Ocular evaluation in Cerebral Palsy patients at Children's and Eye Hospitals at the University Teaching Hospitals, Lusaka, Zambia

ABSTRACT

Background: Cerebral palsy is a group of non-progressive disorders of movement or posture. Visual handicap in Cerebral Palsy patients can have a direct impact on psychosocial status. Refractive errors, strabismus, nystagmus, amblyopia and cortical visual impairment are observed in 50 to 90 % of patients with cerebral palsy.

Objective: To evaluate for visual impairment in CP patients at Children's Hospital at UTHs

Methods: A cross section study was performed on 100 Cerebral palsy patients attending the neurological clinic at the University Teaching Hospitals-Children's Hospital from February to April 2021. The patients were sampled systematically from the register at neurology clinic and ophthalmological examination was conducted at Eye hospital which included measurement of visual acuity, ocular motility, refraction along with the evaluation of the anterior and posterior segments.

Results: Fourty nine percent (49%) of the patients seen had ocular abnormalities of which the most common abnormality was refractive error (32.5%) followed by strabismus (21.5%). Esodeviation was more commonly found than exodeviation (65.0% vs 35.0%), and hyperopia was slightly more prevalent than myopia. Astigmatism was the most common refractive error at 40.0%.

Conclusions: Children with cerebral palsy at the University Teaching Hospitals-Children's Hospital have a high prevalence of strabismus and refractive errors. Esotropia and hyperopia are the most common ocular abnormalities. All children with cerebral palsy may require a detailed ophthalmologic evaluation.

INTRODUCTION

Cerebral Palsy (CP) is a term used to describe a spectrum of deficits of muscle tone and posture that result from damage to the developing nervous system and can be associated with disorders of the sensory pathway[1]. The damage that occurs to the motor control in the developing brain can occur during pregnancy, perinatal or postnatal life. This results in limitation in movement and posture which can be accompanied by seizure disorder, abnormal muscle tone, dysarthria, sensory impairment, mental retardation and learning disabilities[2].

The most common reported aetiologies of CP identified in African cohorts are birth asphyxia, kernicterus, and neonatal infections [3,4] with low birth weight identified as a major aetiology in a study done in Tanzania [5]. This is in contrast with most studies in the United States and Europe in which prematurity or low birth weight were the major risk factors identified [6]. Infants that are born before the gestation age of 28 weeks are 50 times more likely to get CP compared to those born at full term. The likelihood is reduced with increasing gestation age [7].

The incidence of CP has increased over the years owing to improved perinatal care and greater numbers of affected children in better institutional care and therefore early and more capturing of CP patients. Studies conducted largely in Australia and Europe, have historically found CP prevalence ranging from 1.5 to 2.5 per 1,000 live births[8]. However more recently, studies in the United States [9] and Taiwan [10] have found prevalence rates above 3 per 1,000 live births in people 4 – 48 years of age. In Africa, the prevalence ranges from 2 per 1000 live births as shown in the study conducted in Egypt [3] to 10 per 1000 live births from the study performed in South Africa [11]. There have been few studies on CP patients in Zambia most of which involve the caregivers of CP patients such as a study by Chiluba and Moyo [12]. Therefore the prevalence is not exactly known.

The four main types of CP include spastic, ataxic, dyskinetic/athetoid and mixed cerebral palsy. The spastic type can be further classified into spastic hemiplegia, spastic diplegia and spastic tetraplegia types depending on the number and the of limbs affected. Beckung et al., [13] classified them as Spastic unilateral CP, Spastic bilateral CP, dyskinetic CP and ataxic CP. In the spastic type there is stiffness and movement difficulties. In ataxic form there is a disturbance of sense of balance and depth perception, while in the athetoid type there are involuntary and uncontrolled movements.

Ophthalmological problems in CP including significant refractive errors, strabismus, nystagmus, and amblyopia as well as Cortical Visual Impairment (CVI) are observed in 50–90 % of the patients with CP [14]. These problems may be predictable according to the distribution of the motor impairment. The Disorders of visual function is often due to damage to central visual pathway [15]. This is because chronic hypoxia to the brain usually causes damage to the visual cortex, a part of the cerebral cortex which is responsible for processing visual information. Unencumbered visual input is necessary for the brain to accurately interpret what is seen. This is especially true in infants whose brains are still developing and toddlers who are expected to achieve developmental growth phases.

Visual function is related to cognitive, motor and emotional development since children learn to move, talk and do many things they see others doing. Hence a child with CP that is also blind or visually impaired pose a greater challenge in terms of management and rehabilitation. Early detection and treatment of ocular problems will therefore enhance management in this group of children.

METHOD

This was a cross section study done on 100 Cerebral palsy patients at Paediatric Center Of Excellence (PCOE) and Eye Hospital in the UTHs in Lusaka from March to May 2021. Recruitment of the patients was done at PCOE while examination was done at Eye Hospital due to availability of examination equipment and tools. Systematic sampling of Patients between 6 months- 16 years with CP seen at neurological clinic at PCOE Children's Hospital, UTH was done. From the register of neurological patients seen in the clinic, every 2nd CP patient was listed for possible inclusion into the study. The identified patient was then called by telephone to go to UTHs Eye Hospital specifically for the purpose of the study.

Included in the study where patients with a motor disability consistent with a diagnosis of cerebral palsy aged 6 months to 16 years old. Excluded were Patients with acquired neurological disorder or with Prior ocular surgery**.**

Informed consents from the guardians were obtained prior to data collection. A brief history of the visual behaviour of the child, along with histories of antenatal, postnatal and other maternal factors were taken. Ophthalmic evaluation was done by one evaluator to avoid bias. Medical files were reviewed to determine co existing diseases that may also cause ocular abnormalities.

Every child was seated either on their parent's lap or in adaptive wheel chairs throughout the examination. Presenting visual acuity was assessed. The patients underwent detailed ophthalmic examination including visual acuity testing with cycloplegic refraction.

Vision assessment was done using Snellen's chart, Kay Picture test, Preferential Looking Chart and Central Steady Maintained technique (CSM). Patients were seated at a distance of 6 meters from Snellen's chart and were made to read with one eye from top letters and the other eye being closed gently with occluder in the trial frame.

Cycloplegic refraction was also done if needed using one drop of 1% cyclopentolate instilled every 15 minutes for a total of 3 drops. Cycloplegia was followed by retinoscopy 30 minutes after the instillation of the last drop

The ametropic meridian was obtained for each eye and refractive errors were categorized according to the following classifications

•Emmetropia: > -0.5 to +0.5 D
•Low to moderate hypermetropia: > +0.5 to + 4.00 D
•High hypermetropia: > + 4.00 D
•Low to moderate myopia: - 4.00 to > - 0.50 D
•High myopia: > - 4.00 D

Astigmatism and anisometropia were categorised as defined:

•Significant astigmatism: ≥1.00 DC
•Significant anisometropia: ≥ 1.00 D between the corresponding meridians of both eyes.

The anterior segment evaluation was done using a torch light or slit lamp. The posterior segment evaluation in every patient was carried out in a fully dilated state of the eyes with direct ophthalmoscope or indirect ophthalmoscope, whichever was possible.

Findings of the anterior and posterior segments were recorded in a preset proforma especially designed for the study. The data was evaluated using STATA Computer software and the results were analysed accordingly.

RESULTS

One hundred patients with CP were recruited and enrolled for ocular assesment. There were 52 males (52.0%) and 48 females (48.0%) giving a male female ratio of nearly 1:1.Their ages ranged

from 6 months to 16 years with the greater percentage (65%) being between six months and five years. Seventy eight percent (78.0%) were delivered full term while twenty- two (22.0%) were preterm. The birth weight was above 2500g in seventy -seven participants (77.0%) and less than 2.5kg in twenty-three participants (23.0%).Spastic CP accounted for 72.0% cases seen. Majority (90.0%) of the children had delayed developmental milestones.

Vision assessment was Central Steady Maintained (CSM) in 80 eyes (40.0%) and Cerebral visual impairment was suspected in 2 subjects (2.0 %).There were 51 patients with no ocular abnormalities. Twenty seven percent of the patients had one ocular abnormality while 22% had more than one ocular abnormality. Strabismus was found in fourty three (21.5%) eyes made up of esotropia in 28 (65.0%) and exotropia in 15 (35.0%) eyes.

Refractive error was found in 65 eyes (32.5%) where hypermetropia was in 21 eyes (32.3%) and myopia in 20 eyes (30.7%). The distribution is illustrated in figure 1 below

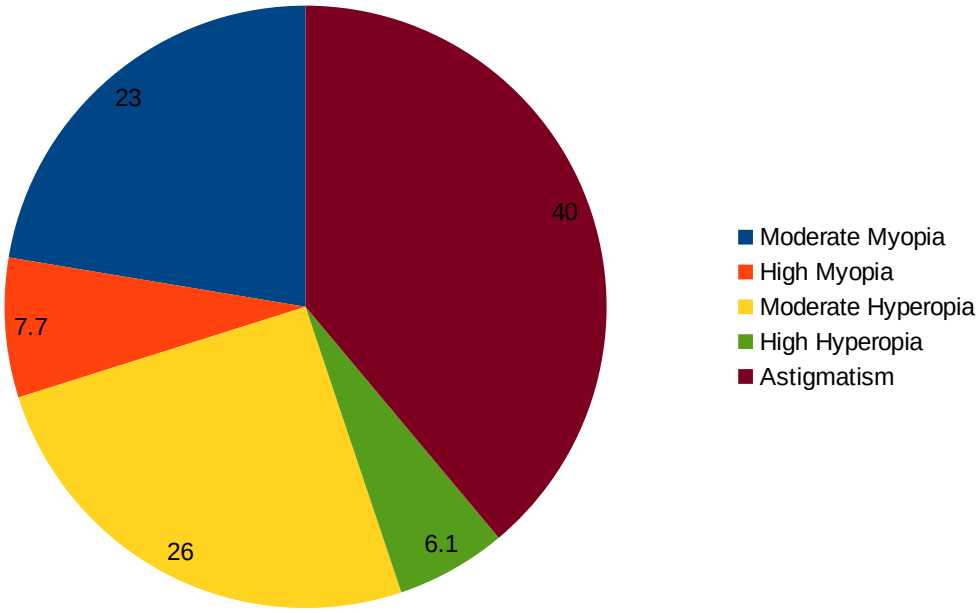

Fig. 1. Distribution of refractive error in percentage(%)

One patient had bilateral anophthalmos (1.0%). Another patient had cataract in one eye representing 0.5% of the eyes seen. One Other patient had lagophthalmos in one eye (0.5%) and one patient had bilateral allergic conjuctivitis (1.0%).

Figure 2 below shows the four most common ocular abnormalities seen as refractive errors (32.5%), Strabismus (21.5%), Nystagmus (11.0%) and optic disc atrophy (12.0%).

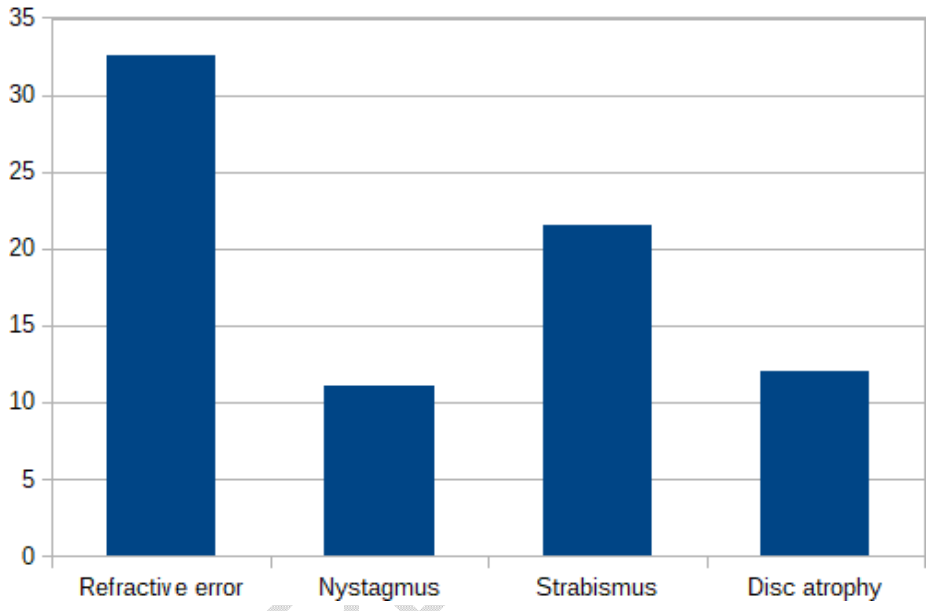

Fig 2. common ocular abnormalities

DISCUSSION

There was a good response rate in this study with 100% responding to the call to present for ocular assessment. A large proportion of the subjects were between one and five years of age which is comparable to other studies [16,17]. This may be due to the fact that the signs and symptoms are not usually present at birth, they commonly evolve as the child is growing up. In this study, male: female ratio in CP was almost 1:1 which was not similar to the worldwide data and different studies where there was more of one sex [18,19].

There is a wide spectrum of visual disorders that is prevalent in CP and has been described extensively in the literature, ranging from a frequency of 28% to 86% [20-22]. Ocular conditions found in this study include refractive errors, strabismus, and optic nerve atrophy. The prevalence of 49% is similar to that found by Sasmal at 42.1% [23]. In this study, 22 (22%) children had more

than one visual deficit. This emphasizes the need for a thorough ocular examination of all persons diagnosed with CP.

Majority (72.5%) of the eyes had VA worse than 6/18. One of the factors that might account for this might have been relative non-motivation of some of the children, fatigue and prolonged inattention to the acuity tests during the testing duration. It is difficult to state whether the presenting acuity recorded for each child was actually their best acuity or merely the best effort the child could offer at that time. Even the children in whom CSM was positive might have had better VA than estimated.

The poor VA frequency is comparable to other studies such as in Bodunde et al. [19] where only 5.4% of the VA was better than 6/18. However, the sample size was almost one third of that used in this study.If a postulation was made, it would assumably reflect similar high percentages of VA less than 6/18.

Refractive error as stated in this study, was the most common type of abnormality documented (32.5%). This finding is consistent with other studies in being the most frequent although occuring at much lesser frequencies than seen such as 79% [24], 50% [19]. It is possible that the higher frequencies in these studies was due to a smaller sample size. However, different prevalence of refractive errors in patients with CP, from 28.5% to 54% have been reported in other parts of the world in CP [18]. Other studies such as by Govinda et al. [25] found strabismus (35.7%) to be the most frequent abnormality.

Much of the literature quotes a higher prevalence of hyperopia in CP[18,22] which this study was not consistent with. Instead, myopia occurred slightly more (32.3%) than hyperopia (30.7%). This finding was similar to the one found in the study done in Nepal [24] with Myopia being of a frequency of 39% while hyperopia being at 29%. It is possible that the difference in prevalence of a particular type of refractive error also depends on the prevailing type of CP. Fantl and Perlstein report a higher prevalence of myopia in those with spastic CP and found that hypermetropia was more prevalent in CP with dyskinesia. This study had a higher prevalence of spastic CP which can be linked in some extent unlike some studies such as in Nepal [24] were analysis of refractive findings according to the CP type were not done due to lack of sufficient medical records.

The prevalence of astigmatism in this study population of 40.0% was similar to some previous studies such as Kozeis et al. [22] who reported the prevalence of astigmatism to be 40.9% and Govinda and Lamba.[25] who reported an even higher incidence of 50%. The higher prevalence of

refractive error even in the lower age group indicates the emmetropization process being hampered in CP patients as suggested by Sobrado [26]. Some studies propose that if emmetropization is impaired or delayed in CP, it may be due to failure in compensatory feedback mechanisms controlling the growth of axial length [14]

The prevalence of strabismus observed in the present study (21.5%) can be matched well with other parts of the world such as India at 35.7% [18], Japan at 39% [25] and Africa as a whole at 50% [20]. Despite the significant number of patients having strabismus, many parents and guardians were however not keen about getting this corrected by surgery or other means such a spectacle prescription because they were more interested in finding a solution to the delayed developmental milestone of their children. A child with a squint is likely to have a poorer level of binocular vision especially depth perception. This occurs because the brain which usually combines the signals from the two eyes that normally focus on the same spot to form a three dimensional image is unable to do so in the presence of a squint as the two eyes will be focusing on two different spots. Therefore tasks requiring fine depth discrimination will be more difficult.

Optic nerve atrophy was present in 12.0% of the eyes. Similar findings are quoted by Black at 10%[27]. Optic nerve neuropathy of CP is incurred from non progressive fetal or neonatal injury. The aetiology is attributed to retrograde, trans-synaptic loss of ganglion cell axons caused by post geniculate lesions [28].

One of the challenges faced was that the study was done during the Covid-19 pandemic and so the process took longer to accommodate the swabbing of the patients prior to ocular evaluation. Some of the children were uncooperative in the whole process due to the longer duration it took.

A strength in the study is the good sample size and also that it is likely that the findings could be a precise estimate of the prevalence of ophthalmic problems to the general public because the patients were gotten from a general pool of CP patients unlike only those referred to the Eye Hospital due to a recognized need for ocular evaluation by the paediatricians.

CONCLUSION

In conclusion Strabismus, refractive errors, Nystagmus and optic disc atrophy are the most common ocular abnormalities in children with CP at University Teaching Hospitals Eye and Children's Hospitals. Parents/guardians and the health practitioners who are responsible for the health care and overall development of CP children should be aware of the ocular defects that may be present in

these children. Early detection and intervention will help for the child's physical, social, academic and visual development.

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