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Short term postoperative tamponade using perfluorocarbon liquid for treatment of giant retinal tears

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全氟化碳液体短期术后填塞治疗巨大视网膜裂孔

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摘要

目的:探讨全氟化碳液体短期术后填塞治疗视网膜脱离伴巨大视网膜裂孔的有效性和安全性。

方法:检索从 1998-01/2010-12 在单一的医疗中心治疗患者的病历数据。比较应用和没有应用全氟化碳液体的患者的视网膜复位成功率,视力预后及术后并发症。

结果:术后,治疗组 22 眼(21 例),对照组 14 眼(14 例)视网膜均附着。两组的最终附着率分别为 81.8% 和 42.9%(P<0.05)。治疗组 4 眼(18.2%),对照组 7 眼(50%)发展为重症增生性玻璃体视网膜病变和持续性视网膜脱离。治疗组 73.3%,对照组 26.7% 患者的视力为 6/12 或更高(P<0.05)。治疗组 50.0%,对照组 14.3% 患者视力提升;治疗组 22.7%,对照组 57.1% 患者视力下降(P=0.054)。

结论:视网膜脱离伴巨大视网膜裂孔使用全氟化碳液体作为短期术后填塞是安全的。全氟化碳液体在预防增生性玻璃体视网膜病变方面有效。

关键词:巨大视网膜裂孔;全氟化碳液体;玻璃体切割术;视网膜脱离;增殖性玻璃体视网膜病变

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Abstract

• AIM: To investigate the efficacy and safety of perfluorocarbon liquid (PFCL) as a short term postoperative tamponade for treating retinal detachment associated with giant retinal tears.

• METHODS: Data was retrieved from the medical charts of patients who underwent vitrectomy from January 1998 to December 2010 at a single medical center. Success rates of retinal reattachment, visual outcome, and postoperative complications were compared between procedures with and without PFCL.

• RESULTS: At the end of surgery, all retinas were attached in the 22 eyes (21 patients) treated with PFCL and in the 14 eyes (14 patients) not treated with PFCL as temporary tamponade. Final reattachment rates were 81.8% and 42.9%, respectively (P<0.05). Four eyes (18.2%) in the study group compared to 7 eyes (50%) in the control group developed severe proliferative vitreoretinopathy with persistent retinal detachment. Visual acuity was 6/12 or better in 73.3% of the study group and 26.7% of the control group, P<0.05. Visual acuity improved in 50.0% of patients in the study group and 14.3% in the control group. Visual acuity worsened in 22.7% of the patients in the study group and 57.1% in the control group (P=0.054).

• CONCLUSION: Perfluorocarbon liquid appears safe and effective as a short term postoperative tamponade in the management of retinal detachment from giant retinal tears and in the prevention of proliferative vitreoretinopathy.

• KEYWORDS: giant retinal tear; perfluorocarbon liquid, vitrectomy; retinal detachment; proliferative vitreoretinopathy
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INTRODUCTION

Giant retinal tears (GRTs) are retinal breaks extending circumferentially for 90 degrees or more[1,2]. The surgical approach for this condition has always been

challenging due to the high risk, (40%-50%) of proliferative vitreoretinopathy (PVR) in operated patients[3]. The use of perfluorocarbon liquids (PFCLs) as an intraoperative tool to unfold and flatten the inverted retina has demonstrated increased surgical success rates[4]. However, recurrent retinal detachment consequent to the use of PFCLs intra-operatively is still high, one of the major problems being slippage of the retinal flap. Sirimaharaj *et al*[5] found PFCLs as a short term postoperative tamponade to be safe and effective in the management of retinal detachment. In the current study, we reported our experience using PFCL as a short term postoperative tamponade for treating retinal detachment associated with GRT.

In many ways, PFCL are ideal substances to manipulate the retina. The three properties of PFCL liquids that confer this benefit are their 1) high density; 2) moderate surface tension; and 3) low viscosity. Perfluorocarbon liquids are biologically inert substances due to a highly stable carbon-fluorine bond. They are optically clear substances that do not absorb the wavelengths used for retinal photocoagulation. This property allows the surgeon to see the retina clearly through the PFC liquid and apply laser directly to lesions just under the PFC liquid.

SUBJECTS AND METHODS

Subjects This is a single center retrospective study of patients who underwent surgery for retinal detachment caused by giant retinal tears (GRTs) in the Ziv Medical Center, Safed, Israel between January 1, 1998 and December 31, 2010. In January 2002, the use of short term post-operative PFCLs was implemented in our department for surgery for retinal detachment from GRTs. Patients treated prior to January 2002 comprised the control group of this study, and those treated after this date comprised the study group. All surgeries were performed by a single surgeon (JP).

Methods In all patients a standard three port pars plana vitrectomy was performed (20 gauge sclerotomies were done until 2007 and then we switched to 23 gauge using the "BUSCH& LOMB MILLENIUM" vitrectomy machine). Perfluoro-n-octane (PFO, C_8F_{18}) was then injected, completely filling the vitreous cavity using a 20 gauge blunt or silicone tipped cannula, placed above the optic disc to unroll the folded retina. Endophotocoagulation was then applied around the tears and to the basal retina for 360°, followed by scleral buckling (2mm wide silicon 360° encircling band was explanted routinely in these patients). Lensectomy was performed in eyes in which cataract obscured the surgical view or the lens was subluxated. In the control group, PFCL was exchanged intra-operatively to balanced salt solution (BSS) followed by fluid/air and air/gas or air/silicone oil exchange. In the study group, PFCL exchange was postponed and PFCL was left in the eye for 7-10d (mean 8.5±1.5, median 7d). At the end of this period PFCL exchange was performed in a way similar to that in the control group. For all patients, sulphur hexafluoride (SF_6) 50% or silicone oil (5700 centistokes) was used for exchange with PFCL. Patients in both groups received a short course of steroid treatment PO (60mg prednisone a day for 1 week). All medical charts of patients who underwent surgery for retinal detachment from GRTs during the study period were reviewed. Rates of retinal reattachment, recurrent retinal detachment, and complications, as well as final visual outcome, were compared between study and control groups.

Statistical Analysis Chi-square correlation was used to calculate the correlations between categorical variables. Values of P lower or equal to 0.05 were considered statistically significant.

RESULTS

During the study period, surgery for retinal detachment from GRTs was performed on 36 eyes of 35 patients. Twenty-one patients (22 eyes) comprised the study group and 14 patients (14 eyes) the control group. Preoperative clinical characteristics of the study and control groups are summarized in Table 1. No statistically significant differences in gender or rates of high myopia, ocular trauma incidence, lens status, preoperative visual acuity, or preoperative PVR were observed between the groups. The mean length of follow up was similar in the study and control groups, 24 and 21 months respectively.

All retinas were attached at the end of the primary intervention in all patients (primary reattachment). Postoperative anatomical and functional results for the study and control groups are presented in Table 2. Re detachment rate was significantly lower and final attachment rate was significantly higher in the study compared to control group. Persistent retinal detachment was detected in four eyes (18.2%) of the study group, all of which had proliferative vitreoretinopathy and in eight eyes in the control group, of whom seven (50% of the group) had proliferative vitreoretinopathy. This difference was statistically significant ($P<0.05$). Post operative visual acuity was significantly better in the study compared to the control group Rate of visual acuity improvement was higher and visual acuity deterioration was lower in the study compared to control group. The difference was of borderline statistical difference ($P=0.057$) No differences in rates of post operative complications (cataract, epirertinal membrane, ocular hypertension and uveitis) were observed between the two groups (Table 3). We did not encounter corneal toxic effect of the cornea in the study group, nor did we have hypotension or subretinal or vitreal residual perfluorocarbon liquid in both groups. Redetachment of retina occurred 1 week to 3 months after administrating replacing the PFCL with gas or silicon oil to the vitreous in both groups. There were no redetachments while the PFCL was used as a temporary tamponade.

Table 1 Preoperative clinical characteristics report according to the use of PFCL *n*(%)

Parameters	Study group (with PFCL)	Control group (without PFCL)	*P*
Number of eyes (*n*)	22	14	
Gender (male)	16 (72.7)	10 (71.4)	0.932
Mean age (a)	54 (19-72)	57(22-65)	
Myopia>6D	13 (59.1)	10 (71.4)	0.452
Eyes with penetrating trauma	3 (13.6)	2 (14.2)	
Eyes with blunt trauma	6(27.2)	2 (14.2)	
Phakic eyes	17 (77.3)	12 (85.7)	0.533
Pseudophakic eyes	4 (18.2)	2 (14.3)	0.760
Aphakic eyes	1 (4.5)	0	
Preoperative visual acuity (eyes)			
6/12 or better	11 (50.0)	4 (28.6)	0.259
6/15 to 6/24	3 (13.6)	6 (42.8)	
6/36 to 6/60	4 (18.2)	2 (14.3)	
6/120 or worse	4 (18.2)	2 (14.3)	
90°< retinal tear ≤180°	16 (72.7)	10 (71.4)	0.932
180°< retinal tear ≤ 270°	6 (27.3)	4 (28.6)	
270°< retinal tear	0	0	
[1]Preoperative PVR grade B or C	10 (47.6)	7 (50.0)	0.650
Replacement of PFCL with gas (SF-6)	10 (47.6)	6(42.8)	0.946
Replacement of PFCL with silicon oil	11(52)	8(57)	0/853

[1]According to Retina Society Classification (Reference 6).

Table 2 Postoperative results according to the use of PFCL *n*(%)

Parameters	Study group (with PFCL) (*n*=22)	Control group (without PFCL) (*n*=14)	*P*
Redetachment of the retina	8 (36.4)	10 (71.4)	0.040
Final attachment	18 (81.8)	6 (42.9)	0.016
Visual acuity			
6/12 or better	10 (54.5)	4 (28.6)	0.015
6/15 to 6/24	2 (9.1)	2 (14.3)	
6/36 to 6/60	4 (18.2)	1 (7.1)	
6/120 or worse	4 (18.2)	7 (50.0)	
Change in visual acuity			
Improvement	11 (50.0)	2 (14.3)	0.054
No change	6 (27.3)	4 (28.6)	
Worsening	5 (22.7)	8 (57.1)	
Postoperative PVR	4(18.2)	7(50)	0.173

Table 3 Complications of surgery according to the use of PFCL *n*(%)

Parameters	Study group (with PFCL) (*n*=22)	Control group (without PFCL) (*n*=14)	*P*
Cataract	4 (13.6%)	2 (14.3%)	0.956
Ocular hypertension	4 (13.6%)	3 (21.4%)	0.810
Epiretinal membrane	2(7%)	2(14.3%)	
Uveitis	None	None	

DISCUSSION

The present study suggests that the use of PFCL is beneficial in preventing postoperative PVR in cases of retinal detachment due to GRT. In cases in which PFCL was usedas a temporary tamponade greater success in reattachment of the retina and less PVR compared to the control group were observed. The rate of cataract and ocular hypertension was similar to those treated and not treated with PFCL. Final visual acuity was better, and the rate of visual acuity improvement higher, for those treated with PFCL as temporary post operative tamponade.

Perfluorodecalin, perfluoroperhydrophenanthrene, and

perflourooctan have been reported to be well tolerated in eyes for 5 or more days[7,8]. Chang *et al*[9] reported occasional macrophages containing oil-like vacuoles on the inner surface of the inferior retina without ultrastructural changes in the outer plexiform layer and photoreceptor outer segments in rabbit eyes containing perfluoro-n-octane for up to one week. Focal areas of narrowing of the outer plexiform layer and ultrastructural distortions of photoreceptor outer segments in the inferior retina were noted after two weeks. These changes may represent a mechanical rather than toxic effect, as similar changes have been reported in the superior retina in silicone filled eyes. Considering their findings, we leave PFCL in the operated eyes for 7-10 days, a period long enough for sufficient chorioretinal adhesion, and short enough to be well tolerated by the eye.

Several studies[3,4,10-20] concluded that PFCLs are safe and useful as an intraoperative adjunct in complicated retinal detachment with severe PVR, diabetic retinopathy, and GRT. The rate of re-detachment in the current study (36.4%) in eyes treated with PFCL is comparable to other reports of patients with GRT: 49.4% in the study of 162 patients conducted by the Vitreon Collaborative Study Group[16] and 30% in the study of 212 eyes conducted by the Perfluoron Study Group[17]. Our rate of 81.8% final anatomic success is somewhat lower than that reported by Chang *et al*[4] (94%), by Sirimaharaj *et al*[5] (93.5%), and by the Vitreon Collaborative Study Group[16] (90.7%). Nevertheless, it is slightly higher than the rate reported by the Perfluoron Study Group (76%)[17], and significantly higher than that observed for the control group in the present study (42.8%).

The use of PFCLs as postoperative tamponade has been reported in other studies. Blinder*et al*[21] used perfluoroperhydrophenanthrene in 16 eyes with complicated retinal detachment, including four eyes with GRT. They left the heavy liquid for 5 days to 4 weeks. Four of 16 eyes (25%) required further surgery for re-detachment and all retinas were attached at the last visit. Bottoni *et al*[22] reported leaving perfluorodecalin for 5 days postoperatively in the management of GRT. In their series, the retina reattached in nine of 11 eyes (82%) and two (18%) underwent successful additional surgery for redetachment. All retinas were attached at final follow up.

In the present study the rate of postoperative PVR was significantly higher in the control than in the study group. This difference may indicate beneficial a preventive effect of short term PFCL tamponade on PVR development.

It has been suggested that the lower rate of re-detachment when using PFCLs as postoperative tamponade may be due to extended apposition of the retinal tear to the underlying retinal pigment epithelium (RPE), resulting in more effective chorioretinal adhesion by retinopexy[4,22], thus reducing the risk of reopening or posterior slippage of retinal tears. This adherence also reduces pooling of RPE cells, over the retina[21,22], which may explain the lower rate of PVR in the study group compared to the control group. Another postoperative advantage of the use of PFCL is the positioning which is significantly easier for patients.

The main limitation of the present study is its retrospective design and the fact that all procedures using PFCLs were performed at a later time than the procedures not using PFCL. Though we are unaware of changes occurring between the period of the control and study groups, we can not negate this possibility. A strength of the present study is that all surgeries were performed by a single surgeon (JP).

In conclusion, this study demonstrated the safety and effectiveness of PFCL as a short term postoperative tamponade in cases of retinal detachment from GRT. Its use is associated with better anatomical and functional results and a lower rate of PVR. Further large scale prospective studies are needed to substantiate our findings.

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