

# Management of Pseudophakic Retinal Detachments by Endovitreals Surgery with Vitreal Cavity Tamponade by Silicone Oil and Air-Gas Mixture

DOI: 10.17691/stm2016.8.1.21

Received October 13, 2015



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**The aim of the investigation** was to assess the efficacy of using air-gas mixture as a substitute for vitreous body in microinvasive surgical management of primary pseudophakic retinal detachment (PRD) and its recurrence after extrascleral intervention performed by 25G endovitreals surgery technique.

**Materials and Methods.** Two groups of patients, which underwent vitrectomy with tamponade of the vitreal cavity by silicone oil or gas, were formed: group 1 (n=24) with primary unoperated PRD and group 2 (n=10) with recurrent PDR after extrascleral surgery. Both groups were further divided into subgroups: A — patients with vitrectomy and introduction of silicone oil; B — patients with vitrectomy and air-gas mixture.

**Results.** A comparative analysis of PRD surgical treatment data, carried out in our investigation, showed that in case of primary PRD treatment higher anatomical and functional results were achieved, when vitrectomy was made with application of silicone oil, which performed more controlled and prolonged tamponade of the vitreal cavity than in vitrectomy with replacement of the vitreous body by air-gas mixture.

In case of PRD recurrence after extrascleral surgery greater efficacy in comparison with the application of the silicone oil was revealed in vitrectomy and air-gas tamponade of the vitreal cavity if there were no coarse retinal fibrosis and large extension of redetached retina.

**Conclusion.** Only differentiated approach to the choice of temporal substitute of vitreous body after vitrectomy in patients with pseudophakic retinal detachment will allow the surgeons to achieve maximally feasible anatomical and functional results.

**Key words:** pseudophakic retinal detachment; endovitreals surgery; vitrectomy; silicone oil; air-gas mixture.

Retinal detachment occupies about 9% among the causes of vision disability, 84% being people of active working age [1]. A special group among patients with retinal detachment comprises people which have been operated previously for cataract with intraocular lens implantation. Changes inside the eye due to cataract surgery predispose to the development of proliferative vitreoretinopathy (PVR) and, as a consequence, to traction and combined rhegmatogenous and traction retinal detachment [2].

The choice of the method and extent of surgical intervention determine in many respects the results of the treatment. Multiple or superior tears and breaks, elderly age, old retinal detachments, PVR stage C and D are considered indications to endovitreals surgery (EVS). As patients with pseudophakic retinal detachment (PRD) have a high risk of PVR development and its more prominent and rapid course compared to phakic detachments, surgeons prefer to perform primarily endovitreals intervention. The tactics of patient management with this pathology is variable, individual in each case, and subjective. The aim of retinal detachment surgical treatment is smoothing out and complete adaptation of the retina in the postoperative period [3]. At present a gold standard of endovitreals approach in case

of heavy retinal detachment, including PRD, is transscleral microinvasive vitrectomy with the following tamponade of the vitreal cavity by silicon oil [3–5]. Despite a high efficacy of this method, recurrences occur in 21.4–77% of cases, according to the data of various authors [6–10]. They may be caused by PVR progression, incomplete removal of the vitreous body during primary vitrectomy, formation of new and unblocking of old ruptures, secondary surgical interventions [11–13].

Performing EVS of retinal detachment a whole number of factors should be taken into consideration: extent, vitrectomy technique, revisions of the vitreal cavity; the need and ways of performing retinotomy and/or retinectomy, elimination of subretinal liquid; choice of vitreous body substitutes (silicone oil, gas) and terms of leaving silicone oil in the eye [13, 14–16].

The silicone oil fills in retinal defects of any size and localization in the adjacent retina free of a tractional component, as well as the vitreal cavity space, preventing free movement of proliferative cells and chemical mediators of inflammation and limiting the spread of proliferative process; it also decreases reduction of epiretinal membranes and directs the vector of the traction forces along the retinal surface (resulting

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in a flatter and area-limited character of the recurrent detachment); partially packs retinal vessels and prohibits blood and fibrin from propagation across the vitreal cavity (reduces the risk of secondary bleeding and proliferation); provides transparency of optical media, enabling retina examination in the postoperative period and, if necessary, performance of supplementary laser coagulation; stabilizes intraocular pressure in case of hypotension, preventing subatrophy, at least for some period [3]. However, complications are possible in vitrectomy with silicone tamponade, caused directly by the presence of silicone oil in the vitreal cavity: penetration of silicone oil into subretinal, suprachorioidal and subarachnoidal spaces, secondary glaucoma, emulsification, keratopathy, reproliferation [17].

Gas tamponade is an alternative to silicone oil in making vitrectomy [18]. The obligatory condition of successful treatment in this technology is a strict observation of a face-down position of the patient in the postoperative period. Nowadays such gases as SF<sub>6</sub>, C<sub>2</sub>F<sub>6</sub>, C<sub>3</sub>F<sub>8</sub> are used for vitreal cavity tamponade. Indications to gas tamponade are: extension of detached retina from 1 to 2 quadrants, absence of fibrosis and retinal edema in the zone of retinal defect, i.e. PVR, stages A and B, and cases of total removal of local subretinal fibrosis and dissection of epiretinal membranes after mobilization of the retina is achieved [19].

**The aim of the investigation** was to assess the efficacy of using air-gas mixture as a substitute for vitreous body in microinvasive surgical management of primary pseudophakic retinal detachment and its recurrence after extrascleral intervention performed by 25G endovitreals surgery technique.

**Materials and Methods.** The results of 25G EVS with silicone oil and gas tamponade of the vitreal cavity in 34 patients, suffering from retinal detachment in pseudoaphakic eyes, have been retrospectively analyzed. An average age of the patients was 62 years (47–81 years). Standard ophthalmologic examination was carried out to all patients before operative treatment.

Two groups of patients, which underwent vitrectomy with vitreal cavity tamponade by silicone oil or air-gas mixture, were formed: group 1 (n=24) with primary unoperated PRD and group 2 (n=10) with recurrent PRD after extrascleral surgery. Both groups were further

divided into subgroups: A — patients with vitrectomy and injection of silicone oil; B — patients with vitrectomy and air-gas mixture.

All operations were performed using Millenium (Baush&Lomb, USA) microsurgical system. The technique of primary posterior closed subtotal vitrectomy was standard: through 3 punctures using 25G technology in the area of the planar part of the ciliary body. The operation was accomplished by endotamponade of the vitreal cavity with 1,300 cSt of silicone oil or air-gas mixture in standard concentrations (fluorinated gas SF<sub>6</sub>, sulphur hexafluoride, or C<sub>2</sub>F<sub>6</sub>, (Arceole) hexafluoroethane).

During vitreal cavity revision epiretinal membranes were removed with a straight retinal forceps in water medium. Retinotomy was performed by a vitreotom within the limits of fibrously changed retina in the medium of perfluoroorganic compounds. Once a complete adaptation of the retina was achieved, these compounds were removed in the air and tamponade of the vitreal cavity was performed using air-gas mixture or 1,300 cSt silicone oil. Endolasercoagulation was conducted around the break and along the retinotomy margin.

Analyzing the results of PRD surgery, indications for vitreal cavity tamponade by silicone oil or air-gas mixture, anatomical adhesion of the retina, presence and terms of the recurrent detachment, visual acuity prior to and 1 month after surgery, outcomes of PRD treatment have been evaluated.

**Results and Discussion.** In **group 1** PRD duration by the time of patients' visits to the ophthalmologist ranged from 1 day to 6 months in subgroup A (n=17) and from 1 to 16 days in subgroup B (n=7). PRD was total and subtotal with PVR stages II–IV in the subgroup A and stages II–III in the subgroup B. Thus, long duration of PRD and the extent of PVR intensity were indications for primary vitrectomy with vitreal cavity tamponade by silicone oil. There were no complications in the course of the operation. In the postoperative period complications were observed in 64.7% (in 11 of 17) in subgroup 1A and in 71.4% (in 5 of 7) in subgroup 1B (Table 1).

Patients with primary PRD, who underwent vitrectomy with vitreal cavity tamponade by silicone oil (Table 2), had higher functional and anatomical results.

Table 1

**Complications in the postoperative period after primary vitrectomy with a tamponade of the vitreal cavity by various vitreous body substitutes (abs. number/%)**

Groups	Complications						
	Secondary glaucoma	Hypertension	Opacity of silicone	Epivitreals membranes	Keratopathy	Torpid uveitis	Penetration of silicone into anterior chamber
Silicone oil (subgroup 1A)	3/17.6	4/23.5	1/5.9	2/11.8	2/11.8	2/11.8	1/5.9
Air-gas mixture (subgroup 1B)	1/4.3	2/28.6	—	3/42.9	—	2/28.6	—

Table 2

**Results of surgical treatment of primary pseudophakic retinal detachment using vitrectomy with a vitreal cavity tamponade by silicone oil and air-gas mixture**

Groups	Vision acuity before surgery of pseudophakic retinal detachment	Visual acuity 1 month after the operation	Increase of visual acuity	Retinal adhesion	Occurrences
Silicone oil (subgroup 1A)	0.05 (average) (p.l. certa — 0.2) <0.1 — in 76.5% (13 of 17)	0.2 (average) (p.l. certa — 0.6) $\geq$ 0.1 — in 70.6% (12 of 17)	82.4% (14 of 17)	76.5% (13 of 17)	23.5% (4 of 17)
Air-gas mixture (subgroup 1B)	0.02 (average) (p.l. certa — 0.1) <0.1 — in 85.7% (6 of 7)	0.2 (average) (p.l. certa — 0.8) $\geq$ 0.1 — 42.9% (3 of 7)	71.4% (5 of 7)	85.7% (6 of 7)	85.7% (6 of 7)

Table 3

**Results of surgical treatment of recurrent pseudophakic retinal detachment after extrac scleral surgery using vitrectomy with a vitreal cavity tamponade by silicone oil and air-gas mixture**

Groups	Vision acuity before surgery of pseudophakic retinal detachment	Visual acuity 1 month after the operation	Increase of visual acuity	Retinal adhesion	Occurrences
Silicone oil (subgroup 2A)	0.008 (average) (0.005–0.1) <0.1 — in 100%	0.08 (average) (0.005–0.2) $\geq$ 0.1 — in 60% (3 of 5)	60% (3 of 5)	40% (2 of 5)	20% (1 of 5)
Air-gas mixture (subgroup 2B)	0.02 (average) (p.l. certa — 0.08) <0.1 — in 100%	0.07 (average) (p.l. certa — 0.2) $\geq$ 0.1 — in 60% (3 of 5)	80% (4 of 5)	100% (5 of 35)	—

A large percentage of recurrences in patients, who were performed vitrectomy with gas introduction, is likely to speak of PVR progression in the zone of the retinal defect, and of the insufficient time of gas effect, as the time of tamponade action for 20% SF<sub>6</sub> is, for example, 10–15 days. Gas resorption is also accelerated by torpid inflammatory processes in the eye, and impairment of hemato-retinal barrier. Besides, if a face-down position of the patient in the postoperative period is disregarded, it may also result in recurrences.

In patients of both groups with recurrent PRD proliferation and/or retinal fibrosis were diagnosed on examination. In all cases revision of the vitreal cavity with removal of epiretinal membranes or performance of retinotomy, endolaser retina coagulation and injection of 1,300 cSt silicone oil were carried out during repeated surgery. In both subgroups complete adhesion of the retina was achieved after repeated surgery in case of recurrence.

In **group 2** vitrectomy with vitreal cavity tamponade by silicone oil (subgroup A, 5 eyes) or by air-gas mixture (subgroup B, 5 eyes) was conducted to the patients with recurrent PRD after extrac scleral surgery.

Indications for endovitreous operation in subgroup 2A were incomplete adhesion of the retina after extraocular surgery in 40% of patients (in 2 of 5) and recurrent PRD within 2 weeks–6 months after the primary surgery in 60% (in 3 of 5) with more than 2 quadrants of the detached retina extension. All patients were diagnosed proliferation, and subretinal fibrosis.

Indications for endovitreous operation in subgroup 2B were incomplete adhesion of the retina after extraocular surgery in 80% of patients (in 4 of 5) and recurrent PRD

3 years after primary surgery in 20% (in 1 of 5) with the extension of the detached retina from 1 to 2 quadrants. No coarse subretinal fibrosis was revealed.

Revision of the vitreal cavity with removal of epiretinal membranes and/or with performance of retinotomy, endolaser retina coagulation and injection of 1,300 cSt silicone oil or air-gas mixture were carried out during repeated surgery. There were no complications during the operation.

In group 2 higher functional and anatomical results were obtained in patients of subgroup 2B, which underwent vitrectomy with vitreal cavity tamponade by air-gas mixture (Table 3). It was connected with a small extension of redetached retina and absence of a coarse subretinal fibrosis in this subgroup relative to subgroup 2A, where marked proliferation and subretinal fibrosis were observed, and during vitreal cavity revision the retina failed to be fully smoothed out.

A low percent of anatomical success after vitrectomy with vitreal cavity tamponade by silicone oil in recurrent PRD after extrac scleral sealing may be associated with re-proliferation in the postoperative period and also with inadequate removal of the traction component from the adjacent retina in the process of vitrectomy. Gas tamponade in comparison with silicone oil tamponade has a more prominent effect owing to greater buoyancy force of the gas bubble and is effective only in complete removal of local fibrosis.

PRD is referred to “heavy” detachments, which are characterized by intensive PVR, retina fixation to the changed vitreous body, preventing its adhesion. Effective tamponade of the vitreal cavity in order to form a strong chorioretinal adhesion and to close

retinal defects is a major object of endovitreous surgery in patients with PRD. Formation of a strong chorioretinal adhesion requires several stages: alteration, exudation, proliferation, lasting from 3 weeks to 2–3 months, depending on eye condition.

Vitreotomy with vitreal cavity tamponade by silicone oil is at present a gold standard of endovitreous approach in case of “heavy” PRD, as silicone oil performs a controlled and long-term tamponade of the vitreal cavity [4, 5]. This is also confirmed by our investigations (See Table 2). However, some authors believe [20], that vitreal operation of any complication should be finished in a single stage by air-gas mixture, which has some advantages over silicone oil. There is no need of subsequent removing of the gas from the vitreal cavity, and, therefore repeated surgical trauma of the eye; the risk of gas penetration to the subretinal area through the retinal tears is also minimal owing to a definite value of surface tension; a more pronounced tamponade effect is produced due to a greater buoyancy force of the gas bubble — it is 16–17 times greater than that of silicone oil [3]. Certainly, in case of marked PVR and retinal edema in the zone of its tear chorioretinal adhesions by the time of gas resorption, SF<sub>6</sub> especially, may not be adequate enough, which results in recurrent PRD. Therefore, definition of the effective time for gas tamponade is of great importance. Perfluoropropan (C<sub>3</sub>F<sub>8</sub>) is the gas, which is recommended in PVR with the effective time of tamponade of 30 days with a full resorption by day 60.

A comparative analysis of PRD surgical treatment data, carried out in our investigation, showed that in case of primary PRD treatment higher anatomical and functional results were achieved, when vitrectomy was made with application of silicone oil, which performed more controlled and prolonged tamponade of the vitreal cavity than in vitrectomy with replacement of the vitreous body by air-gas mixture.

In case of PRD recurrence after extracapsular surgery greater efficacy in comparison with the application of silicone oil was revealed in vitrectomy and air-gas tamponade of the vitreal cavity if there were no coarse retinal fibrosis and large extension of redetached retina.

**Conclusion.** Only differentiated approach to the choice of temporal replacement of vitreous body after vitrectomy in patients with pseudophakic retinal detachment will allow surgeons to achieve maximally feasible anatomical and functional results.

The choice of surgery and its algorithm in primary PRD and their recurrence is variable. The extent and method of vitreal cavity tamponade during the operation is determined depending on the particular clinical situation.

**Study Funding and Conflicts of Interest.** The work was not supported by any sources. The author declares no conflicts of interest.

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