

EEG Use in a Tertiary Referral Centre

Abstract:

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Abstract

The aim of this study was to retrospectively audit all electroencephalograms (EEGs) done over a 2-month period in 2009 by the Neurophysiology Department at Cork University Hospital. There were 316 EEGs performed in total, of which 176/316 (56%) were done within 24 hours of request. Out of 316 EEGs, 208 (66%) were considered appropriate by SIGN and NICE guidelines; 79/208 (38%) had abnormal EEGs and 28 of these abnormal EEGs had epileptiform features. There were 108/316 (34%) inappropriate requests for EEG; of these 15/108 (14%) were abnormal. Of the 67/316 (21%) patients who had EEGs requested based on a history of syncope/funny turns: none of these patients had epileptiform abnormalities on their EEGs. Our audit demonstrates that EEGs are inappropriately over-requested in our institution in particular for cases with reported funny turns and syncope. The yield from EEGs in this cohort of patients was low as would be expected.

Introduction

The Neurophysiology Department at Cork University Hospital (CUH) is the tertiary referral centre for electrophysiological studies for the southern part of the Republic of Ireland and serves a catchment area of approximately 1.5 million people. It is one of only 7 public neurophysiology centres in Ireland and serves both paediatric and adult populations. In our centre, routine and sleep deprived electroencephalography (EEG) are available on request to GPs, consultant neurologists and other specialists. More specialised EEG services such as video-telemetry EEG and multiple sleep latency testing are also available to the neurology service at CUH. We undertook an audit of the utilisation of EEG services in our department with the objectives to see how many EEGs were appropriately requested given the clinical history. Of particular interest was whether one ordering group were more likely than others to order an EEG with subsequent abnormality and whether EEG results were likely to change management of the patients. We also wished to identify any potential areas where a change in the process of referral might prevent unnecessary EEGs and a waste of resources with the hope that any changes implemented as a result might improve patient care.

Methods

The request forms for and the results of 316 EEGs carried out between the 1st of March until the 30th April 2009 were analysed. The following data was documented: patient demographics, the waiting time for EEG, the speciality group of the ordering service (whether neurology, other specialities or general practice), the referring hospitals, the legibility of the manually completed request forms, how clearly the clinical indications were expressed on the forms, the appropriateness of the request and the EEG results. For the purposes of this study: a) whether the request for an EEG was appropriate or not was based on the National Institute for Clinical Excellence (NICE) and the Scottish Intercollegiate Guidelines Network (SIGN) guidelines (Table 1); b) a positive EEG was considered to be evidence of epileptiform activity, status epilepticus, encephalopathic changes or EEG evidence of severe cerebral injury (in patients with hypoxic ischemic injury) where such findings would change management or indicate a cause for the patients symptoms.

Figure 1: Indications for EEG

Results

Over the 2-month period studied, 316 EEGs (including 12 sleep-deprived EEGs) were carried out. Adult patients outnumbered paediatric patients by a ratio of 4:1. The male:female ratio was similar in both children (<16 years) and adults. From date of receipt of the request for an EEG, the waiting times were <24 hours in 176/316 (56%) and < 2 weeks in 122/316 (39%). The waiting time for outpatient sleep-deprived EEGs ranged from 45 to 380 days. Overall (i.e. out of the 316 requests) 13 (4%) were illegible. Interns wrote 5 of these 13 illegible requests (38%), SHOs wrote 3 (46%), consultants wrote 2 (15%) and a registrar wrote one. In 2 requests, we were unable to tell who had completed the forms or interpret what was written. Out of the 226 requests from CUH, 9 (4%) were illegible. Out of the of 90 non-CUH requests, 4 (4%) were illegible.

Figure 2: EEG appropriateness and positive findings

In 161/316 cases (51%), the most common indication for requesting an EEG was a suspected seizure disorder; in 67/316 patients (21%) the indication given was a funny turn/syncope, out rule epilepsy. Seventy-two per cent of the EEGs (226) were ordered by neurologists or other specialists working in CUH; 58/226 (26%) of them showed significantly abnormal findings with either epileptiform or encephalopathic features. Four per cent of the 316 cases (14 patients) had known epilepsy with recent seizures but no clear indication as to why a repeat EEG was requested (Figure 1). Twelve of these 14 EEGs were ordered by SHOs in the outpatient setting; on chart review, none of these

patients had their repeat EEGs requested for the purpose of reviewing the diagnosis, re-classification of epilepsy syndrome or to look for spike wave burden.

Figure 3: Proportion of 'funny turns' and 'syncope' that had an abnormal EEG

Of the total number of the 316 EEGs done, 208 (66%) were considered 'appropriate' by SIGN and NICE guidelines^{1,2}; 79/208 (38%) had abnormal EEGs and 28 of this group of 79 with abnormal EEGs had epileptiform features. Out of the total number of the 316 EEGs done, there were 108 (34%) 'inappropriate' requests for EEGs; of these 15/108 (14%) were abnormal of which 6/15 (40%) had epileptiform features. With regard to the 6 'inappropriate' EEGs which showed epileptiform features: 4 of them were known epileptic patients who had positive EEGs in the past while in 2 cases the reasons for referral for EEGs were unclear. On chart review, none of these patients had their repeat EEGs requested for the purpose of reviewing the diagnosis, possibility of re-classification of epilepsy syndrome or to look for spike wave burden. From the available data, 43/128 (34%) of EEG requests by neurology were considered 'inappropriate' compared with 65/188 (35%) requests from other referring specialities or GPs (Figure 2).

A description of a typical event was provided in only 173/316 (55%) of cases. Although neurologists and other specialists had similar numbers of abnormal EEGs, neurologists had more epileptiform EEGs (66% versus 39%). On 8 EEGs, the electrocardiogram (ECG) tracing was noted to be abnormal during the EEG recording: 2 of these cases were funny turns, 5 were suspected seizures and the final case was in the 'other category'. Epileptiform changes were not documented in any of the EEGs where 'funny turn' or 'syncope' was written on the request form (Figure 3). In 63/316 (20%) of cases, EEG results altered management of the patient; the use of EEG was considered 'appropriate' in 61/63 (97%) of these cases. In 2/63(3%) of this group the use of EEG was considered 'inappropriate' because the reason for referral was unclear.

Discussion

One in 20 people will have a single seizure in their lifetime. In adults with epilepsy, a single EEG recording will show definite epileptiform abnormalities in only 30-40% of patients^{3,4}. EEG should not be routinely done in patients where the clinical picture does not merit a reasonable index of suspicion for the diagnosis of epilepsy, e.g., it is not necessary for all patients with 'blackouts' or 'funny turns'. EEG results are only useful when positive; it is always important to note that a negative EEG does not exclude epilepsy. Many recurrent episodes or funny turns can easily be mistaken for seizures. UK guidelines for the appropriate ordering of EEG are available from the NICE and SIGN guidelines^{1,2} (Table 1).

An abnormal EEG should always be considered in the context of the clinical history/exam as well as other investigations, i.e., it should be used as supportive rather than conclusive evidence towards a diagnosis. An EEG cannot a) 'prove' or 'rule out' epilepsy, b) differentiate a funny turn/syncope from epilepsy (in particular where no witness history is available), c) indicate 'severity of epilepsy' (except in certain childhood epilepsies), d) diagnose or definitively rule out a space occupying lesion nor e) can it differentiate between dementia and pseudodementia. A number of interesting EEG audits have been published in the past. Nicolaidis found that up to 40% of EEG requests in paediatrics were 'inappropriate'. In the same study, over 50% of the referring doctors thought a negative EEG would definitively rule out epilepsy. Binnie demonstrated that 60% of EEG referrals were to 'assess epilepsy control' in known epilepsy patients but results only changed their management in 3% cases et al. reported that 56% of EEGs orders at their centre were 'inappropriate'; in this study, after the initial audit, by educating their colleagues about the uses and limitations of EEG and then re-evaluating services some months later this figure fell to 35%. Pearce and Cock reported a 25% 'inappropriate EEG' rate in their institution⁹.

In our audit, 176/316 (56%) of patients had EEGs performed within 24 hours of the request which is the optimum timing for EEG post-seizure⁴. Thirty-five per cent (108/316) of referrals were deemed 'inappropriate'. 15/108 of these 108 'inappropriate' EEG requests had positive EEGs of which 6 had epileptiform features. Four of the 6 who had EEGs with epileptiform features had been requested in patients with known epilepsy and positive EEGs in the past. After chart review, none of these patients had these repeat EEGs requested for purpose of reviewing the diagnosis, re-classification of epilepsy syndrome or to look for spike-wave burden. As expected, neurology services were more likely to order 'appropriate' EEGs and to pick up epileptiform features. 67/316 (21%) patients with suspected syncope or funny turns had EEGs performed; none of these patients had epileptiform abnormalities. Those that had abnormal EEGs demonstrated either mildly abnormal ECG rhythm, encephalopathic EEG or non specific changes on EEG. EEG examinations are in high demand in our institution; the majority of requests are from in-house physicians and for the adult patient population.

EEGs are often erroneously ordered to 'rule out epilepsy' but a normal EEG does not exclude a diagnosis of epilepsy. Our audit demonstrates that EEGs are inappropriately over-requested particularly in the cases of patients with reported 'funny turns' and syncope but also perhaps by more junior members of staff. Awareness of and adherence to the NICE and SIGN guidelines for ordering tests in patients with syncope or funny turns would have resulted in such patients not being referred for EEGs in the first instance. Education and dissemination of information regarding the proper indications for having an EEG done would reduce inappropriate requests for such and thus improve the neurophysiology and neurology outpatient waiting times for those patients that actually do need an EEG.

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