# Outcomes of Using Perfluorocarbon Liquid as Postoperative Tamponade in Complex Inferior Retinal Detachments

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## ABSTRACT

**Objective:** To determine the outcomes of using perfluorocarbon liquid (PFCL) as postoperative tamponade in complex inferior retinal detachments.

**Study Design:** Quasi-experimental study.

**Place and Duration of Study:** Layton Rahmatullah Benevolent Trust (LRBT) Eye Hospital, Karachi, Pakistan, from January 2020 to December 2021.

**Methodology:** This study was carried out on forty eyes of forty patients from the surgical retina clinic with rhegmatogenous inferior retinal detachment involving macula having proliferative vitreoretinopathy grade C (PVR grade-C). All eyes underwent 25G pars plana vitrectomy with PFCL as postoperative tamponade for 15 to 21 days. All patients were advised to maintain supine position postoperatively. PFCL-Silicon oil exchange was done after 15-21 days. The outcomes were measured as complete retinal reattachment between the neurosensory retina (NSR) and retinal pigment epithelium (RPE), changes in postoperative visual acuity and complications. Patients were followed up for a minimum duration of 6 months. Data were analysed using SPSS version 23.

**Results:** In 39 out of 40 eyes (97.5%) retina was completely attached. Postoperative visual acuity was improved in 24 eyes (60%), while in 16 eyes (40%) it remained stable. Worsening of visual acuity was not noted in any case. During follow-ups, uveitis was detected in 2 eyes (5%), cataract in 4 eyes (10%), optic atrophy in 2 eyes (5%) and endophthalmitis and subsequently redetachment in 1 eye (2.5%).

**Conclusion:** In complex inferior retinal detachments, PFCL is safe and effective postoperative tamponade provided it is used for a short-term period, especially in those patients who are noncompliant with postoperative face-down position.

**Key Words:** *Perfluorocarbon liquid (PFCL), Postoperative tamponade, Complex inferior retinal detachments.*

**How to cite this article:** Naz S, Naz U, Fahad HM, Rizvi SF. Outcomes of Using Perfluorocarbon Liquid as Postoperative Tamponade in Complex Inferior Retinal Detachments. *J Coll Physicians Surg Pak* 2022; **32(11)**:1454-1458.

## INTRODUCTION

Perfluorocarbon liquids (PFCLs) are synthetic fluorinated hydrocarbons fluids that are odorless, colorless, optically clear, having low viscosity, low surface tension, and high specific gravity.[1] These physical properties make perfluorocarbon liquids a good option to flatten the retina peroperatively.[2]

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*Received: June 20, 2022; Revised: June 29, 2022; Accepted: July 22, 2022*
*DOI: https://doi.org/10.29271/jcpsp.2022.11.1454*

Patients with old retinal detachments (RD) or failed surgeries are frequently complicated by severe proliferative vitreoretinopathy (PVR).[3] Routinely used endo-tamponade agents like gas or silicon oil (SO) have a specific gravity lighter than water, therefore, they do not support the inferior retina and advanced proliferative vitreoretinopathy leads to recurrent detachment.[4] An ideal agent used as endo-tamponade for inferior retina should be of higher specific gravity than water.[5]

Since PFCL has higher specific gravity than water it could act as an ideal endotamponade in postoperative period for the inferior retina, but its use as a postoperative tamponade has been controversial due to the concerns regarding corneal toxicity, retinal infiltration, and inflammatory reaction in experimental studies[6]. Some recent studies support the use of PFCL as postoperative short-term tamponade.[7]

Usually face-down positioning is recommended for 1-2 weeks after retinal detachment surgery with gas and silicon oil as

tamponade, which is quite inconvenient and not readily tolerated, especially patients who are young, mentally challenged, elderly, have cervical pain or arthritis. As postoperative tamponade, PFCL obviates the need of postoperative face-down positioning.[8]

The aim of this study was to determine whether PFCL is safe as postoperative tamponade in complex inferior retinal detachment if used for a short duration.

## METHODOLOGY

This quasi-experimental study was done at the Layton Rahmatullah Benevolent Trust (LRBT) Eye Hospital, from January 2020 to December 2021. Patients were enrolled from surgical retina clinic with the macula off inferior retinal detachment and advanced PVR (grade-C) after ethical review board (ERB) approval and patient's consent. The inclusion criteria were primary macula involving inferior retinal detachment (RRD) with PVR-C from any cause and previously failed RRD surgery. The exclusion criteria were dense cataract, glaucoma, uveitis, proliferative diabetic retinopathy, choroidal neovascularization and macular hole.

All patients underwent visual acuity measurement by Snellen's chart, slit lamp biomicroscopy with 90D lens and indirect ophthalmoscopy. Preoperative data included age, gender, best corrected visual acuity (BCVA), intraocular pressure (IOP), configuration of retinal detachment and grade of PVR. The surgery was done under general (GA) or local anaesthesia (LA) using 25G pars plana vitrectomy on constellation vision system (Alcon) and LUMERA-700 microscope by a single experienced vitreoretinal surgeon. After core vitrectomy and induction of PVD (posterior vitreous detachment), vitreous base shaving was done. Before injecting PFCL as tamponade to flatten the retina all pre and subretinal membranes were removed as much as possible. A 360-degree endolaser photocoagulation was carried out. PFCL was filled till it touches the posterior surface of the crystalline lens/intraocular lens.

All patients were instructed to maintain a supine position for 15 days. After 15-21 days, a second surgery was performed in which PFCL was exchanged with 1000cs silicon oil.

The complete retinal reattachment, postoperative best-corrected visual acuity and complications were recorded. SPSS version 23 (IBM, USA) was used for the statistical analysis of data. Mean ± standard deviation (SD) or median with interquartile range (IQR) was used to express continuous variables. The relationships between pre, intra and postoperative factors were analysed using Student's t-test for continuous data and Chi-square test for categorical data. A p-value $<0.05$ was considered statistically significant. Pre-operative, intraoperative and postoperative factors were categorised according to the variable being measured, *i.e*. intraocular pressure was categorised as within normal limits and elevated. Categorical data were expressed as counts and percentages in the statistical software in 2 specific categories and then analysed.

## RESULTS

Forty eyes of forty patients were included in the study. Twenty-two (55%) of patients were males and eighteen (45%) were females, age ranged from 11 to 80 years with a median age of 52.5 years. Patients were followed up from a minimum 6 months to maximum 24 months duration. The BCVA preoperatively was counting fingers (CF) in 15 patients (37.5%), hand movement (HM) in 17 patients (42.5%) and perception of light (PL) in 6 patients (15%). Before surgery 16 eyes (40%) were phakic and 24 eyes (60%) were pseudo-phakic. Thirty-three eyes (82.5%) were primary RRDs and 7 eyes (17.5%) were redetachments in silicon oil (SO) filled eyes. The mean preoperative intraocular pressure was 12.9±4.11 mmHg ranging from 6-22 mmHg. All eyes were macula off inferior retinal detachments with PVR grade-C.

PFCL-SO exchange was done as a second procedure in all eyes after 15-21 days. Two eyes (5%) showed subretinal fluid pocket in superior retina in PFCL-filled eyes that were drained out during PFCL-SO exchange. Complete postoperative retinal flattening or reattachment was achieved in 39 eyes out of 40 eyes (97.5%) after PFCL-silicon oil exchange up to 6 months of follow-up.

After follow-up of 6 months, improvement in best-corrected visual acuity (BCVA) was observed in 24 eyes (60%), and stability in 16 eyes (40%). Worsening of visual acuity was not noted in any case.

Table I shows the relationship between preoperative factors, retinal reattachment, and the final VA. A p-value was taken to be significant if less than 0.05. However, the authors found that none of the preoperative factors had a significant relationship with the anatomical outcome. The only significant predictive factor for better final BCVA was better preoperative Log MAR visual acuity.

IOP intraocular pressure; IQR interquartile range; log Mar logarithm of minimum angle of resolution; PFCL perfluorocarbon liquid; SD standard deviation; VA visual acuity. Student's t- test was used for continuous data, and Chi-square test was used to analyse categorical data.

Post PFCL-SO exchange, 6 eyes had intraocular pressure greater than 21 mmHg, which was medically controlled; none of the eyes went into hypotony.

During follow-ups, uveitis was detected in 2 eyes (5%), cataract in 4 eyes (10%), optic atrophy in 2 eyes (5%) and endophthalmitis and subsequently redetachment in 1 eye (2.5%).

Table II describes the relationship between immediate and medium-term postoperative conditions, retinal reattachment, and the final VA. A relationship was considered statistically significant if the p-value was less than 0.05, which was not the case in any of the tested parameters.

**Table I: Relationship between preoperative factors, retinal reattachment, and the final VA.**

| | Reattachment | | p-value | Final VA Status | | p-value |
|---|---|---|---|---|---|---|
| | No (n = 1) | Yes (n = 39) | | Better (n = 24) | Stable or Worse (n = 16) | |
| Mean Age (SD) | 47.59 (±20.5) | 46.00 (±0) | 0.94 | 48.96 (±20.71) | 45.44 (±20.03) | 0.60 |
| Gender | | | 0.27 | | | 0.44 |
| Male (%) | 0 (0) | 22 (55) | | 12 (30) | 10 (25) | |
| Female (%) | 1 (2.5) | 17 (42.5) | | 12 (30) | 6 (15) | |
| Mean LogMAR VA (SD) | 2.70 (±0) | 1.73 (±0.31) | 0.004 | 1.70 (±0.28) | 1.83 (±0.41) | 0.24 |
| Preoperative elevated IOP | | | 0.97 | | | 0.34 |
| No (%) | 1 (2.5) | 38 (95) | | 24 (60) | 15 (37.5) | |
| Yes (%) | 0 (0) | 1 (2.5) | | 0 (0) | 1 (2.5) | |
| Lens status | | | 0.41 | | | 0.36 |
| Phakic (%) | 0 (0) | 16 (40) | | 11 (27.5) | 5 (12.5) | |
| Pseudophakic (%) | 1 (2.5) | 23 (57.5) | | 13 (32.5) | 11 (27.5) | |
| Mean duration of PFCL placement (d) (SD) | 14 (±0) | 16.69 (±3.08) | 0.39 | 16.83 (±2.96) | 16.31 (±3.30) | 0.605 |
| Type of surgery | | | 0.64 | | | 0.002 |
| Primary (%) | 1 (2.5) | 32 (80) | | 24 (60) | 9 (22.5) | |
| Re-do (%) | 0 (0) | 7 (17.5) | | 0 (0) | 7 (17.5) | |

**Table II: Relationship between immediate and medium-term postoperative conditions, retinal reattachment, and the final VA.**

| | Reattachment | | p-value | Final VA Status | | p-value |
|---|---|---|---|---|---|---|
| | No (n = 1) | Yes (n = 39) | | Better (n = 24) | Stable or Worse (n = 16) | |
| Elevated IOP during PFCL placement | | | 0.70 | | | 0.33 |
| No (%) | 0 (0) | 34 (85) | | 22 (55) | 13 (32.5) | |
| Yes (%) | 1 (2.5) | 5 (12.5) | | 2 (5) | 3 (7.5) | |
| Elevated IOP after PFCL removal | | | 0.90 | | | >0.99 |
| No (%) | | | | | | |
| Yes (%) | 1 (2.5) | 34 (85) | | 21 (52.5) | 14 (35) | |
| | 0 (0) | 5 (12.5) | | 3 (7.5) | 2 (5) | |
| Hypotony | | | - | | | - |
| No (%) | 1 (2.5) | 39 (97.5) | | 24 (60) | 16 (40) | |
| Yes (%) | 0 (0) | 0 (0) | | 0 (0) | 0 (0) | |
| Optic disc atrophy | | | 0.82 | | | 0.77 |
| No (%) | 1 (2.5) | 37 (92.5) | | 23 (57.5) | 15 (37.5) | |
| Yes (%) | 0 (0) | 2 (5) | | 1 (2.5) | 1 (2.5) | |
| Cataract formation | | | 0.74 | | | 0.67 |
| No (%) | 1 (2.5) | 35 (87.5) | | 22 (55) | 14 (35) | |
| Yes (%) | 0 (0) | 4 (10) | | 2 (5) | 2 (5) | |
| Inflammation | | | 0.81 | | | 0.076 |
| No (%) | 1 (2.5) | 37 (92.5) | | 24 (60) | 14 (35) | |
| Yes (%) | 0 (0) | 2 (5) | | 0 (0) | 2 (5) | |
| ERM | | | 0.59 | | | 0.22 |
| No (%) | 1 (2.5) | 30 (75) | | 17 (42.5) | 14 (35) | |
| Yes (%) | 0 (0) | 9 (22.5) | | 7 (17.5) | 2 (5) | |

*ERM epiretinal membrane; IOP intraocular pressure; IQR interquartile range; logMar logarithm of minimum angle of resolution; PFCL perfluorocarbon liquid; SD standard deviation; VA visual acuity. Chi- square test was used to analyse the relationship between postoperative factors and the outcome.*

## DISCUSSION

Surgical failure in eyes with inferior retinal detachment is attributed to multiple factors like incomplete removal of vitreoretinal tractions, high-grade PVR, inadequate support to the inferior retina by gas or SO, as well as failure to maintain face-down position postoperatively.[9] All these factors allow seepage of fluid through the tear in the subretinal space before the formation of a firm chorioretinal adhesion.[7,10] Pars plana vitrectomy for inferior retinal detachment reports primary success rates of 79% that drop to 64% if the patient has preoperative PVR.[11,12]

This study analyses the outcomes of using PFCL as postoperative tamponade in complex retinal inferior detachments. Figures 1 and 2 show fundus photographs peroperatively as well as a flat retina postoperatively at 6 months respectively.

The rate of anatomical success in this study was 97.5%. This is consistent with previously published studies showing anatomical success ranging from 80.3% to 93.7% including complex retinal detachment surgeries and in cases with giant retinal tears.[13] Reza reported a success rate of 69% but he used PFCL as postoperative tamponade only for 3 days.[14]

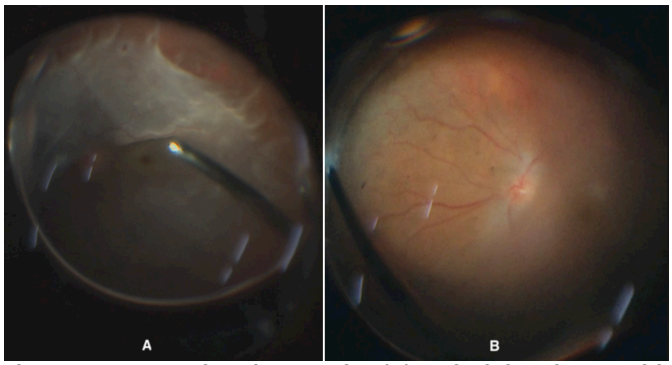


**Figure 1: Peroperative photographs. (A) Retinal detachment with proliferative vitreoretinopathy grade C and inferior retinal break. (B) Retinal flattening with perfluorocarbon liquid**.


**Figure 2: Flat retina after perfluorocarbon liquid and silicon oil exchange.**

In this study, visual acuity improved in 60%, remained stable in 40% and worsening was not noted in any case. Bhurayanontachai *et al*. reported an improvement in 45.9%, stability in 37.7% and worsening in 16.4% of eyes.[6] Sirimaharaj *et al*. reported visual acuity improvement in 54.8%, stability in 32.3%, and worsening in 12.9%.[15] This study showed significantly better results than both studies; a reason might be that cases of tractional retinal detachment (TRD) or giant retinal tears (GRT) were not included. Furthermore, silicon oil was used as the only tamponade in exchange of PFCL after 2-3 weeks.

During follow-up, no serious complications of using PFCL as a short-term tamponade such as corneal toxicity, subretinal migration or photoreceptor damage were encountered. Postoperative inflammation was found in 20%, cataract progression in 10%, raised intraocular pressure in 15%, optic atrophy in 5%, and endophthalmitis followed by redetachment in 2.5% of cases. Sirimaharaj *et al*. reported redetachment in 22.6% cases of giant retinal tears while the study done by Bhurayanontachai *et al.* showed 19.7% re-detachment rate in complex rhegmatogenous and tractional retinal detachment.[15] Rofail *et al*. reported that only 6.3% eyes suffered retinal redetachments.[16] Significantly lesser rate of redetachment in this study might be due to selection bias (RRDs Vs GRT)

With this technique, postoperative positioning is quite easier for patients. However, the obvious disadvantage of this technique is that a second surgery is needed for the PFCL-silicon oil exchange. Limited data, single-centre and short follow-up are the main limitations of this study which restrict generalisation of the results, and necessitate studies with longer follow-up and large sample size.

## CONCLUSION

In complex inferior retinal detachments, PFCL is safe and effective postoperative tamponade provided it is used for a short-term period, especially in those patients who are non--compliant with postoperative face-down position.

### ETHICAL APPROVAL:

The ethical approval was given by the Ethical Committee of LRBT, letter No. LRBT/TTEC/ERC 423/01.

### PATIENTS' CONSENT:

Informed consent were obtained from patients to publish the data.

### COMPETING INTEREST:

The authors declared no competing interest.

### AUTHORS' CONTRIBUTION:

SN: Study design and literature search.
UN: Literature review and initial drafting.
HMF: Statistical analysis and data analysis.
SFR: Critical review of the manuscript for final approval.
All the authors have approved the final version of the manuscript to be published.

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