# Assessment of intraocular pressure in children with cerebral palsy

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## ABSTRACT

**Introduction:** Nearly half of the patients with cerebral palsy (CP) may face frequent ophthalmological problems including strabismus, refractive errors and abnormal intraocular pressure.
**Purpose:** In this study we aimed to investigate the relativeness between intraocular pressure and neurological pathologies in patients with selected types of CP.
**Material and methods:** The subject of the analysis was to show intraocular pressure in patients within two groups of CP: diplegia spastica and tetraparesis, with nervous system pathologies taken into account. Analysis consisted of 103 patients (66 boys, 64%) between 2-18 years old (mean age 9.7±3.87). 44 patients (42%) had diplegia spastica, while 59 patients had (58%) tetraparesis. During the diagnostics process the checking of intraocular pressure was carried out with a non-contact tonometer. The data were evaluated with correlation, Chi Square and Fishers' Extract Test. The border value of significant statistical level was accepted p=0.05.
**Results:** In the statistical analysis of the study was proven some correlations between intraocular pressure and type of CP, type of delivery, term of birth, and possibility of walking of patients with CP.
**Conclusions:** The study affirmed that results of tonometry above the norm were more common in patients with tetraparesis than with diplegia spastica, mainly in non-walking patients. Abnormal intraocular pressure, both hypo and hypertony were diagnosed as being more common in children born naturally, from a full term pregnancy.
**Key words:** cerebral palsy, diplegia spastica, tetraparesis, intraocular pressure

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## INTRODUCTION

Cerebral Palsy (CP) is a group of disorders of movement and posture control, which are a result of permanent, non-progressive damage into a still growing brain [1].

Movement limitation (retarded in develop of movement in relation to norm age) displays usually before 18 months of a child's age [1,2]. In investigation children frequently present with other illnesses, conditions and disorders: mentally retardation, epilepsy, organ of sight disorders, hearing disorders, speech disorders, and alimentary system disorders.

As its importance was underlined a century ago the ophthalmological problems in patients with CP is very common [3]. The most common are: strabismus, refractive errors, abnormal intraocular pressure, pathological eye movements, accommodation disorders, perimetry loss, disorders in colour vision, ptosis, cataract [4-6]. This study was to comply intraocular pressure in correlation to severity of CP and motor possibilities of patients.

The aim of the study is to estimate the correlation between intraocular pressure and neurological disorders in patients with selected types of CP.

## MATERIALS AND METHODS

The study was made in support of materials from medical documentation, with contained subjective and objective examination of the range of ophthalmological and neurological in CP patients from Neurological, Rehabilitation, Ophthalmological and Rehabilitation Clinic of University Children's Hospital in Bialystok. The method of the study is retrospective and dependant on the medical records.

Analysis consisted of 103 patients (66 boys, 64% and 37 girls, 36%) between 2-18 years old (mean age = 9.7±3.87). 44 patients (42%) had diplegia spastica, while 59 patients had (58%) tetraparesis.

The subject of the analysis was to show intraocular pressure in patients within two groups of CP: diplegia spastica and tetraparesis, with nervous system pathologies taken into account.

In the analysis were considered elements from the subjects examined about their pregnancy period and pre-delivery period. In all patients, in the subject examination questionnaire was taken into account pregnancy period (was it complicated or not), number of pregnancies in mothers, number of deliveries, abortions in past, type of delivery - cesarean section or natural, pre-term/term delivery, born weight of neonate, points in Apgar`s score.

Ophthalmological examination was done in Ophthalmological Ambulatory. The diagnostic process was carried out to ascertain intraocular pressure using a non-contact tonometer.

In the neurological examination the most important for this study was to qualify the type of CP, level of motor restriction based on the Gross Motor Function Classification System (GMFCS). It defines the level of mental retardation on a four level scale: non, light, moderate and severe. It established how many children have epilepsy, and how many children can walk.

In analyze of the results of intraocular pressure were also included: age, sex, type of CP, GMFCS scale, pathological pregnancy time, CP risk factors, term of birth, Apgar`s scale score.

All results were presented in a quantitative way and with complying proportion of individual data in percentage. Likewise all data was put to the statistical test, which was made by the statistical package STATISTICA for Windows 9.0. Analyses of correlation were made by double-division tables (Cross Tabs) and (Chi-Square Test) Chi² test or Fisher test for tables does not present the conditions for the classical Chi² test. As border value of significant statistical level was accepted $p=0.05$. For significant statistical probability: $p<0.05$, for high significant statistical probability: $p<0.01$.

## RESULTS

Among pathological changes in the organ of sight in patients with CP were: pathological changes of the anterior segment of the eye, pathological changes in the posterior segment of the eye, eye atrophy, strabismus, refractive errors, amblyopia, nystagmus, disorders in colour vision, abnormal intraocular pressure, perimetry loss. The most frequent problems according to the anatomical presentation of the patients' eyes are presented at Figure 1.

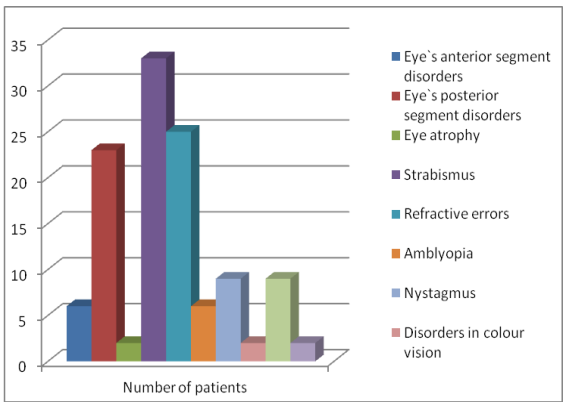


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**Figure 1**. Pathological changes in the organ of sight in patients with cerebral palsy.

In the analyzed group of patients, abnormal intraocular pressure was diagnosed in 9 cases (Fig.2).

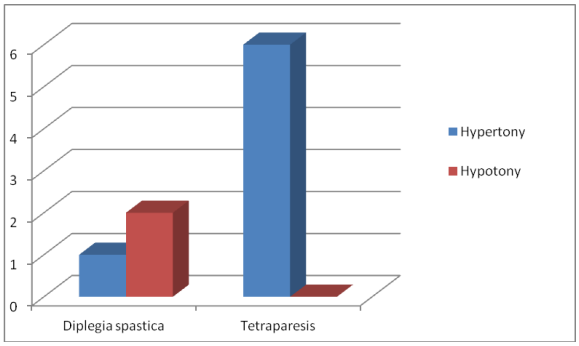


**Figure 2.** Abnormal intraocular pressure in different types of cerebral palsy.

Results over the norm were observed in 7 children (6 with tetraparesis and 1 with diplegia spastica – in which was made OCT and perimetry examination). The perimetry examination affirmed: district restriction form down and up, central, and numerous losses relative and in-relative. However in the OCT examination of optic nerve head affirmed: average thickness Retinal Nerve Fiber Layer (RNFL) was under norm; affirmed loss in upper and down quadrant in OD, and upper and down quadrant in OS. Hypotony of eye was present in two children with diplegia spastica.

The study affirmed statistical correlation (p=0.0212) between results of intraocular pressure measurement and type of CP. Results above the norm (>20mmHg) were more common in children with tetraparesis (Tab.1). That kind of correlation wasn't affirmed between perimetry loss and type of CP (p=0.7160).

**Table 1.** The intraocular pressure groups of the patients according to their cerebral palsy type.

| **CP type** | **Intraocular pressure** | | | |
|---|---|---|---|---|
| | normal | hypotony | hypertony | Total examined |
| diplegia spastica<br>% | 41 | 2 | 1 | 44 |
| | 93.18% | 4.55% | 2.27% | |
| tetraparesis<br>% | 53 | 0 | 6 | 59 |
| | 89.83% | 0.00% | 10.17% | |
| Total | 94 | 2 | 7 | 103 |

Analysis showed correlation (p=0.0189) between results of intraocular pressure and the type of delivery. In patients born by cesarean section – results of tonometry was more common in norm.

Abnormal intraocular pressure (both: hypo- and hypertony) were observed more common mainly in children born by natural way (Tab.2).

**Table 2.** Intra-ocular pressure and the type of delivery

| **Delivery** | **Intraocular pressure** | | | |
|---|---|---|---|---|
| | normal | hypotony | hypertony | Total examined |
| Cesarean section<br>% | 56 | 0 | 1 | 57 |
| | 98.25% | 0.00% | 1.75% | |
| Spontenouss vaginal birth<br>% | 38 | 2 | 6 | 46 |
| | 82.61% | 4.35% | 13.04% | |
| Total | 94 | 2 | 7 | 103 |

In ophthalmology data analysis in relations to term of birth, statistical correlation confirmed between term of birth and intraocular pressure. Study showed correlation (p=0.0142) between results of tonometry and term of birth. If the delivery was before term, then the intraocular pressure was more common in norm. In cases with full time pregnancy, more common was abnormal intraocular pressure (both under and above norm) (Tab.3).

**Table 3.** Intra-ocular pressure in correlation to time of birth.

| **Preterm delivery** | **Intraocular pressure** | | | |
|---|---|---|---|---|
| | normal | hypotony | hypertony | Total examined |
| Yes<br>% | 65 | 0 | 2 | 67 |
| | 97.01% | 0.00% | 2.99% | |
| No<br>% | 29 | 2 | 5 | 36 |
| | 80.56% | 5.56% | 13.89% | |
| Total | 94 | 2 | 7 | 103 |

Study showed correlation (p=0.0212) between results of tonometry and patients' possibility to walk. In children, whom tonometry was examined, results above the norm were more common in non-walking CP patients (Tab.4).

**Table 4.** Intra-ocular pressure in correlation to the possibility of walking of patients with cerebral palsy.

| **Intraocular pressure** | **Patient** | | **Total examined** |
|---|---|---|---|
| | walking | non-walking | |
| hypotony<br>% | 2 | 0 | 2 |
| | 4.35% | 0.00% | |
| normal<br>% | 43 | 51 | 94 |
| | 93.48% | 89.47% | |
| hypertony<br>% | 1 | 6 | 7 |
| | 2.17% | 10.53% | |
| Total | 46 | 57 | 103 |

## DISCUSSION

In the study, intraocular pressure norm range parameters were 10-21 mmHg. In most cases intraocular pressure was correct, both in children with diplegia spastica and tetraparesis. In 1.9% of children with diplegia spastica diagnosed hypotony, and that condition was connected with and presented in that patients eye-atrophy. Pressure above the norm was diagnosed in 6.8% cases. In the study of Sasmal et al., intraocular pressure above the norm was present in 2.1% patients [7].

Statistical analyses showed correlation between results of tonometry above the norm, and the type of CP, that pathology was more common in children with tetraparesis than with diplegia spastica. It was observed too, that intraocular pressure above the norm was mainly in non-walking patients, rather than in patients who could walk. Correlation was present too, between intraocular pressure and the children with CP birth type. In patients born by cesarean section, results of incorrect intraocular pressure, both cases with hypo and hypertony were observed mainly in children born naturally. Similarly situation was in cases of children from full time pregnancy, in which results of tonometry were more common to be incorrect than in pre-term children.

Perimetry examination, in which were present pathological changes, was done in 1 child with diplegia spastica (1%). It was a child with intraocular pressure above the norm.

In the perimetry examination affirmed: district restriction form down and up, central, and numerous loss relative and un-relative. In the OCT examination of the optic nerve head affirmed: average thickness RNFL was under a norm; it affirmed loss in upper and down quadrant in both eyes. Frequency of affirmed perimetry loss in others publications were a little higher 11-19% [8, 9].

## CONCLUSIONS

1. In our study results of intraocular pressure above the norm were more common in patients

with tetraparesis than diplegia spastica, mainly in non-walking children.
2. Abnormal intraocular pressure, both cases with hypo and hypertony were diagnosed more common in children born naturally, from full term pregnancy.

**Conflicts of interest**
The authors declare that they have no competing interests in the publication of the manuscript.

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