Visual Evoked Potential in Children with Spastic Cerebral Palsy

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Abstract

Background: Cerebral palsy is a group of non-progressive neurological disorders appearing in infancy or early childhood which permanently affect body movements and muscle coordination. It is due to abnormal development of the cerebral motor cortex during fetal growth or due to brain injury either before, during or after birth. Spastic cerebral palsy being the most prevalent of its various forms. There is scanty information about the neurophysiologic investigations in children diagnosed as having spastic cerebral palsy.

Aims: To investigate the relationship between abnormal visual evoked potential findings with different clinical parameters in children with spastic cerebral palsy.

Patients and Methods: Twenty four children with spastic cerebral palsy in the age range 1 to 10 years participated in this study. Evaluation of visual evoked potentials, were performed in all study patients as well as 24 healthy children as controls.

Results: A significant difference was found in the visual evoked potential latencies and amplitudes between the children with cerebral palsy and controls. Abnormal visual evoked potentials in children with bilateral spastic cerebral palsy demonstrated a correlation with the presence of moderate to severe developmental delay.

Conclusions: It is concluded that visual evoked potentials of the patient group revealed a marked differences with that of the control group and that it demonstrate a statistically significant correlation with the presence of neurological deficits. Further to conclude, since visual evoked potentials s is non-invasive neurophysiological investigations; they can serve as important tool in the diagnostic work up of spastic cerebral palsy.

Abbreviations: VEP-visual evoked potential , CP-cerebral palsy.

تخطيط العصب البصري للأطفال المصابين بشلل المخ التشنجي

الخلاصة

المقدمة: يعد شلل المخ من مجموعة الأمراض العصبية غير المتقدمة تظهر في الأشهر الأولى أو في مرحلة الطفولة المبكرة و التي تؤثر بشكل دائم على حركات الجسم و تناسق العضلات. يعزى شلل المخ إلى نمو غير طبيعي في القشرة الحركية الدماغية للجنين قبل أو خلال أو بعد الولادة . يعد شلل المخ التشنجي من أكثر الأنواع شيوعاً. ما زالت هناك معلومات شحيحة فيما يتعلق بالفحوصات الكهروفسلجة العصبية للأطفال المصابين بشلل المخ.

الأهداف: لمعرفة العلاقة بين النتائج غير الطبيعية لفحص العصب البصري مع مختلف العلامات السريرية للأطفال المصابين بشلل المخ التشنجي.

المرضى و الطرق: شملت الاستقصاءات الكهروفسلجية تخطيط العصب البصري لأربعة و عشرين طفلاً مصاباً بشلل المخ التشنجي تتراوح أعمارهم بين السنة و العشر سنوات و كذلك تخطيط العصب البصري لنفس العدد من الأطفال الطبيعيين.

النتائج: عدَ تخطيط العصب البصري علامة دالة على مدى إصابة الجهاز العصبي المركزي حيث لوحظ انخفاض سعة الموجة مع زيادة في طول الكمون للعصب البصري للأطفال المصابين بشلل المخ التشنجي مقارنةً بالأطفال الأصحاء مع وجود ارتباط بينهم و بين درجة تأخر النمو لديهم.

الاستنتاجات: لوحظ ان هناك اختلافات واضحة بين نتائج تخطيط العصب البصري للأطفال المصابين بشلل المخ التشنجي و الأطفال الأصحاء مع و جود علاقة إحصائية مهمة بين هذه النتائج و عجز الجهاز العصبي لدى هؤلاء الأطفال. بالإضافة إلى ذلك و لكون

تخطيط العصب البصري من الفحوصات الكهروفسلجية غير العدوانية لذا يمكن عدَه أحدى الوسائل المهمة في تشخيص الأطفال المصابين بشلل المخ التشنجي.

Introduction

Cerebral palsy is a group of non-progressive, [1,2] non-contagious motor conditions that cause physical disability in human development, chiefly in the various areas of body movement.[3]

Cerebral refers to the cerebrum, which is the affected area of the brain (although the disorder most likely involves connections between the cortex and other parts of the brain such as the cerebellum), and palsy refers to disorder of movement.[4]

Cerebral palsy is caused by damage to the motor control centers of the developing brain and can occur during pregnancy, during childbirth or after birth up to about age three.[4,5] Resulting limits in movement and posture cause activity limitation and are often accompanied by disturbances of sensation, depth perception and other sight-based perceptual problems, communication ability; impairments can also be found in cognition, and epilepsy is found in about one-third of cases. Cerebral palsy, no matter what the type, is often accompanied by secondary musculoskeletal problems that arise as a result of the underlying etiology.[6]

Improvements in neonatology, have helped reduce the number of babies who develop cerebral palsy, and increased the survival of babies with very low birth weights; babies more likely to have cerebral palsy.[7,8]

The four major subtypes of Cerebral palsy are spastic, athetoid, ataxic, and mixed cerebral palsy, with spastic forms being the most common (65%).[5] Cerebral palsy prevalence is increasingly encountered in neonatal clinics since more number of premature infants survives because of better neonatal care made available these days [6].

Besides motor deficits in cerebral palsy, the other causes of handicap are the associated disabilities, in particular intellectual impairment, epilepsy, speech defects, disorders of vision and hearing, and specific educational and behavioral abnormalities, with the result that the majority of sufferers cannot take their place in normal society [6,8].

In recent years, the neurophysiologic examination of children with Cerebral palsy has been of increasing interest to both pediatricians and vision researchers because it provides new insights into mechanisms of brain damage and repair in Cerebral palsy. However, there are only very few reports on electrophysiological investigations on children having cerebral palsy [9,10] and on Visual Evoked Potentials in children with CP.

Hence the present study was undertaken to investigate children with spastic cerebral palsy using visual evoked potentials and correlate the electrophysiological findings with clinical features.

Patients and Methods

This study was done in the Neurophysiological Unit of Mirjan Teaching hospital at the period from March 2011 to August 2011.

Twenty four children with spastic Cerebral palsy ranging from 1-10 years participated as patient group in this study, a same number of age matched children were considered as a control group with the same age range and with no significant birth history or visual anomaly were also tested. Data of spastic Cerebral palsy children were collected retrospectively regarding

patient's age, pre-, peri- and postnatal events, and history of epilepsy. Clinical eye examinations included observation of fixation, following objects, pupillary reflexes, refraction, and fundus examination, was done.

The parents of patients and controls were informed about the aim and technique of the study and their acceptance was taken.

Flash VEP recording:

The recording was done using Nicolet. The stimulus for VEP recording was a monocular flash from light-emitting diode goggles that were held lightly over the infants' eyes. Flashes were presented at 0.5 per second. Silver cup electrodes were attached with paste and tape, with impedances below 5 kilo-ohms. As per 10-20 International System of EEG placements, the reference electrode (Fz) was placed 12cm above the nasion, the ground electrode (Cz) at the vertex and the active electrode (Oz) at approximately 2 cm above the inion. A band pass of 1 to 100 Hz was employed, the gain was 10,000, the sweep was 1 sec, and automatic artifact reject routine was employed.

Parameters studied

The absolute latencies of the peaks of positive wave P2 and the negative waves N1 and N2 were recorded. The amplitude of P2 is measured from the peak of N2 to the trough of P2 (N2 – P2). The absolute difference in the components evoked by the right eye and left eye stimulation (inter ocular differences) are also determined.

Statistical Analysis

Significance of difference in the mean values of different parameters in different groups was assessed by Student's "t" test and the P value <0.05 was considered to be significant. All the values were expressed as mean ± SD (Std. Deviation).

Results

A comparison between children with spastic Cerebral palsy and healthy controls regarding the VEP was done and the variations in these records were seen as:

1. Abnormally delayed latencies.
2. reduced amplitude .
3. Increase inter ocular differences in latency.
4. Increase inter ocular differences in amplitude.
5. Unusual and improper wave form.
6. Absent waveform .

The lowest latency obtained was 111.9 msec and highest value was 155.00 msec with maximum amplitude of the most prominent positivity as 12.8 μv. The range of variation in interocular difference for latency was 2 to 8.32 msec and for amplitude was 1 to 4.33 μv.

The mean latencies and amplitude of Flash VEP records in the patient group and control group have been shown in Table 1 and 2, in which there is a marked delay in the latency as well as a reduction in the amplitude when compared with the controls. The means for all VEP parameters of patient group were statistically different from the control group (P<0.05).

Table 1 The mean latency of visual evoked potential recording in both spastic cerebral palsy children and control group.

Groups no.	*REP latency(msec) (mean±SD)*	*LEP latency(msec) (mean±SD)*	*Interocular differences P latency (mean±SD)*
Patients group	130.75±8.27*	135.76±11.84*	4.74±2.42*
Control group	98.5±4.65	98.3±4.77	2.40±1.10

*P- value significant <0.05
REP: right eye evoked potential
LEP: left eye evoked potential

Table 2 The mean amplitude of visual evoked potential recording in both spastic cerebral palsy children and control group.

	REP amplitude(µv) (mean±SD)	*LEP amplitude(µv) (mean±SD)*	*Interocular differences P amplitude(mean±SD)*
	6.08±2.77*	6.11±0.99*	2.52±1.22*
	12.66±4.88	12.98±3.42	1.30±0.98

*P- value significant <0.05
REP: right eye evoked potential
LEP: left eye evoked potential

The presenting features of 24 children with spastic CP along with some associated abnormalities are shown in Table 3.

Table 3 The clinical features and radiological findings of children with spastic cerebral palsy and associated abnormalities

Presenting features	No.
microcephaly	13
Mental retardation	12
Developmental milestone Attained	6
Global delay	14
Delayed	4
Corpus callosal agenesis	5
Seizer	8
B/L SNHL	4
Birth asphyxia	9
hyperbilirubinemea	7
Optic atrophy	2
Typical febrile seizer	5
Frontal lobe atrophy	3
Cerebral atrophic changes	4

B/L SNHL : bilateral senseroneural hearing loss

The above mentioned associated disorders found along with spastic Cerebral palsy are supported by CT and MRI investigations and the diagnosis was confirmed with the help of pediatrician's opinion.

Abnormal visual evoked potentials in children with spastic cerebral palsy demonstrated a significant correlation with the presence of global developmental delay.

Discussion

A significant difference was found in the VEP latencies and amplitudes between the children with spastic CP and controls. This is in agreement with the notion put forward by previous workers that children with Cerebral palsy have abnormalities of the visual sensory and motor pathways at rates exceeding those detected in neurologically normal children.[11-17] In a recent neurophysiologic study [10] on Cerebral palsy patients, increased latencies of VEPs were reported to occur more frequently with alterations in the optic radiation supported by MRI findings. Similar results are obtained in this study in those patients where their MRI findings reveal cerebral disorders such as corpus callosal agenesis, frontal lobe atrophy, cerebral atrophic changes etc.

It has been documented previously that microcephaly leads to more than 40% reduction in VEP amplitude [18]. The small head size might be a possible cause of reduced VEP amplitudes found in microcephalic children of the present study

The abnormal flash VEP findings of this study in cases of Cerebral palsy with developmental delay are in agreement with a most recent study [10] in children with bilateral spastic Cerebral palsy in which they have demonstrated significant correlation of VEP with moderate to severe developmental delay.

Nowadays the neurophysiologic techniques especially VEPs are able to demonstrate the brain plasticity in children with cerebral palsy. The mechanisms of plasticity have been postulated as a change in the balance of excitation and inhibition; a long-term potentiation or long-term depression; a change in neuronal membrane excitability; the anatomical changes-formation of new axon terminals and new synapses.[5]

It has been suggested that children with Cerebral palsy have a remarkable ability to recover from early brain injures. The utility of the neurophysiologic investigations like VEPs in the determination of brain reorganization and repair in patients with cerebral palsy Cerebral palsy has been described in a study.[10] According to this, VEP can be a useful tool in the determination of brain plasticity in children with Cerebral palsy as it has been suggested that VEP latencies are valuable estimators of neuronal injury and even predictors of later intellectual performance.[19,20]

Conclusions

It is concluded that VEPs of the patient group revealed a marked differences with that of the control group, delay in the latency as well as a reduction in the amplitude apart from certain variations in the waveforms. and that it demonstrate a statistically significant correlation with the presence of neurological deficits. Further to conclude, since VEPs is non-invasive neurophysiological investigations; they can serve as important tool in the diagnostic work up of spastic cerebral palsy.

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