Supplemental gas tamponade after conventional scleral buckling surgery – a simple alternative to surgical revision

David R Worsley, Rodney H B Grey

Abstract

Supplemental intravitreal gas injection was used in the early postoperative period in an attempt to achieve long term retinal reattachment in 11 cases of failed scleral buckling surgery. Success was dependent on the presence of a correctly placed scleral buckle underlying all breaks. Surgical revision was thereby avoided in these patients. However, when the scleral buckle was inadequate the technique failed.

The incidence of failure of retinal detachment surgery is 5–10%.¹ Failure of the primary surgical procedure may have several unfavourable consequences, most notably the development of proliferative vitreoretinopathy (PVR), which is the main reason for long term failure of reattachment.² Surgical revision increases the risk of complications, lengthens morbidity, and is itself implicated in the genesis of PVR.

A simple method of restoring retinal attachment following failure in the early postoperative period may avoid surgical revision, lessen the risk of PVR, and should therefore improve the success rate for long term retinal reattachment.

Intravitreal gas injection is a widely used method of retinal break tamponade. 'Pneumatic retinopexy' is considered an alternative to scleral buckling surgery and may be used in the management of established failure of scleral buckling surgery.³ Bedside intravitreal air injection has been successfully used for persistent subretinal fluid (SRF) in seven patients after non-drainage scleral buckling procedures.⁴

We have reviewed our use of a technique of supplemental intravitreal gas injection for redetachment in the early postoperative period after scleral buckling surgery. Our aim was to reattach the retina by the simplest effective method as soon as progressive redetachment was observed.

Patients and method

PATIENT SELECTION CRITERIA

Seven patients had a primary rhegmatogenous retinal detachment managed by scleral buckling surgery. Four criteria were used for selection of patients considered suitable for supplemental gas injection: (1) an increase or reappearance of SRF was documented; (2) an open break was visible; (3) all open breaks lay between 8 and 4 o'clock (clockwise); and (4) the scleral indent was judged to be in the correct position and of adequate height relative to all open breaks.

Patients with static SRF were specifically excluded, as there may be spontaneous retinal reattachment with time.

In all but one patient increasing SRF was observed within the first two to seven days of surgery and in the other patient within three weeks of surgery.

In addition a further four patients who did not fulfill criterion 4 were treated, as we made a clinical judgment that, despite the inadequacy of the buckle, the eye looked likely to benefit. One patient had an additional tear totally unsupported by a circumferential indent; two had horseshoe tears incompletely supported anteriorly; and one had a tear incompletely supported laterally by a narrow radial indent. In all these four cases the break was close to the retinal pigment epithelium.

METHOD

Retrolbulbar anaesthesia was necessary because we found topical anaesthesia to be insufficient in the early postoperative period. The patients lay on their side with the operated eye uppermost and facing the surgeon, who was seated wearing an indirect ophthalmoscope.

Using an aseptic technique the surgeon inserted a wire speculum and instilled chloramphenicol 1% eyedrops into the conjunctival sac. With calipers a point 3.5 mm posterior to the limbus was marked on the temporal conjunctiva. A 1 ml syringe with a 30 G needle and containing 0.5–0.8 ml of 100% sulphur hexafluoride (SF₆) gas was inserted through this point into the centre of the vitreous cavity. The needle was visualised and then withdrawn until the tip was judged to be just within the vitreous cavity. The gas was injected to form a single bubble and the needle withdrawn. The patient was immediately rolled to the opposite side to prevent loss of gas via the injection site.

The central retinal artery was assessed to ensure that there was perfusion. An attempt was made to select a volume of gas that resulted in the endpoint of artery pulsation. For most patients this volume was about 0.6–0.8 ml. If there was no central retinal artery perfusion, gas was withdrawn until arterial pulsation was observed. The patient was positioned so as to achieve gas tamponade of the retinal break(s). Positioning was maintained for two to five days.

Once reapposed to the indent the break was assessed to see whether there was a sufficient surround of cryotherapy. If this was not the case or if the cryotherapy was more than seven days old, then supplemental laser was applied. The binocular indirect laser delivery system was

Bristol Eye Hospital,
Bristol
D R Worsley
R H B Grey

Correspondence to:
D R Worsley, Bristol Eye
Hospital, Lower Maudlin
Street, Bristol BS1 2LX.
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Table 1 Adequate scleral buckle – successful

Patient	Age	Sex	Configuration of primary detachment	Primary surgery	Time to gas injection (days post surgery)	VA Pre-Injection	VA Post-Injection	Follow-up (months)
1	63	F	STQ, SNQ, macula off, round hole	Cryotherapy, SRF drainage, circumferential tyre	5	6/24	6/9	12
2	75	F	STQ, SNQ, macula off, round holes	Cryotherapy, SF6 20%, circumferential tyre	3	HM	6/18	8
3	64	F	STQ, macula on, U tear	Cryotherapy, radial sponge	4	6/6	6/9	9
4	59	M	STQ, macula off, U tears	Cryotherapy, SRF drainage, radial sponge	3	HM	6/36	11
5	64	M	STQ, ITQ, macula off, round holes	Cryotherapy, SRF drainage, circumferential tyre	4	HM	6/36	9
6	78	M	STQ, ITQ, macula off, U tears	Cryotherapy, circumferential tyre	17	HM	6/36	4
7	76	F	STQ, SNQ, macula on, U tears	Cryotherapy, SRF drainage, radial sponge	3	6/9	6/9	3

SNQ=superior nasal quadrant; INQ=inferior nasal quadrant; STQ=superior temporal quadrant; ITQ=inferior temporal quadrant; SRF=subretinal fluid; SF6=sulphur hexafluoride; HM=hand movements.

particularly useful, as the direct view was often difficult owing to the presence of a gas bubble and to the peripheral position of the breaks.

Case reports

Two cases are described in more detail to illustrate the type of patient considered suitable for supplemental intravitreal gas injection.

CASE 1

Highly elevated break. A 63-year-old woman with a right phakic eye developed an upper half bullous detachment with macular involvement due to a peripheral horseshoe tear at 11 o'clock. The visual acuity was 6/24. Primary surgery involved cryopexy, circumferential buckle, and subtotal drainage of SRF. The break remained highly elevated over the indent, and by the fourth postoperative day there was evidence of increasing subretinal fluid.

A supplemental intravitreal injection of 0.5 ml of 100% SF6 was given and the patient positioned. One day later the SRF was markedly reduced and the break flat on the indent. All SRF had been absorbed after five days. The retina remained flat with a visual acuity of 6/9 after 11 months' follow-up.

CASE 2

Communicating retinal fold. A 75-year-old woman with a phakic right eye developed an upper-half detachment involving the macula due to several small round holes in the upper retinal periphery. The visual acuity was hand movements. Primary surgery involved cryotherapy, circumferential buckle, SRF drainage, and 20% SF6 intravitreal

injection to reconstitute volume. The retina was initially flat, but after three days a small amount of SRF reformed and communicated with one of the retinal breaks via a meridional fold. Insufficient intravitreal gas remained for tamponade of the break. 0.7 ml of 100% SF6 was injected into the vitreous cavity and the patient positioned. The SRF was completely resorbed within six hours. Argon laser photocoagulation was applied to surround the break and to the retinal fold over the indent. After eight months' follow-up the retina was flat and the visual acuity was 6/18.

Results

All seven patients who fulfilled the selection criteria had successful anatomical retinal reattachment (Table 1). The follow-up period ranged from three to 12 months and averaged eight months. In all cases complete resorption of SRF was observed. Recently accumulated SRF was resorbed rapidly (in several cases within a few hours), while longer standing SRF was resorbed over one to five days.

In contrast, of the four patients who did not fulfill selection criterion 4, none had retinal reattachment (Table 2).

The adequacy of the scleral buckle was a statistically significant factor in successful retinal reattachment in our cases (Fisher exact probability test, $p < 0.01$) (Table 3).

COMPLICATIONS

It was our clinical impression two of the four patients with an inadequate scleral indent had a less favourable long term outcome as a direct result of the gas injection. These two patients

Table 2 Inadequate scleral buckle – unsuccessful

Patient	Age	Sex	Configuration of primary detachment	Primary surgery	Time to gas injection (days post surgery)	VA Pre-injection	Surgical revision	Final outcome	Final VA	Follow-up (months)
8	77	M	SNQ, INQ, macula on, U tears	Cryotherapy, circumferential sponge	5	CF	Vitrectomy, silicone oil	Phthisis	NPL	9
9	59	M	STQ, SNQ, macula on, U tears	Cryotherapy, SRF drainage, circumferential band	21	6/9	Encircling tyre, SRF drainage	Flat retina	6/9	8
10	54	F	STQ, SNQ, macula on, U tears	Cryotherapy, SRF drainage, radial sponge	6	6/9	Vitrectomy, silicone oil	Flat retina	HM	6
11	44	M	STQ, macula on, U tears	Cryotherapy, radial sponge	4	6/9	Adjustment of radial sponge	Flat retina	6/9	4

SNQ=superior nasal quadrant; INQ=inferior nasal quadrant; STQ=superior temporal quadrant; SRF=subretinal fluid; CF=count fingers; HM=hand movements; NPL=no perception of light.

Table 3 Summary of results

Scleral indent	Number of patients	Retina reattached by gas injection
Adequate	7	7
Inadequate	4	0

Fisher exact probability test: $p=0.206$, $p<0.01$.

rapidly developed PVR (day 2 in patient 8 and days 2–3 in patient 10) over the following two-week period. Three patients had the retina reattached by surgical revision. In patient 8 the retina failed to become reattached despite two further procedures.

Discussion

Intravitreal gas injection is an established method of retinal tamponade. The high surface tension at a gas-fluid interface can seal a retinal break, thereby allowing SRF to become actively resorbed by retinal pigment epithelium action. The buoyant force of the gas bubble may also push SRF out through the break into the vitreous.⁵

We chose 100% SF₆ as the injection gas for the following reasons. An injected volume of 0.6 ml rarely causes occlusion of the central retinal artery and expands to 1.2 ml, which will tamponade approximately 70° of retina.⁶ This is sufficient for most situations. In one case in this series a 1.2 ml bubble (estimated size) was used to tamponade several breaks over an arc greater than the bubble contact by progressive positioning of the patient to tamponade and reattach each break in turn. The 10–14-day life span of an SF₆ bubble is in excess of the time required for chorioretinal adhesion.⁷ As alternatives to SF₆, both air and perfluorocarbon gases have drawbacks. Air requires a relatively large injected volume and has an insufficient longevity. Perfluorocarbon gases have the advantage of requiring only a small injected volume but the disadvantages of excessive longevity and cataractogenesis.⁸

In a large series of cases one might expect to see the same range and frequency of complications as is encountered with pneumatic retinopexy.⁹ In this study no complications were encountered with the seven patients fulfilling all three criteria. However, PVR occurred in two out of four patients who were unsuccessfully given supplemental gas injection in the presence of an inadequate scleral indent.

The use of intravitreal gas to reattach the retina after early failure of scleral buckling surgery provides a simple alternative to surgical revision. It is important to assess the suitability of a particular case. Only eyes with clearly documented reappearance or increase of SRF should be considered for supplemental gas injection. This avoids the treatment of cases in which the retina may spontaneously reattach with time. The adequacy of the scleral indent must be carefully assessed before treatment. If the scleral indent is correctly placed, success is likely. If the scleral indent is inadequate, surgical revision is indicated, and supplemental gas injection should be avoided.

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