

# EEG requests in paediatrics: an audit

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## Abstract

**An audit of 165 requests for electroencephalography (EEG) was undertaken before and after the introduction of guidelines and recommendations, 12 months apart. Inadequate clinical information was provided in requests in both surveys; 40% of requests were considered to be unnecessary, and approximately 50% of clinicians felt that EEG could diagnose epilepsy.**

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Electroencephalography (EEG) is a commonly requested but generally misunderstood and abused investigation. The value and practical usefulness of any investigation, including EEG, depends on both the clinical information as well as its interpretation. The purpose of this audit was to review critically the clinical content and electroclinical usefulness of EEG requests within a general paediatric population. An initial survey of EEG requests was analysed and the results given to the requesting clinicians together with written guidelines for when and how the requests should be made. The survey was repeated 12 months later, enabling a true audit of the quality of EEG requests. It was not the purpose of this paper to audit the methods and quality of reading and reporting the results of EEG.

## Patients and methods

All the children referred for EEG were inpatients or outpatients at the Royal Liverpool Children's NHS Trust (Alder Hey) and local district general hospitals. All consecutive EEG requests were analysed for a two month period (February and March) in 1993 and again (February and March) in 1994. EEG requests from the two paediatric neurologists were excluded from the audit. All other requests irrespective of source were audited and were undertaken within 2-3 weeks of being requested. Recordings were performed in the waking state in the majority of patients, over 30 minutes using 16 channels with the surface electrodes applied according to the international 10-20 system. Recordings were made by two senior neurophysiology technicians and reported by one consultant paediatric neurologist. Analysis of the EEG requests (completion of forms, appropriateness, and clinical usefulness) was undertaken by the same EEG recordists and paediatric neurologist. The usefulness of the report was defined as being helpful or unhelpful on the summation of the clinical information provided and EEG findings as adjudged by the paediatric neurologist.

## AUDIT FORMS

The audit form was divided into two sections; the first recorded information from the EEG request including (a) clinical information, age and sex of patient, age of onset and seizure details, neurological findings, and family history required to facilitate syndrome recognition; drug history and handedness (relevant for  $\alpha$  rhythm and other changes in background activity); (b) provisional diagnosis; and (c) purpose of EEG. The second part focused on the value of EEG in clinical practice and was subdivided into the following three areas: (a) request appropriateness; (b) diagnostic index yield (syndrome, generalised, focal, non-specific, and normal); and (c) usefulness of the electroclinical report.

An audit form for each patient was completed at the time that the results of the EEG were reported. Statistical analysis of the comparison of data obtained from both surveys was by  $\chi^2$ .

## Results

There were 165 consecutive requests for EEG in the first two month period. There were 195 requests in the second period, but only the first 165 were analysed, allowing a comparison between populations of identical size. Sources of requests were almost identical in the two surveys, originating from hospital (80%) and

Table 1 Comparison between clinical information, provisional diagnosis, purpose of EEG, and conclusions between the two surveys; results are number (%)

	Before guidelines	After guidelines	$\chi^2$ (p value)
(1) Clinical information			
Seizure details			
Adequate	74 (45)	89 (55)	0.87
Inadequate	78 (47)	76 (45)	
Nil	13 (8)		
Neurological findings			
Stated	126 (76)	128 (78)	0.07
Not stated	39 (24)	37 (22)	
Handedness			
Stated	84 (51)	88 (53)	0.37
Not stated	81 (49)	77 (47)	
Drug treatment			
Stated	133 (89)	155 (94)	13.2
Not stated	32 (19)	10 (6)	(<0.01)
Family history			
Stated	121 (73)	143 (86)	9.17
Not stated	44 (27)	22 (14)	(<0.05)
(2) Provisional diagnosis			
Stated	130 (79)	137 (83)	2.00
Not stated	35 (21)	28 (17)	
(3) Purpose of EEG			
Stated	90 (55)	105 (64)	2.82
Not stated	75 (45)	60 (36)	
(4) Conclusions			
Request appropriateness			
Yes	109 (66)	104 (63)	0.33
No	56 (34)	61 (37)	
Electroclinical report			
Syndrome	18 (11)	20 (12)	1.29
Generalised	26 (16)	25 (15)	
Focal	18 (11)	20 (12)	
Non-specific	41 (25)	33 (20)	
Normal	62 (37)	67 (41)	
Report usefulness			
Unhelpful	109 (66)	116 (70)	0.68
Helpful	56 (34)	49 (30)	

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community (18%), general paediatricians and child psychiatrists (2%); no requests were received from general practice. The mean and age range of the first group was 7.5 years (3 weeks–16.5 years), and that of the second group 8.0 years (4 weeks–15.5 years). There was no difference in the sex ratio between the two groups. The vast majority of provisional diagnoses were seizure or epilepsy related; only five (4%) and nine (7%) of patients in the two surveys respectively were considered to have an alternative diagnosis, including an encephalopathy or brain tumour. Detailed results of the two surveys (including statistical analysis) are shown in tables 1 and 2. Only two categories showed a statistically significant difference between the initial and repeat surveys; these were drug treatment ( $p < 0.01$ ) and family history ( $p < 0.05$ ).

### Discussion

This study has emphasised the inadequate clinical information provided in EEG request forms both before and after the introduction of guidelines. This may be related to inadequate history taking or to a poor understanding of epilepsy and the function of EEG, or both. In only two categories, drug treatment and family history, was additional information provided in the second survey but this did not significantly affect either the electroclinical report or usefulness of the EEG. It is possible that in the repeat study, relatively new or inexperienced junior medical staff may not have been fully aware of when and how to request EEG, although written guidelines were made available to all medical staff after the findings of the initial survey.

The proportion of requests offering a provisional diagnosis was higher than we had expected although again, there was no difference between the two surveys, and it was clear that there was a duplication of responses between 'provisional diagnosis' and 'purpose of EEG'. A greater proportion of clinicians provided a reason for requesting EEG in the repeat survey (64% *v* 55%), but this was not statistically significant. The most common reasons cited reflected the misconception that it could diagnose or exclude epilepsy; in the two surveys 60% and 54% of clinicians respectively thought that EEG could do this. EEG performed once on an awake subject with negative results is of no diagnostic value and does not exclude epilepsy.<sup>1,2</sup> EEG is important in identifying or classifying specific epilepsy syndromes, most of which occur in childhood and are age related. It was apparent from the repeat survey that more clinicians were aware of the concept of the epilepsy syndrome (nine offering this as a reason for undertaking EEG, in contrast to two in the initial survey) but again this difference was not significant. As the definition of an epilepsy syndrome depends upon the clinical information including age of onset of seizures, neurodevelopmental status, family history and seizure type(s), as well as EEG findings, it is possible that a greater proportion of EEG recordings would have been diagnostic of a specific epilepsy syndrome had there been more clinical information.

Table 2 Provisional diagnosis and purpose of EEG in those patients whose EEG request forms contained this information; results are number (%)

	Before guidelines	After guidelines
(1) Provisional diagnosis		
Total number	130 (79)	137 (83)
Epilepsy	51 (39)	49 (36)
Primary generalised epilepsy	21 (16)	30 (22)
Non-epilepsy	20 (15)	18 (13)
Focal epilepsy	16 (12)	15 (11)
Febrile seizures	15 (12)	12 (8)
Encephalopathy	4 (3)	7 (5)
Epilepsy syndrome	2 (2)	4 (3)
? Brain tumour	1 (1)	2 (2)
(2) Purpose of EEG		
Total number	90 (55)	105 (64)
Diagnostic	27 (30)	25 (24)
Epilepsy/fits	23 (26)	24 (23)
Change in treatment	11 (12)	13 (12)
Further information	10 (11)	12 (11)
Epileptic focus	10 (11)	11 (10)
Define epilepsy syndrome	2 (2)	9 (9)
Change in seizures	3 (4)	6 (6)
To exclude epilepsy	4 (4)	5 (5)

As far as we are aware the identification of a focal discharge on an EEG recording did not lead to the demonstration of any structural lesion/abnormality, but this was not formally assessed.

In 45% (initial survey) and 36% (repeat survey) of requests, the purpose of requesting EEG was not given; the reasons for these high rates of omission are unclear but may include a simple oversight or uncertainty as to why the request was being made. It is also likely that a number of requests were made to reassure the parents or physician, or both, by obtaining, hopefully, a normal report.

On the basis of the clinical information given EEG requests were felt to be appropriate in over 60% of cases in the initial survey. The findings of an almost identical figure in the repeat survey suggests that despite guidelines, clinicians remained unsure as to when and on whom, to request EEG.

Finally EEG was considered useful 70% of the time in the further management of the patient; in the remaining 30% EEG was not felt to be useful, primarily because of non-specific EEG abnormalities and inadequate clinical information. It was not the purpose of this study to assess whether the requesting clinicians themselves considered the EEG report helpful or not, but we appreciate that this could have provided a useful correlation. Although we acknowledge that the EEG recordings were not read blind (that is, the identity of the referring consultant was known) we do not consider that this introduced any interpretation bias which could have significantly influenced the results of the study.

This audit has demonstrated that practical advice and recommendations are still required on the role and clinical relevance of EEG. Finally, this study has again highlighted the (false) belief that EEG is able to diagnose or exclude epilepsy.

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