Pneumatic retinopexy in the treatment of primary rhegmatogenous retinal detachment

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Abstract

Purpose To review the management by pneumatic retinopexy of 31 primary rhegmatogenous retinal detachments performed between August 1994 and December 1997. *Methods* Ocular indications included superior retinal breaks, no evidence of proliferative vitreoretinopathy (PVR) and ability to posture. Patients with inferior breaks and/or areas of vitreoretinal degeneration were excluded. Surgery was performed under local anaesthetic using sulphur hexafluoride (SF$_6$) or perfluoropropane (C$_3$F$_8$) gas injection. Transconjunctival cryotherapy or laser retinopexy was used to create permanent retinal adhesion. The mean length of patient follow-up was 11 months (range 5–24 months). *Results* Thirty-one patients (20 men, 11 women) with a mean age of 63.4 years (range 29–81 years) underwent pneumatic retinopexy which resulted in initial retinal reattachment in 22 patients. Two detachments recurred in the first month and a third at 4 months post-operatively, giving an anatomical reattachment rate with one procedure in 19 out of 31 eyes (61%). Of the 12 failures, 7 were reattached with one additional operation and one case reattached after multiple procedures, giving an overall reattachment rate of 87%. Post-operatively, new or missed breaks were present in 7 patients (22%) and PVR developed in 4 patients (13%). There was no difference in age, gender or extent of detachment between the failed and reattached groups and pseudophakia did not appear to be a poor prognostic factor. *Conclusion* Pneumatic retinopexy can be a useful alternative to conventional rhegmatogenous retinal detachment surgery in carefully selected cases. A larger study addressing the influence of non-ocular factors is warranted.

Key words Pneumatic retinopexy, Rhegmatogenous retinal detachment

Pneumatic retinopexy is a term introduced by Hilton and Grizzard in 1986[1] to describe a treatment for selected primary rhegmatogenous retinal detachments with retinal breaks in the superior periphery. A gas bubble is injected into the vitreous cavity and the patient is positioned so that the bubble tamponades the retinal break. Photocoagulation and/or cryotherapy are used to form a permanent adhesion around the break. Over the past 15 years a variable success rate of reattachment (53–84%[2-9]) after pneumatic retinopexy has been reported and several authors have extended its indications to large and giant tears, multiple breaks in multiple quadrants and detachments associated with a moderate degree of proliferative vitreoretinopathy (PVR).[10-12] Controversy remains as to the application of this procedure in pseudophakic eyes with an intact or breached posterior capsule.[4,13-15]

This series consists of 31 cases of pneumatic retinopexy performed for primary rhegmatogenous retinal detachment at two hospitals between August 1994 and December 1997.

Patients and methods

A proportion of patients presenting with primary rhegmatogenous retinal detachment and deemed suitable for pneumatic retinopexy were offered that treatment. Ocular indications were breaks in the upper retinal quadrants, no evidence of PVR, no previous vitreoretinal surgery and ability to posture. Additional selection criteria included patients' general health and their unfitness for and/or unavailability of immediate anaesthetic cover and operating theatre time. Patients with inferior retinal breaks and/or areas of vitreoretinal degeneration were excluded. The patients understood the procedure and the need for post-operative positioning.

Surgery was performed under local anaesthesia in sterile conditions. The surface of the eye was treated with povidone-iodine solution and firm pressure was applied to the globe in order to reduce the intraocular pressure. Under indirect ophthalmoscopic control, sulphur hexafluoride (SF$_6$) or

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Table 1. *Operative procedures (31 eyes)*

Procedure	No. of eyes
Sulphur hexafluoride gas injection (mean volume 0.44 ml)	8
Perfluoropropane gas injection (mean volume 0.32 ml)	23
Cryotherapy and gas injection on the same day	18
Cryotherapy 1–4 days after gas injection	5
Laser 1–4 days after gas injection	8

Table 3. *Anatomical and visual results (31 eyes)*

Results	No. of eyes
Reattached with pneumatic retinopexy only	19
Reattached with one subsequent operation only	7
Reattached with additional vitreoretinal procedures	1
Total reattachment	27
Macula-on detachments	
Unchanged post-operative acuity	10
Failed to reattach	1
Macula-off detachments	
6/12 or better	9
6/18–6/60	6
Less than 6/60	5

perfluoropropane (C_3F_8) gas was briskly injected through the pars plana 4 mm posterior to the limbus and away from the break, with the patient's head turned to make the injection site uppermost. The gas was injected with only 2–3 mm of the 30-gauge needle tip inside the vitreous cavity to produce a single gas bubble. Transconjunctival cryotherapy or laser retinopexy was used to create a retinal adhesion around the break. In cases of bullous detachment, retinopexy was applied post-operatively once the retina reattached.

The central retinal artery was monitored for 10 min and an anterior chamber paracentesis performed to restore retinal circulation if necessary. The surgical procedures are summarised in Table 1.

Post-operatively, in order to direct the gas bubble to the break site the patient's head was positioned so that the retinal break was uppermost for at least 5 days. Intraocular pressure was measured 6 h after surgery and at regular intervals during follow-up. The mean length of patient follow-up was 11 months (range 5–24 months).

Results

Patient characteristics

Thirty-one patients (20 men, 11 women) with a mean age of 63.4 years (range 29–81 years) underwent pneumatic retinopexy for the treatment of primary rhegmatogenous retinal detachment.

Table 2. *Pre-operative features (31 eyes)*

Feature	No. of eyes
Myopia >−3 D	8
Pseudophakia	
Intact posterior capsule	3
Anterior chamber implant	1
Number of retinal breaks	
One	27
Two	4
Location of retinal breaks[a]	
12 o'clock	2
Superonasal	6
Superotemporal	23
Extent of detachment	
<1 quadrant	9
1 to <2 quadrants	14
2 to <3 quadrants	5
3 to 4 quadrants	3
Macular detachment	20
Duration of detachment	
<1 week	23
1 week to 1 month	3
>1 month	5

[a]All above horizontal.

Twenty-six of the 31 eyes had a single retinal break 1 clock-hour or smaller in size. The remaining had multiple small breaks within 1 clock-hour of each other except for one eye with a single large break 2 clock-hours in size. All the breaks were located in the superior 6 clock-hours of the fundus with the majority present in the superotemporal quadrant.

The detachment involved no more than two retinal quadrants in 23 eyes and the macula was detached in 20 eyes. Of the 4 pseudophakic eyes, 3 had intact posterior capsules and 1 had an anterior chamber intraocular lens implant. Other pre-operative features are summarised in Table 2.

Surgical results

Pneumatic retinopexy resulted in initial retinal reattachment in 22 eyes. In 2 patients the detachment recurred within the first month and in a third at 4 months post-operatively, giving an anatomical reattachment with one procedure in 19 out of 31 eyes (61%) (Table 3). The initial failures were due to the break remaining open in 4 cases, to new or missed inferior breaks in 6 cases and to the development of PVR in two cases (Table 4).

Of the 12 failures, 7 were reattached with one additional operation (6 had scleral buckling and 1 a vitrectomy with SF_6 gas tamponade) and 1 case reattached after four vitreoretinal procedures, giving an overall reattachment rate of 87%. Peripheral epiretinal membrane proliferation caused persistent but stable localised inferior tractional retinal detachments after pneumatic retinopexy in 2 eyes and PVR led to total detachment in 2 others despite multiple operations.

Of the 11 eyes presenting with macula-on retinal detachments, 10 had unchanged post-operative visual acuity and 1 failed to reattach. The post-operative visual acuity of the 20 eyes with pre-operative macular

Table 4. *Complications (31 eyes)*

Complication	No. of eyes
Subconjunctival gas	3
Gas behind the lens	3
New or missed retinal breaks	7
Proliferative vitreoretinopathy	4
Late cataract	5
Macular pucker	3

detachment was 6/12 or better in 9 cases, worse than 6/60 in 5 cases (2 failed to reattach) and between 6/60 and 6/18 in 6 cases (Table 3).

Complications

Per-operative gas entrapment at the injection site between the lens and the anterior hyaloid face occurred in 3 cases (Table 4). In these cases the break remained open and the subretinal fluid failed to absorb despite posturing in the face-down position for the first 24 h. Multiple gas bubbles ('fish eggs') were noted in 4 eyes but these coalesced forming a single bubble at first follow-up examination and did not seem to influence the outcome of the procedure. No significant increase in intraocular pressure was noted 6 h after the operation.

Post-operative complications included new or missed breaks in 7 eyes: all these were detected in the inferior retina within 3 weeks following the pneumatic retinopexy. One patient with no subretinal fluid had laser treatment only, 5 required a scleral buckling operation and 1 patient underwent additional vitrectomy to reattach the retina.

Increased lens opacities were noted in 5 eyes and macular pucker in 3 (Table 4).

Discussion

Our results show a similar reattachment rate following a single procedure compared with some previously published data.[3–7] In a collaborative study of 100 cases, Hilton demonstrated a reattachment rate of 84% with one pneumatic retinopexy procedure only,[9] while a meta-analysis review of a 100 papers reporting results on more than 1200 eyes gives an average single-operation success rate of 80%.[8] Algvere et al. and most recently Han et al. reported a single operation success rate of 62%.[5,3] and a final reattachment rate of 95% and 98%, respectively. Our reattachment rate of 61% with a single procedure and a final success of 87% after additional surgery are comparable to the above results. Moreover if the two cases of localised tractional detachment are considered, then the posterior reattachment rate in our series is 94%.

Pseudophakia did not appear to be a poor prognostic factor in this series, as in 3 of the 4 patients with previous cataract extraction the retina reattached after pneumatic retinopexy alone. The pneumatic retinopexy failed in the patient with an anterior chamber intraocular lens implant.

Although the median age of the failed pneumatic retinopexy group is younger than that of the group with successful reattachment, these data provide no evidence of a difference in age between the two groups as assessed by the rank sum test ($p = 0.143$). This test also demonstrated no significant difference in the duration of the detachment between the success and failure groups ($p = 0.601$). Although the extent of retinal detachment had a higher median value in patients with failed pneumatic retinopexy, the rank sum test demonstrated no significant difference in the number of quadrants

affected between the success and failure groups ($p= 0.165$). Moreover we did not detect any association between macular detachment and surgical outcome as assessed by Fisher's exact test ($p = 0.282$). Contrary to previous reports[16] we did not detect a gender effect as the male to female ratio was the same in both reattached and non-reattached groups after a single pneumatic retinopexy procedure. We acknowledge that failure to detect a significant difference in the extent or duration of detachments and age or sex of the patients in relation to the success of the procedure may be in part related to the small number of patients in the study.

Visual acuity

All our patients with macula-on detachments had the same or better visual acuity after pneumatic retinopexy except for the patient whose retina failed to reattach despite multiple operations. Of the 20 macula-off detachments, 45% improved to 6/12 or better and 30% to between 6/18 and 6/60. The reason for these worse than expected post-operative visual acuities may be that 5 patients had macula-off detachments for more than 2 weeks prior to surgery.

Failure of absorption of subretinal fluid

In 4 of the 12 failed cases (13%) the initial break remained open and subretinal fluid failed to absorb with pneumatic retinopexy alone. This incidence lies within the 1–14% range reported by other studies.[4,9,13,15,17] The cause of the initial retinal break failing to close could be directly related to poor compliance in posturing in 1 patient only. This patient subsequently underwent multiple vitreoretinal procedures and her retina remained detached due to extensive PVR. On the other hand, initial gas entrapment between the lens and the anterior vitreous face could be responsible for non-closure of the break in the remaining 3 patients. Inadequate gas volume or possibly excessive vitreoretinal traction on the break might also have contributed to failure.

New breaks

The high incidence (22%) of secondary inferior retinal breaks following pneumatic retinopexy in our patients is partly responsible for the lower initial success rate of reattachment than in other series of pneumatic retinopexy.[8,9] Although similar figures are reported elsewhere,[4] it appears that the average incidence of these breaks described in larger series is 13%,[8] with most being noted within the first month after the injection of gas. New or missed retinal breaks were responsible for 6 (50%) failures in our series. These breaks were all inferior, leading to retinal detachment within 1 month following pneumatic retinopexy. Of those, 5 patients were successfully managed with one additional operation and in 1 case the retina remained detached due to PVR despite multiple operations. All our patients had

their inferior retina carefully examined with scleral indentation pre-operatively and patients with inferior vitreoretinal pathology were not offered pneumatic retinopexy. The development of new breaks is thought to be related to factors such as posterior vitreous detachment complicated by upward movement of the gas bubble, ocular motion and positioning of the patient.

PVR

An increase in vitreous flare and pigment cells has been observed as a result of subretinal fluid being squeezed through the open break by the gas bubble in pneumatic retinopexy[18] and this may increase the risk of PVR developing. Our incidence of PVR (13%) is similar to that reported by Han et al.[3] and Chen et al.[4] and slightly higher than in some other series.[8,9,13,19] Peripheral epiretinal membranes developed after pneumatic retinopexy in 2 patients leading to inferior tractional detachment at 1 and 4 months. The first patient underwent an additional scleral buckle operation and both had a persistent but stable and localised tractional retinal detachment. PVR led to the ultimate failure of reattachment in 2 other patients.

Our results suggest that pneumatic retinopexy can be a useful alternative to conventional rhegmatogenous retinal detachment surgery in carefully selected cases when reduced tissue trauma and quicker rehabilitation are required. The higher incidence of new inferior breaks, PVR and subsequent failures in our series and the lower single-operation success rate than with scleral buckling diminish its appeal as an apparently quick and simple procedure without the need for expensive hospitalisation. Although a failed pneumatic retinopexy is claimed not to compromise the success of further procedures nor the final visual acuity,[3,13,14,20] and despite being advocated for patients unfit for more invasive surgery, this technique might be particularly unsuitable for some of these cases as it requires the patient's mental and physical co-operation and perseverance with rigorous post-operative positioning and very close post-operative follow-up. It has been our clinical impression that patients whose general health precluded a buckling procedure under general or local anaesthetic also find post-operative positioning difficult to cope with. A larger study addressing the influence of such non-ocular factors is warranted.

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