



PERS 141

ELECTROCORTICAL CHARACTERISTICS OF  
CHILDREN WITH MINIMAL CEREBRAL  
DYSFUNCTION

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### S U M M A R Y

EEG examinations of 22 children with a clinical diagnosis of minimal cerebral dysfunction revealed a high incidence of mild EEG abnormalities and a low incidence of focal disturbances and abnormalities suggestive of epilepsy. It is concluded that the EEG may be of some value in the differential diagnosis of minimal cerebral dysfunction. Recommendations for further studies are made.

### O P S O M M I N G

EEG-ondersoek van 22 kinders met 'n kliniese diagnose van minimale serebrale afwyking het 'n hoë voorkoms getoon van ligte EEG-afwykings en 'n lae voorkoms van fokale steurings en afwykings wat op epilepsie dui. Die gevolgtrekking is dat die EEG van waarde mag wees by die differensiële diagnose van minimale serebrale afwyking. Aanvullende studies word aanbeveel.

## INTRODUCTION

The concept of "minimal cerebral dysfunction" evolved from the recognition, especially during the early 1940's (Lindsley and Cutts, 1940) of the importance of organic factors in behavioural disorders. The term derives lineally from those such as "organic brain syndrome, hyperkinetic syndrome, brain damage behaviour syndrome, postencephalitic behaviour disorder" (Clements and Peters, 1962), some of which are still used today although the tendency is to avoid the use of terms such as "damage" and "organic" as imprecise. However, this does not imply that use of the term "minimal cerebral dysfunction" automatically eliminates the disadvantages of the older concepts, as the constellation of symptoms covered by present terminology is by no means consistently described by different authors. The criteria set out by Clements and Peters (1962), however, would appear to be fairly typical, and comprise the following symptoms : deficits in perceptual-motor, general co-ordination and specific learning abilities, hyperkinesis, impulsivity, emotional lability, distractibility, equivocal neurological signs and equivocal EEG findings. These are associated with an intelligence quotient which may be classified between dull normal and superior (Paine, 1968), and which may be marked by a wide disparity between verbal and performance scales (Clements and Peters, 1962). The most comprehensive definition of minimal cerebral dysfunction, according to Paine (1968) is that arrived at by a task force of physicians and psychologists organised by the National Institute of Neurological Diseases and Blindness, the Division of Chronic Diseases of the U.S. Public Health Service and the National Society for Crippled Children and Adults, and is as follows :

"The diagnostic and descriptive categories included in the term brain dysfunction syndrome refer to children of near average, average, or above average general intelligence

with learning and/or certain behavioural abnormalities ranging from mild to severe, which are associated with subtle deviant function of the central nervous system. These are characterised by various combinations of deficits in perception, conceptualization, language, memory and control of attention, impulse, or motor function." (Paine, 1968, p. 786)

### THE ELECTROENCEPHALOGRAM IN MINIMAL CEREBRAL DYSFUNCTION

Attempts to relate EEG characteristics and behaviour disorders have led to a voluminous literature on the subject. Ellingson (1954), reviewing the literature to that date, concluded that 50-60% of children displaying the hyperactive-impulsive behaviour syndrome had abnormalities in the EEG, in comparison with 10-15% of "normal" children in the same age group. Stevens et al. (1968) summarized the results of other early investigations, together with those of one further study carried out after Ellingson's review, and found the incidence of EEG abnormalities to range from 5-27% in an age-matched control group, and from 35-73% in the group displaying behaviour disorders. Their own investigation showed that of a group of 97 children referred for severe behaviour disorders, 47% displayed "distinctly abnormal" EEGs, and 29% "borderline abnormal" records. "Distinctly abnormal" EEGs were seen in 9% of a "normal" control group, and 19% of a control group with mild behaviour abnormalities, both groups matched for age, sex and socio-economic status with the experimental group. Of the control children 29% had borderline, or mildly abnormal, recordings. The authors reported correlations between clinical symptomatology on the one hand and location and form of EEG abnormalities on the other. However, their clinical arrays were not entirely homogeneous and this findings does not appear to have been confirmed subsequently.

Capute et al. (1968) found that 8% of a group of 106 children with minimal cerebral dysfunction had markedly abnormal EEG records, 42% had EEG abnormalities ranging from slight to moderate, and 50% had normal records. In a control group of 33 mentally and physically healthy children 15% showed abnormal recordings. Non-specific, non-focal abnormalities were encountered far more frequently than specific focal dysfunctions.

Mišurec and Vrzal (1969) reported abnormal EEGs in 65% of children with minimal cerebral dysfunction (N = 43), in 32% of 29 children with partial minimal cerebral dysfunction, and in only 10% of 109 controls of the same age group.

In conclusion then, the EEG may be an aid in the differential diagnosis of minimal cerebral dysfunction. It has also been used to monitor the effects of drug treatment on behaviour disorders (Itil et al., 1967), while recent research suggests that the EEG is a valuable adjunct in assessing the prognosis of children with behaviour disorders. Tymchuk et al. (1970) suggested that the prognosis for behaviourally disturbed children with abnormal EEGs is more favourable than that for similar children with normal EEGs.

### AIM

The aim of the present study as originally formulated was to establish the EEG characteristics of a group of patients with minimal cerebral dysfunction who were referred for routine EEG examination to the Division of Neuropsychology of the National Institute for Personnel Research in Johannesburg.

### SUBJECTS

The subjects were children from Forest Town School for Cerebral Palsy, West Rand School for Cerebral Palsied children, and Cross Roads School for children with learning disabilities who were referred to the

NIPR for clinical EEG examination over a period of about 5 years. Their ages ranged from 20 months to 11 years (mean 6.35 years, S.D. 2.45 years), and of the total number of 22, 12 were males and 10 females. IQs were obtained from the referring institution in respect of all but four patients. These ranged from 79 to 126, but were measured by a number of different tests.

### METHOD

EEGs were recorded in the laboratories of the Neuropsychology Division. Use was made, over the five-year testing period, of a number of EEG machines: eight and 16 channel Elther machines, an eight channel Offner type T machine, and an eight channel Galileo type E8b. Full electrode coverage according to the ten-twenty system was used for older children, while a modified ten-twenty montage employing eight electrodes was used with younger subjects. If the child was unable, or unwilling, to co-operate, sedation was given. Wherever possible, photic stimulation and hyperventilation were carried out.

### RESULTS

Four of the 22 children (18%) had normal EEG records, 10 (45%) had mildly abnormal EEGs, and 8 (36%) showed distinctly abnormal records. No severely abnormal EEGs were seen. Diffuse abnormalities were seen in 11 (50%) of the children, suggesting cortical immaturity, delayed cortical maturation or a maturation defect in 10 of these cases. Seven subjects (32%) had localized EEG abnormalities. Only four subjects (18% of the total) displayed abnormalities which could be interpreted as suggestive of an epileptic disorder.

### DISCUSSION

If allowance be made for possible differences in the interpretation and evaluation of children's EEGs, which display far more variability than those of adults, then the incidence of abnormality

obtained in the present investigation would not appear to differ significantly from those reported by other investigators, for example, Stevens et al., 1968, Capute et al., 1968, and Mišurec and Vrzal, 1969. Other results which are in accord with those of Capute et al. (1968) are the high incidence of diffuse, in comparison with localized, abnormalities, and the relatively low incidence of epileptogenic dysfunction. One feature of the present investigation which does not appear to have been reported in other studies is the high incidence of abnormalities leading to the diagnostic possibility of cortical immaturity.

The recent report of the Committee of Inquiry into the Education of Children with Minimal Brain Dysfunction (1969) suggests that EEG examination should not be carried out as routine due to the limited value of the EEG in the diagnosis of minimal brain dysfunction. It appears, however, that the EEG is of use in monitoring the course of drug therapy and in assessing the prognosis of minimal brain dysfunction, and for these reasons, routine EEG recording may be of value.

However, a number of methodological deficiencies detract from the reliability of the present results. These are :

1. Unsatisfactory criteria for the clinical diagnosis of minimal brain dysfunction. The diagnosis of minimal brain dysfunction was made by the neurologist or paediatrician attached to the referring institution, on the basis of non-EEG criteria. These ranged from such vague entities as "delayed milestones" and "clinical grounds" to more specific descriptions of learning, perceptual and sensori-motor problems. It appeared that inter-specialist diagnostic reliability would be low for this reason. A number of children were diagnosed as displaying minimal cerebral dysfunction and were found to have IQs below 79, sometimes to a marked degree, thus hardly possessing the "near average, average, or above average general intelligence" usually subsumed by the diagnosis of minimal cerebral dysfunction. Rigid application of a set of diagnostic criteria by a

single specialist would have increased the validity of the diagnostic constellations applied.

2. Unstandardized intelligence test results. The age range of subjects in this study was considerable, and necessitated the use of a number of different tests of intelligence. It is uncertain to what extent the scores so obtained may be compared directly with one another. Further, the scores of a number of children could not be traced, and the possibility exists that some of these should have been excluded from the sample on the basis of a score below 79. Subjects whose IQs were not known were not automatically excluded from this study due to the small size of the sample. It is clear that the use of subjects more closely matched with regard to age should be considered in future research of this type.
3. Lack of serial EEGs in the present study prevented assessment of the prognostic value of the EEG in such cases, as demonstrated by Tymchuk et al. (1970).

### CONCLUSION

Although the results obtained in this investigation tend to support those of other researchers, they should not be regarded as conclusive, due to the deficiencies in the method employed.

### RECOMMENDATIONS

A more systematic and extended investigation should be undertaken, comprising EEG examinations before and after remedial education. If the interval between EEGs were of the order of one year, such electrocerebral changes as might occur could be evaluated in the light of assessments of cognitive abilities and scholastic performance.

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