Effects of Retinopathy of Prematurity and its Treatment on Ocular Alignment and Refraction at 1 Year Old: Preliminary Reports

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ABSTRACT

Purpose: We investigated refraction and strabismus in laser treated and non-treated preterm infants at 1 year.

Materials and Methods: Premature infants with a birth weight <1,500 g and a gestational age <32 weeks were included. There were 13 preterm infants whom needed laser treatment for ROP (group 1), 12 preterm infants (group 2) without ROP and 15 term infants as the control group (group 3). We assessed patients with retinoscopy, srtabismus examination (tropias) and fundus examination at the end of their first year. Refraction was expressed as spherical equivalent refraction (SER) (SER= spherical refraction+1/2 cylindirical refraction.) Definition of hyperopia was SER ≥+2,00 D; miyopia was SER ≥ -0,5; astigmatism was as absolute cylindirical refraction ≥ 1,00 D.

Results: The prevalence of refractive errors and ocular alignment abnormalities at 1 year old in groups 1 and 2 compared to group 3 were, respectively: myopia %7,7 and %0 versus %6,7 ($p>0.05$); hyperopia %26,9 and %87,5 versus %60 ($p<0.05$); astigmatism %53,8 and %54,8 versus %43,3 ($p>0.05$); and strabismus %15,4 and %16,7 versus %26,7 ($p>0.05$). (Fig 1)

Conclusion: We recorded higher rates of hiperopia in preterm infants ($p<0.05$) and the risk of developing this disorder decreased significantly with ROP laser treatment. Myopia, astigmatism and strabismus rates were not different between three groups. The parents of the premature babies should be informed of the possible risks of refractive disorders and ocular alignment abnormalities.

Key Words: Refraction, Retinopathy of prematurity, Strabismus.

INTRODUCTION

Retinopathy of prematurity (ROP) had become an important issue in preventable blindness with the development of neonatal care facilities.[1] It is confirmed that the incidences of myopia, astigmatism, strabismus, amblyopia and anisometropia increase in ROP children as compared with healthy children.[2] Laser therapy is an effective treatment of choice for ROP but the Early Treatment for ROP Cooperative Group (ETROP) study reported nearly 60% of those efficiently treated have suboptimal vision (<20/60) and up to 29% of treated children develop severe visual impairment (worse than 20/200).[3] Myopia is the commonest refractive error in children who had laser photocoagulation for ROP treatment. The studies have linked myopia in children with ROP to prematurity, severe ROP and structural sequelae of laser treatment.[4] In this study we investigated refraction and strabismus in laser treated and non-treated preterm infants at 1 year old. We believe that enlightening the mechanism of the development and progression of refractive disorders and ocular alignment in children with ROP who had laser photocoagulation is an important step to develop appropriate management tools as well as counseling of parents regarding refractive error development and progression after laser photocoagulation.

MATERIAL AND METHODS

The study was conducted at a tertiary care referral institute. The study adhered to the Declaration of Helsinki and was approved by the local ethics committee. A review of the charts of all children who visited the pediatric ophthalmology section between January 2015 and June 2018 with a history of ROP was done. We excluded patients

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who underwent surgery or received bevacizumab for ROP. Patients with secondary pathologies like glaucoma or cataract (except strabismus) were also excluded. Patients with any other systemic disease were excluded. The records were reviewed for gestational age and birth weight. The stage of ROP was noted. The children who needed treatment were either threshold ROP and type 1 prethreshold ROP in accordance with ETROP guidelines.[5] Premature babies with a birth weight <1,500 g and a gestational age <32 weeks were included. There were 13 preterm infants whom needed laser treatment for ROP (group 1), 12 preterm infants without ROP (group 2) and 15 term infants as the control group (group 3). The refractive error at follow up visits was noted. The refractive error measured on a subjective streak retinoscopy after the ROP regressed; at any time between 10 and 12 months of age was substituted as the retinoscopy value at 1 year of age when the refraction at 1 year was not available. At presentation, we also examined for ocular alignment (tropias) with the cover test. We defined heterophoria as a deviation that is possible to keep latent by a fusion mechanism. We used the prism cover test and the Krimsky prism reflex test[6] for this purpose. Only clinically significant ocular deviations (strabismus) were considered as heterotropia. The refractive error was measured by streak retinoscopy 60 minutes after dilation with cyclopentolate 1% (three times at an interval of 10 min). We assessed posterior segment with an indirect ophthalmoscope for structural sequelae (in the form of narrowing of arcades/straightening of vessels/disc drag/macular heterotropia/retinal detachment/fold involving fovea/corneal opacity). Refraction was expressed as spherical equivalent refraction (SER): SER= spherical refraction+1/2 cylindirical refraction. Hyperopia was defined as SER ≥+2,00 D; miyopia was defined as SER ≥ -0,5; astigmatism was defined as absolute cylindirical refraction ≥ 1,00 D.

SPSS Version 23.0 (SPSS; IBM SPSS Statistics for windows, version 21.0. NY, USA) was used for statistical analysis. Chi-square test or fisher test was used to compare categorical variables. One way analysis variance was used for ANOVA for the variables with parametric distribution and Kruscal Wallis test for the variables without parametric distribution. P < 0.05 was considered significant.

RESULTS

There were 13 preterm infants whom needed laser treatment for ROP (group 1), 12 preterm infants without ROP (group 2) and 15 term infants as the control group (group 3). The mean gestational age (weeks ± standart deviation) was 28,31±2,78 in Group 1, 31,25±2,26 in Group 2 and 39,42±1,12 in Group 3. The mean birth weight (gr±standart deviation) was 1201,54±409 in Group 1, 1731±406 in Group 2 and 3264±526 in Group 3 (Table 1). The prevalence of refractive errors and strabismus at 1 year old in groups 1 and 2 and 3 were respectively: myopia %7,7, %0 and %6,7 (p>0.05); hyperopia %26,9, %87,5 and %60 (p<0.05); astigmatism %53,8 , %54,8 and %43,3 (p>0.05); and strabismus %15,4 , %16,7 and %26,7 (p>0.05) (Fig 1).

DISCUSSION

In the first epidemic, ROP was initially regarded as a major cause of visual deficit in infants because of the wide application of oxygen in low birth weight infants and preterm neonates with gestational age <32 weeks (7). The oxygen supplement is a double-edged sword as restricting it reduces incidence of ROP but the mortality and risk for cerebral palsy increases.[8]

The second epidemic of ROP started in 1970s, as the incidence of prematurity increased in high-income countries with the preterm neonates having the gestational age of <28

weeks.[9] ROP has an increasing importancy in many parts of the world today but it is an avoidable cause of blindness.[10] Our study presents the status of refractive errors in children with ROP and the effect of laser treatment on refractive errors at age 1 year.

Myopia is a common refractive disorder in preterm infants. Miyopia prevalence seems to increase with the level of prematurity and the ROP degree.[11] There are three types of prematurity associated miyopia with prematurity were described in literature:[12] 1- Physiological myopia characterized by a flat anterior chamber, increased corneal curvature and a spherical lens. 2- Myopia of prematurity , related to a short axial length, a shallow anterior chamber,

Table 1. *Summary statistics of the enrolled patients. Group 1: preterm infants whom needed laser treatment for ROP; Group 2: preterm infants who did not have ROP; Group 3: term infants . Abbreviations: GA:gestational age; SD: standard deviation; BW: birth weight; ROP: retinopathy of prematurity.*

GROUP	PATIENTS	EYES	MEAN GA (week ± SD)	MEAN BW (g ± SD)
1	13	26	28,31 ±2,78	1201,54 ±409
2	12	24	31,25 ±2,26	1731 ±406
3	15	30	39,42±1,12	3264 ±526

and a thick lens. 3-Myopia secondary to severe ROP, a stable form of myopia. The developmental anomaly of the retina in prematurity with or without ROP may lead to local ocular growth signals.[13] These local signals may cause the anterior-segment changes in ROP. However in our study (Figure 1), the myopia prevalence was not high in any of the groups, significantly. (Figure 1) In preterm children we recorded higher rates of hiperopia ($p<0.05$). The risk of developing hiperopia has decreased with ROP laser treatment, significantly. This may be the reason of the myopia-inducing effect of the laser therapy at 1 year.

Term infants generally have axial hypermetropia.[14] The prevalence of hyperopia in groups at 1 year old is shown in Figure 1. The risk of developing this disorder seemed to decrease significantly with ROP laser treatment in our study.

The astigmatism prevalence was not significantly different in all groups in our study.(Figure 1) With the substitution of cryotherapy with laser, perhaps there is a tendency toward lesser astigmatism.[15]

ROP, refractive disorders, anisometropia and neurological deficits may cause strabismus in preterm children.[16] In our study, the incidence of strabismus was not significantly high in term, preterm or lasered-preterm children (Figure 1). This low rate of strabismus in our study may be attributed to a short follow-up duration, predominant symmetric presentation, and regression without sequelae in both eyes. Some reports concluded that the onset of strabismus in preterm infants is variable and this effects the planning of long-term follow-up and care.[17]

There are numerous studies conducted on the refractive status and optical components in ROP babies and those who were treated with laser fotocoagulatio.[18,19] The proposed reasons for high myopia are a steep keratometry and a shallower anterior chamber depth. The optical basis of myopia is a combination of these factors.

Our study had some limitations: It had a retrospective nature and the number of patients included in all groups was limited. We planned to add third an sixth year controls in time and assessed this as a preliminary report. The relationship between refractive errors and premature birth was studied before and differences in the prevalence rates of myopia, hyperopia and astigmatism are attributed to the different birth weight and gestational age criteria used to define a preterm infant.[20]

CONCLUSION

In preterm children we recorded higher rates of hiperopia ($p<0.05$). The risk of developing this disorder decreased significantly with ROP laser treatment, probably related with the local ocular growth signals. Myopia, astigmatism and strabismus rates were not different in all groups. Parents of the preterm infants should be informed of the possible risks of ocular alterations due to refractive and ocular component changes.

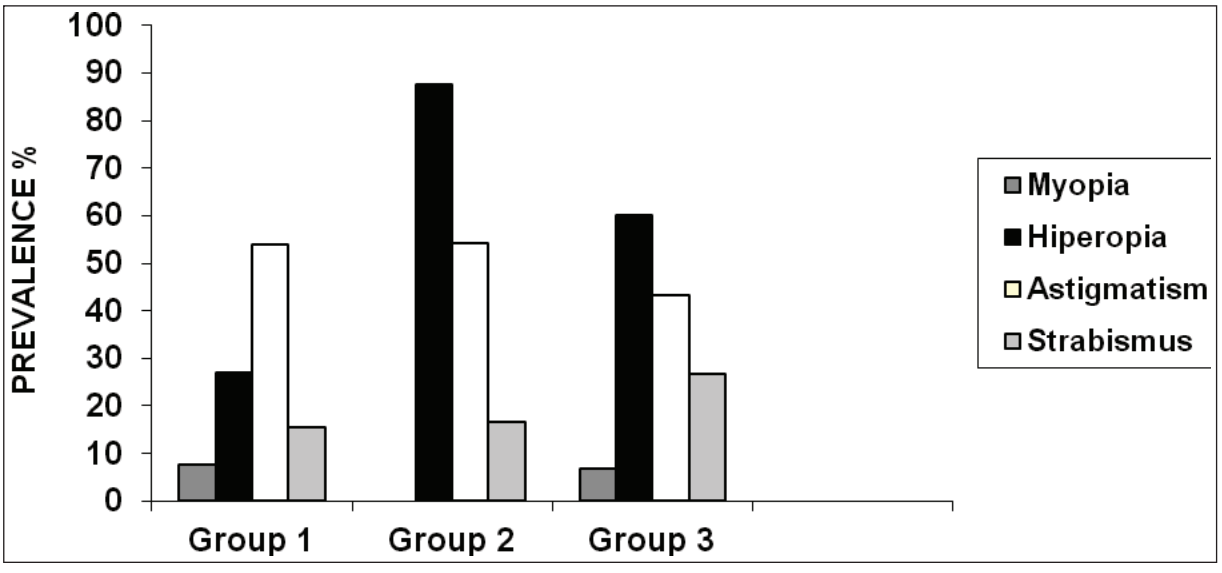

Figure 1. *Refractive error and strabismus prevalence at 1 year old in all groups. Group 1: preterm infants whom needed laser treatment for ROP; Group 2: preterm infants who did not have ROP; Group 3: term infants. Abbreviations; ROP: retinopathy of the prematurity.*

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