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Original Research Article

Refractive and Biometric Outcome of Premature Infants with Retinopathy of Prematurity: Comparison between Treated Vs Spontaneously Regressed

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Abstract:

Purpose: The purpose of this study was to determine refractive error and biometry of babies with retinopathy of prematurity at more than one year of age, and comparison between babies treated vs spontaneously regressed.

Methods: Babies detected with any stage of ROP, threshold or prethreshold type 1 which required laser or pretheshold type 2 and mild ROP which spontaneously regressed, with a minimum follow up of one year were included in this study prospectively. Records were reviewed for gestational age, birth weight, and stage of disease, zone of disease and presence of aggressive ROP. Cycloplegic refraction was done and biometric parameters including the axial length (AL), anterior chamber depth (ACD) and Lens thickness (LT) were measured. Degree and type of refractive error and biometry were determined and a comparison between treated group and regressed group was done. Possible associations of myopia analysed.

Results: Total 100 eyes of 50 babies were included. 64 eyes were treated with laser and 36 spontaneously regressed. Refractive error in treated group ranged from +4D to -18.5D whereas in regressed group it was +1.25D to -0.5D. 57.8% of treated and only 11.1 % of regressed group were myopic. Myope have mean SE of -3.27D (range -0.5 to -18.5D). Treated group had smaller axial length, shallower anterior chamber depth and thicker lens, suggesting myopia to be lenticular in origin. In this cohort lower birth weight and more posterior zone of disease was significantly associated with myopia.

Conclusion: Substantial number of babies, treated for ROP develops myopia. Myopia was found to be mostly of lenticular origin. Early detection & timely rehabilitation of refractive error is imperative.

Keywords: Retinopathy of Prematurity (ROP), Myopia of prematurity (MOP), Central cornea thickness (CCT), Anterior chamber depth (ACD), Spherical equivalent (SE).

Introduction

Retinopathy of prematurity is a leading cause of blindness and visual impairment all over the world. Blindness due to ROP can be prevented by timely screening and prompt treatment of the disease. Despite timely intervention there can be suboptimal visual outcome owing to presence of refractive error, strabismus and other ocular abnormalities. It is known that prematurity, ROP and laser photocoagulation increases the risk for myopia.[1,2]

Myopia, astigmatism, and anisometropia are common in preterm infants with or without ROP. [1-5] which of the eye's refractive elements is most involved in the development of myopia in ROP is not clearly understood. Various studies have shown several possibilities like increased corneal curvature, increased axial length, decreased anterior chamber depth, and increased lens thickness and power as possible cause of myopia in ROP. [6-8]

The aim of this study was to determine and compare refractive status and biometry of babies with severe ROP (lasered) and mild ROP (spontaneously regressed) at more than 1 year of follow up and to find out possible associations of myopia.

Method

All babies screened, diagnosed and treated and followed up with any stage of ROP with a minimum follow up of one year were included in this study. Babies were divided into two groups: group 1 Treated group included babies with severe ROP (threshold and prethreshold type1 ROP) treated with laser photocoagulation and group 2 included babies of mild ROP (pretheshold type 1 or mild) which spontaneously regressed.

Type of laser used in treated eyes was frequency doubled Nd: Yag (Iridex). Babies who developed adverse structural outcome like retinal detachment

were excluded. Retrospective record analysis was done to note birth weight, gestational age, stage and zone of ROP and presence of aggressive ROP.

Refractive status was assessed after full cycloplegic refraction with atropine by streak retinoscope. Myopia is defined as refractive power of ≥ -0.5D, hypermetropia as ≥ +0.5D and astigmatism as ≥ ±0.5D. Hypermetropia was subdivided into two groups – low hypermetropia (SE < +5.0 D) and high hypermetropia (SE ≥ +5.0 D), myopia in to mild (≥0.5 to -3D), moderate (-3 to -6D), and high (>-6D), and astigmatism (cylindrical degree (CD) ≥ ±0.5 D) and high astigmatism (CD ≥ ± 2.0 D). Anisometropia was defined as a difference equal or more than 1.0 D for hypermetropia and equal or more than 2.0 D for myopia. All eyes were scanned using the sonomed a scan ultrasound and the following parameters were noted as part of ocular biometry: axial length (AL), lens thickness (LC) and anterior chamber depth (ACD). All parameters were compared between two groups. Parameters were also analyzed to find possible association for myopia.

Results

100 eyes of 50 preterm babies were included in this study. 64 eyes in group 1 (laser treated) and 36 in group 2 (mild, spontaneously regressed). 56% of cohort was females. Mean age at the time of examination was 28 months. Mean gestational age of the cohort was 30.83 weeks (range was 28-39 weeks), mean birth weight was 1318.33g (range 700-1800gms). The gestational age was comparable in group 1&2 (30.88 wks vs 31.11 wks), but the birth weight was significantly lower (1334 gms) in group 1 compared to group 2 (1666.6gms). There is significant deference in zone distribution in both groups. Most babies have zone II disease in both groups. Zone 1 disease was seen only in group 1 (25%) and zone III disease mostly in group 2 (40%). Most of the babies in group 2 had stage I disease whereas stage II was most commonly seen in group 1. 53.1% of treated eyes had aggressive ROP.

On determination of refractive errors, 41% of total cohort was myopic. The incidence of myopia in treated group was significantly higher than self-regressed ROP group (p0.009). In group 1, 57.8% were myopic and 36% were hypermetropic. In group 2 only 11.1 % have myopia and 80.6% have hypermetropia. All cases of hypermetropia have low degree hypermetropia. Mean spherical equivalent in group 1 was -1.21D, whereas in group 2 it was +0.633D. Myopic eyes have mean SE of -3.27D (range -0.5 to -18.5D). Myopia in group 2 was only mild in nature. In group1 it was mostly mild (42.2%) but moderate (12.5%) and high myopia (6%) were also seen in significant proportions. Incidence of astigmatism was 25% in total cohort and not significantly different in two groups but degree of mean cylindrical was higher in treated group. On comparison of biometric parameters between two groups, group 1 had smaller axial length, shallower anterior chamber depth and thicker lens as compared to their non-treated counterparts. The comparison between two groups summarized in table 1.

Table 1: Comparison of group 1 (treated) vs group 2 (spontaneously regressed)

Variable	Group 1 (n=32,64 eyes)	Group 2 (n=18, 36eyes)	P value
Age (months) at examination	25.72	32.22	0.007
BW (gm)	1334.06	1666.67	0.000
GA (weeks)	30.88	31.11	0.586
Myopia (%)	57.8(37)	11.1(4)	0.000
SE (D)	-1.21	+0.633	0.009
Astigmatism (%)	21.9 (14)	30.16 (11)	0.356
Cyl (D)	-0.41	+0.31	0.000
Axial length (mm)	20.52	21.33	0.003
Lens thickness (mm)	4.22	3.55	0.000
Ant chamber depth (mm)	2.76	3.09	0.000

Further comparison of myopic (37, 57.8%) and non-myopic (27,42.2%) in group 1 was done to find associations of myopia. There was no gender predilection for myopia seen.

Birth weight was significantly lower in myopics (1278.92gms) than in non-myopic (1409.63) (p0.025). Myopic eyes have significantly more posterior zone involvement. Myopes have a significant proportion of disease in zone I and II and non-myopes had mostly in zone II and III. Axial length and anterior chamber depth was lower in myopes than the non-myopes whereas lens thickness was higher, but this difference was not found to be statistically significant.

No significant difference was found in two groups with regard to stage of disease, presence of aggressive ROP or gestational age. This comparison is summarised in Table 2.

Table 2: comparison between myopic and non-myopic in treated group

Variable	Myope (n= 37)	Non Myope (n= 27)	P value
Age (months)	25.35	26.22	0.744
BW (grams)	1278.9	1409.6	**0.025**
GA (weeks)	30.73	31.07	0.493
Sph (D)	-2.93	+1.67	0.000
Cyl (D)	-0.63	-0.12	0.026
SE (D)	-3.27	+1.61	0.000
AL (mm)	20.38	20.69	0.409
ACD (mm)	2.71	2.82	0.141
LT (mm)	4.33	4.07	0.303

On comparison of myopes of treated group (group 1) vs myopes of non-treated group (group 2), though the latter group was very small one, we found significantly lower birth weight and gestational age in treated myopes. Spherical equivalent was significantly higher in treated myopes. Value of astigmatism was also higher in treated myopia group. Axial length and anterior chamber depth was significantly lower and lens thickness was significantly higher in treated myopes.

Discussion

Babies with history of prematurity especially if they develop ROP have higher incidence of myopia. The incidence of myopia rises proportionately with increasing levels of prematurity and severity of ROP. [2] In this cohort we have found a high incidence of myopia in babies treated for threshold and pre threshold ROP as compared to spontaneously regressed cases. In total cohort 41% were myopic, 57.8% of treated eyes were myopic whereas only 11.1% of non-treated. Veleva et al reported incidence of myopia in their cohort to be 63.6%. 9 various other studies have reported variable incidence of myopia in laser treated eyes ranging from 14% to 77%. [10,11] Cryo ROP and ETROP study have also concluded preterm infants with severe ROP exhibit significant refractive errors at a higher frequency than those with mild ROP and without ROP. [2,3]

In this cohort we observed more posterior zone of ROP to be significantly associated with myopia. Lower birth weight was also observed more with myopia. Pidro A et al also showed in their cohort, lowest BW was in patients with myopia suggesting negative correlation between the appearance of refractive errors and birth weight.[12]

Myopia secondary to severe ROP may range from low to high myopia. Most of the cases in our cohort have mild to moderate myopia and only 6% were found to have high myopia (>6D). Age at the time of examination could be one of the possible factors related to lower prevalence of high myopia. Follow up examination of these babies is must to find out progression of the myopia. Myopia of prematurity (MOP) is a result of arrested development of the anterior segment and occurs irrespective of ROP status. The features of an eye with MOP are a low axial length-to power ratio, a shallow anterior chamber, and a thick lens.1 It has been suggested that myopia of prematurity (MOP), tends to regress during the first year of life resulting in emmetropic or hyperopic refractions later; however, this shift does not occur when severe ROP develops. [13,14]

In this cohort on comparing biometric parameters between treated severe ROP group to mild ROP, axial length and anterior chamber depth were found to be significantly lower in treated than non-treated group, whereas lens thickness was significantly higher in treated population. Kaur S et al observed shorter axial length, higher lens thickness, deep anterior chamber in laser treated children, comparable to our study population. [15]

Zeng X et al also concluded, compared to full-term infants, the development of CCT, ACD, LT, and AL was relatively delayed after ROP laser surgery, resulting in thin central corneal thickness, steep corneas, shallow anterior chambers, thicker lenses, “rounder” lens morphology, increased refractive power, and short eye axes, leading to the development of myopia. [14] The refractive error status is mainly influenced by lens thickness. They consider these changes to be effects of laser photocoagulation on the emmetropization of eye. We are not sure these biometric changes observed are due to severity of disease itself or effect of thermal and destructive nature of laser or both. Wu et al. reported disrupted tissue in the avascular zone of the peripheral retina and blocked local growth signal from the peripheral retina after laser treatment, resulting in altered ciliary or lens development with a thickened lens. [16]

Conclusion

In conclusion there is high incidence of myopia in babies with severe ROP treated with laser photocoagulation compare to spontaneously regressed ROP. Lower birth weight and posterior zone of disease are significantly associated with myopia. ROP associated myopia can be attributed to alteration in anterior segment development, primarily, an increase in lens thickness with consequent higher lenticular power. Timely

detection, correction and good follow up are imperative for visual rehabilitation of ROP babies.

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