posterior approach through the pars plana. The latter method is preferred by most surgeons since it not only avoids irritation to the anterior segment, but also allows for sufficient examination of the retina.

The advent of the 23-gauge vitrectomy system brought vitreoretinal surgery into a new era and approaches using a 23-gauge cannula for ROSO, either by passive drainage or by active suction, have been developed accordingly.[2–5] Passive drainage is usually time consuming, especially when the silicone oil is highly viscous. For active suction, an assortment of silicone oil aspiration tubes for a 23-gauge cannula is available; however, the effective lumen is narrowed when using the aspiration tube, significantly hampering the efficiency of surgery. The aspiration tube for ROSO adds an extra financial burden for patients, particularly in developing countries such as China. Some surgeons choose to use suction with manual syringe negative pressure suction instead of a vitrectomy machine to avoid the previously mentioned drawbacks mentioned; however, it is also time consuming and the negative pressure is unstable during the surgery.

In this study, we developed 2 modified approaches for active ROSO (5700 centistokes) through a 23-gauge cannula. The efficiency and safety of the 2 approaches were evaluated and compared.

2. Methods

This prospective, consecutive case study was conducted from January 2015 to December 2016 in the Ophthalmology Department at Shandong University Qilu Hospital. The study protocol has been approved by the institute's ethics committee on

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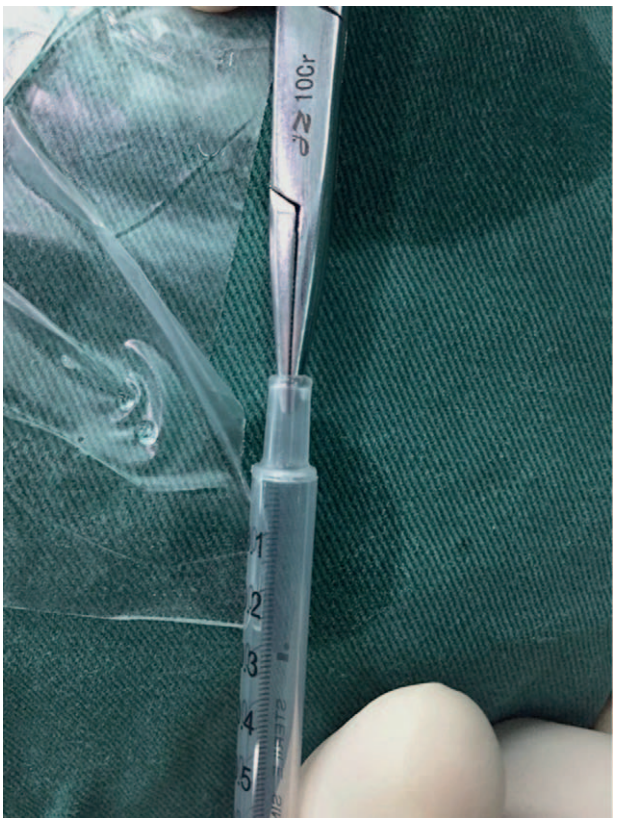

Figure 1. Dilation of the tip of a 1 mL syringe with a hemostat.

human research. After written informed consent was obtained, 89 eyes of 86 patients were enrolled and underwent silicone oil removal. Eyes with other diseases and emulsification of the silicone oil were excluded. Patients were randomly divided into either group A or B.

All the ROSO procedures were performed by the same surgeon (JL) using a 23-gauge transconjunctival sutureless vitrectomy system (Alcon Laboratories, Fort Worth, TX) under retrobulbar anesthesia with a mixture of 2% lidocaine and 75% bupivacaine at a 1:1 ratio. A standard 23-gauge vitrectomy 2-port (inferior-temporal infusion port and superior-temporal [or superior-nasal] operation port) were established for both groups. For group A, the fluid–air exchange tube was connected to a 1 mL syringe with the plunger removed. The tip was dilated with a hemostat so that it fit into the cap of the 23-gauge cannula to form a seal for oil drainage (Figs. 1 and 2). For group B, the tip of the syringe was closely attached to the cap of the 23-gauge cannula by a tube adaptor, which was salvaged from a used silicone oil inject and aspirate pack and sterilized (Figs. 3 and 4). For both groups after all the tubes were connected, the infusion was opened, adjusted to approximately 60 cm, and the silicone oil was then actively removed with 600 mm Hg of negative pressure suction using a vitrectomy machine. A fluted needle was used to remove small oil bubbles and the retinal status was carefully checked under a light probe. At the end of the procedure, the cannulas were removed and the sclerotomy sites were closed with 8-0 vicryl suture.

The time elapsed for the ROSO was recorded. The patients were followed up on days 1, 3, and 5, and at 1 week, 1 month, and 3 months after the surgery. The postoperative ophthalmic examination included a slit lamp examination, measurement of intraocular pressure (IOP), and indirect ophthalmoscopy.

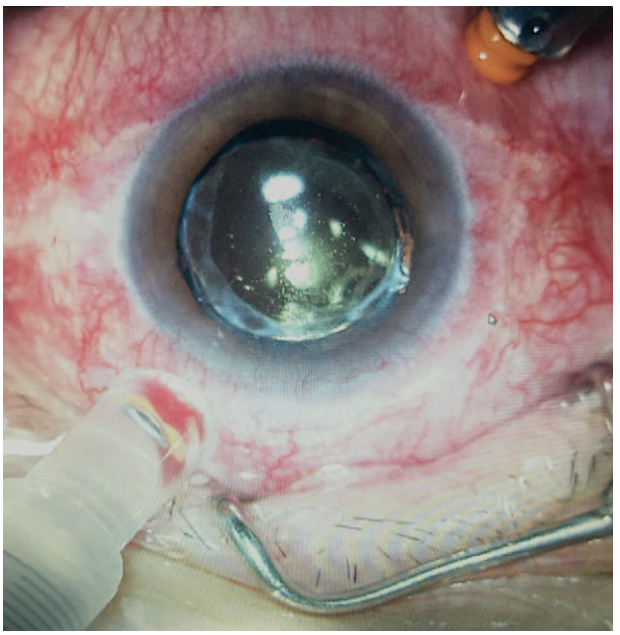

Figure 2. The dilated tip of 1 mL syringe fits into the cap of a 23-gauge cannula to form a tight seal for the drainage of silicone oil.

All statistical analyses were performed using Statistical Analysis System for Windows version 9.1.3 (SAS, Inc., Cary, NC). A *P*-value of $<.05$ was considered statistically significant.

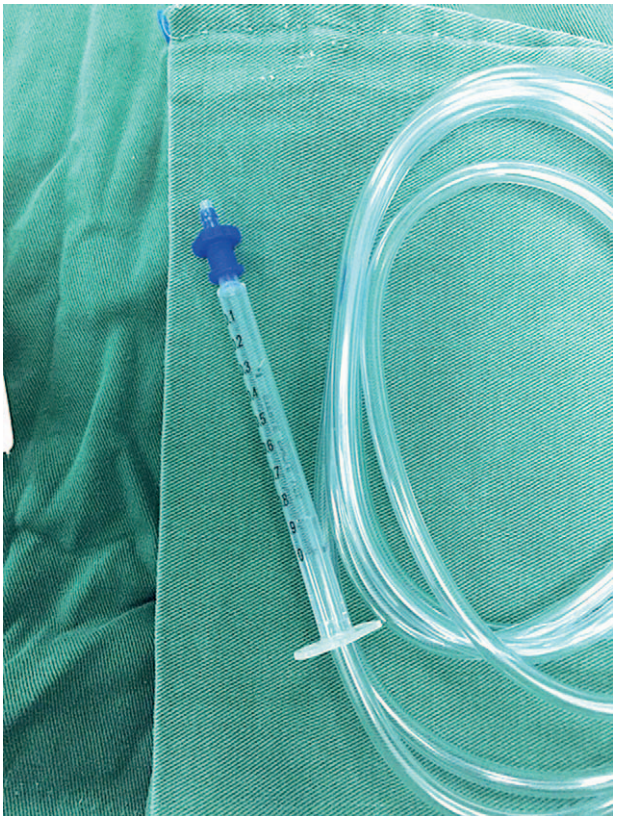

Figure 3. A salvaged and sterilized tube adaptor was connected to the anterior extremity of a 1 mL syringe.

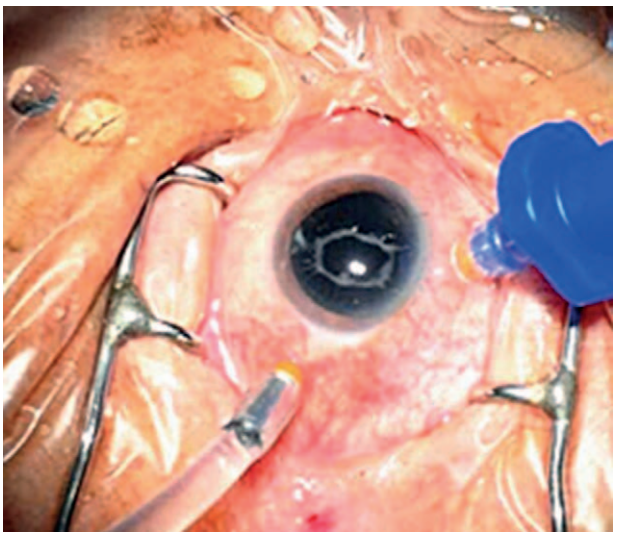

Figure 4. A 1 mL syringe was connected to the cap of a 23-gauge cannula with the tube adaptor to drain silicone oil.

3. Results

The baseline demographics and characteristic of the patients are summarized in Table 1. There was no significant difference between the 2 groups for age, gender, preoperative IOP, or length of silicone oil stay.

Overall, silicone oil (5700 centistokes) was removed successfully in all cases. No severe intraoperative or postoperative complications, including retinal redetachment, intraocular hemorrhage, corneal edema, residual silicon oil, or intraocular tissue damage, were noted.

The average time for ROSO were 6.08 ± 0.31 minutes and 6.11 ± 0.31 minutes in groups A and B, respectively (Table 2). Although the mean surgical time in group A was shorter than group B, this was not statistically significant.

The mean IOPs 1 day and 1 week after the surgery were not significantly different between the 2 groups. There were 1 (2.22%) and 2 (4.55%) eyes that were hypotonic ($\leq$6 mm Hg) at 1 day after surgery in groups A and B, respectively (Table 2). All the eyes healed within 1 week after surgery with eye bandaging compression for 1 to 2 days. The mean IOP at 1 month after surgery was similar to that at 1 week.

On slit lamp examination, we also observed slightly more severe conjunctival injection and hyperemia in group A at 1 day after the surgery. This spontaneously resolved in 2 to 3 days. All the patients had a clear anterior chamber and no patient complained of floaters postoperatively.

Table 1

Baseline demographic data and characteristics of the patients.

Parameters	Group A (n = 44)	Group B (n = 42)	*P*
Age, y	48.42	52.36	.141
Male/female, n*	30/15	33/11	.387
Right/left eye, n*	25/20	18/26	.167
Phakic/aphakic/pseudophakic	14/31/0	7/35/2	–
Pre-op IOP, mm Hg	14.77	14.14	.410
Length of silicone oil stay, mo	4.11	4.20	.857

IOP = intraocular pressure, pre-op = preoperative.
* Compared by Chi-square test, while others were compared by *t* test for independent samples.

Table 2

Intraoperative and postoperative outcomes.

Parameters	Group A (n = 44)	Group B (n = 42)	*P*
Time taken for ROSO, min	6.08	6.11	.611
Intra-op complication	None	None	—
1 d post-op IOP, mm Hg	10.40	9.61	.258
1 d post-op complication (hypotony, n, %)*	1 (2.22%)	2 (4.55%)	.549
1 wk post-op IOP, mm Hg	13.16	12.46	.360
1 mo post-op complication (redetachment of retina)	None	None	—

Hypotony was defined as IOP $\leq$6 mm Hg.
Intra-op = intraoperative, IOP = intraocular pressure, post-op = postoperative, ROSO = removal of silicone oil.
* Compared by Chi-square test, while others were compared by *t* test for independent samples.

4. Discussion

After being introduced in 2005 by Eckardt,[6] the 23-gauge vitrectomy system is gaining popularity among most vitreoretinal surgeons, since it provides a sutureless incision, comfortable surgical experience, and speedy recovery. A 23-gauge silicone cannula designed to inject and aspirate the silicone oil is commercially available. Romano et al report that during the ROSO surgery, the silicone cannula needed to enter through the 23-gauge cannula, which makes the effective outlet lumen decreased. Therefore, the efficiency of the ROSO was significantly reduced, especially for highly viscous silicone oil.[3] In addition, a silicone cannula also adds extra cost for patients in developing counties such as China. Siyal et al[7] introduced an approach for passively draining silicone oil through a 23-gauge vitrectomy system. However, it would be also very time consuming for the ROSO when the viscosity is high (e.g., 5700 centistokes). Lin et al[8] used a temporal head position together with fluid–air exchange for the passive drainage of small oil bubbles. This approach requires patients to turn their heads during the surgery, so it is unsuitable for patients under general anesthesia. Moreover, the mean time of silicone oil removal was 8.0 ± 1.4 minutes, which was longer than that reported by similar studies.[9–13]

Two modified approaches for active ROSO with high viscosity (5700 centistokes) using 23-gauge cannulas were compared in this study. The mean time of ROSO for both approaches are comparable with those reported by Song et al[9,12] and Henderson et al,[13] who removed high viscosity silicone oil by active suction with 600 mm Hg of negative pressure using a 23-gauge vitrectomy machine. In addition to all advantages of using 23-gauge vitrectomy system for ROSO, the major advantages for both approaches introduced in this study includes the ease of preparation, a short procedure time and cost-efficiency. The perfect match of the 1 mL syringe with the fluid–air exchange tube to form a seal is another merit of the 2 approaches. Compared to the approach with the tube adaptor (group B), syringe dilation (group A) causes more irritation to the conjunctiva near the cannula for silicone oil drainage. The proper explanation is that unlike the tube adaptor, the dilated tip of a 1-mL syringe does not fit 23-gauge cannula perfectly and more conjunctiva is drawn into the space during the surgery. Thus the approach using the salvaged tube adaptor approach is recommended for hospitals equipped with a cold sterilization system. For other centers, we still recommend the syringe dilation approach since the conjunctival irritation is not severe and spontaneously heals in 2 to 3 days.

All the patients had clear anterior chambers and vitreous cavities after surgery. No severe complications, including intraocular bleeding, and retinal redetachment, were noted. As Oh et al[2] have reported in their study, we sutured all the sclerotomy sites in order to prevent postoperative hypotony. This method was successful with a relatively low rate of hypotony. It is worth mentioning that best corrected visual acuity (BCVA) was not considered as a parameter for comparison in this study. This is mainly because BCVA is more subjective and dependent on many factors such as age, general condition of the patient, type, duration, and severity of the previous eye disease. Although it is difficult to compare the BCVA among different patients, we still observed that the BCVA did not become worse for each patient after surgery and most improved in 1 to 3 months postoperatively.

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