The study of ocular motility disorders in children with neurological deficits

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ABSTRACT
BACKGROUND: The disorders of ocular movement result from the sensory-motor malfunction of eye leading to faulty alignment of the eyes and/or vision impairment. Aims-1.To evaluate the types of ocular motility defects in neurologically impaired children by a detailed eye examination. 2: To know the prevalence of such neurological cases coming to our hospital. MATERIALS AND METHODS: The study was a cross-sectional observational study carried out over 2 years in which 56 subjects taken from the neurological ward were given a complete ophthalmologic examination. RESULTS: Out of 112 eyes(56 subjects),38(67.85%) subjects were males while 18(32.14%) subjects were females.Age wise distribution was from one month to 13 years with mean age 35.62 months. CT scan showed 38(67.85%)had hydrocephalus,3(5.35%) had periventricular leukomalacia,3(5.35%) had cerebral cortical atrophy,3(5.35%) had spastic cerebral palsy,18 had communicating hydrocephalus. Exodeviation was observed in 12 (21.42%), esodeviation in 10 (17.85%) and no deviation in 34 (60.71%).Eye movements were full in 48(85.71%) subjects, nystagmus found in 3(5.35%),3rd nerve palsy in 2(3.57%),lateral rectus palsy in 1(1.78%),restricted elevation in 1(1.78%) and supranuclear gaze palsy in 1(1.78%) subjects. Normal fundus findings were found in 48(82.85%),disc pallor in 14(12.5%),temporal pallor in 14(12.5%), papilloedema in 10(8.92%), hyperpigmentation of macula in 4(3.57%), blurred hyperemic disc margin in 3(2.67%), toxoplasmosis in 1(0.89%) and multiple retinal haemorrhages in 1(0.89%) subjects.No refractive error was found in 66(58.92%),myopia in 23(20.53%), hypermetropia in 19(16.96%) and pure cylinder in 4(3.57%) subjects. CONCLUSION: Every child with neurological deficit should undergo a baseline ophthalmic examination to identify the silent ocular defects in them for their overall rehabilitation.

Keywords: ocular motility, neurological

INTRODUCTION
The disorders of ocular movement result from malfunction of the sensory-motor malfunction of the eye which leads to faulty alignment of the eyes and/or impairment. These have been seen to occur in various congenital or acquired neurological deficits in children like hydrocephalus¹, periventricular leukomalacia², cerebral palsy³, cerebral cortical atrophy⁴ and intracranial tumors like myelomeningocele.

Aims of the study: 1) The study was carried out to evaluate the types of ocular motility defects in neurologically impaired children by a detailed eye examination consisting of – eye movements, deviation, refractive error , fixation patterns , Fundus, CT scan results. 2) To know of the prevalence of such neurological cases coming over to our hospital.

MATERIALS AND METHODS
The study was a cross-sectional observational study carried out for 2 years in which, a total of 112 eyes of 56 children taken in the study that were seen in the neurological ward and referred from there to our tertiary centre for complete ophthalmologic examination.

Patient inclusion criteria were – 1) Age of the patient was between 0 to 14 years. 2)Participants must be able to undergo a complete ophthalmic evaluation. 3) Established cases of neurological abnormality– Hydrocephalus / PVL / Cortical palsy / Cortical atrophy. 4) The imaging study (CT scan and/or MRI) was done in all cases and only those patients found to have an established neurological abnormality were included.

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Patient exclusion criteria were – 1) Age more than 14 years. 2) Patient with history of trauma. 3) Critically ill children. 4) Normal neuroimaging findings.

The vision, cycloplegic retinopathy, Fundus were done accurately

RESULTS

A total of 112 eyes (56 subjects) were included in this study. Out of 112 eyes (56 subjects), 38 (67.85%) subjects were males while 18 (32.14%) subjects were females. In age wise distribution, from one month old child to 13 years old with mean age 35.62 month. CT scan revealed that 38 (67.85%) of them had hydrocephalus, 3 (5.35%) had periventricular leukomalacia, 3 (5.35%) had cerebral cortical atrophy, 3 (5.35%) had spastic cerebral palsy, 18 (%) had communicating hydrocephalus, 20 (%) had non-communicating hydrocephalus. This discrepancy of patient selection was because patients were taken from neurological ward.

Table 1: CT findings

|Hydrocephalus  | 38 (67.85%) |
a. Communicating hydrocephalus | 18 (32%) |
b. Non-Communicating hydrocephalus | 20 (35.75%) |
Perventricular leukomalacia | 3 (5.35%) |
Cerebral cortical atrophy | 3 (5.35%) |
Spastic CP | 3 (5.35%) |
Meningocele | 1 (1.78%) |
Myeloeningocele | 1 (1.78%) |
Joubert’s syndrome | 1 (1.78%) |
Microcephaly | 1 (1.78%) |
Hypoxic ischemic encephalopathy | 1 (1.78%) |
Galactosaemia (Ventriculomegaly) | 1 (1.78%) |
Cystic encephalomalacia | 1 (1.78%) |
Adrenoleukodystrophy | 1 (1.78%) |
Astrocytoma | 1 (1.78%) |
Trigonocephaly | 1 (1.78%) |

The fixation patterns noted were central steady and maintained in 73 (65.17%) of the eyes, central steady but preferring one in 9 (8.03%) of the eyes, central steady but not maintained in 1 (0.89%) of the eyes, unsteady central in 7 (6.25%) of the eyes and grossly eccentric in 22 (19.64%) of the eyes.

Table 2: Fixation Patterns

|Central steady and maintained | 73 eyes (65.17%) |
|Central steady but prefers one | 9 eyes (8.03%) |
|Steady but not maintained | 1 eye (0.89%) |
|Unsteady central | 7 eyes (6.25%) |
|Gross eccentric | 22 eyes (19.64%) |

The deviation pattern seen was exodeviation in 12 (21.42%), esodeviation in 10 (17.85%) and no deviation in the rest 34 (60.71%) of the subjects

Table 3: Deviation

<table>
<thead>
<tr>
<th>Deviation</th>
<th>Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>No deviation</td>
<td>34 (60.71%)</td>
</tr>
<tr>
<td>Exo deviation</td>
<td>12 (21.42%)</td>
</tr>
<tr>
<td>Eso deviation</td>
<td>10 (17.85%)</td>
</tr>
</tbody>
</table>

The movements were full in 48 (85.71%) of the patients, nystagmus was found in 3 (5.35%), 3rd nerve palsy was observed in 2 (3.57%), lateral rectus palsy in 1 (1.78%), elevation was found to be restricted in 1 (1.78%) and supranuclear gaze palsy was found in 1 (1.78%) of the patients.

Table 4: Eye Movements

<table>
<thead>
<tr>
<th>Eye Movements</th>
<th>Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full movements without nystagmus</td>
<td>48 (85.71%)</td>
</tr>
<tr>
<td>Full movements with nystagmus</td>
<td>3 (5.35%)</td>
</tr>
<tr>
<td>3rd nerve palsy</td>
<td>2 (3.57%)</td>
</tr>
<tr>
<td>LR palsy</td>
<td>1 (1.78%)</td>
</tr>
<tr>
<td>Elevation restricted</td>
<td>1 (1.78%)</td>
</tr>
<tr>
<td>Supranuclear gaze palsy</td>
<td>1 (1.78%)</td>
</tr>
</tbody>
</table>

The Fundus findings were normal in 48 (42.85%), disc pallor was found in 14 (12.5%), temporal paller in 14 (12.5%), papilloedema in 10 (8.92%), deep cup/disc ratio was seen in 10 (8.92%), hyperpigmentation at macula in 4 (3.57%), blurred hyperemic disc margin in 3 (2.67%), toxoplasmosis in 1 (0.89%) and multiple retinal hemorrhages in 1 (0.89%). There were no refractive error was found in 66 (58.92%), myopia was seen in 23 (20.53%), hypermetropia in 19 (16.96%) and pure cylinder was seen in 4 (3.57%) of the patients.

DISCUSSION

In our study, 31.57% of hydrocephalous patients had strabismus\(^5\) out of which 7 (18%) showed exotropia, 5 of which were contributed by obstructive variety and 2 by communicating variety. 5 (13.15%) showed esotropia, 4 of which were contributed by non-communicating hydrocephalous and 1 by communicating variety. There is 40-75% incidence of strabismus amongst hydrocephalous patients Rothstien et al 1974, Clements and Kaushal 1970, Rabinowitz and Walker 1975, Gaston 1991, most have deviation with esotropia being more common than exotropia. In a study by Ozgǔl Altintas et al, 10 out of 24 patients (40%) were found to have manifest squint. In our study 21.05% (16) eyes of hydrocephalous were seen to have disc paller. Ghosh found that only 7% of
hydrocephalous patients had temporal pallor of the optic disc. The papilloedema was found in total of 5 (13.15%) patients of which 3 (7.89%) were communicating type and 2 (5.26%) was contributed by obstructive type. The papilloedema has been found in association with many studies in the past. The Optic atrophy is common in all forms of hydrocephalous and is a major cause of visual morbidity. Ghosh found that 17% of infants with hydrocephalous had optic atrophy. A similar figure was reported by Gaston and Rabinowitz reported that 30% of children in his study had optic atrophy. The 2.6% of hydrocephalous patients showed presence of nystagmus. Other studies by Rabinowitz and Gaston 1991 have shown an incidence of 3-5% nystagmus amongst hydrocephalous patients. Anderson S et al studied seventy five school-aged children with surgically treated hydrocephalous and 140 comparison children. Visual function deficits were identified in 83% of the children with hydrocephalous. Visual impairment was found in 15% but in none with myelomeningocele. Cognitive visual dysfunction was identified in 59%. A study by Ekan et al indicated that infants with a gestational age of 35 weeks or more, who sustained extensive cystic leukomalacia during the neonatal period, and were subsequently not fixating at the acuity cards at term and three months of age invariably developed cerebral visual impairment (CVI). Extensive cystic leukomalacia proved to be highly predictive of CVI, as well as of severe mental and motor deficit in these nine infants. A study by Glass HC et al was done showing white matter injury is associated with impaired gaze in premature infants. Periventricular leukomalacia is a risk factor for visual impairment in children born prematurely. Their preliminary findings suggest that white matter injury affects visual function even before term equivalent postmenstrual age. Khetpal et al carried out study to evaluate the etiology, prognosis and associated neurological and ophthalmological findings of children with cortical visual impairment (CVI). The most common etiologies were perinatal hypoxia (35%), prematurity (29%), hydrocephalous (19%), structural central nervous system abnormalities (11%) and seizures (10%). Many children (69%) had multiple etiologies. Associated ophthalmological abnormalities include esotropia (19%), exotropia (40%), nystagmus (21%), and optic atrophy (42%). The significant refractive errors (> +3.0D or < -2.0D) was common (20%). Clarke et al studied results of flash visually evoked potentials (VEPs) in 44 infants blind or severely visually impaired from non-ocular causes are presented, and related to the subsequent visual outcome. Ocular causes of visual impairment were excluded by clinical examination and electroretinography. They found that flash VEP, despite its limitation, is a useful prognostic tool, particularly in those apparently blind infants whose normal ocular examination/electroretinogram is accompanied by normal VEPs. Those with abnormal VEPs, however, do not necessarily have a poor prognosis, but should be followed up as maturational changes and/or improvements in function of the sensory pathway will be reflected in the evoked potentials. In a case series done by Muen WJ et al, amongst seven children who presented with strabismus and no apparent known neurological deficit, all seven (100%) patients presented with esotropia. One patient also had dissociated vertical deviation.

Limitations of study: a) Visually evoked potential (VEP) and electroretinographic (ERG) recording units were not available at our institute. b) CT scan was done in place of MRI imaging due to financial reasons. c) Patients could not come in follow up. d) No correlation has been done between the type of ophthalmic problem and type of neurological disease.

Conclusion
Every child with neurological deficit should undergo a baseline ophthalmic examination as some of them may be silent at first, identifiable only through screening examination with overall rehabilitation of the children.

References
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