

Visual impairment in premature children in school age

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Background: The developments in neonatology have resulted in an increasing number of deliveries of extremely immature infants that are associated with high morbidity. The main cause of eye disorders is retinopathy of prematurity (ROP) and neurological diseases. Eye disorders related to the retinopathy of premature infants may be presumed and examined very early after birth. Many of the eye disorders appear, however, later in life.

The aim of this study was to document the quality of visual functions in premature infants in their school age and to compare them with the visual functions in a group of full-term healthy children.

Materials and methods: The research was carried out on 37 children at the age of 8, who were born prematurely with a weight below 1500 g. The visual acuity, contrast sensitivity, strabismus and refraction errors were examined. Similar qualities of vision were examined in the group of full-term born children of the same age.

Results: The visual acuity in the group of premature infants was in the range of 1.0–0.8 in 80.6% of eyes, 0.7–0.5 in 6.9%, 0.4–0.3 in 2.8%, 0.2–0.1 in 8.3%, less than 0.1 in 1.4% of eyes. 48.6% of the examined children wear glasses, and hypermetropic correction prevails in 28.4% of their eyes. Strabismus was found in 18.9% of premature children. Contrast sensitivity was reduced in all spatial frequencies, mostly to the level of 3.69 c/deg ($P < 0.001$).

Conclusions: Results of this study confirm an increased prevalence of refraction errors and strabismus in premature infants. The contrast sensitivity was in the group of premature infants significantly lower. The ophthalmologic follow-up of the premature infants should include the children both with and without ROP.

Key words: premature infants, refractive errors, strabismus, contrast sensitivity

INTRODUCTION

In recent years, the numbers of rescued premature infants that are extremely immature has been substantially growing due to the development of neonatology. In the year 1950, approximately only 8% of infants with a birth weight below 1000 g survived. At present this number is already more than 80%. However, these infants are afflicted with a high morbidity. Great problems are CNS disorders, chronic pulmonary diseases, liver and heart disorders, and others. In spite of great progress in contemporary neonatology, these rescued immature infants are not saved from various health disorders, including visual disorders (1), later in life. Their main cause remains retinopathy of pre-

maturity (ROP) and, later in their life, neurological diseases as well. The eye disorders related to retinopathy of prematurity may be presumed and examined already very soon after birth, but many of eye disorders appear only later in life. Complete examination of the visual functions is possible as late as at the age of school attendance. The aim of the present study was to document the visual functions of premature infants in the school age.

MATERIALS AND METHODS

The study cohort comprised 8-year-old children that had been born pre-term and whose birth weight had been 1500 g or less. Fifty children were invited to the research, of them 37 appeared for the 8-year examination. From the available documentation, information on general diseases of the children was obtained (mainly neurological disorders that may markedly influence vision).

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Visual acuity was examined on an automatic optotype projector from a distance of 5 m and refraction errors with an autorefractor and a Powerref device (EriLens).

The contrast sensitivity was examined on the Ginsburg's table VCTS of the Vistech Consultants firm (Dayton, USA) with the coverage of spatial frequencies 1.15–27.25 c/deg at the examination distance of 208–420 cm.

Strabismus and binocular balance were examined on a synoptophore.

The control group comprised 18 full-term healthy infants (36 eyes) with the average age 9.5 (9–12) years.

The results were statistically processed by means of the Mann-Whitney U-test.

The parents of the children were acquainted with the goal of the research and provided informed consent. The research was approved by the ethics commission.

RESULTS

The average birth weight of infants in the sample of premature was 1093 g (minimum 600 g and maximum 1500 g). The average gestation age at birth was 29 weeks (the lowest 26 weeks, the highest 35 weeks).

One child (2.7%) attends a special school, 6 children (16.2%) kindergarten, and others attend the primary school.

One child (2.7%) had suffered from cryopexy of retina due to retinopathy of prematurity. Bilateral surgery had been performed.

The best corrected visual acuity ranged within 1.0–0.8 in 58 eyes (80.6%), 0.7–0.5 in 5 eyes (6.9%), 0.4–0.3 in 2 eyes (2.8%), 0.2–0.1 in 6 eyes (8.3%), less than 0.1 in one eye (1.4%).

Nineteen children did not wear glasses (51.4%), 10 eyes (13.5%) had myopic correction, and 21 eyes (28.4%) had hypermetropic correction. Astigmatism over one cylindrical dioptre was found in 9 eyes (12.2%). The significant difference ($p < 0.001$) between the spherical equivalent (SE) in the premature infants and the control group is shown in Fig. 1, from which it is evident that in 100% of control group children the SE was up to ± 2 D, in 70.3% of eyes of children in the premature group the SE is $> \pm 2$ D, in 16.2% of children it is $> \pm 4$ D.

Strabismus was found in 7 children (18.9%). In 3 cases (8.1%) it was

exotropia, in 4 cases (10.8%) esotropia. Three children (8.1%) had been operated on for strabismus. Nystagmus was detected in one child (2.7%). In the control group, neither strabismus nor nystagmus occurred.

The contrast sensitivity was reduced in all spatial frequencies except 1.15 c/deg ($p = 0.709$), the biggest difference in comparison with the control group was found on the level of 4.0 c/deg ($p < 0.001$) (Fig. 2).

The motility problems in this group were found in 9 children (24.3%), 4 children (10.8%) had undergone an orthopaedic operation. In 5 cases (13.5%) perinatal intracranial bleeding had occurred.

DISCUSSION

As evidenced by our results, the quality of vision in premature infants is in many parameters worse than in the group of full-term infants. In the group of premature infants a lower best corrected vision acuity was found compared to the control group. Similar results have been found by other authors as well. Holmström et al. (2) tested the vision acuity in a group of 260 premature infants with a birth weight below

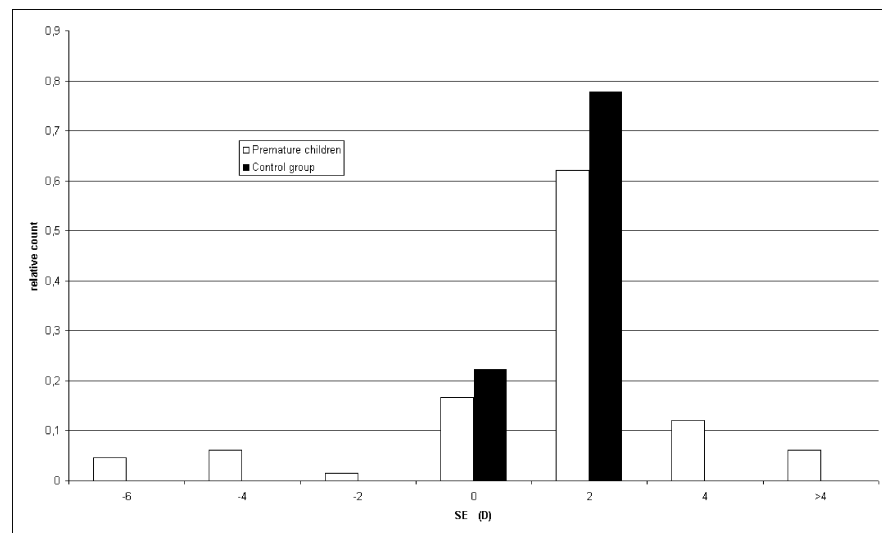


Fig. 1. Spherical equivalent in the premature childer and the control group

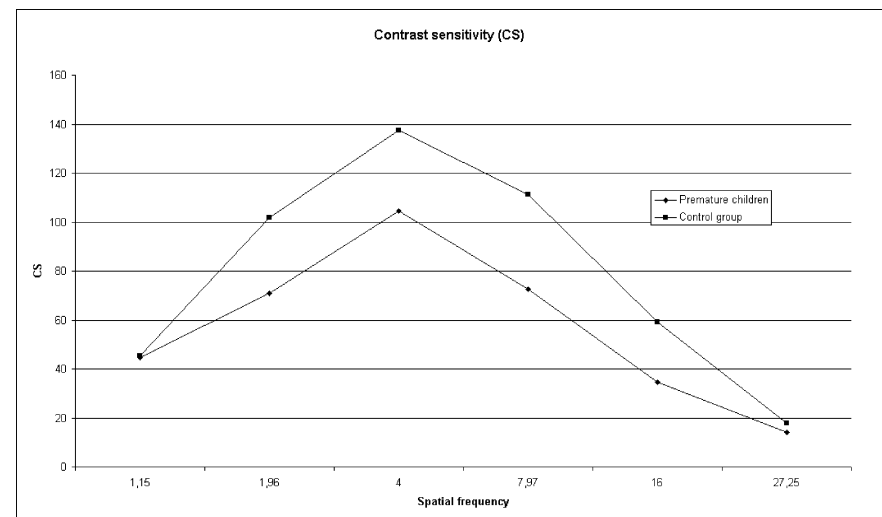


Fig. 2. Contrast sensitivity in the premature infants and the control group

1500 g and found that good vision acuity (0.7 and better) was absent in 34% of premature infants, versus 6% of infants from the control group. This results from the consequences of ROP and neurological lesion. Schalijs-Defos et al. (3) offered even a predictive model on the ground of their observations, enabling the probability of eye disorder to be counted at 5 years of age. In their calculations they took into account the gestation age, the length of oxygen therapy and the length of hospitalisation. Furthermore, a higher rate of refraction errors, myopia as well as hypermetropia and astigmatism, was found. To what extent the occurrence and level of short-sightedness are affected by the cryotherapy of ROP is discussed. Ben-Sira et al. (4) alleged the grade of short-sightedness to be higher in eyes after cryotherapy, Laws et al. (5) proved that the short-sightedness occurred more frequently after the treatment of retina by cryotherapy in comparison with laser treatment. On the other hand, Nissenkorn et al. (6) found that there was no difference in the incidence and grade of myopia in the group with scarred ROP after or without cryotherapy, and presented the idea that cryotherapy itself may not be the cause of short-sightedness. Other authors, such as Kent et al. (7), state that the occurrence of short-sightedness is markedly higher in eyes with the third grade of ROP as compared with the first and second grade. During refraction examination they also found that with a higher grade of ROP astigmatism increased as well. They have further proved that the extent of myopia is related not only to the axial length of the bulb but also to the lenticular constituent (7). Saunders et al. (8) found in their group clinically significant disorders of refraction in 19% of 4-year-old premature children. Their study confirmed a higher occurrence of myopia, astigmatism and anisometropia in premature children.

We have observed strabismus in 18.9% of premature children. Similar results have been published by O'Connor et al. (9) who found 19.3% of strabismus in her group of 169 premature children, in contrast to 3% in healthy children. Similar results have been described by Darlow et al. (10) – namely strabismus in 22% of premature infants with the birth weight below 1500 g. Strabismus occurs also in children with brain defects. Obviously, disorders of a developing brain may result in a plenty of eye disorders including high refraction errors, oculomotor palsy, strabismus, nystagmus, abnormality of the visual pathway. Pennefather et al. (11) found strabismus in 52% of children with a brain defect that were born before the 32nd gestation week. These numbers contrast sharply with the 2% of occurrence of strabismus in the normal population.

In the test group, contrast sensitivity was significantly decreased in comparison to the group of full-term infants. The influence of prematurity on contrast sensitivity has been studied by O'Connor et al. (9) who found distinctly decreased values of contrast sensitivity in the group of 169 premature infants compared with the

control group. A lower contrast sensitivity was also found in patients with normal vision acuity, which obviously reflects a central neurological affliction. The decline of contrast sensitivity in premature infants in comparison to the group of full-term infants has been confirmed by the study of Dowdeswell et al. (12) who found the difference even after excluding children with eye or brain pathology from the test group.

In our group, motility disorders have been found in up to one third of the children. In one child (2.7%) strabismus occurred together with the third grade retinopathy of prematurity. Two children (5.4%) suffered from strabismus accompanied by motility disorder.

CONCLUSION

The results of our study, namely a higher occurrence of vision disorders, show the necessity of following regularly premature infants with a low birth weight. Follow-ups, even in later age, together with the attempt to overcome and compensate these errors, are very important, especially in children with common problems who have frequent vision complications as well.

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