Late Retinal Detachment in Patients Born Prematurely

Outcome of Primary Pars Plana Vitrectomy

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Objective: To describe the indications and results of pars plana vitrectomy for rhegmatogenous retinal detachment in patients born prematurely.

Patients and Methods: Between 1995 and 2001, primary vitrectomy for retinal detachment was performed in a consecutive series of 11 eyes of 10 patients. Gestational age ranged from 26 to 30 weeks, and birth weight ranged from 810 g to 1475 g.

Results: Myopia was found in 9 of 11 eyes. Two patients initially had a vitreous hemorrhage. One of these children was previously treated with cryotherapy during the acute phase of stage 3+ retinopathy of prematurity. Three eyes had a normal posterior pole and only mild peripheral retinal changes. Primary vitrectomy was performed in all 11 eyes. Patients received follow-up for 7.2 months to 6.6 years (mean, 2.7 years). Three eyes with severe cicatricial changes due to retinopathy of prematurity needed multiple procedures with silicone oil tamponade for reattachment. In 10 (90%) of 11 eyes, the retina was completely attached at the last follow-up visit. Visual acuity ranged from light perception to 20/25 in the affected eye.

Conclusions: Patients born prematurely may develop late-onset retinal detachment due to vitreoretinal changes caused by retinopathy of prematurity. Primary vitrectomy is an effective treatment technique for retinal detachment in patients born prematurely.

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RETINOPATHY OF prematurity (ROP) is a neovascular disorder that develops in 11% to 56% of preterm infants with low birth weight.[1-3] Only 5% to 7% of these cases require coagulation treatment (Cryo ROP Study[4]). In most patients, retinal changes of the acute phase regress completely or with residual vitreoretinal alterations.

In patients born prematurely, increased liquefaction of the vitreous and vitreoretinal traction may cause retinal detachment (RD). Characteristic retinal and vitreous pathologic conditions place these patients at increased risk for retinal complications throughout their lives.[5,6] Retinal changes in the posterior pole include dragging of the retina, retinal folds, and chorioretinal scarring. Neovascularization, elevated retinal vessels, cystoid degeneration, diffuse retinal pigment epithelial clumping, and retinal holes may be present in the periphery. Changes of the vitreous gel and peripheral vitreous membranes are other common findings.

To date, few published reports describe the functional and morphological outcomes of patients born prematurely who develop late RD. Vitrectomy as an initial treatment was described in 3 small series with 4 eyes each.[7-9] We report the results of surgery for RD in 11 eyes of 10 patients with premature birth. These patients had a birth weight lower than 1500 g or a gestational age less than 31 weeks and came to us with or without clinically visible retinal cicatricial changes of ROP.

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METHODS

In this study, we evaluated a consecutive series of patients born prematurely who had RD between 1995 and 2001 and a follow-up time of at least 6 months. Only 1 of these patients was treated with cryotherapy, according to the recommendations of the Cryo ROP Study,[4] during the acute phase of ROP.

Baseline ocular characteristics were obtained from clinical records. All patients had decreased vision and RD. Best-corrected visual acuity was documented at baseline and the final examination. Spherical equivalent was also recorded at baseline for each eye. Treatment modalities for RD, the need for multiple treatments, and interval until retreatment were noted. Characteristics of the fundus changes were recorded at the first examination or during surgery in cases of vitreous hemorrhage.

Table 1. Characteristics of the Cohort

Characteristic	Mean ± SD	Median	Range
Birth weight, g	1128 ± 216	1073	810-1475
Gestational age, wk	28 ± 1.4	28	26-30
Age at first surgical procedure, y	22.0 ± 11.9	15.4	9.9-42.4
Follow-up duration, y	2.7 ± 1.8	2.4	0.6-6.6

RESULTS

Characteristics of the 10 patients are listed in **Table 1** and **Table 2**. Five of the patients were female, including 1 pair of monozygotic twins. One of the twins had bilateral RD. Birth weight ranged from 810 g to 1475 g, with a mean of 1128 g and a median of 1073 g. Gestational age ranged from 26 to 30 weeks, with both a mean and median of 28 weeks. The age at first retinal surgical procedure ranged from 9.9 to 42.4 years, with a mean of 22 years and a median of 15.4 years. The mean follow-up time was 2.7 years with a range of 0.6 to 6.6 years.

Baseline spherical equivalent refraction was present in all patients. Myopia was found in 9 of 11 eyes. The mean refractive error for all eyes was –8.6±7.0 diopters (D), with a median of –8.5 D and a range of 0.75 to –17.6 D.

All eyes had RD and vitreoretinal interface changes. Retinal breaks were located posterior to the equator or at the edge of the staphyloma in the eyes with high myopia. Two patients initially had vitreous hemorrhage, with RD detected at an ultrasound examination. Distribution of fundus characteristics at first examination appears in **Table 3**. Five eyes had an abnormal retinal vessel angle, macular ectopia, and mild peripheral vitreoretinal changes. Three of these were highly myopic. Three additional eyes had severe cicatricial retinal changes with tractional RD. Another patient had a retinal fold. Two eyes were initially aphakic as a result of surgery for congenital cataract. One patient was treated with cryotherapy during the acute phase of stage 3+ ROP. This boy developed vitreous hemorrhage with RD after experiencing blunt trauma at age 9 years. No characteristics of traumatic RD were seen, but a retinal break with vitreoretinal traction developed anterior to the scars caused by coagulation treatment. Severe retinal changes due to residual stages of ROP were present in 6 contralateral eyes, 2 of which had no light perception because of the disease.

All patients complained of acute visual loss. Distribution of visual acuity before surgery and at the final examination is shown in the **Figure**. Vision improved after surgery in 8 eyes and decreased in 3 eyes. Poor visual outcome occurred in eyes with recurrent RD or the development of optic atrophy.

Treatment for RD was performed with general anesthesia. During the first operation, all eyes underwent pars plana vitrectomy, in 1 eye, an additional encircling band was performed. Sulfur hexafluoride (SF6) was used in 7 eyes as an intraocular tamponade, and silicone oil was used in 4 eyes with more severe vitreoretinal abnormalities. A complete retinal attachment was obtained in 7 eyes after a single procedure (6 with SF6 and 1 with silicone oil). In 1 additional eye, the macula was attached with silicone oil tamponade. Further surgery including removal of the silicone oil was not considered owing to optic atrophy and a persistent peripheral RD or retinal fold.

Retinal redetachment occurred in 3 eyes. In 2 of these eyes, the redetachment was due to proliferative vitreoretinal traction under the silicone oil tamponade with secondary breaks on the equator in one eye and posterior to the equator in the other. In these 2 eyes, tractional membranes were removed in a second vitrectomy procedure, and a repeated silicone oil tamponade was used. In 1 of the 2 eyes, a second redetachment was treated with an encircling band, and the silicone oil was finally removed during another operation. The second of these 2 eyes developed recurrent tractional RD even with silicone oil tamponade. Prior to the fifth surgical procedure, the eye began to develop phthisis; after this surgery, the retina remained attached. Although the phthisis did not progress for 3½ years, the eye later developed optic atrophy. Therefore, we decided not to remove the silicone oil. The third eye with a redetachment was primarily treated with SF6. This RD was due to retinal traction and a new retinal hole and occurred after gas absorption. In the second operation, silicone oil was used. After 6 months of follow-up, the retina is attached and silicone oil removal is scheduled.

In 10 (90.9%) of 11 eyes, the retina was completely attached at the last follow-up visit. In the remaining eye, only the macula was attached. Four eyes still had a silicone oil tamponade.

In our study, a secondary cataract developed in 3 eyes. One of these patients was an 11-year-old boy with a primary silicone oil tamponade. The silicone oil was removed 6 months after primary surgery. Eight months later a secondary cataract developed, and surgery was performed with intraocular lens implantation. The other 2 patients were aged 36 and 39 years at primary treatment. In both cases, SF6 tamponade was used during primary surgery. One of these patients developed a redetachment, and silicone oil was used in the second operation. It was removed 6 months later in combination with cataract surgery. In both adults, cataract surgery was performed with intraocular lens implantation.

Three eyes with permanent silicone oil tamponade were either aphakic initially (n=2) or the lens was removed during primary surgery (n=1) because of anterior traction. No patient younger than 26 years with SF6 tamponade developed a secondary cataract. Follow-up for these patients was 0.9 to 6.6 years (median, 2.6 years).

COMMENT

With advances in neonatology, the number of prematurely born children surviving and reaching adulthood is expanding. Premature birth increases the risk of retinal tears or RD.[7] In our study, we report the results of surgery for RD in 11 eyes of 10 patients born prematurely who ranged in age from 9 to 42 years. The characteristic appearance of the premature fundus included myopic changes, tortuous retinal vessels, temporal dragging of the vessels, macular ectopia, retinal folds, pigmentation of the retina, and in 1 case chorioretinal scars due to coagulation treatment during an acute phase of ROP.

Table 2. Characteristics of the Patients*

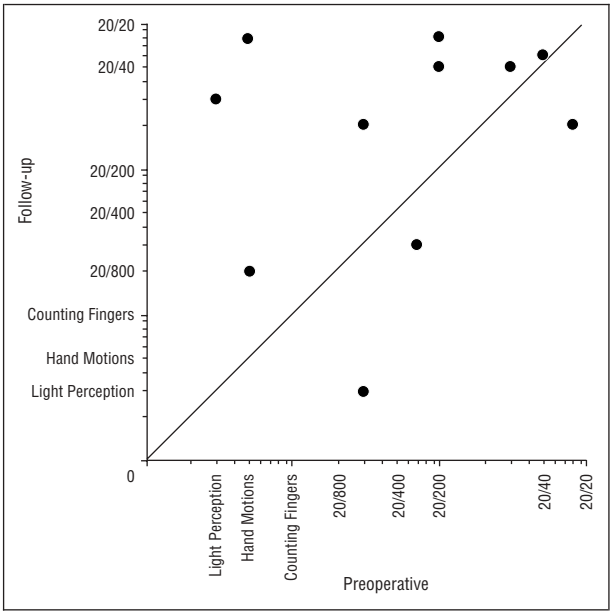
Patient No./ Sex/GA, wk	Birth Weight, g	Refractive Error, D	Age at Surgery, y	Visual Acuity (Preoperative)	Visual Acuity (Postoperative)	Surgery 1	Surgery 2	Surgery 3	Surgery 4	Surgery 5	Follow-up, y
1/M/26	810	–2.50	9.9	HM	20/25	Vitrectomy, SF6					0.9
2/M/29	970	–12.25	11.6	LP	20/60	Vitrectomy, silicone	Vitrectomy, silicone	Encircling band	Silicone oil removal	ECCE + IOL	2.1
3/F/28	1000										
Left eye		–17.63	13.3	20/200	20/40	Vitrectomy, SF6					4.4
Right eye		–15.50	15.1	20/60	20/40	Vitrectomy, SF6					2.5
4/F/28	1035	–15.50	15.0	20/200	20/25	Vitrectomy, SF6					2.6
5/M/27	1475	–8.50	15.4	20/600	LP	Vitrectomy, silicone	Vitrectomy, silicone	Vitrectomy, silicone	Silicone oil removal	Vitrectomy, silicone	3.3
6/M/26	1020	–6.00	17.9	HM	20/800	Vitrectomy, silicone, lensectomy					2.4
7/F/30	1450	–3.63	25.8	20/40	20/25	Vitrectomy, SF6					6.6
8/M/28	1073	0.75	36.1	20/700	20/80	Vitrectomy, encircling band, SF6	ECCE + IOL				0.6
9/F/28	1300	0.00	39.3	20/25	20/80	Vitrectomy, SF6	Vitrectomy, silicone	Silicone oil removal, ECCE + IOL			0.8
10/F/30	1150	–13.75	42.4	20/300	20/700	Vitrectomy, silicone, IOL removal					2.4

Abbreviations: D, diopters, ECCE, extracapsular cataract extraction; GA, gestational age; HM, hand movement; IOL, intraocular lens; LP, light perception; SF6, sulfur hexafluoride.
*Visual acuity refers to the affected eye.

Table 3. Initial Retinal Findings

Findings	No. of Eyes
No cicatricial changes but peripheral retinal changes*	1
Abnormal retinal vessel angle and macular ectopia	5
Retinal fold	1
Tractional RD	3
Peripheral scars after cryotherapy for acute phase of ROP	1

Abbreviations: RD, retinal detachment; ROP, retinopathy of prematurity.
*Peripheral retinal changes refer to latticelike degeneration or an avascular peripheral retina.



Distribution of visual acuity in the affected eye preoperatively and at the last follow-up visit.

One eye had been treated with transscleral cryotherapy for stage 3+ ROP. This eye developed RD after blunt trauma. Greven and Tasman[10] described 3 eyes with rhegmatogenous RD 1 to 3 years after cryotherapy for stage 3+ ROP. After a scleral buckling procedure, 2 of 3 eyes were anatomically reattached, but only 1 eye developed useful vision.

In our study, all eyes were treated with primary vitrectomy. In 1 eye, an additional scleral buckling procedure was performed during primary surgery. In 3 (27.3%) of 11 eyes, the initial treatment failed and additional procedures were required. These treatment failures were observed in the 2 eyes with the most severe vitreoretinal traction, due to cicatricial ROP, and in 1 eye with strong adherence of the vitreous cortex.

In older reported series vitrectomy was not available, and only a scleral buckling procedure was used in the treatment of RD associated with regressed ROP. These studies show final success rates of 63% (5 of 8 eyes),[11] 87% (34 of 39 eyes),[12] 88% (14 of 16 eyes),[13] and 94% (15 of 16 eyes).[14] The good results of some of these studies may be owing to the exclusion of inoperable eyes with vitreoretinal traction. Harris[13] described 52 eyes with late RD and a cicatricial stage of ROP; 13 of these eyes were considered inoperable because of severe vitreoretinal involvement.

Sneed et al[9] treated 16 eyes with late-onset RD associated with regressed ROP. All of their patients demonstrated temporal straightening of the retinal blood vessels and diffuse retinal pigment epithelial clumping. The

initial scleral buckling procedure had a failure rate of 50%. Eight eyes were operated on with pars plana vitrectomy techniques (4 as a primary procedure). After long-term follow-up (6 months), 14 (87.5%) of the 16 treated eyes were successfully reattached. The authors concluded that pars plana vitrectomy in conjunction with scleral buckling may be necessary to achieve long-term retinal reattachment.[9] Of the 31 eyes with RD treated by Kaiser et al,[7] 26 were treated with primary scleral buckling, 3 with primary vitrectomy, and 2 with vitrectomy plus scleral buckling. They reported initial treatment failure in 5 (16%) of the 31 eyes. All 5 eyes were treated initially with a scleral buckling procedure. Although there were no failures in the primary vitrectomy with scleral buckling group, there was no statistical difference between the 2 groups because of small numbers. Despite the small sample sizes, these authors concluded that scleral buckling alone may be inadequate in many eyes to relieve vitreoretinal traction. They suggest primary vitrectomy combined with scleral buckling as initial treatment for late RD caused by ROP. In our study, an additional scleral buckling procedure for reattachment was performed in only 1 eye.

Tasman[5,11,14] described vitreoretinal changes in cicatricial retrolental fibroplasia. He detected round or oval breaks and suggested that cicatricial retrolental fibroplasia is a progressive disease caused by vitreoretinal adhesions. He concluded that primary vitrectomy is the only way to approach these vitreoretinal changes and that silicone oil may sometimes be necessary.[15] Machemer[8] reported 4 cases of late tractional RD that occurred in eyes with cicatricial ROP. All of these eyes had temporal dragging of the retinal vessels. He treated this kind of RD successfully with primary vitrectomy. The results of our study indicate that late RD in patients born prematurely can be successfully treated with pars plana vitrectomy. Silicone oil tamponade and additional scleral buckling may be needed in more severe cases.

Retinal detachment is a possible complication of regressed ROP. It is uncertain whether retinal breaks and RD in regressed ROP are secondary to ongoing changes of ROP, to abnormal vitreoretinal interface changes caused by ROP, or to other unrecognized factors. Tasman[5] speculated that as a result of vitreous traction, retinal vessels sometimes pulled into the vitreous cavity because of shrinking vitreous gel. He implied that temporal vitreous traction on the retina is the rule and proposed that this occurs because the temporal retina, even in full-term infants, is the last area to become vascularized and is thus more sensitive to changes in oxygen concentration. That vitreous gel may partially liquefy and form syneresis cavities may also be important. Between these cavities, the vitreous fibrils condense and may insert into the retina. Thirteen years later, Sebag[16] described age-related differences in the human vitreoretinal interface. He found that in 40% of eyes of individuals 20 years or younger, adhesion between the internal limiting membrane and the posterior vitreous cortex was stronger than that of the Müller cells. Consequently, in his study of dissection of the vitreous from the retina, the inner portions of the Müller cells tore away from the retina and adhered to the internal limiting membrane–vitreous cortex complex. If the process of liquefying occurs without adequate dehiscence between the vitreous cortex and the internal limiting membrane, traction will be exerted at sites of persistent adhesion and may cause retinal tears. Sebag presumed that this may be the reason for severity in patients with high myopia and vitreous degeneration in whom liquefaction is advanced but there is no vitreoretinal dehiscence.

In our study, 6 eyes of 7 patients younger than 20 years were highly (6 D) myopic. In some cases, a strongly adherent vitreous cortex was noted during surgery. Vitreoretinal changes due to high myopia or premature birth may cause RD. Abnormal vitreoretinal traction may be another factor in the development of RD.

Machemer[8] obtained specimens for histological examination during vitrectomy. The membranes in the vitreous cavity were collagen rich and contained cells with glial characteristics. He assumed that chronic exudation from vascular abnormalities was the stimulus for this proliferation. In addition, high myopia and frequent latticelike changes placed these patients at a higher risk for RD.

We recommend that patients with premature birth should be informed about the possibility and symptoms of RD. Those born prematurely, with or without significant fundus changes, should be monitored regularly for retinal complications. When RD occurs, primary vitrectomy without scleral buckling can be used for successful reattachment of the retina.

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