

Residual Perfluorocarbon Liquid (PFCL) in Human Eyes

Dear Editor,

The use of perfluorocarbon liquid (PFCL) has changed the surgical approach to retinal detachment, as its high density allows unfolding and stabilisation of the retina while displacing the subretinal fluid anteriorly.¹ However, this same high density, together with the low viscosity, are causes of retinal toxicity and emulsion if PFCL is left into the vitreous cavity.² PFCL removal is commonly obtained by air-fluid exchange. We noticed that, after an appropriate interval of 10 minutes, small epiretinal droplets could be detected at the posterior pole. The purpose of this study was to investigate the nature of this fluid.

Materials and Methods

Study Subjects

We conducted a prospective, non-comparative, case series involving 8 eyes affected by rhegmatogenous retinal detachment of 8 consecutive patients treated with pars plana vitrectomy with intra-operative use of PFCL.

Surgical Techniques

Perfluorodecalin (F-Decalin, Fluoron GmbH, Ulm, Germany) was used to assist surgical vitrectomy procedures and stabilise the retina. During vitrectomy, the vitreous base was thoroughly trimmed. Air-fluid exchange was then performed with humidified air. The PFCL was completely removed with active 25 gauge flute needles. The last drops of fluid were removed with passive aspiration on the optic disc, waiting until the retinal surface appeared dry. Ten minutes after the air-fluid exchange, a residual amount of epiretinal fluid was detected on the posterior pole, aspirated with a new flute needle and sent for analysis.

Fluid Samples

Three samples were collected for each patient: (A) a sample of pure PFCL from the original vial; (B) a sample of PFCL removed from the eye at the time of air-fluid exchange; and (C) the residual epiretinal fluid. Low viscosity silicone oil was added to each sample to avoid evaporation. The heavy micro-bubbles of fluid were taken from the bottom of the tube using 5 μ L microsyringe and were injected into gas-chromatographic system.

Results

In all 8 eyes, the data obtained from the 3 chromatograms confirm the presence of residual perfluorodecalin even after its careful removal by air-fluid exchange. In particular, we observed 2 peaks related to the 2 isomers cis- and trans- in the perfluorodecalin area ranging from 15 minutes to 18 minutes (Fig. 1). The perfect overlap of retention times of the 2 isomeric forms cis- and trans- of the samples examined confirms that the residual fluid is perfluorodecalin (Fig. 1).

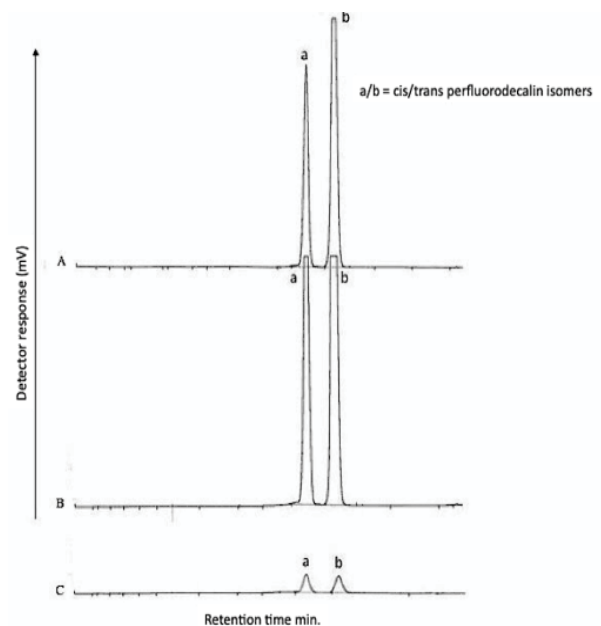


Fig. 1. The quantitative analysis with gas-chromatography confirms that the sample of residual fluid, 10 minutes after careful air-fluid exchange, is perfluorodecalin. The bottom part of the graph shows the 3 chromatograms: (A) a sample of pure PFCL from the original vial; (B) a sample of PFCL removed from the eye at the time of air-fluid exchange; and (C) the residual epiretinal fluid. The 2 peaks correspond to the 2 isomers of cis- and trans- perfluorodecalin.

Discussion

The fully fluorinated compounds with high specific gravity are associated (if left in the vitreous cavity) with damage of the photoreceptor outer segments and outer plexiform layer.³ The risk of ocular toxicity persists even if a small amount of PFCL remains in the vitreous cavity postoperatively despite intraoperative removal.⁴

Recently, we reported histological evidence of proliferative “vitreoretinopathy reaction” to the PFCL used to assist surgery and that was carefully removed afterwards. The swollen retinal pigment epithelial cells contained tamponade agent and the histological characteristics were compatible with a foreign body response to the PFCL used during the surgery.⁵

This made us willing to investigate whether the common surgical technique for removal of PFCL (air-fluid exchange) did really warrant the complete removal of PFCL from the vitreous cavity. A 10-minute long interval after the air-fluid exchange (during which careful inspection of the peripheral retina can be performed treating the retinal tears) led to the discovery of progressive accumulation of tiny droplets of unknown fluid on the vitreo-retinal interface at the posterior pole.

Chromatographic analysis of such fluid showed perfect overlap of retention times with the 2 isomeric forms of perfluorodecalin originally injected into the eye, confirming that the residual fluid is PFCL. To the best of our knowledge, this is the first report showing that the widely accepted technique of air-fluid exchange might not be sufficient to warrant a complete removal of PFCL from the vitreous cavity.

There are relevant clinical implications to this finding, both in terms of potential retinal toxicity but also in respect to intraocular emulsification of long-standing vitreal substitutes.

Friberg et al reported that PFCL and silicone oil interact physically and that PFCL can dissolve in small amounts of oil into solution over time.⁶ This interaction is particularly relevant for high-density silicone oil, as the close chemical relationship of the 2 substances makes them more prone to emulsion and inflammation.⁷ We advise to spend time at the end of the surgery, under air infusion, to clear the PFCL from the vitreous cavity. Stained PFCLs could also be helpful to facilitate appropriate visualisation and removal.

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