

Displacement of Retained Subfoveal Perfluorocarbon Liquid After Vitreoretinal Surgery

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Objective: To report a novel surgical procedure to displace retained subfoveal perfluorocarbon liquid (PFCL).

Methods: Retrospective cases series. Three patients had retained subfoveal droplets after PFCL was used in vitrectomy repair of retinal detachment. In each case, submacular PFCL was displaced to the subretinal space in the inferior periphery. A retinal detachment at the posterior pole and the inferior periphery was created by injecting balanced salt solution through a retinal puncture near the inferotemporal vessels. Fluid-air exchange

was performed, followed by short-term postoperative upright head positioning.

Results: In all cases, PFCL droplets were successfully displaced toward the inferior periphery, with good visual recovery.

Conclusion: This procedure seems to be safe and is an alternative to direct aspiration of PFCL through a juxtafoveal retinotomy, which risks damage to the foveal region.

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SUBRETINAL RETENTION OF PERFLUOROCARBON LIQUID (PFCL) after vitreoretinal surgery can have drastic consequences on visual outcome in the case of subfoveal location because of its potential direct toxic effects on retinal pigment epithelium (RPE) and photoreceptor cells.¹⁻³ Most authors^{1,4-6} recommend that subfoveal PFCL persisting after vitreoretinal surgery be removed when central visual acuity is substantially reduced.

Several techniques have been described. Some authors attempted to perform pneumodisplacement by injecting intravitreal gas, without success.⁴ Direct aspiration of PFCL droplets using a 36-gauge,⁴ 39-gauge,⁵ or 49-gauge cannula⁶ via retinotomy adjacent to the droplets on the extrafoveal facing has been attempted, with variable results. Irreversible alterations of the pigment epithelium of the macula have been reported as a potential complication of this surgical aspiration procedure.⁶

REPORT OF CASES

We report 3 cases of subfoveal PFCL displacement. Good anatomical and functional outcomes were obtained in all 3 patients.

CASE 1

A 65-year-old man was initially seen with vision loss in his left pseudophakic eye for 2 days, with visual acuity limited to hand motions. Fundus examination revealed a superior bullous macula-off retinal detachment with 4 retinal horseshoe tears at the 9-, 10-, 1-, and 3-o'clock positions, as well as a large long tear at the 11-o'clock position associated with grade A proliferative vitreoretinopathy. The patient underwent standard 20-gauge 3-port pars plana vitrectomy (Accurus; Alcon Laboratories, Inc, Fort Worth, Texas) with PFCL injection (DKline; Bausch & Lomb, Montpellier, France), laser treatment to the retinal tears, and PFCL-air exchange, followed by isovolumetric perfluoroethane tamponade. One month later, his visual acuity was 20/800 OS. The vitreous cavity was 25% filled with gas and the retina reattached, but 2 small PFCL bubbles were noticed beneath the macula (**Figure, A**). The presence of subfoveal PFCL was confirmed by optical coherence tomography (OCT) (**Figure, B**). Removal of all traces of subfoveal PFCL was performed 2 weeks later through a 3-port pars plana route. Retinal detachment of the posterior pole was induced by slowly injecting saline solution through a retinal puncture near the inferotemporal vessels using a 39-gauge flexible cannula (Synergetics, Inc, O'Fallon,

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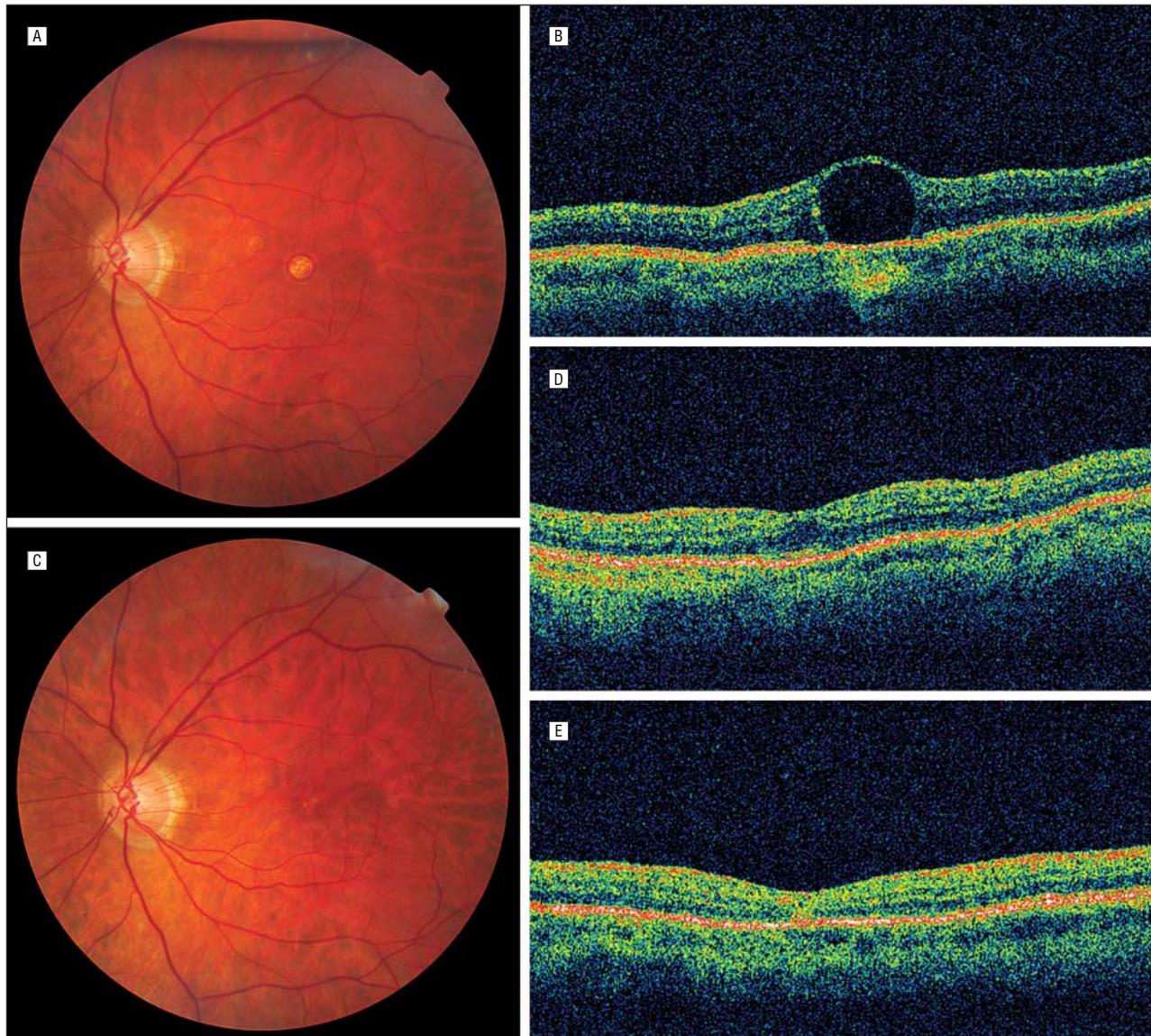


Figure. Displacement of retained subfoveal perfluorocarbon liquid (PFCL) in case 1. Preoperative fundus examination (A) and horizontal macular 6-mm optical coherence tomography (OCT) (B) reveal 2 PFCL bubbles beneath the foveal region. Gas fills 25% of the vitreous cavity. One-day postoperative fundus examination (C) and OCT (D) demonstrate the disappearance of the subfoveal PFCL droplets and a normal foveal profile with foveal pit recovery. E, Posterior pole free of PFCL and with a normal foveal profile (E) at 6 months after surgery.

Missouri). The cannula was placed on a 10-mL syringe filled with balanced salt solution and connected to the injection line of the vitrectomy machine at an injection pressure of 4 mm Hg. The serous retinal detachment was slowly enlarged to the middle inferior periphery. Balanced salt solution (0.8 mL) was finally injected subretinally. Fluid-air exchange with 1 mL of filtered air was performed after closure of the sclerotomies. The patient was instructed to keep an upright head positioning during the immediate postoperative period to force the subretinal PFCL toward the inferior peripheral area. One day after

surgery, the retina was attached, and the macula was free of PFCL, with a normal recovery profile on OCT (Figure, C and D). The subretinal PFCL droplet was displaced inferiorly at the 6-o'clock position. At 6 months after surgery, the macula was unchanged (Figure, E), and visual acuity had improved to 20/32 OS.

CASE 2

A 72-year-old man reported vision loss in his left pseudophakic eye for the past 6 weeks. Visual acuity was limited to hand motions. Fundus examination revealed complete retinal detachment, with 3 retinal tears

at the 9-, 12-, and 1-o'clock positions associated with grade C2 proliferative vitreoretinopathy. A standard 3-port pars plana vitrectomy with PFCL and laser treatment to the tear edges was performed. A superior 120° retinotomy was necessary because of numerous tears and their posterior position. Direct PFCL-silicone oil exchange was performed at the end of the procedure. Subfoveal PFCL was not observed at the conclusion of the procedure but was noted the next day. Visual acuity was 20/200 OS. Removal of the silicone oil associated with displacement of the subfoveal PFCL was scheduled for 1 month later. The

same procedure as that described for case 1 was performed. The patient was instructed to maintain an upright head position during the early postoperative period. One day after the procedure, the subretinal PFCL droplet had moved to the extreme inferior periphery. The retina was entirely reattached. On OCT, disappearance of the PFCL droplet from the macular region was confirmed. Visual acuity was 20/63 OS at 5 months after surgery.

CASE 3

A 57-year-old man was referred for retinal detachment of the left eye. Best-corrected visual acuity was 20/20 OD and 20/32 OS. Fundus examination revealed a superior macula-off retinal detachment with a large horseshoe tear extending clockwise from the 10- to 12-o'clock positions and a dense intravitreal hemorrhage. The patient underwent 20-gauge 3-port pars plana vitrectomy. Perfluorocarbon liquid was used to reattach the retina. Retinopexy of the retinal tear using endolaser PFCL-air exchange was performed, followed by isovolumetric perfluoroethane tamponade. Three weeks later when the gas had resorbed, visual acuity was 20/400 OS, and examination revealed a flat retina with 2 subfoveal PFCL droplets, which were confirmed by OCT. Displacement of the subfoveal PFCL using the already described surgical procedure was scheduled promptly. One day after surgery, fundus examination revealed a reattached retina, a normal foveal profile, and inferior displacement of subretinal PFCL at the 6-o'clock position near the equator. Postoperative OCT showed a normal macula recovery profile. Five months after surgery, best-corrected visual acuity was 20/32 OS.

COMMENT

Intraocular retention of PFCL after complex retinal detachment surgical treatments is estimated to occur in 7.4% of cases.⁷ This rate is variable depending on the type of PFCL used. For example, perfluoro-*n*-octane (Perfluoron; Infinitect, Chesterfield, Missouri) and perfluoroperhydrophenanthrene (Vitreon, Vitrophage, Lyons,

Illinois) are associated with intraocular retention rates of 7.8% and 38.3%, respectively, owing to different vapor pressures, indexes of refraction, and viscosities.⁸ Such retention may lead to well-known complications such as retinal degeneration, gravity deformation, and RPE and photoreceptor toxic effects when retention is at the posterior pole. Subretinal PFCL has been found in 0.9% to 11.1%¹⁰ of cases following vitreoretinal surgery with the use of PFCL. Risk factors for this complication are large retinotomies of 120° or more¹⁰ (as in case 2) and failure to perform a saline rinse after fluid-air exchange¹⁰ (as in case 1 and case 3).

The presence of extramacular subretinal PFCL does not seem to affect final visual and anatomical outcomes.¹⁰ In contrast, subfoveal PFCL retention is a more serious complication but apparently is infrequent, as only a few cases have been reported.^{4-6,11} Perfluorocarbon liquid is initially toxic to the RPE and foveal photoreceptor cells. In a rabbit model, short-term exposure to subretinal PFCL resulted in damage to the overlying photoreceptor cells.¹² Subretinal PFCL prevents anatomical reattachment of the fovea. Therefore, it is recommended that residual PFCL droplets in the subfoveal area be removed. Although some authors⁴⁻⁶ propose direct aspiration by puncture over the droplet, this procedure may be difficult to perform and may result in complications. Direct trauma by the aspiration cannula may cause macular hole, submacular hemorrhage, enlargement of the juxtafoveal retinotomy, or damage to the macular photoreceptor or RPE cells and may lead to submacular fibrosis or RPE atrophy,⁶ resulting in irreversible visual impairment. The preferred technique causes displacement of the subfoveal PFCL droplet toward the inferior periphery away from the visual axis. A 39-gauge retinotomy is performed far from the fovea so that any bleeding from the site will not affect vision.

Because in our cases the fovea was already detached by the PFCL, we did not believe that creating a new therapeutic macular detachment was of particular consequence. The therapeutic retinal detachment had

to be wide enough to involve the posterior pole and the mid-inferior periphery to allow the PFCL droplet to move inferiorly when the patient's head was upright. The therapeutic macular detachment was transient, lasting less than 12 hours. Full-thickness macular hole may be a potential operative complication of this procedure. If balanced salt solution is injected at high pressure, the foveal neuroepithelium (already thinned by the PFCL droplet [Figure, B]) may rupture and create a macular hole. Therefore, we recommend monitoring the subretinal fluid injection pressure by means of an injection pump.

It has not been established how long subfoveal PFCL must be present to cause irreversible damage to photoreceptor or RPE cells. A patient was described with substantial visual recovery following removal after 6 months of subfoveal retention.⁵ When chronically retained, subfoveal PFCL activates an inflammatory response that features macrophages with intracellular vacuoles containing PFCL.³ We speculate that chronic retention of subfoveal PFCL could lead to formation of a full-thickness macular hole if the thin neurosensory retina above the bubble (Figure, B) is ruptured. Therefore, we believe that the sooner the PFCL is displaced, the better the visual outcome will be.

A possible explanation as to why PFCL was found under the fovea in these 3 patients could be incorrect postoperative head positioning. At the end of a PFCL-air or PFCL-silicone oil exchange, residual subretinal fluid may accumulate at the posterior pole. If PFCL bubbles have migrated beneath the retina, they may accumulate within the subretinal fluid under the macula unless the patient assumes a prone or facedown position soon after surgery, allowing the subretinal fluid and PFCL to move away from the submacular space.

Subfoveal retention of PFCL is a rare but serious complication. As a preventive measure, early postoperative facedown or prone positioning is recommended. As a curative measure, inferior displacement of the subretinal bubble should be considered as an alternative to direct juxtafoveal aspiration. This approach allows

anatomical macular recovery and improvement of visual acuity.

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