

Audit in practice

The EEG in psychiatry

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Although the EEG has been in constant clinical use for over 40 years, there have been surprisingly few systematic studies of the pattern of referral and clinical use of electroencephalography in a NHS psychiatric service. In view of the current concern about medical audit and cost effective use of special investigation facilities, it is an opportune time to audit the use of clinical electroencephalography in psychiatry. The current study examines the clinical use of electroencephalography in a district psychiatric service that provides comprehensive care for the population of Dundee (population 180,000).

The study

The Regional Department of Clinical Neurophysiology at Ninewells Hospital and Dundee Royal Infirmary provide an EEG service for the Dundee Mental Health Unit. All adult psychiatry referrals, both in-patient and out-patient, from the Dundee catchment area during a 12 month period were identified. "New" patients, defined as either first referrals or patients who had not had an EEG in the previous year were selected for study. Children and mentally handicapped patients were excluded.

Review of case-notes

The case-notes of the new EEG referrals were reviewed by one of us (KS) who was 'blind' to the EEG reports. An item sheet recording demographic and clinical data was completed, including the primary psychiatric diagnosis at the time the patient was referred, as well as the reasons for the referral.

In order to control for referral bias between different consultants and to identify clinical features that prompt referral, a similar analysis was carried out on the records of a sample of patients who did not have an EEG investigation. For each individual in-patient and out-patient referred for EEG investigation, a "non-EEG" patient was selected at random from in-patients admitted under the care of the same consultant to the same ward and during the same

month and year as the patient, and out-patients attending one of the consultants' clinics. None of the "non-EEG" patient group had been referred for EEG examination during the previous year. They will be described as the non-EEG or control group.

EEG review

Eighty-seven patients (96%) had a routine waking recording with hyperventilation and photic stimulation carried out. A further four had barbiturate induced sleep recordings in addition to the waking records. No evoked potential investigations were requested or carried out.

The EEGs of the new referrals were examined by an experienced clinical neurophysiologist (GWF) who was 'blind' to the outcome of the review of the patient's case-notes, as well as to the contents of the referral. On the basis of his examination, the records were classified as normal, anomalous or abnormal, using the criteria of Fenton *et al* (1971). "Anomalous" referred to records with an excess of slower background features or minor paroxysmal phenomena of non-specific significance while "abnormal" ratings were given to those with unequivocal evidence of organic brain dysfunction or epileptiform activity.

Joint review

After each EEG had been classified "blind" to the clinical referral data, the clinical information on the referral forms was reviewed and found to be generally satisfactory. From the case record data, we were unable to judge reliably the extent to which the EEG findings influenced management decisions. We therefore made a joint decision whether the investigation had been of positive value, negative value or of little or no value. Positive value was defined as EEG findings that provided useful additional evidence to support a clinical diagnosis of organic brain dysfunction or epilepsy, hence increasing the probability of such target diagnoses. In contrast, negative value referred to an EEG finding that significantly reduced the probability of organic brain involvement or epilepsy.

Findings

During the 12 months under review the Clinical Neurophysiology Department received 1,303 referrals, of which 145 (11%) were from psychiatric sources, including new referrals and follow-ups. After excluding children and mentally handicapped patients we were left with a final sample of 91 new referrals, 63 (69%) being in-patients and 28 (31%) out-patients. The sex distribution was equal and 23 patients (25%) were aged 65 or over.

Comparison of referred patients and controls

Both groups had similar age and sex distributions. Of the referred patients, 82 had a primary psychiatric diagnosis, the remaining nine not having a firm diagnosis. Of the EEG referrals, 29% had a diagnosis of organic brain syndrome compared with 6% of the controls (acute * 8% v. 2% respectively; chronic ***21% v. 4%). By contrast, unipolar depressive illness was more common among the controls* (EEG referrals 19%, controls 30%). Similarly, the controls *** contained a significant excess of patients with neurotic disorder (EEG referrals 16%, controls 41%). There were no significant differences between the groups in the remaining diagnostic categories. Among the latter 12% of the EEG referral group suffered from schizophrenia, 8% from bipolar affective disorder, 9% from personality disorder, 19% from alcoholism, and 7% from drug dependence.

A check list of clinical features leading to EEG referral was compiled by scrutiny of the referred group's case records and the respective prevalence of these phenomena in the two groups compared. The EEG referral group contained significantly more patients with a suspected organic brain syndrome ($P < 0.001$), suspected epilepsy ($P < 0.001$), episodes of unconsciousness ($P < 0.01$), memory impairment ($P < 0.01$), periods of mental confusion ($P < 0.05$), temporal lobe features ($P < 0.01$), organic mental state findings ($P < 0.001$), episodic violence or behaviour disturbance ($P < 0.01$), impulsive or unusual behaviour ($P < 0.05$) and acute onset psychosis ($P < 0.01$).

EEG findings

EEG changes due to psychotropic medication were noted in 12 records (13%). In five cases (6%) poor compliance on the part of the patient affected the quality of the recording.

Forty (44%) of the present records were normal, 17 (19%) anomalous and 34 (37%) abnormal. The abnormal EEGs showed a range of pathological features which included diffuse slowing of the background frequencies, significant asymmetries in frequency and amplitude between the hemispheres, focal theta and delta wave disturbances and paroxysmal abnormalities of both focal and generalised

origin (spike and wave, sharp and slow waves, theta and delta wave paroxysms). The significant associations with an abnormal EEG were a diagnosis of organic brain syndrome ($P < 0.001$) or organic personality change ($P < 0.001$), a history of attacks of unconsciousness ($P < 0.05$), bouts of mental confusion ($P < 0.05$), history of cognitive deterioration ($P < 0.05$), a recent memory impairment on testing ($P < 0.01$), organic mental state changes ($P < 0.001$) and acute onset psychosis ($P < 0.05$).

The anomalous EEGs contained a different spectrum of phenomena, which were regarded as anomalous but insufficient to provide hard evidence of organic brain dysfunction or epileptiform activity. These included an excess of theta and/or delta waves for the age, either generalised or localised to the posterior temporal regions in the presence of a normal alpha rhythm, sharply formed transients usually recorded from the temporal areas, but occasionally elsewhere in the cortex or of generalised distribution. The significant clinical associations were much less strong ($P < 0.05$)*, being a history of previous cerebral insult, episodic violence or psychosis.

In those with normal EEGs, the clinical associations were also weak, being male, having a history of impulsive behaviour, acute onset or atypical psychosis ($P < 0.05$).

Temporal lobe epilepsy. Although suspected temporal lobe epilepsy was a reason for EEG referral in 32% of all patients, analysis of the case records reveal that no patient manifested clinically convincing complex partial seizures. The clinician's suspicions were aroused by much softer data, such as subjective accounts of perceptual phenomena of a nature commonly associated with complex partial seizures and/or episodic behaviour disturbance accompanied by amnesia for such episodes in the absence of convincing evidence of clouding of consciousness.

Value of the EEG

Seven (8%) of the investigations were rated to be of little or no value, e.g. because of medication effects, non-compliance on the part of the patient or because of lack of relevance to the clinical problem. Of the other 84 recordings, 48 (53% of the total) were of positive value and 36 (39%) of negative value. Cross-tabulation of our data showed that a rating of positive value was associated with the EEG being abnormal and the patient having a primary diagnosis of an organic brain syndrome. Conversely, negative value of the EEG was associated with a normal record and a low frequency of organic psychosyndromes.

Follow-up EEG examinations

In 25 cases (27%) we felt that a follow-up EEG was desirable, e.g. to confirm the consistent presence or

otherwise of the EEG changes, look for evidence of progression of brain dysfunction or check medication effects. However, such an investigation was carried out in only four.

Comment

In the Dundee service, the symptoms and signs that prompt EEG referral can be classified as those that indicate a high probability of organic brain dysfunction or those that raise the suspicion of an organic process, but, when taken alone, are not compelling evidence of such, e.g. the presence of perceptual or behavioural phenomena of the type associated with temporal lobe epilepsy in the absence of unequivocal complex partial seizures or behaviour disturbance that is episodic, atypical or has an acute onset. The two classes differed in that the former had a significantly higher prevalence of abnormal EEGs and ratings of positive value while the latter class showed a significantly greater number of normal EEGs and ratings of negative value. Only two of the EEGs were of no value because of technical problems or difficulties with obtaining the patients' co-operation. This small number in a series containing many acutely ill psychiatric patients suggests a high standard of skill among the EEG technicians and a careful selection of patients by the psychiatric teams.

The 53% of positive value cases provide confirmation of the clinical diagnosis of established organic brain disease with definite organic mental symptoms and signs. By contrast, the 39% of cases with negative value rating relate mainly to normal EEGs in patients with functional psychoses, neurotic and personality disorders, alcohol and drug abuse, where the clinical state is observed to be atypical because of acute onset, or the presence of mental state phenomena or behavioural manifestations that are inconsistent with the target diagnosis but yet are not associated with unequivocal organic mental state features. In this negative value situation, the EEG is applied to the assessment of functional psychiatric states in order to provide evidence to exclude the suspicion of organic brain involvement which has been aroused by clues elicited during the initial clinical work-up.

The retrospective design of our study made it difficult to assess accurately the extent to which the EEG data influenced the clinicians' care plans for each patient. In a study of the work of one clinical team, Bowie *et al* (1988) estimated that the EEG results influenced the clinical practice of the referring psychiatrist in 13% of cases, a figure essentially similar

to that for CT scanning at the Maudsley Hospital (Roberts & Lishman, 1984) and much higher than the 2% found for 49 elderly patients referred for EEG investigation (Colgan & Philpott, 1985).

Our findings demonstrate that the EEG abnormality yield is greatest when the clinical history, physical and psychiatric examinations reveal definite organic mental state phenomena and/or abnormal CNS signs. In contrast, functionally ill psychiatric patients with atypical features in the absence of frank organic symptoms or signs have a high probability of manifesting normal EEGs. Further, EEG investigation of temporal lobe dysfunction is unlikely to be productive in the absence of a history of unequivocal complex partial seizures or grand mal attacks. The EEG study of subjective complaints alone or episodes of disturbed behaviour with amnesia but without clouding of unconsciousness will usually result in negative results. Finally, it is of general interest that there were no cases of clinically proven temporal lobe epilepsy among the year's EEG referrals.

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χ^2 or Fisher tests were used to compare the significance of differences between the EEG referral group and the controls (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$). Full details of the results can be obtained from the authors.