Chorioretinal coloboma in a paediatric population

OM Uhumwangho¹ and S Jalali²

Abstract

Aim To determine the validity of laser photocoagulation as a prophylactic treatment in the prevention of rhegmatogenous retinal detachment (RRD) in a group of paediatric patients presenting with chorioretinal coloboma.

Methods Observational case series of consecutive patients aged 0–15 years with chorioretinal coloboma seen in a tertiary eye hospital were reviewed. Data were analysed with SPSS version 16, a *P*-value of <0.05 was considered significant.

Results One hundred and ninety-eight patients (335 eyes) were identified. The prevalence of retinal detachment and ocular anomalies was 17.6 and 87.2%, respectively. Ocular anomalies included iris coloboma (71%), microcornea (45.1%), nystagmus (41.5%), strabismus (21.2%), and microphthalmos (19.1%). The prevalence of retinal detachment was 2.9% in those eyes that received prophylactic laser photocoagulation, whereas the risk of retinal detachment was 24.1% in eyes left untreated. Post-operative complications following retinal detachment surgery occurred in 86.7% eyes; the most frequent being recurrent retinal detachment (53.8%). The mean duration of follow-up was 1.59 ± 0.21 years (0–7 years) and 0.79 ± 0.16 years (0–8 years) in the group that had laser and in those that were treatment naive, respectively.

Conclusions Prophylactic laser treatment appears to have a protective effect for the prevention of RRD in eyes with chorioretinal coloboma. Measures towards prophylactic therapy should be instituted to reduce the risk of retinal detachment in choroid colobomatous eyes due to the problems in the management of these retinal detachments. *Eye* (2014) 28, 728–733; doi:10.1038/eye.2014.61; published online 28 March 2014

Introduction

Ocular coloboma is a rare eye malformation due to defective closure of the embryonic fissure, which normally occurs in the sixth and seventh weeks of fetal development.^{1–4} Coloboma may involve various parts of the eye, including the iris, ciliary body, choroid, retina, and optic nerve. Classic defects include the partial absence of the inferior quadrant of the iris, choroid, and retina. Frequently associated ocular anomalies include cataract, microphthalmia, and anophthalmia.⁵ Ocular coloboma can be sporadic or transmitted as an autosomal recessive, autosomal dominant, or X-linked trait. Genetic as well as environmental causes have been proposed to cause an intrauterine insult that can lead to defective closure of the embryonal fissure, leading to coloboma of the fundus.^{6,7}

The severity of visual disability is dependent on many factors including the size and extent of coloboma, associated anomalies of the globe such as microphthalmos and nystagmus, and the risk of rhegmatogenous retinal detachment (RRD).^{4,8,9} RRD occurs in ~40% of eyes that have choroidal coloboma.^{10–16} This can occur in the abnormally thin retina and the normal extracolobomatous retina. The aim of this study was to assess the efficacy of prophylactic laser photocoagulation in preventing RRD for a series of paediatric patients with chorioretinal coloboma.

Patients and methods

A retrospective review was conducted of all patients aged 15 years and younger who presented to the L.V. Prasad Eye Institute, Kallam Anji Reddy campus, Hyderabad, India, between January 2003 to December 2009 with a diagnosis of chorioretinal coloboma.

¹Department of Ophthalmology, University of Benin Teaching Hospital, Benin City, Nigeria

²Smt Kanuri Santhamma Centre for Vitreo Retinal Diseases, L.V. Prasad Eye Institute, Hyderabad, India

Correspondence: OM Uhumwangho, Department of Ophthalmology, University of Benin Teaching Hospital, P.M.B. 1111, Benin City, Nigeria
Tel: +234 8051100633;
E-mail: uhumwangho@uniben.edu

Received: 11 October 2013
Accepted in revised form: 5 February 2014
Published online: 28 March 2014

Demographic and clinical data included age at presentation, gender, parental consanguinity, and duration of follow-up. The best-corrected visual acuity was measured with a Snellen chart or Teller chart where possible. If available, the refraction was recorded. The presence of associated ocular anomalies and history of prophylactic laser photocoagulation was recorded. Laser photocoagulation was performed using a light-intensity burn to the margins of the colobomatous area, the goal being to achieve a chorioretinal adhesion at the margins of the defect. There was no difference in the clinical characteristics of those who received prophylactic laser photocoagulation and in the treatment naive group. The presence and duration of RRD together with proliferative vitreoretinopathy were noted. In eyes with a history of RRD, the nature and type of surgery together with outcome were noted. The grading of the coloboma was performed according to the Ida Mann classification as stated below.¹⁷ Media opacities precluding accurate grading were graded as zero for this study.

Type 1—coloboma extending above the anatomic disc

Type 2—coloboma extending up to superior border of disc

Type 3—coloboma extending below the lower border of disc

Type 4—coloboma involving the disc only

Type 5—coloboma present below the disc with normal retina above and below the coloboma

Type 6—pigmentation present in the periphery

Type 7—coloboma involving only the periphery

The data of the patients were entered into SPSS version 16 (SPSS Inc., Chicago, IL, USA) software and analysed. For statistical comparison, a *P*-value of <0.05 was considered significant. All applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research.

Results

Epidemiologic data

A total of 335 eyes of 198 patients were studied, comprising 106 (53.5%) males and 92 (46.5%) females. There were 138 (69.7%) patients with bilateral chorioretinal colobomata and 59 (29.8%) with unilateral involvement. There were 175 (52.2%) right eyes and 160 (47.8%) left eyes. Parental consanguinity was documented in 57 (28.8%) of the patients. The mean age at presentation was 7.8 ± 4.75 years (range 2 days to 15 years). One hundred and fifty-seven (46.9%) eyes were graded as type 2 (Table 1).

Visual acuity ranged between 20/20 and no perception of light. One hundred and forty-eight (44.2%) eyes had an acuity worse than 20/200 but better than light

perception. The refractive error was known in $\sim 50\%$ of eyes. Approximately 40% of the cohort was myopic with refraction <10 dioptres (Table 1). Prophylactic laser photocoagulation was performed in 103 (30.7%) eyes. In these eyes, the mean age at which laser was performed was 7.66 ± 4.31 years. Of the treated eyes, three (2.9%) had a RRD. Two of these eyes had RRD at presentation, of which one was confined within the colobomatous area, whereas the third developed RRD 3 years after laser was performed. In the non-treated group, 56 (24.1%) eyes developed a RRD. In all, a total of 59 (17.6%) eyes developed a RRD (22.147 , $P < 0.001$). The likelihood of developing a RRD was 10.606 times more in those who did not receive prophylactic laser treatment (95% CI = 3.236–34.764). A multivariate analysis after exclusion of 12 (3.6%) eyes with media opacities, which precluded accurate grading of coloboma, showed that for every year increase in patient's age, the likelihood of RRD increased by odds of 1.147 ($P < 0.001$), whereas a step increase in the type of coloboma decreased the likelihood of RRD by odds of 0.653 ($P = 0.020$). Eyes that did not have prophylactic laser performed were 8.755 times more likely to develop RRD when compared with eyes that received prophylactic laser ($P < 0.001$; Table 2). The duration of RRD could not be determined in 28 eyes (47.5%). The mean interval before presentation in patients recalling the duration of visual loss was 0.61 ± 0.95 years (range 4 days to 4 years). Spontaneous reattachment of the detached retina occurred in one (1.7%) patient with retinal detachment following appropriate positioning. Proliferative vitreoretinopathy changes (PVR) were present in 28 (47.5%) eyes (Table 3). In seven (11.9%) eyes, the presence or absence of PVR could not be ascertained. A total of 59 eyes in this series developed RRD, of which 30 (50.8%) opted for retinal detachment surgery. The remaining 29 (49.2%) patients did not, including the patient with spontaneous reattachment. No cases of bilateral RRD were recorded.

The mean age of onset of RRD was 10.03 ± 3.93 years. In 26 patients (46.1%), the age of onset of RRD was not known. For the patients who had prophylactic laser retinopexy, the mean age of onset of the RRD was 9.50 ± 6.36 years (range 5–14 years). Those patients developing RRD who were treatment naive had a mean age of 10.07 ± 3.89 years (range 1–15 years).

Surgical outcome

All the patients who had surgery underwent vitrectomy with encircling band and silicone oil used as intraocular tamponade, except one patient (0.3%) who did not have encircling band. Thus, no patient had scleral buckling done and gas was not used as intraocular tamponade in any patient. Among the operated patients, 20 (66.7%)

Table 1 Grading of choroid coloboma, visual acuity, and refraction

	Frequency (%)
<i>Grade</i>	
0 (Not gradable) ^a	12 (3.6)
Type 1	60 (17.9)
Type 2	157 (46.9)
Type 3	68 (20.3)
Type 4	10 (3.0)
Type 5	24 (7.2)
Type 6	3 (0.9)
Type 7	1 (0.3)
Total	335 (100.0)
<i>Visual acuity</i>	
20/20–≥20/40	47 (14.0)
<20/40–≥20/200	93 (27.8)
<20/200–>LP	148 (44.2)
LP	28 (8.4)
NLP	6 (1.8)
Not known	13 (3.9)
Total	335 (100.0)
<i>Refraction (D)^b</i>	
≤ −6.0	107 (31.9)
> −6.0	50 (14.9)
≤ −10.0	138 (41.2)
> −10.0	19 (5.7)
Not known	178 (53.1)
Total	335 (100.0)

Abbreviations: D, dioptre; LP, light perception; NLP, no light perception.

^aNot gradable due to media opacities.^bSpherical equivalent.**Table 2** Prophylactic laser, age at presentation, type of coloboma, and occurrence of rhegmatogenous retinal detachment

Variables	Regression coefficient	P-value	Odd ratio	95% Confidence interval	
				Lower	Upper
Age at presentation	0.137	<0.001	1.147	1.063	1.238
Type of coloboma	−0.426	0.020	0.653	0.456	0.935
<i>Prophylactic laser</i>					
No	2.170	<0.001	8.755	2.625	29.206
^a Yes			1		

^aReference category.

subsequently had silicone oil removal done, whereas 10 (33.3%) did not have removal of silicone oil. Following surgery, 14 (46.7%) patients had a recurrent retinal detachment that required repeat surgeries. A total of 19 (63.3%) patients had attached retina after surgery within the follow-up period. Post-surgical complications occurred in 26 (86.7%) eyes after surgery. In those with

complications, the most frequent was recurrent retinal detachment in 14 (53.8%), cataract in 12 (46.2%) eyes, hypotony in 9 (34.6) eyes, secondary glaucoma/ glaucoma surgery in 7 (26.9%) eyes, band keratopathy/ penetrating keratoplasty in 4 (15.4%) eyes, and phthisis in 1 (3.8%) eye. Following surgery, visual acuity improved in 17 (56.7%) eyes, was unchanged in 9 (30.0%) eyes and worsened in 4 (13.3%) eyes.

Associated ocular anomalies/follow-up duration

Table 4 shows associated ocular anomalies, which were present in 292 (87.2%) eyes with iris coloboma being the most common in 238 (71%) eyes, microcornea 151 (45.1%), nystagmus 139 (41.5%), strabismus (21.2%), and microphthalmos (19.1%). There were no associated ocular anomalies found in 43 (12.8%) eyes. The total mean duration of follow-up was 1.03 ± 0.18 years (range 0–8 years). The mean duration of follow-up was 1.59 ± 0.21 years (0–7 years) and 0.79 ± 0.16 years (0–8 years) in the group that had laser and in those that were treatment naive, respectively. The difference between both groups was significant with $P = 0.005$, Table 5.

Discussion

A coloboma of the choroid is characterized by congenital absence of part of the retinal pigment epithelium and choroid. It appears clinically as a prominent white zone within the ocular fundus, usually in the inferonasal quadrant. The lesion consists of a rudimentary retina with a few blood vessels over the sclera, which may be ectatic. The neurosensory retina continues as the intercalary membrane (ICM) in the area of the coloboma.⁴

In the series described by Mann, the most frequent coloboma extended to and beyond the superior aspect of the optic nerve and likely involved the papillomacular fibres.¹⁷ In our series, more than half the eyes classified as type 1 or 2 had vision less than 20/200. Other factors could account for the reduced vision in this subgroup, namely, lens opacities and associated ocular anomalies, which coexisted in ~90% of eyes. Such anomalies and limited visual potential may have influenced the decision to proceed with retinal detachment surgery, which in our series was performed in 50% of the cases. RRD in eyes with chorioretinal coloboma is thought to be secondary to a combination of breaks in the ICM and the presence of a communication between the sub-ICM space and subretinal space.^{10,13,15,18–21} There was one case (1.7%) of spontaneous reattachment of the retina following positioning. Although spontaneous retinal reattachment has been reported in the literature, most retinal detachments associated with chorioretinal coloboma

require surgery and often have poor visual outcomes.^{10,13,22}

Chorioretinal coloboma with a wider area of rudimentary thin retina as found in types 1–3 are more likely to harbour breaks, resulting in a greater risk of

RRD when compared with the other subgroups with smaller areas of abnormal retina. Increasing age is also an established risk factor of RRD. The use of prophylactic laser photocoagulation along the coloboma margin conferred significant benefit in reducing the risk of retinal detachment (odds ratio 8.755, $P < 0.001$). Retinal detachment occurred in 2.9% of eyes that had prophylactic laser photocoagulation in comparison with 24.1% in eyes that did not have prophylactic laser photocoagulation. As histology shows that the margins of paediatric choroid colobomas are usually compromised,¹⁹ strengthening or reinforcing these margins with laser to create a strong chorioretinal adhesion will reduce the risks of extracolobomatous retinal detachment. Pigmentation resembling laser scars and demarcation lines has been found in the margins of some colobomatous eyes, but its association with a lower incidence of RRD has not been reported.^{13,19,23,24}

In managing RRD in eyes with coloboma, difficulties may arise because of locating the retinal breaks and creating an adequate chorioretinal adhesion. The presence of atrophic holes without the presence of flaps or operculae in thin rudimentary retina, poor visualization of breaks due to white sclera background, hidden breaks in overhanging edge of coloboma or in areas of haemorrhage, and absence of retinal pigment epithelium all contribute to these difficulties.^{24,25} Furthermore, in colobomatous involvement of the optic disc, fluid may enter the subretinal space through defects in the optic nerve tissue. Various surgical techniques have been described to improve success of these eyes.^{13,16,21,23–28} The persistence of detachment of the ICM in most patients following surgery for retinal detachment in colobomatous eyes has been documented with optical coherence tomography.²⁹ This emphasizes

Table 3 Age of all patients and characteristics of eyes with RD

	Frequency (%)
<i>Age at presentation</i>	
<1 year	25 (12.6)
1–5 years	47 (23.7)
6–10 years	52 (26.3)
11–15 years	74 (37.4)
Total	198 (100.0)
<i>Duration of RD</i>	
<1 month	12 (20.3)
1–3 months	7 (11.9)
>3–6 months	3 (5.1)
>6 months–1 year	5 (8.4)
>1 year	4 (6.8)
Unknown	28 (47.5)
Total	59 (100.0)
<i>Proliferative vitreoretinopathy</i>	
None	24 (40.7)
Early	5 (8.5)
Late	23 (39.0)
Unknown	7 (11.9)
Total	59 (100.0)
<i>Outcome after RD surgery</i>	
Attached	19 (63.3)
Detached	8 (26.7)
Partially attached	3 (10.0)
Total	30 (100.0)

Abbreviation: RD, retinal detachment.

Table 4 Coloboma grading and ocular anomalies

Grade	Variables (%) ^b									
	Refraction		Laser performed	Nystagmus	Microcornea	Iris coloboma	Microphthalmos	Cataract	Strabismus	Lens coloboma
	>6	>10								
0	0 (0.0)	0 (0.0)	0 (0.0)	6 (50.0)	7 (58.3)	10 (83.3)	5 (41.7)	7 (58.3)	6 (50.0)	0 (0.0)
1	11 (34.4)	3 (9.4)	15 (25.0)	37 (61.7)	34 (56.7)	46 (76.7)	16 (26.7)	9 (15.0)	14 (23.3)	1 (1.7)
2	25 (34.2)	11 (15.1)	52 (33.1)	75 (47.8)	82 (52.2)	120 (76.4)	35 (22.3)	20 (12.7)	33 (21.0)	2 (1.3)
3	11 (30.6)	5 (13.9)	25 (36.8)	17 (25.0)	20 (29.4)	46 (67.6)	7 (10.3)	7 (10.3)	13 (19.1)	5 (7.4)
4	1 (16.7)	0 (0.0)	0 (0.0)	3 (30.0)	3 (30.0)	3 (30.0)	1 (10.0)	0 (0.0)	3 (30.0)	0 (0.0)
5	2 (20.0)	0 (0.0)	10 (41.7)	1 (4.2)	2 (8.3)	11 (45.8)	0 (0.0)	0 (0.0)	1 (4.2)	1 (4.2)
6	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (66.7)	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
7	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	1 (100.0)	1 (100.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)
P-value	0.871	0.739	0.001 ^a	0.001 ^a	0.001 ^a	0.002 ^a	0.005 ^a	0.002 ^a	0.032 ^a	0.253
Total	50 (31.8)	19 (12.1)	103 (30.7)	139 (41.5)	151 (45.1)	238 (71.0)	64 (19.1)	43 (12.8)	71 (21.2)	9 (2.7)

^a $P < 0.05$.

^bOthers: sclerocornea 0.6%, congenital ptosis 0.6%, lens dislocation 0.6%, blepharophimosis 0.6%, cornea plana 0.6%, epiblepharon 0.6%, glaucoma 0.6%, haemangioma 0.6%, aniridia 0.6%, persistent pupillary membrane 0.3%, toxoplasma scar 0.3%, nanophthalmos 0.3%, ectopia lentis 0.3%, epicanthus inversus 0.3%, and pigmentary retinal degeneration 0.3%.

Table 5 Duration of follow-up and laser intervention

Duration of follow-up	Laser intervention		Total (%)
	Laser not performed (%)	Laser performed (%)	
< 1 month	135 (58.2)	19 (18.4)	154 (46.0)
1–3 months	23 (9.9)	23 (22.3)	46 (13.7)
> 3–6 months	10 (4.3)	6 (5.8)	16 (4.8)
> 6 months–1 year	17 (7.3)	9 (8.7)	26 (7.8)
> 1–6 years	40 (17.2)	36 (35.0)	76 (22.7)
> 6 years	7 (3.0)	10 (9.7)	17 (5.1)
Total	232 (69.3)	103 (30.7)	335 (100.0)

$\chi^2 = 49.199$, $P = 0.001$.

the importance of sealing the junction between the ICM and extracolobomatous retina with a laser barrier. No case had scleral buckling done probably because of documented poor success rate of scleral buckling in colobomatous eyes.^{10,13}

This study found a high incidence of complications after surgery (86.7%). These complications will further worsen the prognosis for useful vision in these eyes, which underscores the need for interventions that will reduce the risk of retinal detachment. The most common complication was recurrent retinal detachment (53.8%). The most effective process for continued retinal attachment is the retinal pigment epithelial pump, which is deficient in the colobomatous area. However, within the follow-up period, 63.6% had attached retina. The decrease in the success rate of retinal detachment surgery in colobomatous eyes has necessitated the adaptation by various surgeons to improve the success rate.^{13,16,21,23–28} The laser-treated group had a longer follow-up period than the treatment naive group probably because knowledge that a procedure had been performed may have created some motivation to know outcome of the intervention.

Owing to the suboptimal vision usually found in eyes with choroidal coloboma, a predisposition to retinal detachment that can result in further worsening of vision and the complexities of surgery, it is recommended that prophylactic laser photocoagulation be done along the margin of the coloboma in these eyes to reduce the risk of retinal detachment. This can be done with light intensity burns that produce a minimal reaction, which is just enough to create the needed chorioretinal adhesion that will reinforce the margins of the coloboma while sparing the papillomacula bundle to reduce damage to the nerve fibre layer. This will also localize the colobomatous area and avoid visual loss that can arise from the procedure. Limitations of the study include the fact that the study was not randomized and there were no criteria on which eye received laser and which eye did not.

Summary

What was known before

- Chorioretinal coloboma is associated with retinal detachment that has a poor success rate with surgery.

What this study adds

- The risk of retinal detachment in chorioretinal coloboma can be reduced by performing prophylactic laser photocoagulation along the margins of the coloboma.

Conflict of interest

The authors declare no conflict of interest.

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