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Intravitreal air in retinal detachment surgery

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The use of intravitreal air in the treatment of retinal detachment was described by Rosengren (1938, 1951), and Norton, Aaberg, Fung, and Curtin (1969) applied this technique to the treatment of giant tears. The method described in this paper differs from that of Rosengren in several features.

A series of forty patients is divided into two broad groups:

(A) Those appearing *de novo* at the Outpatient Department and undergoing a first operation for retinal detachment.

(B) Relapsed detachments following some other previous operative technique. Eight aphakic patients previously described in detail (Chawla, 1973) are included.

The method described is used in all cases in which tears lie superiorly between the 8 and 4 o'clock meridians. If additional inferior tears exist, some other manoeuvre must be included.

Method

EXAMINATION

The patient is admitted to the ward, and examination is undertaken with the binocular indirect ophthalmoscope. The periphery of both eyes is examined using transpalpebral indentation of the sclera; no local anaesthetic drops are instilled into the conjunctival sac. The patients are not compelled to rest in bed unless a functioning macula is in imminent danger of detachment. Double padding is never used.

Slit-lamp examination is essential to determine the state of the vitreous. If narrow anterior chamber angles are suspected, gonioscopy is performed.

In the preoperative state, a large amount of subretinal fluid is an advantage for two reasons:

(1) Subretinal fluid can be released with greater safety. **(2)** Removal of fluid at operation makes way for the requisite 1 to 3 ml. air to be injected. Thus rest in bed may be unhelpful.

OPERATION

The patient is operated upon as soon as possible under general anaesthesia. A 360° limbal conjunctival incision is made and the rectus muscles are secured with 5/0 silk stay sutures. The sclera is examined; any thinning and the position of the vortex veins are noted.

Cryopexy to the areas of tear(s) is performed; the monitoring of each application prevents overfreezing. The onset of iceball formation is clearly seen. The cryoprobe must not be removed from the sclera until it has defrosted, thus avoiding scleral cracking (Shea, 1969) and rupture of vortex veins during posterior applications.

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The site of subretinal fluid release is placed near the area of greatest retinal elevation, provided the vortex ampullae permit this. In practice this is usually near the rectus muscles. A radial incision is made in the sclera with a Bard Parker No. 15 blade, deep enough to expose the *black* of the choroid. The choroid is then punctured by light touching with a fine diathermy point. Gentle pressure is applied to the globe with cotton-tip applicators in order to obtain the maximal flow of subretinal fluid through the sclerotomy. With flat detachments, room must be made for the intravitreal air. This can be achieved by sclerotomy as near as possible to the tear to allow fluid vitreous to flow through the tear and the sclerotomy,—"through tear" drainage! If this is not possible, fluid vitreous may be removed through the pars plana—a purse-string suture (Ethiflex—Ethicon No. Special 135/70 on a half-circle needle) is placed around the injection site and perforation is then made with a small gauge needle No. 25G followed by a larger gauge needle No. 21G on a 2-ml. syringe. Up to 2 ml. of fluid vitreous may then be removed. The large needle is left *in situ*, an air syringe is substituted, and, after injection of air, the suture is tightened as the needle is withdrawn.

In bullous detachments, between 1 and 3 ml. of sterile air are injected into the eye through the pars plana between the rectus muscles. The posterior limit of the pars plana is indicated by the furrow produced between the rectus insertions by applying tension on the stay sutures. Sloping backwards to avoid the lens, the perforation should be made with a No. 25G needle 2 mm. anterior to the furrow. A single continuous movement with a dry syringe will inject the air in a single bubble (Dobbie, 1969). The eye is palpated gently during the injection of air to avoid raised intraocular pressure.

A precautionary visualisation of the central retinal artery is made at this stage.

The No. 40 silicone band is placed deep to the rectus muscles to encircle the sclera, so that it lies behind the site of the tear(s) and covers a greater circle of the eye. Thus it is usually equatorial. To gauge the required tension, the band should be tightened to contract the globe deep to the rectus insertions. On being secured over a greater circle of the eye from its initial position, it achieves the correct tension (Dobbie, 1969). It must be stressed that this band is not covering the tears and is not tension sutured; it causes only gentle counter-traction on the globe. The band is secured by four Ethiflex sutures in the four quadrants and the ends are secured in the lower nasal quadrant with a Watzke sheath using Chawla forceps (Chawla, 1970).

The conjunctiva is sutured with two or three interrupted 6/0 catgut sutures.

Contrary to some opinion, the retina may still be seen after the air is *in situ*.

POSTOPERATIVE CARE

This is kept simple. The patient is positioned so as to allow the air bubble to push the retinal tears against the treated choroidal bed. Only the operated eye is padded, and local treatment consists of 1 per cent. atropine drops twice daily and Sofradex drops four times a day. Systemic antibiotic is not routinely given.

Strict rest in bed is not enjoined and stenopoeic glasses have not been used.

Particulars of the forty patients are listed in the Table (overleaf).

Results

Of 41 cases of detachment of the retina in 40 patients, 37 were successfully re-attached. These patients have been followed-up for various lengths of time since early in 1970 and, apart from four incurable detachments (Cases 8, 20, 29, and 32) and one late vitreous haemorrhage (Case 39), none has shown any advance in vitreous pathology or signs of relapse.

Discussion

The discovery of all the retinal tears, as stated by Gonin (1928), still remains the chief requirement for any successful retinal detachment operation. The second vital need is to seal these tears, but just how this should be achieved is not beyond controversy.

Table *Clinical and surgical features of forty patients with retinal detachment*

Case	*Age (yrs)*	*Sex*	*Refraction*	*Duration of detachment*	*Type*
GROUP A					
1	74	M	Mild myope Phakic	6 days	R upper temp. quadrant spreading to upper nas and downwards to lower temp. Macula OFF
2	35	F	High myope Phakic	Not known	L inferior half
3	51	F	High myope Phakic	4 mths	R total
4	51	F	High myope Phakic	5 days	L inferior nasal 10 o'c round to inferior tempora 4 o'c Macula ON
5	60	F	Emmetropic Phakic	2 days	R superior half Macula OFF
6	17	M	Moderate hypermetrope Phakic	1 mth	R total
7	63	F	High myope Phakic	1 wk	L upper temp. discrete; upper nasal discrete No continuity of elevation seen between detach areas
8	50	F	High myope Phakic	3 wks	R subtotal
9	60	F	High myope Phakic	2 wks	R upper nasal quadrantic spreading down to lower nasal quadrantic Macula ON
10	69	F	Emmetropic Phakic	4 wks	R upper and lower temp Macula OFF
11	54	F	Emmetropic Phakic	6 mths	L temp. half Macula OFF
12	65	M	Emmetropic Phakic	1 wk	R temporal half Macula OFF
13	63	F	Mild hypermetrope Phakic	10 days	R small peripheral temp. Macula ON

eatures of tears tate of vitreous	*State of fellow eye*	*Pre-op. visual acuity*	*Comment*	*Post-op. visual acuity*
orseshoe tears equatorially 10.30 and 1.30 o'c attice degeneration	Lattice degeneration superiorly 10 to 2 o'c Retina FLAT	HM	Prophylactic cryopexy to other eye required FLAT	6/12
nferior temporal dialysis with fibrotic edges facular cystic changes	Inferior temp. and nasal areas white with pressure Retina FLAT	CF 1 m	Prophylactic cryopexy to other eye required FLAT	6/60
pper nasal equatorial tear 1 o'c	Some equatorial lattice degeneration	HM	FLAT	6/36
iant horseshoe tear 8 o'c extending to disc	Nothing abnormal detected	6/24	Tear so extensive as to be untreatable by other methods FLAT	6/18+
pper temp. horseshoe tear equator 11 o'c rrounded by lattice degeneration	Upper temporal equatorial thinning	CF 1 m	Macular cystoid change seen post-op. FLAT	6/60
iant inferior temporal dialysis	Nothing abnormal detected	CF 1 m.	Head down position not tolerated; encircling 3 mm. sponge; Light coagulation FLAT	6/36
iant horseshoe tears 10 and 1.30 o'c rrounded by lattice degeneration hinning of retina in other sup. area also pen tear equatorially 5 o'c eneral equatorial fragility	Previous detachment with upper temp. hole located Failed sponge implant Total detachment	6/6 pt	Required removal vitreous prior to air injection. Had further air injected 4 days post-op. FLAT	6/6
small macular holes ripheral small holes just retro-oral 8, 11.30, 12.30 o'c	Peripheral degeneration	CF 2 ft	NOT FLAT post-op.	PL
uatorial horseshoe tear 1.30 o'c treous synchisis ++	Dense cataract Eye poor since childhood	6/18 N5	Early lens opacities FLAT	6/12
uatorial horseshoe tear 10.30 o'c any cells in degenerate vitreous	Open "mirror image" tear 1.30 o'c Retina FLAT	CF 1 ft	Prophylactic cryopexy to other eye FLAT	6/36 pt
small retro-oral tears 12–12.30 o'c nall round hole 2 o'c	"Mirror image" tears 12 o'c open and open tear retro-oral at 7 o'c Retina FLAT	HM	No. 40 silicone band migrated forwards—removed 5 mths post-op. Prophylactic cryopexy other eye FLAT	6/9
arge equatorial tears 11 and 12 o'c	Nothing abnormal detected	CF	Patient has simple glaucoma FLAT	6/36
rge equatorial horseshoe tear 9 o'c at tear 1 o'c midway between equator and ora serrata treous synchisis	Flat tear 1 o.c Retina FLAT	6/18	Prophylactic cryopexy to other eye 3 yr. history of vitreous floaters and photopsiae FLAT	6/12

Table (*continued*)

Case	*Age (yrs)*	*Sex*	*Refraction*	*Duration of detachment*	*Type*
14	62	M	Mild myope Phakic	3 wks	L temp. half Macula ON
15	23	F	Mild myope Phakic	Not known	L inferior temporal Macula ON
16	61	M	Emmetropic Phakic	1 wk	R inf. temp. spreading to inferior nasal
17	81	F	Mild myope Phakic, but both lenses dislocated	Not known	L upper half Macula ON
18	55	M	High myope Phakic	10 days	L upper nasal quadrant Macula ON
19	25	M	Mild myope Phakic	6 wks in R ? in L	Inferior temp. R and L Maculae ON R and L
20	66	F	Mild myope Phakic	Not known	L total
21	67	F	Emmetropic Phakic	2 mths	R total
22	76	M	Moderate hypermetrope Phakic	1 mth	R lower half Macula OFF
23	63	M	Moderate myope Phakic	1 wk	R total
24	51	M	Emmetropic Phakic	Not known	R upper half Macula OFF

Features of tears *State of vitreous*	*State of fellow eye*	*Pre-op. visual acuity*	*Comment*	*Post-op. visual acuity*
Large equatorial tear 3.30 o'c Surrounded by lattice degeneration Mobile vitreous	Nothing abnormal detected	6/9 pt N5	FLAT	6/5
Inf. temp. dialysis Vitreous NAD	Patches of cystoid change lower temp. peripheral retina	6/5 N5	No. 40 silicone band removed electively 6 weeks post-op. owing to youth FLAT	6/6
Round equatorial hole 10.30 o'c Flat tear ora 1 o'c Equatorial lattice degeneration upper nasal and upper temp. quadrant Vitreous NAD	"Mirror image" flat tear at ora 11 o'c Retina FLAT	CF	Prophylactic cryopexy to other eye required FLAT	6/24
2 upper temp. horseshoe tears equatorially 12 and 11 o'c	VA = No PL Patient has simple glaucoma, dislocated, cataractous lens	6/18 pt	Patient suffered sudden vitreous haemorrhage 2 mths post-op. This cleared and retina FLAT	6/18 → HM
Multiple small equatorial holes in upper nasal periphery Peripheral degeneration other quadrants	Nothing abnormal detected	6/24–1	Anisometropic Fellow eye emmetropic FLAT	6/12
Inferior temp. dialyses R and L Vitreous floaters (R) Vitreous normal (L)	See previous columns	R 6/36 L 6/5	Early case, initially nursed with head tilted down Guttered implant used also on R side FLAT	R 6/12 L 6/5
Equatorial horseshoe tear 1.30 o'c Two small round holes equatorially 10.30 and 11 o'c Lattice degeneration superiorly Tears with curled edges 2 severe fibrous vitreous strands pulling on operculum-taut	Lattice degeneration equatorially 9.30 and 10 o'c	HM	Normal procedure + radial sponge to indent over horseshoe tear 1st op. unsuccessful. Sponge removed 2nd op.—7 mm. silastic sponge encirclement Massive vitreous retraction Prophylactic cryopexy to fellow eye NOT FLAT	HM
3 small holes in upper nasal area 12.30 to 1 o'c just behind ora serrata Peripheral postequatorial region all white with pressure	"Mirror image" lattice degeneration	HM	*No* No. 40 silicone band was used here for counter-traction FLAT	6/18 pt
Equatorial horseshoe tear 11 o'c Fixed immobile vitreous strands	Normal vitreous No degeneration seen in periphery	CF 1 m. N/48	FLAT	6/18 pt
Equatorial lattice degeneration + + Multiple cracks 10, 11, and 6 o'c	Total detachment Failed Arruga string	6/18	6 o'c tear not sealed by radial sponge or any other scleral manoeuvre Band slid backwards (intentional) Post-op. light coagulation required FLAT	6/12
Giant horseshoe tear on equator 11 o'c	Nothing abnormal detected	CF Amblyopic Childhood Squint	Very slight leak due to non-contiguous cryopexy around the hole Sealed with light coagulation FLAT	CF

Table (*continued*)

Case	*Age (yrs)*	*Sex*	*Refraction*	*Duration of detachment*	*Type*
25	61	F	Moderate myope Phakic	4 mths	L subtotal Small area of upper temp. quadrant only attached Macula OFF
26	82	M	Mild myope Phakic	4 wks	L superior temp. quadrant spreading Macula OFF
27	68	M	High myope Phakic	2 days	L superior temp. quadrant spreading nasally Macula OFF
28	65	M	Moderate myope Phakic	1 wk	R superior temp. quadrant spreading to nasal side Macula ON
29	54	F	High myope Phakic	2 wks	R total
30	79	M	Moderate myope Aphakic	1 day	L upper temp. quadrant only Macula ON
31	79	M	Mild myope Aphakic	2 days	L nasal half Macula ON
32	74	F	Emmetropic Aphakic	4 wks+ ? more	L subtotal
33	65	M	Myope Aphakic	2 wks	R total
34	65	M	Mild myope Phakic	10 days	R. temp. lower half Macula OFF
GROUP B					
35	63	F	Moderate myope Aphakic	4 days	R subtotal Macula OFF
36	23	M	Emmetropic Aphakic	Not known	R upper temp. following needling op. for traumatic cataract Macula OFF

Features of tears State of vitreous	*State of fellow eye*	*Pre-op. visual acuity*	*Comment*	*Post-op. visual acuity*
2 equatorial round holes 1 and 1.30 o'c Surrounded by extensive lattice degeneration	Some degenerate retina 7 o'c equatorially	HM	Prophylactic cryopexy to other eye required FLAT	6/18
Equatorial horseshoe tear 1.30 o'c Vitreous NAD	Nothing abnormal detected	HM	FLAT	6/24
Huge slit-like tear extending backwards from equator with rolled operculum	Superiorly thinned retina white with pressure	6/36	Little light coagulation required 7 days post-op. equatorially FLAT	6/24
Large postequatorial slit tear 10.30 o'c Vitreous synchisis	"Mirror image" tear 1.30 o'c Retina FLAT	6/18	Detached eye remained flat for 7 weeks; then slight leakage from tear caused subsequent detachment Re-op. with "tear drainage" FLAT	6/12
2 retro-oral tears 10 and 1 o'c Equatorial horseshoe 2 o'c Taut operculum Vitreous synchisis ++	Nasal quadrants paving stone degeneration	CF	Vitreous retraction Failed air 1st op. Radial sponge failed 2nd op. NOT FLAT	PL
Equatorial horseshoe tear 2 o'c	Had detachment 7 yrs before Not operated on at that time	6/60	Thin sclera Guttered unburied silicone plate over tear FLAT	6/9
Open oral tear 12 o'c 2 small round retro-oral tears 10 o'c Vitreous synchisis	Myopic Otherwise normal	6/6 N5	FLAT	6/6
Retro-oral horseshoe tear 10 and 6.30 o'c	Nothing abnormal detected	HM	Massive vitreous retraction Vitreous haemorrhage at top NOT FLAT	HM
Upper temp. horseshoe tear at equator 11 o'c	Nothing abnormal detected	HM	Relapsed detachment "Tear drainage" at re-op. FLAT	6/18
Equatorial round tear 10 o'c Vitreous NAD	Equatorial degeneration 2 and 5 o'c	HM	Prophylactic cryopexy to fellow eye required FLAT	6/60
Round hole at ora serrata 10 o'c Equatorial lattice degeneration 10 and 11 o'c Anterior vitreous opacities	Aphakic	HM	Originally circumferential 7 mm. silastic sponge used; removed at 2nd op. Intravitreal air for choroidal detachment Tear later sealed with radial sponge FLAT	6/12
Giant upper temp. dialysis Fluid vitreous	Nothing abnormal detected	HM	Retina held by incarceration Non-progressive elevation FLAT	CF

Table (*continued*)

Case	*Age (yrs)*	*Sex*	*Refraction*	*Duration of detachment*	*Type*
37	20	F	Mild myope Phakic	6 wks	R extensive temp. half Macula ON
38	70	M	Moderate hypermetrope Aphakic	3½ mths	L lower half Macula OFF
39	59	F	Emmetropic Aphakic	6 days	L subtotal only a little of upper temp. quadrant attached
40	43	M	Emmetropic Aphakic	1 yr+	L total Macula OFF

Mild hypermetrope = 0–+3D Moderate hypermetrope = +3–+6D High hypermetrope

N.B.—In our experience the relationship of the limits of the retinal detachment to the likely positions of the retinal

The method described above may be recommended on several grounds. It is successful, gentle, and simple, takes little more than one hour to perform, and leaves the eye contours almost normal. Patients find the quiet eye and rapid postoperative mobilization encouraging and comfortable. We have occasionally used this method for inferior tears (Cases 2, 6, and 19), but the head-down position makes great demands on even the most phlegmatic of subjects.

In our hands monitored cryopexy has eliminated the formation of secondary tears and has made for easier exposure at re-operation, but we have found that, in very vascular operative fields, freeze-burns of the chorio-retina are hard to produce.

The No. 40 silicone band is remarkably inert, and since it is not tension sutured, there is little fear of suture cut-out and band migration. To date, we have had to remove only one band, and even in this case the ocular disturbance was minimal (Case 11).

We have been using and modifying this technique since our first case early in 1970. The following cases call for special comment.

Group A

Case 1 The enormous tear stretching from the equator to the disc was untreatable by conventional scleral buckling; with air, however, the retina was easily replaced and the sealing even survived the patient's falling out of bed on the third post-operative day.

Case 8 This highly myopic retina had seven tears (equatorial and macular) and vitreous haemorrhage may have concealed more. The retina relapsed 1 month after surgery.

Case 20 Clearing vitreous haemorrhage revealed a 6-month-old detachment with taut strands pulling on the tear edges. When air injection failed, a large encircling sponge held the retina flat for a month until advancing shrinkage caused relapse.

'eatures of tears 'tate of vitreous	*State of fellow eye*	*Pre-op. visual acuity*	*Comment*	*Post-op. visual acuity*
;iant dialysis infero-temp. quadrant with numerous small holes equatorially in same quadrant Retro-oral degeneration thinning continuing in upper temporal quadrant	Nothing abnormal detected	Amblyopic HM	Previously 2 ops with quadrantic silastic sponge implant and subsequently circumferential silastic sponge implant Original tear still leaking before final op. Alternating posture upper and lower tears FLAT	6/60
)pen tear retro-oral 3 o'c 'reviously-used suture perforating retina 2.30 o'c evere folds in retina 'luid vitreous	Nothing abnormal detected	CF 2 m.	Chronic simple glaucoma FLAT	6/60
,arge secondary equatorial horseshoe tear 10 o'c ome equatorial degeneration	Lattice degeneration 12 o'c	HM	Prophylactic cryopexy to fellow eye required FLAT	6/18
,quatorial round tears open 10 and 2 o'c	Nothing of note	HM	Vitreous irreparably damaged by multiple ops FLAT	CF

= +6D and upwards Mild myope = 0--3D Moderate myope = −3D--6D High myope = −6D and upwards
tears agrees with those described by Lincoff (1971).

Cases 24, 28, and 33 In all these cases there was leakage from the original tears which the too sparse cryopexy had failed to seal. Cases 28 and 33 responded to further cryopexy in a wider circle around the tears and their shallow detachments required "through-tear" drainage to make room for the intravitreal air.

Case 24 responded to simple light coagulation over the inadequately frozen areas at the posterior angle of the tear.

Case 29 The large upper equatorial tear defied closure at two operations, first with air and then with a radial sponge. Although it is idle to speculate, the two approaches combined in a single operation might well have contained the traction forces which pulled the retina too far for surgery to be successful.

Case 32 In this longstanding detachment, alternating posturing failed to seal the lower of the two large tears which lay behind the ora at 6.30 and 10 o'clock. Advancing fibrosis dissuaded us from further interference.

Group B

All six cases achieved flat retinae although, in Case 40, the multiple surgical procedures reduced the vitreous to a network of optically useless bands. In Case 36 a non-progressive elevation remains in the lower temporal area.

The dangers of this method are noteworthy, but happily in our experience they are only theoretical.

The greatest risk is closure of the central retinal artery by over-inflation of the eye. Intravenous Diamox 500 mg. will bring about a leisurely fall in intraocular pressure. If the urgency is greater, then 500 ml. 25 per cent. Mannitol may be given quickly by the same

route. A paracentesis and finally removal of air through the pars plana will lower the intraocular pressure even more quickly, but this should be reserved for desperate situations; it is surgically inelegant and involves further penetration into the vitreous cavity.

Other hazards include:

(1) Angle closure (due to forward movement of the iris diaphragm)
(2) Tearing off the inner layer of the pars plana
(3) Touching the lens
(4) Tearing a retinal bulla
(5) Passage of air deep to the retina
(6) Intraocular infections
(7) Injection-site bleeding.

We have experienced only the last of these complications and this problem has now been eliminated by previous puncture with a catholysis point. Of the 35 patients with detachments in the first eye, ten had other ocular degenerations which were considered sufficiently dangerous to warrant prophylactic cryopexy or light coagulation.

Summary

The use of intravitreal air, cryopexy, and an encircling No. 40 band is discussed in relation to forty patients (41 eyes including eight aphakics) with both primary and relapsed retinal detachments. The technique is offered as a simple alternative to the more complicated scleral buckling techniques for phakic and aphakic retinal detachment with upper tears between the 8 and 4 o'clock meridians.

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examination. They showed that there was a definite histological pattern of mucopolysaccharide deposits in the inner layers of the pigment epithelium, distinguishing them from colloid bodies. Fluorescence retinal photography showed widespread background mottling (Brown and Hill, 1968). The genetic pattern is not definitely known although both dominant and recessive patterns have been described (Duke-Elder and Dobree, 1967).

This condition is often misdiagnosed as tapeto-retinal dystrophy, but can be distinguished by the typical morphological appearance, benign course, normal or near normal dark adaptation, and minimal field loss. The electroretinogram and electro-oculogram may be normal or slightly reduced. Though familial cases have been described, no history of similar lesions in other members of the family has been obtained in many cases.

Summary

A case of fundus flavimaculatus is described, and the differential diagnosis from tapeto-retinal dystrophy discussed.

I am grateful to the Superintendent, Government Ophthalmic Hospital, Madras, for permitting me to report this case, and to Dr. J. Agrawal for the fundus photographs.

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Correction

In the article by H. B. Chawla and C. H. Birchall in the January issue (*Brit. J. Ophthal.*, 1973, **57**, 60), on p. 61, l. 24, for *contract* read *contact*.

To gauge the required tension, the band should be tightened to CONTACT the globe deep to the rectus insertions.