Complicated retinal detachment and its management with pars plana vitrectomy

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SUMMARY Fifty patients with retinal detachment accompanied by vitreous haemorrhage, perforating eye injuries, intraocular foreign bodies, massive preretinal retraction, giant tears greater than 180°, and proliferative retinopathies underwent pars plana vitrectomy, cryocoagulation, scleral buckling, and intravitreal gas injection. Intraoperative complications included minimal to moderate bleeding and iatrogenic retinal tears, but no retinal dialysis was produced at the pars plana sclerotomy site. Postoperative complications included recurrent vitreous haemorrhage, rubeosis, haemolytic, erythroclastic, or neovascular glaucoma, transient increase of intraocular pressure, uveitis, and macular pucker. Phthisis bulbi occurred in 6 eyes; in 3 of these eyes enucleation was required. Successful reattachment was accomplished in 56% of these complicated retinal detachments, most of which had been considered inoperable by conventional techniques. Visual improvement was achieved in 46% of eyes. Follow-up ranged from 6 to 29 months.

The difficulty involved in managing retinal detachment accompanying vitreal opacities and bands has been recognised in cases including traumatic eye injuries (Johnston, 1971; Percival, 1972), proliferative retinopathies (Blach, 1975; Goldberg, 1971), vitreous haemorrhage obscuring the fundus view, and so-called massive preretinal retraction (MPR) (Cockerman *et al.*, 1970) or massive periretinal proliferation (MPP) (Machemer and Laqua, 1975). These 'complicated' cases were often considered to be inoperable, and the success rate prior to the pars plana vitrectomy approach was discouraging. With the advent of this technique it has been felt that removal of vitreous opacities as part of the retinal detachment surgery might improve the prognosis (Machemer and Norton, 1975; Peyman *et al.*, 1975a, b).

This report describes our experience with 50 consecutive patients who had 'complicated' retinal detachments operated on at the University of Illinois Eye and Ear Infirmary.

Subjects and methods

Selection of patients and their preoperative evaluation are described elsewhere (Peyman *et al.*, 1976). Procedures included indirect ophthalmoscopy, bio-

microscopy with three-mirror Goldman contact lens where feasible, ultrasonography, and bright-flash intensity electroretinography in some cases.

The basic surgical technique is described in previous reports (Peyman *et al.*, 1975a, b; Peyman and Huamonte, 1975). It involves the following methods:

(1) Removal of opaque vitreous, including vitreous bands and membranes, with the vitrophage. Vitreous scissors and forceps (Peyman and Huamonte, 1976) were used in only 2 cases for bands too tough to be engaged with the vitrophage and for extraction of intraocular foreign bodies.

(2) Localisation of retinal breaks through clear media.

(3) Placement of a silicone plate as an exoplane with an encircling band and drainage of subretinal fluid (Fig. 1). Silicone sponge was also used as an exoplane.

(4) Exchange of fluid for gas (Fig. 2). Disposable needles, 25 and 27 gauge, were attached to 10 ml syringes, then introduced simultaneously through the pars plana about 180° apart into the vitreous cavity. The syringe with the 25 gauge needle served to aspirate the intraocular fluid, while the syringe with the 27 gauge needle was used to inject air or gas. The intraocular pressure did not exceed 30 mmHg at the end of surgery. Air alone was used in 3 eyes; and air-gas mixture or pure gas was used in 40 eyes. Either sulphur hexafluoride or octafluorocyclobutane was chosen arbitrarily for gas

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injection. No air or gas was injected in 7 eyes. Patients with giant tears were placed in a prone position prior to exchange of fluid for gas.

(5) Cryocoagulation of retinal breaks. If retinal breaks could not be detected, a 360° cryocoagulation

in 1 or 2 rows was performed prophylactically under the band.

Indications for this combined procedure included retinal detachment accompanied by opaque ocular media, vitreous body organisation with bands and membranes, perforating eye injuries, and severe MPR that developed after multiple unsuccessful retinal detachment operations. These cases were considered inoperable by conventional scleral buckling procedures.

Follow-up ranged from 6 to 29 months with a mean of 11 months. Anatomical success was achieved if the retina was attached for a minimum of 6 months after surgery, and anatomical failure was defined as incomplete reattachment of the retina after retinal and vitreous surgery.

Results

The cases are grouped according to their prime aetiological factor. Results of visual acuity and anatomical success or failure are categorised in Table 1. A classification based on degree of improvement of visual acuity has been reported previously (Peyman *et al.*, 1976) (see Table 2) and was used in our data analysis. Results of surgical, postoperative, and late complications after vitrectomy are categorised in Table 3.

Group 1—Vitreous haemorrhage or opacities accompanying retinal detachment. Six eyes are included in this group—5 with vitreous haemorrhage and 1 with retropupillary membrane and vitreous haemorrhage. Duration of detachment before surgery ranged from 1 to 2 months; in 1 patient the time was undetermined. 5 eyes showed visual improvement postoperatively. For 1 patient the operation was an anatomical failure (MPR), but visual acuity remained unchanged. In 1 patient a retinal tear that was sustained during the operation was cryocoagulated. Macular pucker was detected during surgery in 1 eye. Postoperatively, transient corneal oedema was seen in 3 eyes and macular pucker was observed in 2. Follow-up ranged from 6 to 19 months (mean, 11 months).

Group 2—Traumatic retinal detachment due to perforating injuries with and without retained foreign bodies. Part of this group was reported previously (Peyman *et al.*, 1975a). A total of 14 eyes were operated on—5 eyes with intraocular foreign bodies, 5 injured with sharp perforating objects, 2 with scleral rupture, and 2 with corneoscleral laceration of undetermined origin. The interval from time of injury to vitrectomy varied from hours to 15 years. In 2 eyes pre-existing macular scar was detected at surgery. Visual acuity improved in 7 eyes, remained unchanged in 3, and became worse in 4. Anato-

Fig. 1 Encircling band and silicone plate as an exoplane. Drainage of subretinal fluid

Fig. 2 Exchange of intravitreal fluid for gas with two syringes attached to disposable 25 and 27 gauge needles

Table 1 Visual and anatomical results after vitrectomy

Diagnosis	No. of eyes	Visual improvement			Vision unchanged	Vision worse	Others*	Anatomical results	
		3+	2+	1+				Success	Failure
Group 1									
Vitreous haemorrhage and media opacification	6	2 (33%)	2 (33%)	1 (17%)	1 (17%)	0	0	5 (83%)	1 (17%)
Group 2									
Trauma; perforating injuries									
(a) With intraocular foreign bodies	5	1 (20%)	1 (20%)	0	3 (60%)	0	0	3 (60%)	2 (40%)
(b) Without intraocular foreign bodies	9	2 (22%)	1 (11%)	2 (22%)	0	4 (45%)	0	6 (67%)	3 (33%)
Group 3									
Massive preretinal retraction	13	0	2 (15%)	3 (23%)	4 (31%)	2 (15%)	2 (15%)	7 (54%)	6 (46%)
Group 4									
Giant retinal tears greater than 180°	4	0	1 (25%)	0	1 (25%)	2 (50%)	0	1 (25%)	3 (75%)
Group 5									
Proliferative retinopathies									
(a) With rhegmatogenous retinal detachment	4	1 (25%)	2 (50%)	1 (25%)	0	0	0	4 (100%)	0
(b) With tractional retinal detachment and massive fibrous proliferation	9	0	0	1 (12%)	4 (44%)	4 (44%)	0	2 (22%)	7 (78%)
Total	50	6 (12%)	9 (18%)	8 (16%)	13 (26%)	12 (24%)	2 (4%)	28 (56%)	22 (44%)

*Mental retardation in 2 patients prevented measurement of visual acuity but the retina was re-attached

Table 2 Classification of visual acuity improvement after vitrectomy

	1+	2+	3+
Level 1			
Light perception	↓		
Hand motion		↓	
Counting fingers <20/400			↓
Level 2			
20/400		↓	
<20/100			↓
Level 3			
20/100		↓	
20/20			↓

1+ Indicates improvement within any level; 2+ improvement to the next better level; and 3+ improvement from level 1 to level 3

mical success was accomplished in 9 eyes. Postoperative complications included the following: transient elevation of intraocular pressure (IOP), 4 eyes; transient corneal oedema, 4 eyes; rubeosis, 1 eye; and macular pucker, 2 eyes. Enucleation was required in 2 eyes because of phthisis bulbi and fear of sympathetic ophthalmia. Follow-up was from 6 to 29 months (mean, 13 months).

Group 3—Massive preretinal retraction. A total of

13 eyes were operated on in this group. Anatomical success was achieved in 7 eyes and visual acuity improved in 5 eyes. Visual acuity could not be determined in 2 patients as they have severe mental retardation. Only 1 significant intraoperative complication occurred: this was one retinal tear that was cryocoagulated and caused no retinal separation postoperatively. Postoperative complications included vitreous haemorrhage in 2 eyes, which cleared with conservative measures; transient elevation of IOP in 3; transient corneal oedema in 5; development of macular pucker in 2; and phthisis in 1. In addition severe uveitis with sterile hypopyon, which responded to medical therapy, was observed in 1 eye, and pigment migration to the macular area was observed in another eye. Follow-up ranged from 6 to 14 months (mean, 10 months).

Group 4—Giant retinal tears greater than 180°. A total of 4 eyes were operated on; preoperatively 2 of these eyes had severe preretinal organisation. In only 1 eye was the retina successfully reattached with resultant visual improvement. Of the remaining 3 eyes the vision was unchanged in 1 and worsened in 2. There were no intraoperative complications. Postoperatively 1 eye developed vitreous haemorrhage and haemolytic or erythroclastic glaucoma and eventually became phthisical; 1 eye progressed to

Table 3 Surgical, postoperative, and late complications following vitrectomy of retinal detachments*

Diagnosis	Surgical complications					Postoperative and late complications										
	Number of eyes	Minimal bleeding with clearing	Moderate bleeding, clearing with lavage	Cataract	Retinal tear at surgery	Haemorrhage	Haemolytic or erythroclastic, and neovascular glaucoma	Transient increase in intraocular pressure	Bullous keratopathy	Transient corneal oedema	Cataract	Severe uveitis	Rubeosis	Macular pucker	Tractional retinal detachment or massive preretinal retraction	Phthisis
Group 1																
Vitreous haemorrhage and media opacification	6	0	1 (17)	0	1 (17)	1 (17)	0	0	0	3 (50)	0	0	0	2 (42)	1 (17)	0
Group 2																
Trauma: secondary to perforating injuries	14	2 (14)	1 (7)	0	0	0	0	4 (29)	0	4 (29)	0	0	1 (7)	2 (14)	2 (14)	2 (14)
Group 3																
Massive preretinal retraction	13	0	0	0	1 (8)	2 (15)	0	3 (23)	0	5 (38)	0	1 (8)	0	2 (15)	0	1 (8)
Group 4																
Giant retinal tears >180°	4	0	0	0	0	1 (25)	1 (25)	0	0	1 (25)	0	0	0	0	1 (25)	1 (25)
Group 5																
Proliferative retinopathies																
(a) With rhegmatogenous retinal detachment	4	1 (25)	1 (25)	1 (25)	2 (50)	1	0	0	0	3 (75)	1 (25)	1 (25)	0	1 (25)	0	0
(b) With tractional retinal detachment and massive fibrosis proliferation	9	1 (11)	1 (11)	0	1 (11)	1 (11)	3 (33)	0	2 (22)	3 (33)	0	0	3 (33)	0	2 (22)	2 (22)
Total	50	4 (8)	4 (8)	1 (2)	5 (10)	6 (12)	4 (8)	7 (14)	2 (4)	19 (38)	1 (2)	2 (4)	4 (8)	7 (14)	6 (12)	6 (12)

*Each complication is considered individually. Figures in parentheses are percentages

end-stage MPR. Follow-up ranged from 7 to 12 months (mean, 9 months).

Group 5—Proliferative retinopathies: A total of 13 eyes had proliferative retinopathies of different aetiology including diabetes, sickle cell disease, and sarcoidosis. This category was subdivided into 2 groups:

(1) **Rhegmatogenous detachment with vitreous traction:** These eyes had moderate to severe vitreous haemorrhage or opacities, traction bands, and retinal breaks. A total of 4 eyes were operated on: 2 corresponded to sickle cell retinopathy and 2 to diabetic retinopathy, both with early fibrovascular proliferation. In 4 eyes the retina was reattached and visual acuity improved in all. Retinal tears were created in 2 eyes during surgery. These were cryocoagulated and no retinal detachment was noted postoperatively. A cataract was created intraoperatively that was removed at the time of vitrectomy. Postoperatively 1 eye developed macular pucker and

another had severe uveitis. One patient developed posterior subcapsular cataract.

(2) **Tractional detachment with massive fibrovascular proliferation with no retinal holes:** This group included 9 eyes, 8 of which were diabetic. Each had severe fibrous proliferation and fibrovascular stalk arising from the disc. Peripapillary tractional retinal detachment involving the macular area was caused by the extensive fibrovascular tissue. The nondiabetic case was a patient with sarcoidosis accompanied by fibrovascular proliferation, preretinal organisation, and long-standing retinal detachment, for which multiple procedures previously had failed to reattach the retina. Visual acuity improved in 1 eye, was unchanged in 4, and became worse in 4. Anatomical success was achieved in 2. A retinal tear was created in 1 eye that was cryocoagulated intraoperatively; eventually tractional retinal detachment worsened in this eye.

Major postoperative complications included hae-

molytic, erythroclastic, or neovascular glaucoma and corneal oedema. Two eyes became phthisical and 1 of them was enucleated for intractable severe pain. In 1 eye, which had additional panretinal cryocoagulation performed during surgery, moderate exudative retinal detachment was observed postoperatively. This reabsorbed spontaneously at the end of the second postoperative week. Follow-up ranged from 8 to 18 months (mean, 11 months).

Discussion

Although conventional buckling operations are most often employed to reattach the retina in the great majority of retinal detachment cases, these techniques are not usually successful if the fundus view is obscured and vitreous opacities are present, and if severe vitreo-retinal traction or preretinal organisation exists. For these complicated situations newly developed methods and techniques of vitreous removal can make the eyes operable (Machemer and Norton, 1975; Peyman *et al.*, 1975 a, b; Peyman and Huamonte, 1975; Benson and Machemer, 1976; Hutton *et al.*, 1976; Peyman *et al.*, 1976; Peyman and Huamonte, 1976).

In our series the complicated retinal detachment cases were separated into 5 groups according to the prime associated condition and cause: vitreous haemorrhages, trauma, giant retinal tears greater than 180°, massive preretinal retraction (MPR), and tractional and rhegmatogenous detachment accompanying proliferative retinopathies.

Group 1: Conservative measures such as bilateral patching and bed rest are important to clear the vitreous body preoperatively when a haemorrhage obscures the fundus view. In spite of these procedures vitreous haemorrhage can persist and no clearing is achieved. However, there is a limitation between the time that a detachment is discovered and when the surgery should be performed. It has been demonstrated that surgical management of a retinal detachment involving the macula for longer than 8 weeks has poor prognosis for recovery of visual function (Grupposo, 1975). If the surgery is performed without a long delay, the visual outcome should be better. Therefore removal of vitreous haemorrhage or opacities which have not reabsorbed within 2 to 4 weeks is considered important for successful management of rhegmatogenous retinal detachment. Our results indicate a reasonably good prognosis in this group of cases.

Group 2: Perforating eye injuries are often accompanied by vitreous haemorrhage damage of the vitreous, retina, and uvea, and intraocular foreign body in the acute stage. Later, fibrous ingrowth and retinal detachment often complicate these situations.

In the past the cure rate for these disrupted eyes associated with retinal detachment ranged from 12 to 16% (Johnston, 1971; Percival, 1972) but the use of vitrectomy and of new surgical techniques has improved the prognosis in injured eyes (Peyman *et al.*, 1975a; Benson and Machemer, 1976; Hutton *et al.*, 1976; Mandelcorn, 1977) from 40 to 60%. In our series we were successful in reattaching the retina in 64% of eyes. We believe that early management is extremely important to remove the vitreous haemorrhage, to seal the retinal tears, and to eliminate the situation that ordinarily results in fibrovascular ingrowths, cyclitic membranes, ciliary body detachments, retinal detachments, and massive preretinal organisation.

Group 3: Massive preretinal retraction has been a sombre complication of retinal detachment surgery, and it continues to present a difficult and challenging problem. The advent of vitrectomy and gases that expand and reabsorb slowly can possibly afford a better outcome for these eyes. In our cases vitrectomy has been used to remove many of the bridging bands and membranes, mobilising in this way the immobile retina. In addition the mechanical expansion of the gas can tamponade the retina smoothly against the buckle (Fig. 3). Buckling is an important step in releasing traction of thick preretinal membranes located at the equator, membranes that are inseparable from the retina by mechanical means. (Peeling of epiretinal membranes

Fig. 3 Retinal tamponade by expansion of gas

was performed in only 3 cases.) In other series, when MPR was treated with silicone oil injection and scleral buckling, the success rate ranged from 9% (Cockerman *et al.*, 1970) to 62% (Cibis *et al.*, 1962). The usefulness of intravitreal silicone oil injection, however, has been questioned because of the long-term sequelae such as corneal degeneration, cataracts, and retinal degeneration. In our group of patients with MPR we were successful in reattaching 54% of the retinas. Most of these eyes with MPR had had multiple unsuccessful buckling operations prior to treatment with our combined technique.

Group 4: For patients with giant retinal tears greater than 180° the results were not very satisfactory. Two of these cases were accompanied by severe preretinal organisation. In other series the success rates were 14% (Schepens and Freeman, 1967), 25% (Norton *et al.*, 1969), and 43% (Machemer and Allen, 1976).

Group 5: Eyes having proliferative retinopathy and rhegmatogenous retinal detachment are clearly helped by the combined procedure of vitrectomy and buckling. Holes that were missed because of vitreous opacities were easily detected after removal of vitreous. Most of these cases had minimal to moderate proliferative changes accompanied with vitreous haemorrhage and opacities. In one series of similar cases (Gragoudas and McMeel, 1976) the authors reported retinal reattachment by routine buckling procedures in 74% of eyes, but cases with undetected breaks or poor visibility of the fundus were excluded. In our series 4 eyes with these last characteristics were all successfully reattached.

In the end-stage proliferative retinopathies with massive fibrous proliferation our results have not been encouraging. Only in 2 cases out of 9 was anatomical success achieved. It is important to state that proliferative retinopathies with tractional detachment surrounding the disc have had the worst prognosis among our patients. The precise time to operate on these patients, either before or after detachment of the macula, has not been clearly decided. In the past we have operated only when the macula has already been detached. Further observations need to be made to determine whether an early operation will prevent irreversible deterioration of vision or not.

Intraoperative complications encountered in our series included minimal to moderate bleeding, which was usually stopped by raising the IOP; intraocular diathermy was not commonly required. Iatrogenic retinal tears occurred in 5 cases (10%), a relatively high incidence if they are compared with the 2% incidence in our overall pars plana vitrectomy series (Peyman *et al.*, in press). These tears were produced when vitreoretinal traction was attacked

at the vitreous base or at the equator and, consequently, more manipulation was required. This is exemplified in patients with sickle cell retinopathy.

No retinal dialysis was produced at the pars plana sclerotomy in any of our cases. The absence of this complication might be explained by the length of the sclerotomy (4 mm), which permits the smooth passage of the vitrophage and avoids forcing the vitrectomy instrument into the eye. Also, it might be explained by the linear oscillation of our instrument and the fact that we did not use fibroptic bundles in any of these cases.

Postoperatively 1 eye showed exudative retinal detachment which had had panretinal cryocoagulation during vitrectomy, a complication that has been described with other types of energy (Huamonte *et al.*, 1976). Exudation was noted the second day after vitrectomy and reabsorption occurred at the end of the second week without any additional intervention.

We noticed a higher incidence of neovascular glaucoma and fresh rubeosis in the group of patients with severe fibrovascular proliferation. Most of these patients were diabetic and had advanced retinal vasoproliferation. Macular pucker was also observed in some of our patients. This was possibly due to multiple operations before vitrectomy or the magnitude of the surgery, or to other undetermined factors.

The overall anatomical success rate in our patients was 56%. Visual acuity improvement was achieved in 46%.

The combined technique of pars plana vitrectomy, scleral buckling, release of subretinal fluid, and intravitreal gas injection thus appears to offer a better chance for otherwise inoperable, 'hopeless' eyes than is at present afforded by routine procedures. This radical type of surgery should be performed only in extreme cases of retinal detachment where conventional techniques have failed or are virtually certain to fail.

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