INTRODUCTION

Silicone oil is a liquid with unique properties of surface tension. It had been widely used as long term internal tamponading agent during retinal reattachment surgery by vitreo retinal (VR) surgeons for the last almost six decades.\(^1\) However, silicone oil in long term not only can be toxic to photoreceptors\(^2\) but also cause other complications such as cataract, secondary glaucoma and keratopathy as well.\(^3,4\) Therefore removal of silicone oil (ROSO) becomes essential in several cases and even some surgeons recommend it in almost all cases with few exceptions. Few VR Surgeons advocate ROSO as early as a month or few weeks after initial surgery so as its related complications can be prevented or treated.\(^5\) Although ROSO carries risk of retinal re-datachment and some other complications but
all VR specialist agreed that once the objectives of
temponade is achieved and retina become stable,
silicone oil should be removed.

Studies report several techniques for ROSO
including anterior approach through limbus and
posterior through pars plana route. Conventional
pars plana technique of ROSO include conjunctival
peritomy followed by 20 G sclerotomy that need
closure with sutures and 3-4 weeks for that
discomfort to recover. Not only it take more time
for ROSO with 20 G vitrectomy but also carries
the risk of post operative wound leakage, retinal
incarceration, higher intra ocular pressure (IOP)
and choroidal detachment as well.6 With the advent
of 23 G and 25 G transconjunctival sutureless
vitrectomy systems (TSVS), vitreo retinal surgery
entered into a new micro incisional era. These
sutureless, self sealing, angled trans conjunctival
sclerotomies had greatly minimized opening and
closing times thus resulting quick recovery had
reduced patients stress as compared to classic 20
G three port vitrectomy.7,8 Active ROSO through
conventional 20 G instruments is easy while passive
ROSO is quite difficult by 20 G system because
sclerotomies made by micro vitreo retinal (MVR)
knife tend to collapse. In 23 G system, rigid cannulae
are passed into sclerotomy wound that keeps it
open all the time so oil easily flow out passively.
Moreover, passive ROSO is more controlled with
less fluctuation of pressure and requires minimal
maneuvring during procedure.9

The purpose of our study was to see the outcomes
of passive ROSO through 23 gauge TSVS. To the best
of our knowledge no such study has been conducted
in our setup so we studied the efficacy and safety of
23 Gauge TSVS in terms of per operative and post
operative difficulties and complications.

METHODS

This prospective, descriptive interventional case
series study was conducted from January 2011 to
December 2014 at Ophthalmology Department
Unit I, Dow University of Health Sciences and Civil
Hospital Karachi. Seventy nine eyes underwent
passive ROSO through 23 gauge TSVS under
retrobulbar anesthesia. All gender patients of all age
group were enrolled after explaining pros and cons
of the procedure and written informed consent was
obtained. Only pseudophakic eyes having history
of retinal reattachment surgery with silicone oil
temponade were included in this study. Phakic and
aphakic eyes were not enrolled. Eyes with corneal
pathology or having any other retinopathy were
excluded from this series. After complete history
and ocular examination, indication for ROSO was
established. Pre operative best controlled intra
ocular pressure was recorded in each case.

Under all aseptic measures, the conjunctive was
displaced 1-2mm cross wise in the direction of limbus
at infero-temporal, supero-temporal and supero-
nasal quadrants. Making an angle of 10 degree to
crera, three polyamide micro cannulae (trocar) of
23 gauge were inserted trans conjunctivally in the
crera at pars plana site. After advancing the trocar
for 2mm, the angle was changed to 30 degree into
the mid vitreous cavity. Through infero-temporal
trocar site infusion line was connected with 70 to
90 cm bottle height. The silicone oil started to drain
passively upon opening the infusion line through
the two superior sclerotomy sites. The cannula
was used to eliminate the last bubble of silicone
oil. At the complete removal of silicone oil, retinal
status was closely examined and fluid air exchange
(FAX) was done. While removing micro cannulae,
moderate pressure was applied at each sclerotomy
site with a cotton applicator and eye patched
for 24 hours after installing topical antibiotic
(Moxifloxacin) drops. Endolaser photocoagulation
was performed wherever required and silicone
oil refilled where retinal detachment was found
on follow up visits. Time taken for ROSO was
measured by video recordings. Any per operative
difficulty or complication were recorded.

The patients were examined on next day and
follow up was scheduled on 1st week, one, three
and six month interval post operatively. On each
visit, complete ocular examination was performed,
intraocular pressure (IOP) was noted and retinal
status was checked.

Statistical analysis was done using SPSS version
17.0. The difference between pre and post operative
IOP was compared by using two-tailed paired
t-test and mean values with standard deviation
were computed using difference of 95% confidence
interval. Chi square test was applied for correlation
of different variables. P-value of less than 0.05 was
considered statistically significant.

RESULTS

Out of 79 patients who underwent passive
ROSO, 38 (48.1%) were males while 41 (51.9%)
were females. Mean age of patients was 47.5 ± 7.1
(sd) years while majority (53.2%) were in the age
group of less than 45 years. The main indication for
ROSO was glaucoma in 53 (67.1%) cases followed
by emulsification and presence of oil in anterior
chamber. The silicone oil viscosity of 1000 and 5000 centistokes (cs) was found in 70 (88.6%) and 9 (11.4%) cases respectively (Table-I).

The mean time interval between silicone oil tamponade surgery and maneuver for ROSO was 5.05 ± 3.09 (sd) months. Mean time taken for passive ROSO by 23 G TSVS was 7.31 ± 2.41 (sd) minutes (Table-II).

The comparison of pre and post operative intra ocular pressure (IOP) shows statistically significant (p=0.000) decrease in IOP after ROSO. Mean pre operative IOP was 28.81 ± 11.45 mmHg which declines to mean IOP of 19.54 ± 4.38 (sd) mmHg after ROSO (Table-III).

Hypotony (IOP < 5mmHg) was observed in 5 cases post operatively which normalizes within first two days of ROSO. During passive silicone oil removal, extrusion of trocar cannulae were observed in 7 (8.9%) cases which were reinserted back successfully. All the silicone oil was removed successfully and retina found flat during the surgery. In majority of cases retina remain flat after the surgery whereas retinal redetachment developed in 13 (16.5%) cases during first month of follow up period (Table-IV).

**DISCUSSION**

Various techniques have been adopted for ROSO to combat the established complications of silicone filled eyes. Eckardt\(^10\) in 2005 introduced 23 gauge TSVS which offer angled self sealing tunnel sclerotomies maintained through trocar cannulae throughout surgery period. As it uses firmer and sturdier instruments as compared with 25 G, it does not require a prolonged learning curve. Hence this system is now getting popularity among VR surgeons for ROSO as well.

Raised IOP is a frequent complication of silicone oil tamponade. The incidence of glaucoma varies widely from 2.2% to 56% cases and is reversible in Table-IV: Per operative and post operative complications.

| Complications     | Per operative | Post operative |
|-------------------|---------------|----------------|
| Extrusion of Trocar| 7 (8.9%)      | Nil            |
| Retinal           | N/A           | 13 (16.5%)     |
| Re-detachment     | N/A           | 5 Recovered within two days |
| Hypotony          | Nil           | 28 (35.4%)     |
| Glaucoma          | N/A           | Nil            |
| Wound leak        | Nil           | Nil            |

**Table-I: Descriptive data (n=79).**

| Data              | Frequency |
|-------------------|-----------|
| **Age**           |           |
| • Minimum         | 34 years  |
| • Maximum         | 62 years  |
| • Mean            | 47.56 ± 7.18 (SD) |
| **Groups (Years)**|           |
| • Less than 45    | 42 (53.2 %) |
| • 46 to 55        | 23 (29.1 %) |
| • 56 & above      | 14 (17.7 %) |
| **Gender**        |           |
| • Male            | 38 (48.1 %) |
| • Female          | 41 (51.9 %) |
| **Indications for ROSO** |       |
| • Glaucoma        | 53 (67.1 %) |
| • Oil Emulsification | 16 (20.3 %) |
| • Oil in AC       | 10 (12.7 %) |
| **Silicone Oil Viscosity** |       |
| • 1000 centistokes | 70 (88.6 %) |
| • 5000 centistokes | 09 (11.4 %) |

**Table-II: Silicone oil tamponade duration and time taken for ROSO (n=79).**

| Time interval between tamponade surgery and ROSO | Frequency |
|-------------------------------------------------|-----------|
| • Minimum                                       | 2 months  |
| • Maximum                                       | 15 months |
| **Groups (Months)**                             |           |
| • Less than 3                                   | 33 (41.8 %) |
| • 3 to 6                                        | 33 (41.8 %) |
| • More than 6                                   | 13 (16.5 %) |
| Mean interval = 5.05 ± 3.09 SD months.          |           |

**Table-III: Pre Operative & Post Operative IOP Comparison (n=79).**

| IOP             | PRE OP | POST OP | P -Value |
|-----------------|--------|---------|----------|
| < 20 mmHg       | 26 (32.9%) | 51 (64.6%) | < 0.000* |
| 21 – 30 mmHg    | 16 (20.3%) | 24 (30.4%) |          |
| 31-40 mmHg      | 19 (24.1%) | 04 (5.1%) |          |
| >41 mmHg        | 18 (22.8 %) | nil |          |
| Pre operative mean IOP = 28.81 ± 11.45 SD | |
| Post operative mean IOP = 19.54 ± 4.38 SD | |
| Reduction in mean IOP= 9.26 ± 11.79 SD | |

*P-value less than 0.05 is statistically significant, IOP = Intra Ocular Pressure, PRE OP = Pre operative, POST OP = Post Operative.
most patients after oil removal. In our series we observed 53 (67.1%) eyes with chronic glaucoma which stands main indication for ROSO. In eyes having silicone oil endotemponade and raised IOP, ROSO is a preferred maneuver compared to invasive filtration glaucoma surgery. In this study mean IOP reduction was 9.26 ± 11.79 (sd) after ROSO which is statistically highly significant (P=0.000). Similar results were noted in a study where 93.4% of patients had normalization of IOP after removal of silicone oil temponade.

Patwardhan and colleagues reported 6.86 minutes mean time for ROSO with 23 G trocar canullae system. However Yildirim et al. noted approximated 9 minutes for passive ROSO while Kapran et al. mentioned 7.3 minutes for passive ROSO with 25 G micro canullae system. In our study by 23 gauge TSVS, majority of eyes with 1000 cs silicone oil temponade, we observed 7.3 minutes mean surgical time for passive ROSO which is comparable with other studies. We recorded relatively longer time i.e. 12 to 15 minutes in 7 (8.9%) cases of passive ROSO which had 5000 cs silicone oil temponade so we recommend passive ROSO in such cases as well.

Timing for ROSO has remained under debate since long time. Many VR surgeons now are of the opinion that once the objective of internal tamponade is achieved, silicone oil must be removed to prevent or treat complication associated with it. Nagpal et al. observed that the duration of tamponade did not have an effect on the incidence of retinal redetachment after silicone oil removal. In our study mean interval between silicone oil tamponade and ROSO was 5.05 ± 3.09 (sd) months. Decision of ROSO must be weighed against the possible risk of retinal detachment. Khurram et al. reported retinal redetachment in 38% eyes, whereas Jahangir found same complication in 33.3% cases after first month of ROSO through pars plana route. Although mechanisms for ret detachment after ROSO includes the opening of pre existing breaks, the posterior migration of an occult rhegmatogenous RD or formation of new breaks; but none of these can be blamed definitely. In our series, we encountered 13(16.5%) retinal redetachment after ROSO. All cases were found in first month of ROSO. Our results are comparable to Falkner et al. and Tan HS et al. who reported 17.4% and 19.2% cases of redetachment after ROSO respectively.

O’Reilly et al. reported transient hypotony in 10 out of 39 cases while Lakhanpal et al. noted same in 2 out of 140 cases. We noticed post operative hypotony in 5 cases which normalized within two days. This transient hypotony can be due to choroidal detachment or wound leak. No wound leak or choroidal detachment was found post operatively in any of our 79 cases. We observed extrusion of micro cannulae in 7 (8.9%) eyes during surgery. However reinserted successfully but slippery trocar could be a problem in this technique. Further larger, controlled studies must be conducted to understand detailed outcomes of this technique.

Passive ROSO through 23 gauge TSVS is technically easy in scarred conjunctiva from prior retinal surgery and being suture less makes it comfortable to patients. Small scleral incisions (23g transconjunctival) are advantageous in preventing endophthalmitis because they are immediately covered by intact Tenon capsule with an overlying intact conjunctiva which prevent bacterial invasion in vitreous cavity. Aseptic measures like sterile preparation with povidine-iodine decrease the potential risk of vitreous infection during trocar insertion. Sutureless technique eliminates post operative inflammatory reaction resulting from irritation of exposed sutures material which offers more patient comfort and early rehabilitation.

CONCLUSION

Passive removal of silicone oil with 23 G transconjunctival suture less vitrectomy system is safe and effective in terms of less per operative and post operative complications. In this simple technique, there is less tissue trauma, less inflammation and little time consumed so it provides more comfort to patients and surgeons as well.

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Authors’ Contributions:

NAS conceived and designed the study.
LDH did data collection, statistical analysis, writing and editing of manuscript.
SW did literature review and final approval of manuscript.