ELECTROENCEPHALOGRAPHIC FINDINGS IN CHILDREN WITH CEREBRAL PALSY: A STUDY OF 151 PATIENTS

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EEG abnormalities were studied in 151 patients (79 boys, 72 girls age range 0.4-13 years) with cerebral palsy (CP). They all had standardised EEG recordings, which were read by the same electroencephalographer. Eighty-one children had seizures and 70 were seizure-free. The EEG abnormalities in the seizure group included slow waves in 36 patients (generalised asynchronus in 33 and generalised synchronous in 3); amplitude abnormalities in 2 (focal in 1, generalised 1); epileptiform activity (including isolated sharp waves, isolated spikes, and spike-wave and polyspike-wave complexes) was seen in 66 (focal in 12; generalised in 48 and multifocal in 6). Hypsarrythmia was found in 4 and burst suppression in 1. Only 6 recordings were normal giving an overall percentage of abnormality of 92.6%. Of the CP patients without seizures, 28 (40%) showed generalised asynchronous slow waves; epileptiform activity was found in 27 (focal in 2, generalised in 23 and multifocal in 2); 3 subjects showed hypsarrythmia and 24 recordings were normal. The overall percentage of abnormality in this group was 76%. Cerebral palsy in children, regardless of its cause may be associated with generalised focal EEG abnormalities. This may reflect heterogeneity of the neural-generator in the underlying disease process.

KEY WORDS: Cerebral palsy, children, EEG, Saudi Arabia.

INTRODUCTION

The electroencephalogram (EEG), which allows the pictorial display of abnormal cerebral activity, is central to the identification and even the classification of a number of neurological disorders in both the paediatric and the adult population. This is well demonstrated in the identification and classification of the epilepsies and epilepsy syndromes (1,2). In contrast, the role of the EEG in cerebral palsy (CP) has not been clearly defined despite the significant progress that has been made in this regard (3,4). Cerebral palsy, which is a chronic disability of central origin characterised by aberrant control of movements or posture and absence of progressive diseases, is not uncommon (5). Due to varying inclusion and exclusion criteria as well as diversity in economic, geographic, and ethnic factors (6), estimates of the incidence of CP vary between 1.5 and 2.2 per cent of live births. Although the incidence
is decreasing in the developed world it remains appreciably high in the developing world with a prevalence of 5.3-11 per 1,000 children under the age of 12 years (7). Diagnosis of CP is frequently based on both clinical evaluation and neuro-imaging studies. The EEG abnormalities in patients with CP have not been extensively studied, although non-specific, generalised or focal changes have been reported (1,2,8). The aim of the present study was to examine the EEG abnormalities in children with CP who were referred to the neurodiagnostic laboratories at the King Fahd University Hospital (KFUH) of Al-Khobar, Saudi Arabia, between January 1997 and December 1999.

MATERIALS AND METHODS

A total of 151 CP patients under the age of 13 years were seen in the neurodiagnostic laboratories at the KFUH during the study period. Of these, 79 were boys (mean age: 5.1, range: 4-13 years) and 72 were girls (mean age: 8.8 years, range: 4-12.4 years). A pre-coded data form was completed to collect the relevant history, neurological examination and CT findings for each patient. Standardised EEG recordings were obtained using a 21-channel electroencephalograph (model EEG - 4421, Nihon Kohden Corporation, Tokyo, Japan). The data were entered into a standard database file using a personal computer and analysed using the SPSS statistical package.

RESULTS

The anthropometric characteristics of the 79 boys were as follows: (mean values) bodyweight: 18.3 kg (range: 4.0-51 kg), height 64.4 cm (79-149 cm), and head circumference 41.9 cm (28.7-56 cm). The corresponding values in the girls were: bodyweight 14.4 kg (5-65.7 kg), height 72.3 cm (23.9-142 cm) and head circumference 42.6 cm (28.9-56 cm). The main neurological abnormalities found in the sample are detailed in Table I. Of the 151 children, 81 (44 males, 37 females; mean age 4.9 years) had seizures and 70 (35 males, 35 females, mean age 4.5) did not. The most common EEG abnormalities in both groups were generalised slow wave abnormalities and epileptiform activity (including isolated sharp waves, isolated

<table>
<thead>
<tr>
<th>Neurological abnormality</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>%</th>
</tr>
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<tr>
<td>Language delay</td>
<td>50</td>
<td>43</td>
<td>93</td>
<td>61.5</td>
</tr>
<tr>
<td>Seizures</td>
<td>44</td>
<td>37</td>
<td>81</td>
<td>53.6</td>
</tr>
<tr>
<td>Hypotonia</td>
<td>35</td>
<td>33</td>
<td>68</td>
<td>45.0</td>
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<tr>
<td>Hypertonia</td>
<td>30</td>
<td>26</td>
<td>56</td>
<td>37.0</td>
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<td>29</td>
<td>23</td>
<td>52</td>
<td>34.4</td>
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<tr>
<td>Cerebellar abnormalities</td>
<td>16</td>
<td>8</td>
<td>24</td>
<td>15.8</td>
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<tr>
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<td>5</td>
<td>1</td>
<td>6</td>
<td>3.9</td>
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<tr>
<td>Visual deficit</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2.6</td>
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<tr>
<td>Musculoskeletal deformities</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>1.9</td>
</tr>
</tbody>
</table>

* Each patient has more than one abnormality.
spikes, and spike-wave and polyspike-wave complexes). The EEG abnormalities are detailed in Table II. The amplitude recorded was normal in 149 patients (97.7% of the whole sample), while amplitude abnormalities were found in the other two (1.3%), focal in 1 and generalised in 1.

The EEG abnormalities in the patients with seizures included generalised asynchronous slow waves in 33 and generalised synchronous slow waves in 3. Epileptiform activity was seen in 66 (generalised in 48, focal in 12 and multifocal in 6). A hypsarrhythmic pattern was found in 4 and burst suppression in 1. Six recordings were normal.

In the seizure-free group, generalised asynchronous slow waves were detected in 28 patients, generalised epileptiform activity in 23, focal epileptiform activity in 2 and multifocal epileptiform activity in 2. Hypsarrhythmia was seen in 3 and 24 recordings were normal. Table III compares the EEG abnormalities found in the groups of patients with and without seizures (percentage values).

Brain CT was abnormal in 76.1% of the patients. The most frequent abnormality was cerebral atrophy (53.7%), followed by hydrocephalus (10.4%), agenesis of the corpus callosum (4.5%) and generalised ischaemia and porencephaly (each found in 3%).

**DISCUSSION**

Cerebral palsy is diagnosed predominantly on the basis of clinical assessment and neuroimaging – CT and magnetic resonance imaging (9) – findings. The EEG does not play a vital role in the battery of tests for the diagnosis of CP. However, in the presence of associated seizures, it is essential for the electrical characterisation of the seizure discharge. In our study, abnormal EEGs were found in 80.1% and normal EEGs in 19.9% of the total population studied, which is similar to earlier reports (12). The EEG changes generally reported are non-specific and non-focal disturbances of cerebral activity. We found the abnormalities to be predominantly generalised, asynchronous, slow wave discharges and generalised and focal epileptiform activity. The frequency of these abnormalities was higher in the seizure than in the seizure-free group.
In a finding reminiscent of the 51 patients reported by Sussova et al., where 80% of children had epileptic discharges on EEG (10), epileptiform activity in our patients was more frequent in the group with seizures (81.5%) than in the group without seizures (38.7%). However, it is interesting to note that of the 93 patients with epileptic discharges, 66 were having clinical seizures, which is presumably a reflection either of the severity of the underlying primary disease, or of missed/unreported seizures. In newborns with seizures, disturbance of background EEG activity, such as burst suppression or low voltage, has been found to be the most reliable indicator correlating with the development of specific outcomes, particularly CP (11,12).

Brain CT was abnormal in 76.1% of our population, corroborating earlier results in 120 patients with CP in whom abnormal CT was found in 72.5% (13). The most frequent abnormalities on CT in our study were cerebral atrophy and hydrocephalus (23.7% and 10.4% respectively) compared to 30.8% and 10% in the earlier study (13). Pedersen found CT abnormalities in 67.5% of a population of 83 children with CP, 44 of whom had cerebral atrophy (14). In our patients with CP, the percentage correlation between the EEG abnormalities and CT findings was 60%. However, the pattern of EEG abnormalities varies in CP patients with or without seizures due to the variability of the aetiopathological conditions underlying the CP.

REFERENCES