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Gas Tamponade for Retinectomy in PVR-Related Retinal Detachments: A Retrospective Study

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ABSTRACT

Introduction: The purpose of the study was to evaluate the anatomical and functional results in patients with proliferative vitreoretinopathy (PVR) treated with retinectomy and perfluoro-octane gas (C_3F_8) as a tamponade agent.

Methods: 12 patients with inferior and anterior complicated PVR-related retinal detachment, who were treated with retinectomy, where C_3F_8 was used as the tamponade agent were examined. Primary outcome was the anatomical success, while visual acuity, existence of an epiretinal membrane (ERM) and intraocular pressure (IOP) postoperatively were secondary outcomes.

Results: The primary success rate was 75% (mean follow-up of 9.8 months). Reoperation was needed on 25% of patients after the retinectomy procedure. Preoperative best corrected visual acuity (BCVA) was poor due to macular involvement in all cases. BCVA was improved in three patients (25%), remained stable in 25% and deteriorated in 16.7%. Two patients were lost during the follow-up period. Postoperative ERM formation was noted in 33.3% of patients. One patient developed hypotony, while no other complications were observed.

Conclusion: Retinectomy with C_3F_8 as the tamponade agent provides anatomical and functional restoration at a 75% primary success rate in PVR-related retinal detachment.

Keywords: Perfluoro-octane tamponade; Proliferative vitreoretinopathy; Retinal shortening; Retinotomy; Rhegmatogenous

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INTRODUCTION

Proliferative vitreoretinopathy (PVR) is characterized by proliferation of cells on either retinal surface or in the vitreous cavity, leading to contraction and foreshortening of the retina and resulting in traction and recurrent detachment of the retina [1]. The use of silicone oil has traditionally been the standard tamponading agent when retinectomy was performed for PVR [1]. However, silicone oil tamponades may cause complications, such as increased intraocular pressure (IOP), emulsification or intraretinal fibrosis, while a secondary procedure for oil removal is also required [2]. In light of the above, the purpose of this study was to investigate the clinical efficacy of a gas tamponade in cases of retinectomy for PVR.

METHODS

This is a retrospective review of 12 patients who underwent retinectomy with a perfluoropropane (C_3F_8) gas tamponade for rhegmatogenous retinal detachments complicated by PVR from 2010 to 2015. PVR grading was done based on Machemer classification [3]. Patient data were collected through electronic and paper records. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964, as revised in 2013. Informed consent was obtained from all patients for being included in the study.

All patients underwent one to two procedures using a standard 23-gauge pars plana approach. One procedure was used in cases where primary retinectomy was performed, whereas two procedures occurred where either the primary repair failed and the retinectomy was performed as a secondary operation, or where retinectomy as a first operation failed. The operations were performed by the same surgeon. No scleral buckling procedures were performed. The surgical technique involved core vitrectomy where required (primary operation). The posterior retina was mobilised by meticulous peeling of any membranes. If further peeling was not possible, retinectomy was performed. Endodiathermy was used to mark the edge of the retina to be excised, and close as possible to bleeding points. The vitreous cutter was then used to complete the retinectomy. Shaving of the anterior retinal remnant was performed on the ora serrata. The standard extent of retinectomy was around 270° (from 2 to 11 o-clock or 8 clock hours) allowing a superior isthmus of the retina between 11 to 2 o-clock to prevent rotation. Perfluorodecalin (heavy liquid) was used to flatten the retina and a 360° endolaser procedure was then performed under the heavy liquid. The perfluorodecalin was then replaced with air and attention was given to avoid retinal slippage. 14% C_3F_8 gas exchange was then performed. Vicryl sutures were used to close the ports.

Preoperative data were collected for the patients, including best-corrected visual acuity (BCVA), ocular comorbidities, lens status, previous operations, PVR grade, macular status and final IOP. IOP was considered elevated in cases of more than 25 mmHg, and hypotony was defined as IOP less than 5 mmHg. The length of the retinal detachment was difficult to define accurately, but we considered retinal detachment as long-standing if the presence of symptoms was more than 3 months.

Primary outcome was the anatomical success after one operation. Secondary success with more than one operation in which intravitreal gas was still used as a tamponade was recorded. BCVA, existence of macular epiretinal membranes (ERMs) postoperatively and IOP status were also analysed.

BCVA was measured by means of Snellen charts, but was converted to logMAR scale for statistical purposes. The following logMAR notations were used for non-numerical BCVA: counting fingers (CF) = 1.7 logMAR, hand movement (HM) = 2.0 logMAR, light perception (LP) = 2.3 logMAR and no perception of light (NPL) = 3.0 logMAR, as mentioned in previous studies [4].

Statistical analysis was performed using MedCalc v.14.12.0 (Medcalc Software bvba, Ostend, Belgium). Mann–Whitney–Wilcoxon testing was used to compare pre- and postoperative BCVA. Statistical significance was set to 0.05.

RESULTS

Table 1 shows the demographic and clinical characteristics of our study sample. The mean age of patients was 61.8 years. There was no gender preponderance in our cohort with 58.3% male and 41.7% female patients. 75% of patients were phakic at initial presentation. One patient had diabetic retinopathy and one sickle cell retinopathy complicated by a combined tractional and rhegmatogenous element, while 10 cases (83.3%) presented only a rhegmatogenous component. There were no traumatic cases; however, 75% of

Table 1 Demographic and baseline clinical characteristics of our study sample

	N (%)
Gender	
Male	7 (58.3)
Female	5 (41.7)
Baseline BCVA	
6/60	1 (8.3)
CF	5 (41.7)
HM	4 (33.3)
NPL	2 (16.7)
Refractive status	
Myopia	9 (75)
Emmetropia	1 (8.3)
Hypermetropia	2 (16.7)
Lens status	
Phakic	9 (75)
Pseudophakic	3 (25)
Prior operations	
None	3 (25)
One	9 (75)
Diagnosis	
RRD	10 (83.3)
TRD/RRD	2 (16.7)
Number of breaks	
1–2	6 (50)
>3	3 (25)
Not documented	3 (25)
PVR stage	
CP1–CP6	2 (16.7)
CP7–CP12	2 (16.7)
CA1–CA12	8 (66.6)

BCVA best-corrected visual acuity, *CF* counting fingers, *HM* hand movement, *NPL* no perception of light, *RRD* rhegmatogenous retinal detachment, *TRD* tractional retinal detachment, *PVR* proliferative vitreoretinopathy

patients had either failed primary repair under a gas tamponade or long-standing detachments (>3 months) with poor visual acuity. The originally treated rhegmatogenous retinal detachments had superior located breaks and their failure was deemed to have been attributed to PVR formation. The location of the breaks in all patients was in the upper two-thirds of the retina. All patients had stage 3 PVR ranging from the posterior to anterior with the majority being CA1–12, while some presented with a mixed appearance of posterior and anterior configurations according to the classification by Machemer et al. [3]. Two patients had a closed funnel configuration at the time of the operation. Preoperative BCVA was poor due to macula involvement in all cases. Refraction was not always available preoperatively; however, judging by the axial length from the biometry data, myopia was the dominant feature. Three patients had retinectomy as a primary procedure, while nine had at least one previous vitreoretinal procedure.

Postoperative results are shown on Table 2. The primary success rate was 75% (9 patients) and secondary 88.3% (1 patient) at a mean follow-up of 9.8 months (range 4–30 months). Reoperation was needed in three patients (25%) after the retinectomy procedure, in two of which long-term silicone oil had to be used to obtain reattachment. Postoperative ERM formation was noted in 4 patients (33.3%), while 2 of them had subsequent ERM peeling with an attached retina. Hypotony only developed in one patient (8.3%).

Regarding the postoperative BCVA, there was no statistically significant difference in comparison with the preoperative BCVA ($p = 0.42$). Three patients (25%) had improved vision, in 3 (25%), it was stable, in 4 (33.3%), there was deterioration and 2 (16.7%) were lost to follow-up. Figure 1 depicts the mean pre- and postoperative BCVA, together with correlation.

DISCUSSION

The principal finding of our study was that the use of a long-acting gas (C_3F_8) as an alternative tamponade agent in retinectomy provides

Table 2 Postoperative results in our study sample

	N (%)
Success	
Primary	9 (75)
Secondary	1 (8.3)
Fail (use of oil)	2 (16.7)
Reoperations	
1	1 (8.3)
2	2 (16.7)
Postoperative ERM	
Yes	4 (33.3)
No	8 (66.7)
N/A	
Intraocular pressure	
Normal	11 (91.7)
Hypotony	1 (8.3)
Postoperative BCVA	
>6/60	2 (16.7)
CF	3 (25)
PL	3 (25)
NPL	2 (16.7)
N/A	2 (16.7)

BCVA best-corrected visual acuity, *CF* counting fingers, *PL* perception of light, *NPL* no perception of light, *N/A* not applicable

encouraging results for severe cases of PVR, avoiding potential complications of silicone oil.

Retinectomy is typically considered a technique of 'last resort' and is usually used when previous surgery has failed and the existence of PVR is so extended that removal of ERMs is technically impossible, as retinal shortening is significant [1]. When PVR is mainly located in the inferior retina, usually two options are present before considering retinectomy: either removal of the membranes and use of heavy silicone oil, or combine the vitrectomy with an external buckle technique.

One can consider the above; however, given the reduction, on one hand, in buckling procedures as vitrectomy is essentially more commonly performed hence potentially lack of experience, while on the other the use of heavy silicone oil is as well less used due to its side effects, the sacrifice of the peripheral retina appears as the best option to achieve anatomical success [1]. Silicone oil of various viscosities has been typically employed as a tamponading agent, providing a long-term tamponade. However, silicon oil has been associated with a great variety of complications and an additional surgery for its removal [1].

The surgical technique of retinectomy and laser photocoagulation of the retinal edge does not differ from the usual method of dealing with a mobilised rhegmatogenous retinal detachment (RRD) once all PVR elements have been eliminated. Therefore, the need for a long-term tamponade in excess of 4–6 weeks should not be needed. In addition, the surface tension of gas vs. oil is higher, and intravitreal gas will provide a better tamponade for the duration that is required for a full retinal adhesion [5]. Given that gas is self-resorbing, further surgery to remove the tamponading agent is not necessary. The silicone oil study reported no difference in outcome between silicone oil and C_3F_8 in eyes that had retinotomies of various sizes [6]. Our study showed that the primary success rate post retinectomy was 75%, and 83.3% after a second similar procedure at a mean follow up of 9.8 months (range 4–30). In the largest published series of 304 patients, the primary anatomical success after oil removal was 51.1%, and final success was in 72% of the cases [2], while the primary anatomical success rate in various smaller series ranged from 51% to 93% [2, 7–10].

It is also worth noting that there was a discrepancy between the anatomical and the structural outcomes in our series. Visual acuity was found to be low due to the macular status preoperatively with the presence of detachment in all cases, as well as due to the chronicity of the retinal detachment in the majority of cases. Also of note was that one patient had a preexisting macular hole. Moreover, an ERM
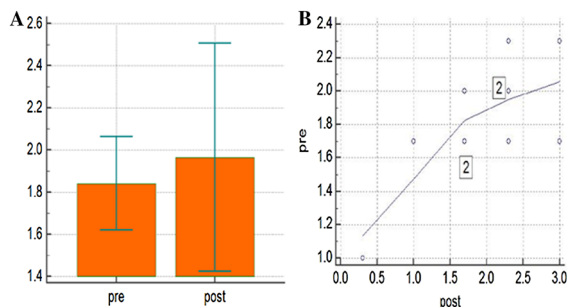
Fig. 1 **a** Bar chart of pre- and postoperative best-corrected visual acuities (mean ± SD); **b** scatter plot of pre- and postoperative best-corrected visual acuities

was present postoperatively in four cases (33%), which is a common finding even after use of silicone oil. Two patients subsequently underwent a peeling procedure with visual improvement.

Potential limitations of this study pertain to its retrospective nature, to the lack of a control group and to the small sample size. Therefore, the results of this study should be interpreted taking into account the above-mentioned limitations.

CONCLUSION

In conclusion, our study suggested that the use of C_3F_8 as a long-acting tamponade agent combined with adequate prone positioning could be sufficient for severe cases of PVR treated with retinectomy, providing relatively encouraging anatomical and functional results. Nevertheless, since our study sample is small, these preliminary results need to be justified in larger studies.

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