Surgical Outcomes of Complicated Retinal Detachments using Heavy Silicone Oil as an Internal Tamponade

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Abstract

***Purpose*:** To evaluate the anatomical and functional outcomes of using heavy silicone oil as an internal tamponade for complicated cases of retinal detachment associated with proliferative vitreoretinopathy involving inferior retinal quadrants

***Methods*:** 55 eyes from 55 patients with complicated retinal detachments enrolled in this interventional case series study. All eyes underwent standard three-port pars plana vitrectomy with endolaser photocoagulation and heavy silicon oil injection. Patients were categorized in traumatic and nontraumatic groups based on underlying retinal pathology. Anatomical and functional outcomes as well as complications were evaluated during 14 months (mean follow-up was 10.3 months), postoperatively.

***Results*:** 55 patients, 11 women, and 44 men with a mean age of 37.18±24.2 years (from 4 to 104 years) underwent pars plane vitrectomy with heavy silicone oil injection. Mean preoperative logMAR visual acuity was 2.24 (±0.78) which significantly improved to 1.55 (±0.63) (P<0.005). Retinal redetachment occurred in 11 (20%) at early postoperative period (first month postoperatively) that was successfully managed by reoperations. Heavy silicone oil was removed in 39 (70%) patients after a mean of 5.8 months. Retinal reattachment was ultimately achieved in 37 (67.3%) patients after a mean of 2.3 operations per patient. Reattachment rates were significantly lower in traumatic (48%) compared to nontraumatic (83.3%) group (P=0.038). Intractable glaucoma, retinal redetachment due to proliferative vitreoretinopathy and band keratopathy were among the observed complications.

***Conclusion*:** Heavy silicon oil internal tamponade is a safe and effective therapeutic modality in complicated retinal detachments associated with pathologies affecting inferior retinal quadrants.

***Keywords*:** Heavy Silicone Oil, Internal Tamponade, Complicated Retinal Detachment

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Introduction

Modern vitrectomy techniques have had tremendous impact on management of complicated retinal detachments including severe proliferative vitreoretinopathies (PVR), giant retinal tears and traumatic retinal detachments. In vitrectomized eyes, different substances have been used as vitreous substitutes. Gasses and silicone oils have specific gravities lower than water; therefore, they can produce effective tamponade on superior retinal quadrants.[1] When dealing with pathologies affecting inferior retina, the above-mentioned substances lack producing an effective tamponade.[2] In fact, the most common complications of silicone oil internal tamponade is persistence or recurrence of inferior retinal detachment.[3] As a result, using vitreous substitutes heavier than water has always been a matter of intensive research.

In the late 90's, different kinds of fluorinated silicone oils and perfluorocarbon liquids (PFCL) have been tried. Despite their high specific gravities, they have been abandoned due to complications relevant to their physical and chemical characteristics and the resultant retinal toxicity.[4] The mixture of silicone oil with fluorinated and hydrocarbonated olefin (RMN3) (Oxane HD®) and silicone oil with perfluorohexyloctane (Densiron®) have been recently introduced to vitreoretinal surgery. These compounds have specific gravities higher than water and therefore can effectively tamponade inferior retinal quadrants.[5] In our study, we evaluated the therapeutic benefits of these two substances in complicated retinal detachments associated with high-grade PVR affecting inferior retina and/or inferior retinal tears.

Methods

The study was conducted as an interventional case series in a 14-month period at Farabi Eye Hospital.

Inclusion criteria were:

1. Inferior retinal tears with PVR grade C or higher
2. Inferior retina detachments secondary to penetrating ocular injuries
3. Giant retinal tear involving inferior retinal quadrants
4. Retinal tears posterior to the equator

Exclusion criteria included:

1. Pregnancy
2. Uncontrolled ocular disease other than retinal detachment
3. Presence of silicone intraocular lens
4. Monocular patients

After explaining the details and possible complications and acquiring an informed consent, eligible patients entered the study.

At first, a complete and detailed ocular examination including best corrected vision, slit-lamp examination, intraocular pressure (IOP) measurement and indirect funduscopy was performed for each patient. The characteristics of retinal detachments were meticulously evaluated and recorded in standard retinal charts. Proliferative vitreoretinopathy was graded according to latest revision of retina society grading system.[6]

Operations were performed under general or retrobulbar anesthesia as governed by the patients' general condition. A standard three-port pars plana vitrectomy including complete removal of vitreous, vitreous base shaving, placement of band according to individual surgeons' decision, removal of epiretinal membranes and when necessary, retinotomy, was performed. In situations when lens opacities interfered with intraoperative visualization or in cases of anterior PVR, lensectomy was a part of the procedure. After mobilizing the retina, perfluorocarbon liquid (DKline) was used to flatten the retina. Endolaser photocoagulation was applied around retinal breaks and retinotomies. Fluid/gas exchange was performed after which, vitreous cavity was filled with heavy silicone oil (Densiron® or Oxane HD®) and the procedure terminated after performing peripheral iridectomy at 12 o'clock position.

Patients were visited postoperatively at fist day, first week, first month and third month. Best corrected visual acuity, slit-lamp examination, IOP measurement and indirect funduscopy were performed in each visit, and anatomic retinal condition was precisely evaluated. Any possible complication including significant inflammation, band shaped keratopathy, increased IOP, occurrence or progression of lens opacities, per-silicone fibrous proliferation,

emulsification, retinal redetachment, occurrence or progression of PVR and epiretinal membranes were evaluated. Four months after the procedure, silicone oil was actively aspirated and replaced with balanced salt solution. After silicone oil removal, patients were visited periodically for at least six months. Some patients were not willing to undergo silicone removal due to acceptable visual acuities and knowing the possibility of retinal redetachment. These patients were also followed but their relevant data were recorded separately. Data were analyzed by SPSS software V. 11.5.

Results

Patients' mean age was 37.18±24.2 years (from 4 to 104 years). There were 11 (20%) women and 44 (80%) men among the study population. Patients were followed for 14 months postoperatively with a mean follow-up of 10.3 months. Underlying causes of retinal detachment are summarized in table 1.

Table 1. Underlying pathologies of retinal detachments

Underlying Pathology	Number of patients	Percent
Traumatic	25	45.5%
Spontaneous	8	14.5%
Aphakic/pseudophakic	9	16.3%
High myopia	7	12.7%
Diabetic	2	3.6%
Giant retinal tear	2	3.6%
Postvitrectomy	2	3.6%

Mean preoperative logMAR visual acuity was 2.24 (±0.78) which significantly improved at early postoperative visits to 1.77 (±0.82) (P<0.005). The visual acuities continued to improve to a mean of 1.55 (±0.63) at the last visit (P<0.005). The differences between early and late postoperative visual acuities were not statistically significant (P=0.246).

Preoperative mean IOP was 11.0 mmHg which significantly increased postoperatively to a mean of 13.2 (P=0.004) and at late postoperative visit to 13.18 (P=0.006). There was no statistically significant difference between early and late postoperative IOP means (P=0.281).

Due to the small number of patients in some of the etiologic subgroups, stratification among all groups could not be achieved. Instead, we categorized patients in two traumatic and nontraumatic subgroups. Preoperatively, mean visual acuities were worse in the traumatic group (P=0.048) but IOPs were not significantly different (P=0.83). At the early postoperative visit, mean visual acuities and IOPs were significantly worse among the traumatic patients (P<0.005 and P=0.027, respectively). At the latest postoperative visit, however, the differences in visual acuities and IOPs were not significantly different between the traumatic and nontraumatic groups (P=0.687 and P=0.579, respectively).

At early postoperative visits, retinal redetachments occurred in 11 patients (20%) that were further managed by reoperations. Occurrence of redetachments was not related to gender, placement of prophylactic band (P=0.076) or silicone tire (P=0.098), performing retinotomy (P=0.579) or preoperative visual acuity (P=0.057), or preoperative IOP (0.0456). Redetachment rates were significantly lower among patients who underwent lensectomy as part of the vitrectomy procedure (P=0.004). In addition, a significant reverse relationship was discovered between age and redetachment rates (P=0.004). Redetachment rates were significantly higher among traumatic patients (9 cases, 36%) compared to other groups (2 cases, 6.7%) (P=0.007).

Significant presilicone fibrous proliferation occurred in 7 (12.7%) patients all of whom were among the traumatic group (P<0.005). the occurrence of presilicone fibrous proliferation was not statistically related to age, gender, placement of band or tire, or performing retinotomy but it was significantly related to aphakia (P<0.005). During a reoperation in a case of retinal redetachment, the presilicone fibrous tissue was excised and submitted for pathologic examination. The pathologic report showed a tissue mainly composed of fibroconnective tissue, negative for elastin fiber in Orcein-Giemsa (OG) stain, and scattered firbrous astrocytes and pigmented retinal epithelium, compatible with

foreign body-type granulomatous inflammation.

Silicone emulsification did not happen during the study period. Band keratopathy developed in three (5.5%) eyes, all of which were aphakic.

Heavy silicone oil was ultimately removed in 39 (70%) patients after a mean of 5.8 months. The remaining 16 patients (30%) either refused the silicone removal procedure due to their acceptable visual function and the possibility of redetachments, or were not suitable surgical candidates due to their poor prognostic retinal condition. During silicone removal, vitrectomy revision including lensectomy with or without intraocular lens implantation, membrane peeling and endolaser photocoagulation, and injection of silicone oil or sulfur hexafluoride (SF6) was performed in nine (23%) patients due to development of proliferative vitreoretinopathy.

Retinal reattachment was eventually achieved in 37 (67.3%) patients after a mean of 2.3 operations per patient. Reattachment rates were significantly lower in traumatic (48%) compared to nontraumatic (83.3%) group (P=0.038). Eventual retinal reattachment rate did not show a significant relationship with gender (P=0.902), placement of band (P=0.122) or tire (P=0.383), performing retinotomy (P=0.459), or lensectomy (P=0.189). Finally, 16 eyes (29%) became visually lost due to extensive proliferative vitreoretinopathy, intractable glaucoma, branch retinal vein occlusion, traumatic optic neuropathy, extensive corneal scarring, and advanced diabetic retinopathy.

Discussion

Silicone oil tamponade in association with modern microsurgical techniques and sophisticated instrumentation permit satisfactory anatomical and functional outcomes in retinal detachment surgery.[7] The anatomical success rate in treatment of retinal detachments associated with proliferative vitreoretinopathy varies between 30% and 75%.[8-10] However, retinal redetachment with PVR in inferior quadrants is still the most common complication of silicone oil tamponade.[11] This is mainly due to the weak inferior tamponading effect of silicone oils permitting accumulation of fluid and inflammatory debris in inferior retinal quadrants, which lead to the development of inferior PVR subsequently.[12] Likewise, in those cases that the pathologic process mainly affects the inferior retina, lack of inferior tamponade of silicone oil will not be able to alleviate the inferior retinal pathology, and may result in surgical failure.[13] In our study, we addressed the above-mentioned issues using heavier-than-water silicone oil as a long term internal tamponade.

There were two cases of retinal detachment due to complications of proliferative diabetic retinopathy among our patients. Although we were aware of the pathophysiologic differences between PVR and proliferative diabetic retinopathy (PDR), we enrolled them in our study because we were confident that these two cases would not cause a significant bias in the study.

We stratified our data into traumatic and nontraumatic categories. We decided to do so because we presumed that the traumatic nature of retinal detachment and diverse pathologic processes accompanying traumatic retinal detachments including corneal scarring, traumatic optic neuropathy and so forth, could worsen the anatomical and functional outcomes of the surgery, affecting the results of the whole study.

Mean preoperative logMAR visual acuity was 2.24 (±0.78) which significantly improved to a mean of 1.55 (±0.63) at the last visit (P<0.005). Since all of our patients were suffering from complicated retinal detachments accompanied by large areas of PVR (mean 3.93±2.44 clock hours), the functional outcomes in our study is comparable to previous studies that used silicone oil in less complicated cases of retinal detachment.[14,15] The differences in final visual acuities in traumatic and nontraumatic subgroups were not statistically significant (P=0.687). Since this difference was significant both preoperatively and in early postoperative period, we concluded that the functional success of heavy silicone oil tamponade in traumatic retinal detachments is higher than nontraumatic cases. We proposed that since the trauma group mainly consisted of young adults with no previous retinal conditions, they have a higher functional reserve and a good potential for recovery. This presumption must be evaluated in further

studies incorporating more functional and electro-physiological tests.

Preoperative mean IOP was 11.0 which significantly increased postoperatively to a mean of 13.2 (P=0.004) and at late postoperative visit to 13.18 (P=0.006). Overall, one eye was lost due to intractable glaucoma that did not respond to multiple surgical procedures. The mean IOP was significantly higher at early postoperative visits among the traumatic cases (P<0.027) but this difference was not significant in later visits (P=0.57). Probably, the intense postoperative inflammation that is commonly observed in the early postoperative period of traumatic patients accounts for the higher IOPs that subside upon proper control of the inflammation.[16,17]

At early postoperative visits, retinal redetachments occurred in 11 patients (20%) that were further managed by reoperations. Redetachment rates were significantly lower among patients who underwent lensectomy as part of the vitrectomy procedure (P=0.004). We proposed that performing lensectomy would allow better visualization, and shaving of the vitreous base and discovering undetected small peripheral retinal breaks would be more achievable. Younger patients had a higher rate of retinal redetachment possibly because proliferative vitreoretinopathy is more common and more intense in younger patients.[18] In addition, redetachments were significantly more common in traumatic patients. This finding can have three explanations. First, traumatic patients were younger and therefore more prone to developing PVR. Second, traumatic eyes are severely inflamed, potentiating the development of PVR and tractional forces that can ultimately lead to redetachments. Third, intraoperative visualization in traumatic eyes is more difficult than nontraumatic eyes, making proper management of all the retinal pathologies very difficult.

Significant presilicone fibrous proliferation occurred in seven (12.7%) patients all of whom were among the traumatic group (P<0.005). we speculated the severe postoperative inflammatory response to be the main culprit in this complication. Aphakia was also a risk factor in the development of presilicone fibrous proliferation. Because of the exclusive occurrence of this complication in traumatic patients, we were not able to show an isolated relationship between aphakia and presilicone fibrous proliferation. Further studies will be needed to address this issue.

Pathologic specimen acquired from presilicone fibrous membranes in a heavy silicone-filled eye showed foreign body-type reaction. Comparing this tissue with epiretinal membranes from silicone-filled eyes reveals no significant pathologic difference between epiretinal membranes formed in silicone oil and heavy silicone-filled eyes.

Retinal reattachment was ultimately achieved in 37 (67.3%) patients after a mean of 2.3 operations per patient which is comparable to previous studies using silicone oil as an internal tamponade.[19-23] Reattachment rates were significantly lower in traumatic (48%) compared to nontraumatic (83.3%) group (P=0.038). the possible explanations were mentioned previously in this article.

Conclusion

Heavy silicone oil can be used as an effective long term internal tamponade in complicated cases of retinal detachments involving inferior retinal quadrants. The anatomical and functional success rates are at least comparable to silicone oil. Traumatic patients show less favorable surgical outcomes.

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