

Double Endotamponade With Perfluorodecalin and Silicone Oil in Retinal Detachment Surgery

A clinical study finds the technique effective in treatment of complicated retinal detachments.

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Silicone oil endotamponade is commonly used in retinal detachment surgery. Silicone oil with specific gravity of 0.95 to 0.98 g/cm³ is used when retinal breaks are located in the superior retina and heavy silicone oil (specific gravity 1.02-1.06 g/cm³) is used when retinal breaks are located in the inferior retina. Multiple breaks located in both the upper and the lower retina and proliferative vitreoretinopathy (PVR) remain clinically challenging.

For a variety of reasons, it is practically impossible to create an ideal tamponade with silicone oil. "Conventional" silicone oil floats upward in the vitreous cavity. This results in a good tamponade of the upper retina but leaves the lower retina without an effective tamponade (Figure 1). Conversely, heavy silicone oil sinks and provides less effective support of the upper retina (Figure 2).

Another group of heavier substances, the perfluorocarbon liquids (PFCL), have gained important roles in vitreoretinal surgery. PFCL are recommended to be removed at the end of the surgical procedure. The traditional notion that long-term use of PFCL is dangerous for

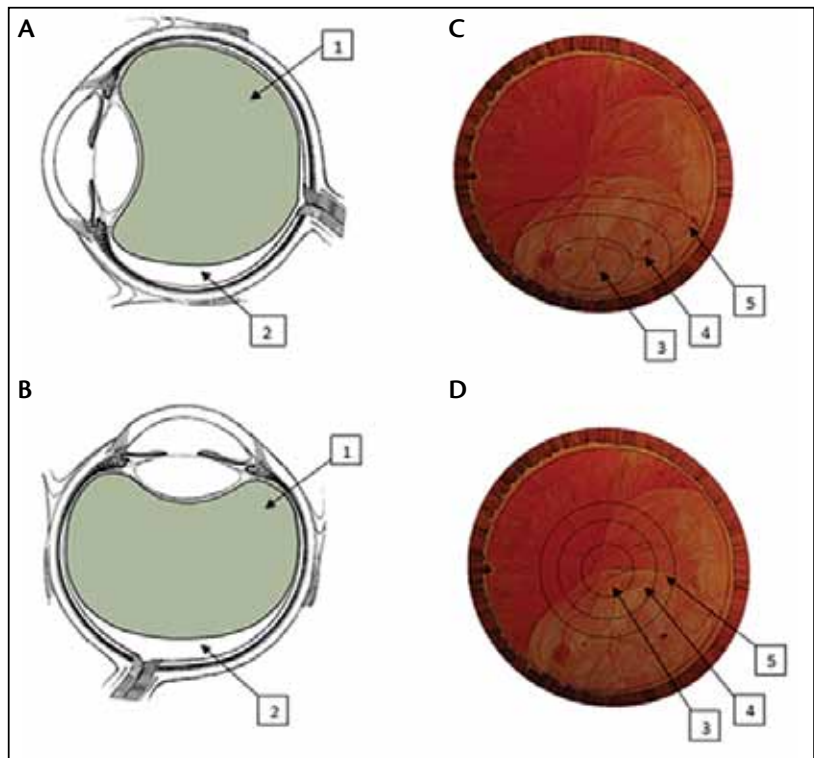


Figure 1. Diagram of the vitreous cavity filled with silicone oil in different patient postures: (A) in the standing position; (B) in the supine position; (C, D) areas of the retina without tamponade effect. Arrows show: (1) silicone oil; (2) unfilled vitreous cavity volume; (3-5) retinal area without tamponade effect depending on silicone oil meniscus stepover distance height: (3) meniscus stepover distance height 1 mm; (4) meniscus stepover distance height 2 mm; (5) meniscus stepover distance height 3 mm.

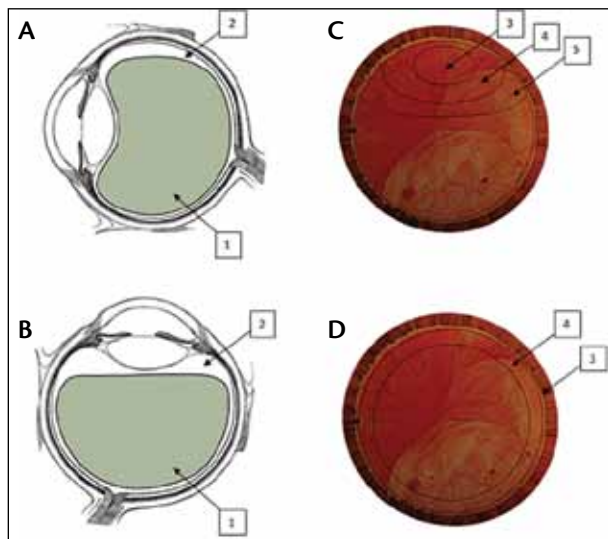


Figure 2. Diagram of vitreous cavity filled with heavy silicone oil in different patient postures: (A) in the standing position; (B) in the supine position. (C, D) areas of the retina without tamponade effect. Arrows show: (1) heavy silicone oil; (2) unfilled vitreous cavity volume; (3-5) retinal area without tamponade effect depending on silicone oil meniscus stepover distance height: (3) meniscus stepover distance height 1 mm; (4) meniscus stepover distance height 2 mm; (5) meniscus stepover distance height 3 mm.

the retina is based upon experimental reports. Meanwhile, some experimental¹⁻⁴ and clinical^{5,6} data show no retinal degeneration with PFCL left in the vitreous cavity for several weeks.

DOUBLE ENDOTAMPONADE

We performed a study to assess the effectiveness and safety of retinal detachment surgery employing vitrectomy, photocoagulation, and long-term double endotamponade with perfluorodecalin (PFD) and silicone oil. In this double endotamponade technique, the vitreous cavity was filled to 50% of its volume with PFD and the remaining 50% with silicone oil. Patients did not need to maintain any prescribed posture because PFD provides support to the inferior retina and silicone oil to the superior retina (Figure 3).

The study included 67 patients (67 eyes), all white and aged 17 to 55 years. Patients included had retinal detachment complicated by retinal breaks located in both the upper and lower retina and/or with severe PVR, and best corrected visual acuity (BCVA) in the fellow eye of 20/20. Patients were excluded with any concurrent eye disease apart from myopia, eye length greater than 26.5 mm, or systemic diseases such as diabetes mellitus and severe arterial hypertension.

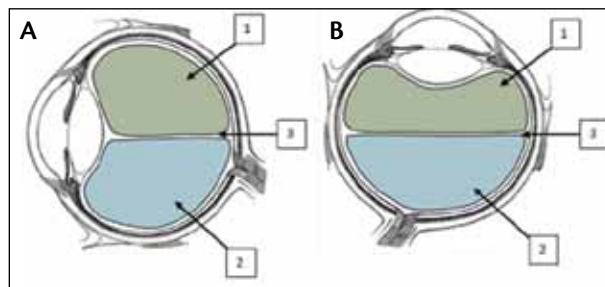


Figure 3. Diagram of double tamponade of the vitreous cavity in different patient postures: (A) in the standing position; (B) in the supine position. Arrows show: (1) silicone oil; (2) PFD; (3) the interface of PFD and silicone oil.

In the study group (31 eyes), the surgery was concluded with double tamponade with PFD and silicone oil. In the control group (36 eyes), the surgery was concluded with silicone oil tamponade using “conventional” silicone oil or heavy silicone oil. Tamponade agents were removed after 1 month.

Follow-up visits were conducted 1, 3, 6 and 12 months after tamponade removal. The aim of the study was to look for possible retinal degeneration in the study group; therefore, examinations included optical coherence tomography (OCT) and microperimetry along with standard eye examination. OCT data analysis included automatic calculation of total retinal thickness and manual calculation of outer and inner nuclear layer thickness. Microperimetry analysis included calculation of mean retinal sensitivity in the central 12° and in the central 4°.

RESULTS

Retinal reattachment by means of 1 surgical procedure was achieved in 26 eyes (84%) in the study group and 27 eyes (75%) in the control group. The rate of patients who developed cataract and required phacoemulsification combined with tamponade removal was 57% in the study group and 36% in the control group. There was no significant difference in BCVA ($P > .05$) between the 2 groups.

In the study group, emulsification of PFD was observed in patients with chronic uveitis (3 eyes). These cases required additional vitreous cavity rinsing several weeks after the tamponade removal.

OCT data analysis showed no significant differences between the groups in total retinal thickness ($298 \pm 29 \mu\text{m}$ vs $312 \pm 20 \mu\text{m}$, $P = .1$), outer nuclear layer thickness ($30 \pm 6 \mu\text{m}$ vs $27 \pm 8 \mu\text{m}$, $P = .82$) and inner nuclear layer thickness ($56 \pm 8 \mu\text{m}$ vs $61 \pm 11 \mu\text{m}$, $P = .13$). Both groups showed statistically significant thinning of the inner nuclear layer comparing to fellow eyes: $9 \pm 5 \mu\text{m}$ thinning in the study group and $11 \pm 7 \mu\text{m}$ thinning in the control group ($P = .04$).

Because the PFD was in contact with the lower retina

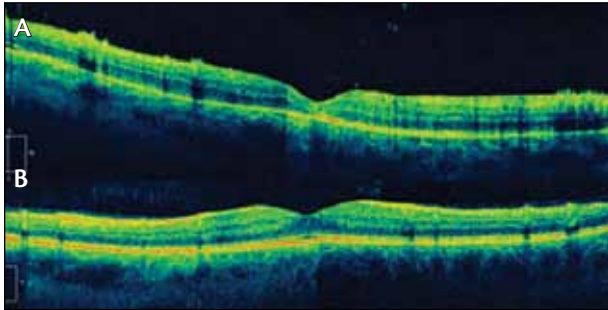


Figure 4. Case Example 1, OCT of the retina: (A) operated eye after PFD removal; (B) fellow eye.

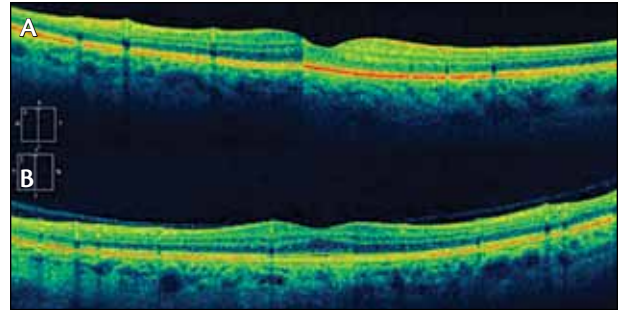


Figure 6. Case Example 2, OCT of the retina: (A) operated eye after double tamponade removal; (B) fellow eye.

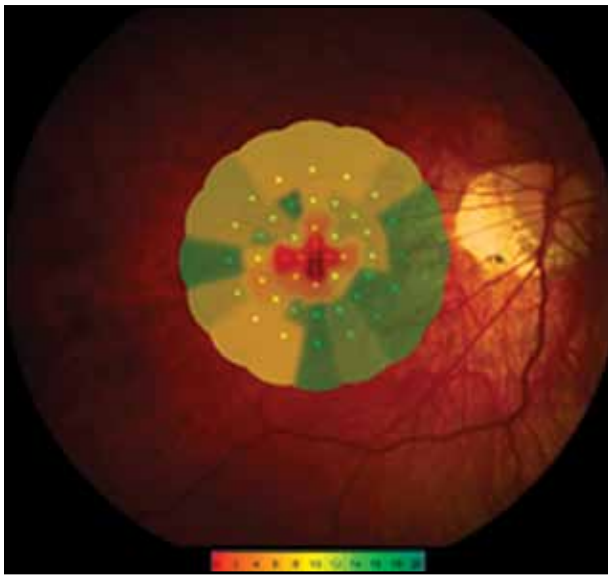


Figure 5. Case Example 1, microperimetry results: Test 12° 10 dB, stimulus Goldman III, 200 msec, white background.

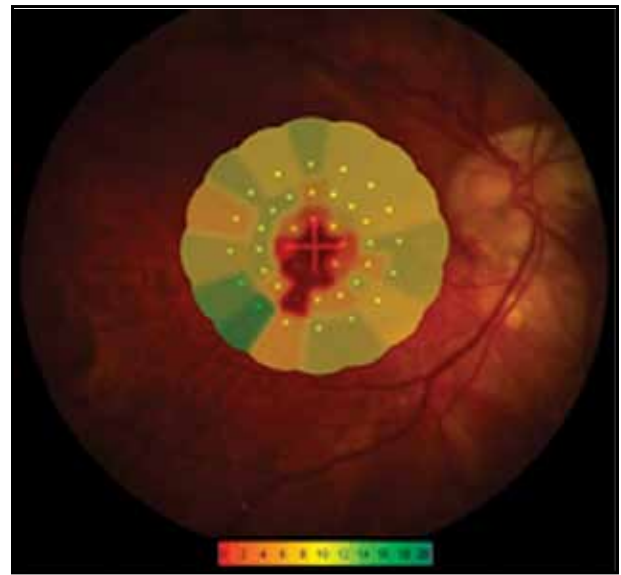


Figure 7. Case Example 2, microperimetry results: Test 12° 10 dB, stimulus Goldman III, 200 msec, white background.

most of the time, in the study group we compared OCT images of the superior and inferior temporal vascular arcades. There were no significant differences in the retinal layers between these areas.

Microperimetry showed a decline in mean retinal sensitivity in the central 12° zone in both groups but no significant differences between the groups ($P = .25$). In both groups the mean sensitivity in the central 4° zone was significantly lower than in the 12° zone (8 ± 4 dB vs 12 ± 5 dB, $P = .008$).

CASE EXAMPLE 1

The first long-term PFD endotamponade was performed by accident. A 43-year-old patient had retinal detachment in the right eye with severe PVR. After vitrectomy and epiretinal membrane removal we filled the vitreous cavity with PFD, but we did not manage to accomplish photocoagulation because of incomplete

retinal reattachment in the lower retina. We decided to leave the PFD in the vitreous cavity for several days and complete the photocoagulation and perform PFD-silicone oil exchange during a secondary surgical procedure.

Two days later the patient developed acute abdominal distress, was taken to a surgical department by ambulance, and was diagnosed with peritonitis. The patient returned for an eye examination 6 weeks later. The examination showed that the retina had reattached; BCVA was 50/200.

We took an interest in this case and performed OCT and microperimetry. OCT revealed residual epiretinal fibrosis, but no signs of anatomic retinal damage (Figure 4). Microperimetry showed a decline in retinal sensitivity but no absolute scotomas (Figure 5). Thus, this first patient demonstrated satisfactory anatomic and functional results, prompting us to initiate further studies.

CASE EXAMPLE 2

A 55-year-old patient presented with retinal detachment with multiple retinal breaks located in both the upper and lower retina. At the time of surgery his retinal detachment was 3 weeks old. We performed vitrectomy, vitreous cavity tamponade with PFD, and photocoagulation. We then exchanged half of the volume of PFD for silicone oil. This double tamponade was in the vitreous cavity for 1 month, and the retina reattached. After that, the tamponade agents were removed and the vitreous cavity was filled with SF₆ gas. One month later, the gas dissipated, and BCVA was 8/20. There were no anatomic differences between OCT images of the superior and inferior temporal vascular arcades (Figure 6). Mean retinal sensitivity according to microperimetry was 10 dB (Figure 7).

CONCLUSION

Double endotamponade with PFD and silicone oil seems to be an effective method for treatment of complicated retinal detachments. Complications of double tamponade include a high rate of cataract formation and PFD emulsification in eyes with chronic uveitis. After double tamponade, OCT revealed no changes in the retinal anatomy compared with conventional silicone tamponade. Microperimetry showed equal functional damage to the retina after double tamponade and silicone tamponade. Presumably, double tamponade with PFD and silicone oil is safe for the retina if the tamponade agents are removed in 1 month. ■

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1. Nabih M, Peyman GA, Clark LC Jr, et al. Experimental evaluation of perfluorophenanthrene as a high specific gravity vitreous substitute: a preliminary report. *Ophthalmic Surg.* 1989;20:286-293.
2. Peyman GA, Conway MD, Soike KF, et al. Long-term vitreous replacement in primates with intravitreal Vitreolene plus silicone. *Ophthalmic Surg.* 1991;22:657-664.
3. Flores-Aguilar M, Munguia D, Loeb E, Crapotta JA, Vuong C, Shakiba S. Intraocular tolerance of perfluorooctylbromide (Perflubron). *Retina*. 1995;15:3-13.
4. Mackiewicz J, Maaijwee K, Luke C, et al. Effect of gravity in long-term vitreous tamponade: in vivo investigation using perfluorocarbon liquids and semi-fluorinated alkanes. *Graefes Arch Clin Exp Ophthalmol.* 2007;245:665-675.
5. Kirchhof B, Wong D, Meurs JV, et al. Use of perfluorohexyloctane as a long-term internal tamponade agent in complicated retinal detachment surgery. *Am J Ophthalmol.* 2002;133:95-101.
6. GehVS, Dabbs TR, Ansari E. Perfluorodecalin and silicone oil used to achieve retinal tamponade left in an eye for 6 months. *Br J Ophthalmol.* 1997;81:252-254.

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