

Characteristics and surgical outcomes of pediatric rhegmatogenous retinal detachment

Yoshihiko Oono
Koji Uehara
Masatoshi Haruta
Ryoji Yamakawa

Department of Ophthalmology,
Kurume University School
of Medicine, Kurume, Japan

Purpose: To describe the characteristics and surgical outcomes of pediatric rhegmatogenous retinal detachment.

Methods: A retrospective study of pediatric patients (15 years old or younger) who had undergone primary surgery for rhegmatogenous retinal detachment was conducted. Patients were divided into five groups according to the predisposing factors: trauma (group 1), myopia (group 2), atopic dermatitis (group 3), congenital or developmental anomalies (group 4), and others (group 5).

Results: A total of 48 eyes of 44 patients were included in this study. There were 18 eyes (37.5%) in group 1, twelve eyes (25.0%) in group 2, six eyes (12.5%) in group 3, five eyes (10.4%) in group 4, and seven eyes (14.6%) in group 5. The initial retinal reattachment rate was 89% in group 1, 100% in group 2, 83% in group 3, 20% in group 4, and 86% in group 5 ($P = 0.002$). The final retinal reattachment rate was 100% in group 1, 100% in group 2, 100% in group 3, 80% in group 4, and 86% in group 5 ($P = 0.16$). The frequency of visual acuity of 0.1 or better after surgery was 100% in group 1, 92% in group 2, 83% in group 3, 40% in group 4, and 71% in group 5 ($P = 0.01$).

Conclusion: The overall surgical outcome was successful, but the patients in group 4 had the lowest initial reattachment rate and the worst visual prognosis.

Keywords: children, detached retina, surgical outcome, predisposing factor

Introduction

Rhegmatogenous retinal detachment (RRD) in a pediatric population is rare compared with adults and the clinical features are quite different. It often presents with a longer duration of detachment, proliferative vitreoretinopathy (PVR), and a macula involving retinal detachment. It also has some predisposing factors, such as trauma, developmental abnormalities, myopia, preceding uveitis, atopic dermatitis, and previous intraocular surgery.¹⁻⁵ However, the clinical features vary by report. Here, we describe the characteristics and surgical outcomes of pediatric RRD patients in our hospital.

Patients and methods

We conducted a retrospective study of pediatric patients (15 years old or younger) who underwent primary surgery for RRD at Kurume University Hospital, Kurume, Fukuoka, Japan, between November 1997 and August 2008. Patients with perforating ocular trauma were excluded from the study. Patients were divided into five groups according to the predisposing factors. Patients with a trauma history were included in group 1. Patients with myopia more than -3 diopters (D) but without a history of

Correspondence: Yoshihiko Oono
Department of Ophthalmology,
Kurume University School of Medicine,
67 Asahi-machi, Kurume,
Fukuoka 830-0011, Japan
Tel +81 942317574
Fax +81 942370324
Email ohno_yoshihiko@kurume-u.ac.jp

trauma, atopic dermatitis, or congenital or developmental ocular anomalies were included in group 2. Patients with atopic dermatitis were included in group 3. Patients with congenital or developmental ocular anomalies were included in group 4. Other patients without obvious predisposing factors were included in group 5. Previous intraocular surgery and preceding uveitis were not present in any of the patients in this study.

The ophthalmic findings recorded at presentation included visual acuity, refractive status, macula status, type of breaks, extent of subretinal fluid, and presence of PVR of grade C or worse.⁶ Initial reattachment was defined as complete retinal reattachment following the initial surgery with or without the use of silicone oil, and final reattachment was defined as complete retinal attachment in the absence of silicone oil. Patients with no significant problems after surgery were monitored by local ophthalmologists.

The visual acuities of counting fingers, hand movements, light perception, and no-light perception were assigned ratios of 0.005, 0.002, 0.001, and 0.0005, respectively, for statistical calculations. Visual acuity was measured with a Landolt C chart and converted to a logarithmic scale of the minimum angle of resolution (logMAR) to perform calculations.

A conventional external approach with scleral buckling was performed as far as possible in patients with visible retinal breaks. Three-port vitrectomy was performed in patients with obscure ocular media, undetected breaks, extensive retinal tears, complicated retinal detachment, and the presence of significant PVR.

Univariate analyses using the Mann–Whitney U test were used for unpaired data. The chi-square test or Fisher's exact test was used for categorical data. Statistical significance was defined as $P < 0.05$.

Results

Surgery for RRD was performed in 48 eyes of 44 patients (39 eyes of 35 boys and nine eyes of nine girls). The average age was 12.3 years (range, 4–15 years). The mean follow-up period was 24 months (range, 3–98 months). The initial retinal reattachment rate was 83% (40 eyes) and the final reattachment rate was 96% (46 eyes). Scleral buckling was performed as initial surgery in 37 eyes (77%) and vitrectomy was performed in eleven eyes (23%). As for the scleral buckling, two eyes had encircling plus segmental buckling and the others had segmental scleral buckling alone. Silicone oil was used in nine eyes and perfluoropropane gas was used in two eyes. The causes of primary failure included PVR (six eyes), a new break (one eye), and an inadequate buckle (one eye).

The characteristics of the five groups are presented in Table 1. A predominance of males was observed in all groups, especially in group 2. The patients in group 4 developed the detachment at a significantly younger age than patients in the other groups. A retinal break was found during vitrectomy in three patients who did not have retinal breaks detected preoperatively. The frequency of total retinal detachment, detached macula, and PVR grade C or worse was more common in group 4 than in the other groups, but there was no significant difference. The trauma in group 1 was caused by a ball while playing sports (eleven eyes), a blow (two eyes), a ballpoint pen (one eye), a pebble (one eye), and another person's head (one eye), while the cause was unknown in two eyes. One eye in group 3 that had longstanding retinal detachment with PVR had coexisting total lens opacity. The abnormalities in group 4 were familial exudative vitreoretinopathy (FEVR) (three eyes), morning glory syndrome (MGS) (one eye), and Coats' disease (one eye). The three patients with FEVR

Table 1 Demographic characteristics in the five study groups

	Group 1 (n = 18)	Group 2 (n = 12)	Group 3 (n = 6)	Group 4 (n = 5)	Group 5 (n = 7)	P
Male*	16 (89)	11 (92)	4 (67)	3 (60)	5 (71)	0.37
Age (yrs) (mean ± SD)	12.3 ± 2.1	14.2 ± 1.0	12.5 ± 1.9	7.8 ± 4.7	11.9 ± 3.1	
Type of breaks						
Round hole with lattice*	1 (6)	10 (83)	2 (33)	0	3 (43)	
Round hole without lattice*	13 (72)	0	0	3 (60)	0	
Tear*	0	1 (8)	0	0	3 (43)	
Giant tear*	0	1 (8)	0	0	1 (14)	
Oral dialysis*	4 (22)	0	3 (50)	0	0	
Undetected*	0	0	1 (17)	2 (40)	0	
Total retinal detachment*	1 (6)	2 (17)	1 (17)	2 (40)	1 (14)	0.43
Macula off*	4 (22)	3 (25)	3 (50)	3 (60)	3 (43)	0.4
PVR grade C or worse*	2 (11)	1 (8)	1 (17)	2 (40)	1 (14)	0.53

Note: *Number (%) of eyes.

Abbreviations: PVR, proliferative vitreoretinopathy; SD, standard deviation.

had no exudation. One patient with FEVR had a small retinal break close to a falciform retinal fold, which progressed to total retinal detachment during follow-up. Another had a retinal hole in the temporal peripheral avascular zone, which caused shallow retinal detachment not involving fovea, and the third had an old retinal detachment with extensive subretinal strand and macular hole, which resulted from a retinal hole in the temporal peripheral avascular zone. The patient with MGS developed total detachment caused by a slit-like break at the margin of the excavated disc with fibrous tissue. The patient with Coats' disease developed peripheral exudative retinal detachment with hard exudate in the macula and a retinal hole occurred in the detachment during follow-up.

The refractive statuses of the five groups are presented in Table 2. Preoperative refractive status could not be measured in three eyes. The frequency of myopia more than -3 D was 28% (five eyes) in group 1, 100% (twelve eyes) in group 2, 40% (two eyes) in group 3, and 25% (one eye) in group 4. The frequency of myopia over the entire study was 44%.

The surgical procedures and outcomes in the five groups are presented in Table 3. The overall surgical outcome was successful, however, in group 4, the frequency of visual acuity of 0.1 or better after surgery, the initial retinal reattachment rate, and the mean number of surgeries were significantly worse than in other groups.

Discussion

Trauma has been reported as one of the most common predisposing factors in pediatric RRD. The frequency of trauma has been reported to range from 21.9% to 43%¹⁻⁵ and most authors report a higher incidence in males than females. In our study, more than one-third of the cases (38%) were in the trauma group and the frequency of males was 89%. The predominance of males among traumatic patients may be related to higher exposure to trauma such as being hit by a ball during playing sports.² However, a higher incidence in males was also observed in other groups, especially in group 2.

Myopia is an important factor in Asians^{2,3} and its frequency ranges from 17% to 38%.¹⁻⁵ Though there were

differences in the prevalence of refractive errors between ethnic groups, Asians had the highest prevalence for myopia.⁷ In our study, the frequency of myopia in group 2 was 25% and the frequency of myopia over the entire study was 44%. However, the definition of myopia in previous reports ranged from -3 D to -6 D.¹⁻⁵ It was reported that the risk for idiopathic RRD increased tenfold compared with a nonmyopic eye, if the refractive error was greater than -3 D.⁸ However, it is difficult to clearly define myopia because clinical findings for emmetropic and moderate myopic eyes are not very different. The patients of group 2 were thought to have adult retinal detachment with early onset.

RRD associated with atopic dermatitis, one of the most common forms of dermatitis in Japan, has been increasing recently, and the prevalence of atopic dermatitis in Japanese elementary schoolchildren has been reported to be about 10%.⁹ Although there have been several theories about the pathogenesis of retinal detachment associated with atopic dermatitis, the mechanism of break formation is unclear at present. As for the types of break, in our study three of six breaks were caused by oral dialysis. Takahashi et al reported that retinal dialysis may result directly by slapping the eye, since the force would strongly affect that area of the eye under blunt trauma.¹⁰ The frequency of myopia more than -3 D of group 3 was relatively high at 40%. In group 3, blunt trauma and myopia might also contribute to the pathogenesis of RRD.

In Asian countries such as Japan and Taiwan, there is a high incidence of FEVR, accounting for 13% to 20% of pediatric RRD.³⁻⁵ However, in our study, the rate of FEVR in subjects was low at 6.3%. Some FEVR patients could have been included in group 5 without being diagnosed as FEVR, as there was only minute peripheral vascular abnormality. More careful attention is needed for the diagnosis of FEVR in pediatric RRD, as its protean manifestations are easily mistaken for other ocular disorders.^{4,5,11} The patients in group 4 developed RRD at a younger age than the other groups and undetected breaks, total retinal detachment, macula off, and PVR were more common.

Table 2 Refractive statuses in the five study groups

Refractive status	Group 1 (n = 18)	Group 2 (n = 12)	Group 3 (n = 5)	Group 4 (n = 4)	Group 5 (n = 6)
Spherical equivalent (mean \pm SD) (D)	-2.1 ± 3.3	-6.3 ± 1.8	-3.8 ± 2.7	2.0 ± 11.7	-1.0 ± 1.0
Myopia more than -3 D*	5 (28)	12 (100)	2 (40)	1 (25)	0
Moderate myopia*	4 (22)	10 (83)	1 (20)	0	0
High myopia*	1 (6)	2 (17)	1 (20)	1 (25)	0

Notes: *Number (%) of eyes. Moderate myopia = from -3 D to less than -8 D; high myopia = -8 D or higher.

Abbreviations: D, diopters; SD, standard deviation.

Table 3 Surgical procedures and outcomes in the five study groups

	Group 1 (n = 18)	Group 2 (n = 12)	Group 3 (n = 6)	Group 4 (n = 5)	Group 5 (n = 7)	P
Preoperative visual acuity						
In logMAR (mean ± SD)	0.22 ± 0.55	0.34 ± 0.84	0.88 ± 1.06	1.51 ± 1.51	0.61 ± 1.09	
≥0.1*	16 (89)	9 (75)	3 (50)	2 (40)	5 (71)	0.15
Final visual acuity						
In logMAR (mean ± SD)	0.04 ± 0.42	0.24 ± 0.67	0.36 ± 0.84	1.23 ± 1.36	0.54 ± 1.34	
≥0.1*	18 (100)	11 (92)	5 (83)	2 (40)	5 (71)	0.01
Initial retinal reattachment*	16 (89)	12 (100)	5 (83)	1 (20)	6 (86)	0.002
Final retinal reattachment*	18 (100)	12 (100)	6 (100)	4 (80)	6 (86)	0.16
Initial procedure						
Scleral buckling*	13 (72)	11 (92)	5 (83)	2 (40)	6 (86)	0.2
Vitreotomy*	5 (28)	1 (8)	1 (17)	3 (60)	1 (14)	
Number of surgical procedures (mean ± SD)	1.4 ± 1.0	1.1 ± 0.3	1.3 ± 0.8	2.8 ± 1.5	1.4 ± 1.1	

Note: *Number (%) of eyes.

Abbreviations: logMAR, logarithmic scale of the minimum angle of resolution; SD, standard deviation.

Therefore, the patients in this category will often require vitrectomy as an initial surgical procedure.

In cases in which a retinal break was precisely localized, scleral buckling allowed reattachment of the retina at a high rate similar to that expected in adults with retinal detachment. However, the initial reattachment rate after vitrectomy was not satisfactory. It is often difficult to perform a complete removal of the cortical vitreous on the detached retina, as there is less frequent posterior vitreous detachment and stronger vitreoretinal adhesion in pediatric RRD patients. Particularly in patients with FEVR, dissection of the vitreous in the peripheral avascular area is very difficult, since the vitreoretinal adhesions are so strong that iatrogenic retinal breaks easily occur.¹² Furthermore, since fibrovascular proliferation extended to the pars plicata in the patient with a falciform retinal fold, the placement of the infusion cannula and the removal of the fibrovascular proliferation were difficult. Therefore, we placed the infusion cannula in the inferonasal segment and removed the cortical vitreous and the fibrovascular proliferation as much as possible with triamcinolone-acetonide-assisted 25-gauge vitrectomy to facilitate easy access to the small space in pediatric eyes.^{13,14} However, the iatrogenic retinal break reopened under the silicone oil and retinal redetachment occurred. The etiology of MGS is unknown, and the treatment for retinal detachment associated with this syndrome is controversial. We considered traction as the pathogenesis of retinal detachment and performed vitrectomy to release traction. However, this case required multiple surgeries because of the difficulty in completely removing the cortical vitreous and the multiple iatrogenic retinal breaks. In addition, postoperative problems peculiar to pediatric patients include higher intraocular cellular activity and

difficulty in maintaining a posture. Therefore, the possibility of redetachment and PVR after surgery is higher in patients requiring vitrectomy than in the patients requiring buckling surgery. We hope that newer materials and instruments will improve surgical outcomes in the future.

We have described the characteristics and surgical outcomes of pediatric RRD patients in our hospital. However, our study is limited by its retrospective nature and the small number of patients, especially in group 4. Moreover, our study included some patients with short follow-up. It is difficult to evaluate the surgical outcomes for pediatric RRD patients from the results of our study alone. Also, it seems that the poor surgical outcomes in patients with congenital or developmental ocular anomalies were primarily caused by delayed diagnosis and prolonged retinal detachment. Thus, early detection and early treatment are the most important ways to improve the surgical outcomes of pediatric RRD.

Disclosure

The authors indicate no financial conflicts of interest in this work.

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