Long-term results of office-based pneumatic retinopexy using pure air

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ABSTRACT

Aims The long-term results of office-based pneumatic retinopexy (PR) using only filtered air were evaluated in a case series of rhegmatogenous retinal detachments with more than 3 years of follow-up, on average.

Methods 77 cases of primary rhegmatogenous retinal detachments arising from superior tears (mean=1.6 tears) were treated with cryopexy (n=61) or laser (next day, n=16) and intravitreal injection of pure air in an office setting. The macula was detached preoperatively in 37 eyes (48.1%). Outcome measures were single-operation success, final reattachment rates and visual acuity (VA).

Results Subjects were followed for 6–186 months (mean follow-up = 40.7 months, 46.8% ≥2 years, 25% ≥5 years). In all cases, the air bubble was gone within 5 days. Single-operation success was achieved in 62/77 (80.5%) eyes. Repeat PR was successful in four cases, increasing the PR reattachment rate to 85.7%. Scleral buckle was performed on the remaining 11 eyes (14.3%), 1 with vitrectomy. The final reattachment rate was 100%. VA improved ≥2 Snellen lines in 53.2% of patients, with 50/77 (64.9%) attaining VA ≥20/40. Following PR, 87% of subjects had the same or better VA.

Conclusions Office-based pure-air PR achieves acceptable reattachment rates with good visual outcomes and long-term efficacy. Eliminating the need for expansile gases makes this approach more widely available, decreases recovery time and lowers healthcare costs.

INTRODUCTION

The surgical repair of retinal detachment has undergone technical advances and improvement in outcomes. Pioneered by Schepens in America, Fison in Britain and Gonin in Europe, scleral buckle was the first technique that achieved good success.[1] The most recent surgical option for primary rhegmatogenous retinal detachment (RRD) is vitrectomy surgery,[2] at times in combination with scleral buckle.

In 1938, Rosengren proposed the use of air combined with external diathermy to achieve retinal reattachment.[3] As currently performed, pneumatic retinopexy (PR) typically involves an intravitreal injection of long-acting, expanding gas. Sulphur hexafluoride (SF_6) or perflouropropane (C_3F_8) have average intraocular durations of 12 days and 38 days, respectively.[4] It has been shown that intravitreal SF_6 and especially C_3F_8 can cause irreversible damage to the retina and impair retinal function in rabbits.[5] Expanding gases have also been shown to cause breakdown of the blood–ocular barrier and may induce an inflammatory response due to mechanical damage,[6–8] findings that were not evident with pure air.[5 9] This may explain why previous studies,[4 10–12] which showed good clinical success with expanding gas PR, have also shown a higher incidence of macular pucker and proliferative vitreoretinopathy (PVR) following PR with SF_6 and C_3F_8 as compared to pure air.[13]

To date, the long-term clinical outcome of pure-air PR has not been the subject of extensive study. Previous long-term studies of PR using SF_6 and C_3F_8 expansile gases found a single-operation success of 83% and 85.9% and a final reattachment rate of 98.7% and 100%, respectively.[10 11] The present study was undertaken to determine the long-term clinical outcomes of office-based PR using only pure air.

MATERIALS AND METHODS

Patient population

There were 77 eyes in 76 patients (45 men, 31 women) with primary RRD and no evidence of vitreous haemorrhage or proliferative vitreoretinopathy preoperatively. The mean age of the study population was 61.3±13.2 years. All RRDs arose from retinal tears located at or above 9:00 and 3:00 in the superior peripheral fundus. Inferior (below the 3:00 and 9:00 meridian) tears in attached retina were observed preoperatively in 11 (14.3%) eyes and treated with cryopexy at the time of PR. No cases had retinal tears with only a rim of retinal elevation, as all cases had subretinal fluid elevating the retina for at least 1 clock hour in extent. The average number of clock hours of elevated retina was 4.6±2.5. Of the 77 eyes, 26 (33.8%) had multiple tears, but none were more than 3 clock hours apart. The average number of tears was 1.6±1.0. Fifty-one of 77 (66.2%) patients were phakic, 23/77 (29.9%) were pseudophakic, and 3/77 (3.9%) were aphakic (table 1).

Operative procedure

Informed consent was obtained and strict patient confidentiality was maintained throughout the study. Retrobulbar anaesthesia was administered in the office without an anaesthetist and without cardiovascular monitoring using 2% Xylocaine (Hospira Inc, Lake Forest, Illinois, USA) injected into the retrobulbar space with a 25-gauge Atkinson needle (BD, Franklin Lakes, New Jersey, USA) inserted via an inferior orbital approach. Indirect ophthalmoscopy was performed with 360° scleral depression of the peripheral fundus. Retinal cryopexy (Frigitronics, Trumbull, Connecticut, USA) was performed about the tear(s) in 61 cases (79.2%). In 16 cases, peripheral retinal laser

Table 1 Summary of clinical data

	Number (unless otherwise indicated)	
Average age (years)	61.3±13.2	
Men	45	59.2%
Women	31	40.8%
OD	43	55.8%
OS	34	44.2%
Phakic	51	66.2%
Pseudophakic	23	29.9%
Aphakic	3	3.9%
Myopia (> −6 dioptres)	10	13.0%
Extent (clock hours)	4.6±2.5	
Tears	1.6±1.0	
Cryopexy applied	61	79.2%
Laser applied	16	20.8%
SOS	62	80.5%
Repeat air PR success	4	5.2%
Scleral buckle	11	14.3%
Length of FU (months)	40.7±42.1	
FU at least 6 months	76	98.7%
FU at least 24 months	36	46.8%
FU at least 60 months	19	24.7%
FU at least 120 months	13	16.9%
Macula off	37	48.1%
Macula on	40	51.9%
Inferior tears in attached retina	11	14.3%
Cases of inferior tears needing SB	1	9.1%
Postop premacular membrane	1	1.3%
Postop proliferative vitreoretinopathy	0	0.0%
Preop VA 20/40 or better	29	37.7%
Postop VA 20/40 or better	50	64.9%
VA unchanged (within 2 lines)	26	33.8%
VA improvement (≥2 lines)	41	53.2%

FU, follow-up; OD, right eye; OS, left eye; PR, pure-air pneumatic retinopexy; RD, retinal detachment; SB, scleral buckle; SOS, single-operation success; VA, Snellen visual acuity.

photocoagulation (Novus 2000 Laser with indirect ophthalmoscope; Coherent, Palo Alto, California, USA) was administered during the first few postinjection days, after the retina was reattached. Using full-strength Betadine (Alcon, Fort Worth, Texas, USA), the external globe and fornices were sterilised and then irrigated with balanced salt solution. A total of 0.8 cc of filtered (0.45 μm pore size; Millipore, Billerica, Massachusetts, USA) air was injected via a stab incision through the inferotemporal or inferonasal pars plana (3.5–4.0 mm posterior to the limbus) using a 30-gauge needle. Indirect ophthalmoscopy was used to visually position the needle tip in order to ensure the formation of a single large bubble with a moderately slow injection. A paracentesis was performed at the limbus with a 30-gauge needle. Patients were instructed on proper head positioning so that the retinal tears were in the uppermost position. They were asked to maintain that position continuously with the exception of meals and hygiene until the bubble dissipated, which occurred within 5 days in all cases.

RESULTS

A minimum of 6-month follow-up evaluation was obtained in 76 cases. One patient died 3 months postoperatively. The follow-up duration ranged up to 186 months, with an average follow-up period of 40.7±42.1 months. Nearly half (46.8%) of the cases had a follow-up duration of 2 years or more. Nineteen of 77 eyes (24.7%) had a follow-up duration of 5 or more years, and 13/77 (16.9%) had 10 or more years of follow-up.

There were no systemic or ocular complications related to the retrobulbar anaesthesia. Complete retinal reattachment was achieved in 62/77 (80.5%) eyes after a single PR procedure with pure air. Of the 11 patients with inferior (below 3:00 and 9:00 o'clock) tears in attached retina, 10/11 (90.9%) had successful retinal reattachment in one procedure by air PR performed in combination with cryopexy of the inferior tears. Reattachment was achieved in a single operation in 42/51 (82.4%) phakic, 22/26 (84.6%) pseudophakic and 1/3 (33.3%) aphakic patients. Four patients required a second pure-air PR procedure due to a new/missed tear in the superior fundus, and one of these patients required a third PR to treat a new superior tear 18 months after the first procedure. This patient had high myopia with a refractive error of −6.00 dioptres. Eleven of 77 (14.3%) cases required a scleral buckle operation due to a new/missed tear in the inferior fundus. Two scleral buckle patients (2.6%) underwent vitrectomy surgery status post PR, one of which was the only patient (1/77=1.3%) who developed a premacular membrane inducing macular pucker. No cases of PVR developed following office-based pure-air PR. The final attachment rate after reoperations was 100%.

Figure 1 shows that there was improvement in vision from a Snellen visual acuity of ≥20/40 in 29/77 (37.7%) cases preoperatively to 50/77 (64.9%) cases postoperatively. Visual acuity increased two or more lines in 53.2% (41/77) of cases, while 26/77 (33.8%) of cases had the same (within two lines) preoperative and postoperative visual acuities. Thus, 67/77 (87%) of the patients in this study had the same or better visual acuity at the end of the evaluation period. Forty-four of 51 (86.3%) phakic patients, 21/23 (91.3%) pseudophakic patients and 2/3 (66.6%) aphakic patients had the same Snellen VA or better.

DISCUSSION

While previous studies[2 13 14] have shown the short-term usefulness of pure air, which is often used intraoperatively during vitrectomy surgery, this study demonstrates the long-term efficacy of office-based PR using pure air. The approach achieves a single-operation reattachment rate comparable to PR using long-acting expansile gases. Furthermore, the long-term

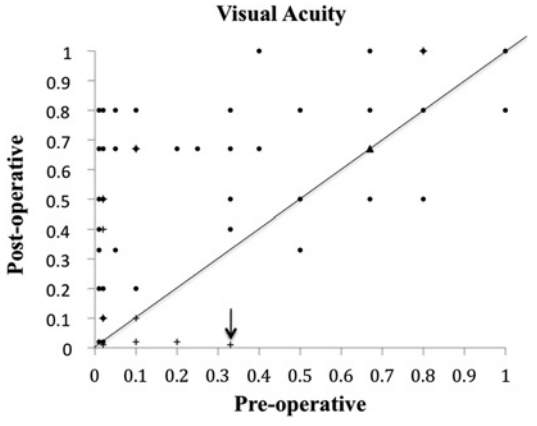

Figure 1 Scattergram of visual acuity (VA) preoperatively and postoperatively. Points above the diagonal line represent improvements in VA, and points below the line represent worsened VA. Points on or within 1 Snellen unit of the line represent no change. The arrow indicates a patient with an inferior tear requiring a secondary scleral buckle and vitrectomy surgery. The triangle marker indicates the one case of postoperative premacular membrane requiring vitrectomy surgery. A plus sign indicates cases requiring a secondary scleral buckle operation.

efficacy has been shown by this study to be on the order of years. Although some studies using long-acting expanding gas have had single-operation success rates as low as 54%[12] and 59.4%,[15] pure-air PR achieves a single-operation success rate of 80.5%, a repeat PR success rate of 85.7% and a final reattachment rate of 100%, which are comparable to other studies of expanding gas PR.[4] It is not clear why some studies had such low success rates, but clinical experience has underscored the importance of case selection and careful preoperative examination of the fundus. To that end, this study excluded subjects with vitreous haemorrhage and early PVR, factors known to predispose to recurrent retinal detachment (RD). The most common cause of recurrent RD following PR is the formation of a new retinal tear,[16] although some of these are likely to have existed at initial presentation. Prior to PR in our study, inferior tears were identified in 11/77 (14.3%) eyes, a finding that if undetected could have resulted in recurrent RD. Only 1/11 (9.1%) patient with inferior tears required a secondary operation (scleral buckle with vitrectomy), while 10/11 (90.9%) patients with inferior tears were reattached after a single PR that included cryopexy of the inferior tears in attached retina at the time of PR.

Vision improvement following pure-air PR is comparable to that of PR using expansile gases,[4] with 86% of patients attaining the same or better visual acuity postoperatively and nearly two-thirds (50/77) attaining visual acuity ≥20/40. More than half (41/77) of patients improved by two lines or more. Some cases of superior RD with macular attachment improved because RD repair resolved the overhanging superior retina which substantially blocked the macula, lowering visual acuity. This study furthermore demonstrates that these beneficial results are sustained over long periods of time, with nearly half of the cases observed for 2 years or more and a fourth of cases observed for 5 years or more.

While PR has previously been shown to be an effective treatment for primary rhegmatogenous RD,[4] the common use of long-acting expansile gases can cause changes to the retina and ciliary body [5] and is associated with postoperative PVR in up to 10% of cases and premacular membranes with pucker in 3%.[4] In our study, no patients developed PVR and only 1/77 (1.3%) developed a premacular membrane with macular pucker, confirming previous findings with pure-air PR[13] and suggesting that short-term internal tamponade can yield long-term benefits with a low risk of complications and untoward sequelae. However, a potential drawback of pure-air PR is the need for a larger volume injection and consequent obligatory paracentesis in each case. In spite of this, there were no complications in any of the 77 cases related to the larger injection volume or the paracentesis. Also, the short duration of internal tamponade provided by pure air may be considered a limitation. Clinical experience has shown, however, that even relatively extensive retinal detachments flatten after a day or two, while an air bubble can remain for up to 5 days.[4 13 14] Clinical experience[17 18] has also shown that, with proper case selection and good patient compliance (positioning), a couple of days are all that is needed to attain successful retinal reattachment.

Office-based PR with pure air achieves a high success rate for primary RD in a relatively short period of time without incurring surgical and hospital-related costs. The use of unmonitored retrobulbar anaesthesia as opposed to monitored or general anaesthesia contributes to a quicker recovery, reduced costs and greater accessibility. This study suggests that retrobulbar anaesthesia is a safe option in an office setting without patient monitoring and the supervision of an anaesthetist. The widespread availability of air makes this approach practical in healthcare settings that do not have an inventory of expansile gases. Furthermore, PR with expansile gases prolongs the recovery time during which patients must maintain proper head positioning and cannot travel to high altitudes or by plane. Thus, office-based pure-air PR makes possible the repair of RD in underdeveloped countries with limited healthcare resources. Furthermore, in these times when the 'developed' world is grappling with the rising costs of healthcare, there is great value to simplifying the RD repair process and lowering healthcare costs.[17 18]

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Competing interests None to declare.

Ethics approval This was a retrospective case series which reviewed the clinical results of one option of treating retinal detachment. Informed patient consent was obtained in each case, and strict patient confidentiality was maintained throughout the study.

Contributors Kenneth M.P. Yee was responsible for data collection, data analysis and writing the manuscript. Doctor Jerry Sebag performed all examinations and surgical procedures as well as writing the article and is the guarantor of this manuscript.

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