ORIGINAL ARTICLE

Utility of Electroencephalograms in Paediatrics – An Analysis of 626 Records

I H M I Hussain, MRCP, A R Mazidah, MD, Neurology Unit, Paediatric Institute, Hospital Kuala Lumpur

Summary

The usefulness of the EEG in paediatric practice is unclear given the recent advances in neuroimaging. We reviewed all the EEGs done during a period of 1 year in our department to analyse the clinical utility of this test. Six hundred and twenty six recordings were made, 71% for epilepsy and the remainder for a wide spectrum of disorders. The EEG findings added valuable information to the patients' clinical assessment especially in distinguishing partial from generalised epilepsy. In non epileptic conditions the EEG was most useful in behaviour disorders. It was unhelpful in mental retardation and tumours. For the other conditions it proved a useful adjuvant in assessment of severity and prognosis. In conclusion the EEG remains a useful tool that is cheaper and more readily available in developing countries compared to the new techniques in radioimaging.

Key Words: EEG paediatrics

Introduction

Discovered by Hans Berger at the beginning of this century electroencephalograms (EEG) have been widely used since the 1950s, but are still limited to tertiary centres in most parts of the world, more so in the tropics. The actual indications for an EEG, apart from suspected epilepsy remain controversial especially with recent advances in neuroimaging. In November 1992, a separate neurophysiology unit was established at the Paediatric Institute, and as of January 1993, all EEGs in children under 12 years referred to Kuala Lumpur Hospital were performed at the Institute. We present here an analysis of all the cases done in 1993.

Materials and Methods

A retrospective analysis was made of all EEGs recorded between 1 January and 31 December 1993 at the Paediatric Institute. The recordings were made on a SAN-E1 Model 1A93 10 channel EEG machine. The International 10-20 system of electrode placement was used. All recordings included transverse and anterior posterior bipolar montages and a referential montage using the right auricular lead (A2) as common reference. Photic stimulation was used in all cases and hyperventilation in children who could cooperate. When sedation was required, syrup chloral hydrate was used in doses of 50-70mg/kg. Patient details namely age, sex, indication for EEG, clinical description of epileptic seizures and drug treatment were obtained from the EEG requisition card. All technical reports and conclusions for the EEGs were prepared by the first author, (HIHMI) and these were analysed in conjunction with the clinical data. The terminology used to describe EEG activity was that proposed by Binnie[3]. In patients with epilepsy, the seizures were classified according to the 1981 Classification of the International League Against Epilepsy[1].

Results

A total of 626 EEG records were analysed. The indications for an EEG are shown in Table I. As expected the majority of requests (71.7%) were epilepsy related. The age distribution of these children is shown in Figure 1. The largest number of recordings was made in the first year of life. However, the remaining 28.3% of requests covered a wide spectrum of

paediatric neurological disorders. The clinical classification of the 449 children with epilepsy is shown in Table II. Paucity of clinical details in the EEG requisition card did not allow a syndromic classification. Of the 337 with clinical generalised epilepsy, only 39 had generalised bilaterally synchronous spike wave discharges, 28 had secondary generalisation, 3 had continuous epileptic discharges suggesting status epilepticus, 20 had polyspike and wave discharges and 31 had multifocal epileptiform discharges, 126 had focal discharges, 7 had suspicious sharp activity and 83 were normal. Conversely although only 112 children had partial seizure clinically, 189 epilepsy related records showed focal changes. Of the 152 normal EEGs, 109 were for epilepsy, forty-nine were newly diagnosed cases or suspected epilepsy, 55 were children with epilepsy already on treatment and 5 were children with epilepsy who had already been weaned off anticonvulsants. Among the non epileptic indications for an EEG, 22 of the 27 EEGs done for encephalopathy were abnormal, but only 6 had lateralised abnormalities suggesting the possibility of Herpes simplex encephalitis. In all of these serology for herpes was subsequently reported as negative. All of the 37 records done for meningitis were in children whose acute illness had been complicated by fits. Thirty-two of the records were abnormal; 15 had multifocal epileptiform discharges, 15 focal discharges and 2 cases had focal slowing. Data on the number of these children who subsequently developed epilepsy is not available.

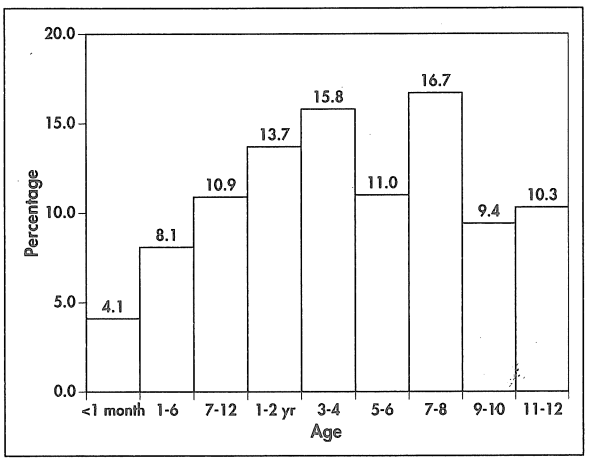

Fig. 1: Age distribution of patients with clinical epilepsy

The details of EEG findings in the other conditions listed in Table I are shown in Table III.

Discussion

The EEG is an important tool in assessing brain function, and together with advance in neuroimaging, has greatly improved our understanding of the nervous system. However, all tests have their limitations. The aim of this study was to analyse the usefulness and limitations of the EEG and draw guidelines for the optimal use of this investigative modality.

As expected the majority of requests were epilepsy related but almost one third were for non epileptic conditions. Fifty per cent of EEG requests were in children under 4 years of age reflecting the higher incidence of epilepsy in young children[3]. Of the EEG done for epilepsy only 24.3% were normal, much lower than that predicted by some workers[2]. This is

Table I
Indications for EEG in 626 children

Case	No.	Percentage
Epilepsy	449	71.7%
Encephalopathy	27	4.3%
Post Meningitis	37	5.9%
Mental Retardation	16	2.6%
Regression of Development	18	3%
Behaviour Disorder	14	2.2%
Acute Hemiplegia	4	0.6%
Tumour	3	0.5%
Brain Death	5	0.8%
Post Ischaemic Brain Damage	16	2.6%
Birth Asphyxia	5	0.8%
Neonatal Seizures	19	3.0%
Intracranial Haemorrhage	9	1.4%
Systemic Medical Illness	4	0.6%
Total	626	100%

Table II
Types of clinical epilepsy seen

	Number of Patients	Percentage
A) **Partial Seizures**	112	25%
Simple Partial Seizures	43	9.6%
Complex Partial Seizures	47	10.5%
Partial Seizures Secondarily Generalised	22	4.9%
B) **Generalised Seizures**	337	75%
Absence Seizures	35	7.8%
Atypical Absence Seizures	3	0.7%
Myoclonic Seizures	61	13.6%
Clonic Seizures	15	3.3%
Tonic Seizures	75	16.7%
Tonic-Clonic Seizures	109	24.3%
Atonic Seizures	37	8.7%
Non Convulsive Status	2	0.4%
	449	100%

probably because almost all the EEGs done in children under 4 are sleep recordings, and sleep is regarded as an activation procedure[4]. The findings among patients with generalised epilepsy diagnosed clinically is interesting, as the majority, 126 out of 254 abnormal records had focal changes, of which 28 had secondary bilateral synchrony documented on EEG. This may have therapeutic implications as traditionally, phenobarbitone and valproic acid have been used for primary generalised epilepsy while phenytoin and Carbamazepine are preferred for partial epilepsies with or without secondary generalisation. However, two recent studies[5,6] have shown all these drugs to be equally effective in both types of epilepsy, although carbamazepine and valproic acid are preferred in children. Nonetheless this is an important clinical distinction as prognosis for control and risk of recurrence on withdrawal of treatment are significantly different in these two groups of patients[7].

Forty-nine children with newly diagnosed or suspected epilepsy had normal EEGs while a further 30 patients from the total of 449 had suspicious sharp activity

Table III
E.E.G. findings in 626 records according to indication

Indication	N	G	FG	MY	ME	FD	SSA	SE	EN	BD	O	Total
EPILEPSY	109	39	28	20	31	189	30	3				449
Encephalopathy	5					7	3		12			27
Post meningitis	5				15	15					2*	37
Mental retardation	10										6#	16
Mental regression	9				8			1				18
Behavioural	5					5	4					14
Acute hemiplegia	2					2						4
Tumour	1										2*	3
Brain death										5		5
Post ischaemic	1					13			2			16
Birth asphyxa					1				4			5
Neonatal seizures	2				7	10						19
Intracranial H'age	2					1	3		3			9
Systemic Illness	1					2			1			4
Total	152	39	28	20	62	244	40	4	22	5	10	626

*N: Normal, G: Generalised discharges, FG: Focal discharges with secondary generalisation, MY: Myoclonic, ME: Multifocal epileptiform discharges, FD: Focal discharge, SSA: Suspicious sharp activity, SE: Status epilepticus, EN: Encephalopathy, BD: Brain death, O: Other. #: Delayed maturation, *: Focal slow.*

which is not a particularly useful finding, stressing the fact that the most important investigation in epilepsy is a good clinical history and an eyewitness account. On the other hand, the finding of multifocal epileptiform discharges and polyspike and wave discharges on EEG often have unfavourable implications that may not be apparent from the clinical history. This emphasises the point that epilepsy classification is an electroclinical one.

Among the non epileptic requests it would appear that doing an EEG for mental retardation is not useful. The finding of delayed maturation of background activity does not affect management, nor does it help in the diagnostic workout.

On the other hand, half of the patients with mental regression had significant findings, including one with non convulsive status epilepticus, which is a treatable cause of regression. Among the 8 who had multifocal discharges, 2 had changes suggestive of an underlying poliodystrophy and 4 others of a leukodystrophy[8].

This information is particularly useful in centres like ours which do not have facilities to investigate lysosomal and peroxisomal disorders. The finding in meningitic and encephalopathic patients has been alluded to earlier and these requests were appropriate. Nine of 14 patients with behavioural disorders had abnormalities on EEG, of whom 5 had focal discharges, and were started on carbamazepine.

We have, since, been very liberal in doing EEGs for such children. This contrasts with the EEG done for patients with hemiplegia and suspected tumours which did not help in their management. Two of the 3 patients with a suspected tumour had abnormalities on CT scan, and neuroimaging should now replace EEG for this condition. All 5 patients in the brain death group were infants who were clinically brain dead and an EEG is an added test for brain death in infants under 1 year in our department. In the remaining 5 groups shown in Table III, EEGs were done to help assess the extent of brain damage and to decide on the need for anticonvulsants. Of the 4 children with systemic illness (1 acute lymphoblastic leukaemia (ALL) with central nervous system involvement, 2 systemic lupus erythematosus (SLE) and 1 with chorea, one of the patients with SLE had a normal EEG whereas the child with ALL had diffuse slow activity suggestive of an encephalopathy.

In conclusion, the EEG remains an important investigative tool in child neurology, not only in epilepsy but in a broad spectrum of disorders where EEG findings affect prognosis and may modify treatment.

This is an important observation in an era where advances in neuroimaging may distract clinicians from the usefulness of neurophysiological testing, which is cheaper and more readily available in developing countries.

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References

1. Commission on Classification and Terminology of the International League against Epilepsy: proposal for revised clinical and electroencephalographic classification of epileptic seizures. Epilepsia 1981;22 : 489-501.

2. CD Binnie. Electroencephalography in Textbook of Epilepsy, Ed. Laidlaw, Ricken, Chadwick. 4th Edition. Churchill Livingstone, 1993.

3. Cowan LD. Prevalence of Epilepsy in Childhood and Adolescence. Epilepsia 1989;30(1) : 94-106.

4. Sundaram M, Hogan TP, Hiscook M. Factors affecting interictal spike discharges in adults with epilepsy. Electroencephalography and Clinical Neurophysiology 1990 (75) : 358-60.

5. Verity CM, Hosking G, Easter DJ. A Multicentre Comparative Trial of Sodium Valproate and Carbamazepine in Paediatric Epilepsy. Dev Med Child Neurol 1995;37 : 97-108.

6. Heller AJ, Chesterman P, Elwes RDC *et al.* Phenobarbitone, Phenytoin, Carbamazepine or Sodium Valproate for newly diagnosed adult epilepsy: A randomised Comparative Monotherapy Trial. Journal of Neurology, Neurosurgery and Psychiatry 1995;58 : 44-50.

7. Shinnar S, Beng AT, Moske SL *et al.* Discontinuing Antiepileptic Drugs in Children with Epilepsy: A Prospective Study. Ann Neurol 1994;35 : 534-45.

8. Tharp BR. Neonatal and Paediatric Electroencephalograms in Electrodiagnosis in Clinical Neurology. Ed. Aminoff MJ. 2nd Edition Pg. 77-125. NY: Churchill Livingstone, 1986.