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# Auditory Impairment in Children with Cerebral Palsy

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**Abstract:** Cerebral palsy refers to a group of conditions that affect control of movement and posture.The aim of our study was to detect early changes in audiologic function in children with cerebral palsy. Data resulting from audiometry, tympanometry and auditory brain stem response of thirty children with cerebral palsy were collected and analyzed. Abnormal tympanometry in the form of secretory otitis media and Eustachian tube dysfunction was present in 52% of spastic quadriplegic patients, while sensorineural hearing loss was present in 40% of our patients. Early audiological assessment in children with cerebral palsy, allows early aural habilitation which enable better development of hearing and speech in these children and hence, auditory brain stem testing should be incorporated into the diagnostic plan of all children with spastic cerebral palsy.

**Key words:** Cerebral palsy, secretory otitis media, hearing loss, auditory brain stem response.

## INTRODUCTION

In 2004, the international working group on definition and classification of cerebral palsy, defined cerebral palsy as a group of permanent disorder of development of movement and posture causing activity limitation, that are attributed to non progressive disturbances that occurred in the developing fetal or infant brain Rosenbaum, 2007.

These children suffer from involuntary movements, and/or disturbances in gait and motility. Motor function is usually affected and its degree could be assessed by the scale of GMECS Palisano *et al*, 1977.

Children with cerebral palsy may also experience a range of additional problems that may require treatment including, impairment of vision, hearing or speech with consequent learning difficulties, mental retardation, seizures, difficulties in bladder and bowel control and feeding problems. Hearing loss account for 25% of cerebral palsy population in Western Europe . These abnormalities are thought to be associated with prenatal, perinatal, postnatal problems, often multifactorial in nature *Odding et al, 2006.* Our aim is to increase the awareness of possible correctable audiological impairment that hinder development and learning in children with cerebral palsy, which may be encountered in our daily practice as pediatricions.

## MATERIALS AND METHODS

Thirty cerebral palsy patients from Al-Hussein University Hospitals and the Research institute of ophthalmology were chosen according to readiness of parents to cooperate.

Their ages ranged from 2 months to 8 years.

Risk factors for cerebral palsy were identified through history taking. Patients were topographically sorted as having hemiplegia, diplegia, and quadriplegia after detailed physical and neurological examination.

Twenty nine patients were further classified into: spastic and dyskinetic using the European classification of motor impairment in cerebral palsy Can, 2000. One patient with hypotonia and hypokinesia was labeled as atonic.

***Procedures and Tests for Auditory Assessment:***

I. Physical examination: ear canal is examined by an otoscope for presence of excessive wax and foreign objects, ear drum for any perforation and signs of fluid or infection.

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II. Tympanometry: using interacoustics, AZ26: abnormal tympanometry in the form of secretory otitis media or Eustachian tube dysfunction was present in 52% of spastic quadriplegic patients, while other types of palsy had normal tympanometry. Otitis media is accompanied by variable degrees of conductive hearing loss, ranging from non to as much as 50 decibels hearing level (dBHL). Middle ear effusion, secretory otitis media may persist for 3 months or longer in approximately 10%-25% of cases.

III. Auditory brain stem evoked response (ABR):

After treatment of Eustachian tube dysfunction and secretory otitis media, ABR using click stimuli was recorded by Nicolet compact system using the following criteria;

- Recording parameters: ipsilateral electrode montage FZ/M1-M2 with 100-3000 HZ band pass fitter. Recording is done through 10 msec window.
- Stimulus parameters: click stimuli, rarefaction polarity 1000 sweeps at 21 pulse/second with 20 dB decrements till absence of response.

Only 12 cases (40%) showed sensorineural hearing loss. This was detected by changes in the shape of waves and abnormal latencies.

Hearing loss of the sensorineural type is reported by *Morales et al, 2006* to affect 60% of cerebral palsy children, while in our series it accounted for 40% of patients.

***Results:***

Results are illustrated in the following Tables:

1. **Table (1):** the types and severity of cerebral palsy in the study group.
2. **Table (2):** etiology of cerebral palsy from history and cerebral imaging.
3. **Table (3):** possible risk factors for cerebral palsy.
4. **Table (4):** associated problems as perceived by parents.
5. **Table (5):** tympanometry and auditory brain stem response.

**Table 1:** Types and severity of cerebral palsy in the study group

| Type | Mild No (%) | Moderate No (%) | Severe No (%) | Total No (%) |
|---|---|---|---|---|
| Spastic quadriplegia | 2 (6.67%) | 6 (20%) | 15 (50%) | 23 (76.6%) |
| Spastic hemiplegia | 0 | 0 | 2 (6.67%) | 2 (6.67%) |
| Spastic diplegia | 0 | 0 | 1 (3.33%) | 1 (3.33%) |
| Choreoathetotic | 0 | 1 (2.33%) | 2 (6.67%) | 3 (10%) |
| Atonic | 0 | 0 | 1 (3.33%) | 1 (3.33%) |
| Total | 2 (6.67%) | 7 (23.34%) | 21 (70%) | 30 (100%) |

**Table 2:** Etiology of cerebral palsy from history and cerebral imaging

| Etiology | No | % |
|---|---|---|
| Hypoxic ischemic encephalopathy | 11 | 36.67% |
| Post cardiopulmonary arrest | 2 | 6.67% |
| Post meningitic | 2 | 6.67% |
| Post encephalitic | 2 | 6.67% |
| Brain malformation | 2 | 6.67% |
| Asphyxia | 1 | 3.33% |
| Head trauma | 1 | 3.33% |
| Bilirubin encephalopathy | 2 | 6.67% |
| Indeterminate | 7 | 23.33% |
| Total | 30 | 100% |

**Table 3:** Possible risk factors for cerebral palsy

| Etiology | No (%) | Type of palsy |
|---|---|---|
| LBW | 2 (6.67%) | |
| PT | 3 (10%) | |
| Twins | 0 | |
| IU infection | 2 (6.67%) | |
| Rh incompatibility | 0 | |
| Low APGAR score | 8 (26.67%) | 6 SQ, 1 Ath, 1 SH |
| Difficult delivery | 2 (6.67%) | 2 SQ |
| Kernicterus | 2 (6.67%) | 2 Ath |
| Seizures | 4 (13.33%) | |
| Total | 23/30 | |

LBW : Low birth weight PT : Preterm Ath: Athetiod
IU infection : Intrauterine infection SQ: spastic quadriplegia SH: spastic hemiplegia

**Table 4:** Associated problems as perceived by parents

| Problem | N | % |
|---|---|---|
| Seizures | 19 | 63.34% |
| Speech | 14 | 46.76% |
| Visual | 14 | 46.76% |
| Auditory | 16 | 53.34% |
| Swallowing | 5 | 16.67% |

**Table 5:** Tympanometry and auditory brain stem response

| | Spastic quadriplegia | | | SH | SD | Atonic | Athetoid | Total (%) |
|---|---|---|---|---|---|---|---|---|
| | Mild | Moderate | Severe | | | | | |
| *Tympanometry* | | | | | | | | |
| Normal pressure | - | 3 | 8 | 2 | 1 | 1 | 3 | 18 (60) |
| Eustachian tube dysfunction | 2 | 2 | 6 | - | - | - | - | 10 (33.33) |
| Secretory otitis media | - | - | 2 | - | - | - | - | 2 (6.67) |
| *ABR (2-4 KHz)* | | | | | | | | |
| Normal | 2 | 2 | 10 | 1 | 1 | 1 | 1 | 18 (60) |
| SNHL: | | 3 | 6 | 1 | | | 2 | 12 (40) |
| - Mild | - | 2 | 3 | - | - | - | 1 | 6 (20) |
| - Moderate | - | 1 | 1 | 1 | - | - | 1 | 4 (13.33) |
| - Severe | - | - | 2 | - | - | - | - | 2 (6.67) |

SNHL : Sensorineural hearing loss SH:spastic hemiplegia
SD : Spastic diplegia

(Table 1) demonstrates the types of cerebral palsy in our cases, which are classified in to spastic (76.6%), choreoathetotic (10%), and atonic (33%). The spastic type is further classified according to the number of involved limbs: into spastic quadriplegia , spastic hemiplegia and spastic diplegia.Each type of cerebral palsy is graded into mild, moderate and severe according to the degree of severity.

(Table 2) demonstrates the causes of cerebral palsy in our cases which revealed that the most common cause was hypoxic ischemic encephalopathy (36.6%) while hypoxia and head trauma constitute the least common causes (3.3%)

(Table 3) illustrates the risk factors for cerebral palsy in our cases, in which low APGAR score represents the most common risk factor (26.6%) followed by seizures (13.3%) ,then prematurity (10% )and lastly low birth weight, intra uterine infections , difficult labour, kernicterus were the least common risk factor.

(Table 4) represents the associated problems in our cases which are from the most Common to the least common; seizures (63.3%) auditory (53.3%), speech (46.7%), visual (46.7%) and lastly swallowing problems in (16.6%) of the cases.

(Table5): demonstrates the results of tympanometry and auditory brain stem responses. Tympanometry revealed Eustachian tube dysfunction in the spastic quadriplegic group only and secretary otitis media in the severe form of spastic quadriplegia while the results of tympanometry were normal in the remaining types of cerebral palsy cases.

On the other hand the results of auditory brain stem response revealed mild sensorineural hearing loss in moderate and severe spastic quadriplegic type and in the athetoid type , moderate senorineural hearing loss in moderate and severe spastic quadriplegic patients, spastic hemiplegic and in the athetiod type and severe sensorineural hearing loss only in the severe type of spastic quadriplegia .

***Discussion:***

In our study, we found that, abnormal tympanometry in the form of secretory otitis media, Eustachian tube dysfunction, was present in 52% of spastic quadriplegic patients while other types of cerebral palsy had normal tympanometry. Otitis media is accompanied by variable degrees of conductive hearing loss ranging from none to as much as 50 decibels hearing levels (dBHC). While *Masaki et al, 2005* revealed a threshold elevation of 50-75 dB in his cases.

Study of auditory brain stem response after treatment of Eustachian tube dysfunction and secretory otitis media revealed sensorineural hearing dysfunction in 12 patients (40% of cases) mostly in the spastic quadriplegic group (75%). This is in contrast with what was reported by *Morales et al, 2006* who revealed, that sensorineural hearing loss affected 60% of cerebral palsy patients, while *Odding et al,*2006 states that the incidence of hearing loss is 25% of cerebral palsy patients in Western Europe.

Intrauterine infection, kernicterus, ototoxic drugs, bacterial meningitis, hypoxia, chromosomal abnormalities,

can cause both cerebral palsy and hearing loss *Rennie et al, 2007.*

For further study of cochlea and cochlear nerve function, distortion product otoacoustic emission (DPOAE), has recently become a useful tool Dauis *et al* 2004, but this investigation is unavailable to us to imprement its use in our cases.

The importance of detecting hearing disabilities in cerebral palsy patients, is to start early intervention by using hearing aids, listening devices, and if the child is two years age or more, speech therapy and phonetic rehabilitation may be an assist, as about 30.2% of cases with hearing loss will have an additional disability as reported by *Daneishi et al, 1989*.

Cochlear implantation may be of help if indicated as this may improve the patient's self confidence, independence and social integration
*Bacciu et al, 2009.*

***Conclusion:***

1. Abnormal tympanometry in the form of secretory otitis media, Eustachian tube dysfunction, was present only in spastic quadriplegic patients accounting for 52% of cases. Other types of cerebral palsy showed no changes.
2. Sensorineural dysfunction as detected by ABR testing (auditory brain stem response) was found in 12 patients only (40% of cases) while *Morales et al, 2006* reported that it affects 60% of cerebral palsy patients. On the other hand *Odding et a*l, 2006 reported abnormal ABR in 25% of his cases. These variabilities in the incidence of abnormal "ABR" studies may be due to the variations in types of cerebral palsy in each case study and/or the variable causes of cerebral palsy in these cases.

***Recommendations:***

1. As the incidence of hearing loss in cerebral palsy cases, varies between 22.7% *Zafeirio et al 2000,*and 40% in our cases, auditory examination is mandatory in every case.
2. Thorough examination of the ear for wax, fluid in the middle ear or perforation of the ear drum should be done. Tympanometry is helpful.
3. Brain stem evoked response (ABR) testing should be incorporated into the diagnostic plan of all children with spastic cerebral palsy newly referred to neurodevelopment centers.
4. Auto acoustic emission, should be assessed if possible, as it is a useful tool for evaluating outer hair cell function and help to decide, if cochlear implantation will be beneficial or not.
5. Emphasis is needed on the fact, that early detection of hearing disorders and subsequent early aural habilitation using hearing aids will enable optimal development of auditory function Masaki *et al*, 2005.

## REFERENCES

Bacciu Andrea, Pasaniso Encrico, Ormitti Francesca, DiLella Eilippo, 2009. International journal of oto rhinolaryngology, 73(5): 717-721.

Brownell, W.E., 1990. Outer cell electro motility and otoacoustic emission Ear Hear, 11: 82-92.

CANS, C., 2000. Surveillance of cerebral palsy in Europe : a collaboration of cerebral palsy surveys and registers. Dev. Med Child Neurol, 24: 816-24.

Daneishi, A. and S. Hassanzadeh, 1989. Cochlear implantation in prelingually deaf person with additional disability. The journal of laryngology and otology, 121: 635-638.

Dauis, B., W. Qui, R.P. Hamesnick, 2004. The use of distortions product otoacoustic emissions in the estimation of hearing and sensory cell loss in non-damaged choc leas Hearing. Res., 187: 12-24.

Masaki Sano, kimitaka Kago, Eijikitazumi, Kazuo kodama, 2005. Sensorineural hearing loss in patients with CP. International journal of pediatric otorhinolaryngology, 69: 1211-1217.

Morales, A.C., B.N. Azura, J. Gallot, A.A. Gonzales, Q.J. Rama, 2006. Sensorineural hearing loss in cerebral palsy patients. Acta otolaryngology, 5(7): 300-2.

Odding, E., M. Roebroech Hendrik, 2006. The Epidemiology Of cerebral palsy, incidence, impairment and risk factors. Disability and Rehabilitation, 183-191.

Palisano, R., P. Rosenbaum, S. Walter *et al.*, 1977. Development and reliability of system to classify gross motor function in children with cerebral palsy Dev. Child Neurol., 39: 214-223.

Rennie, J.M., C.F. Hagmann and N.J. Robertson, 2007. Outcomes after intrapartum hypoxic ischemia at term. Seminars in fetal and Neonatal Medicine, 12: 398-407.

Rosenbaum, P., 2007. A report: the definition and classification of cerebral palsy April 2006 Dev Med child Neuro, 49: 480.

Zafeirio, D.I., A. Andreou, K. Karasavidou, 2000. Acta paediatr. February, 89(2): 194-7.