ORIGINAL ARTICLE

Neurological & Psychiatric Society of Zambia's Evidence-Based Guidelines for EEG Utilization at the University Teaching Hospital

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BACKGROUND

Electroenphalograph (EEG) technology via a Natus Bio-Logic Ceegraph digital EEG machine will be available at University Teaching Hospital (UTH) very soon. In anticipation of this newly available technology, members of the Neurologic & Psychiatric Society of Zambia discussed the importance of optimizing the use of EEG. These guidelines have been developed with the recognition that EEG has the potential to substantially improve the care of select patients who are referred for an EEG study. Importantly, such improvements in care are only possible if the patients who receive EEG are appropriately selected for study and the recordings and interpretations are of sufficient quality.

The goal of these guidelines is to offer the referring and/or requesting clinician information on how to best select patients for EEG based upon existing evidence and guidelines from authoritative bodies in countries or regions where EEG is broadly available. Given the limited nature of the resource (only one EEG machine which could at the very most provide 5-10 EEGs per day), these guidelines will also try and offer priorities delineating where the use of EEG is likely to provide the greatest positive impact on patient care since prioritization may be required. Prior studies in multiple settings have established that at least a third of patients referred for EEG are referred inappropriately, meaning the study is very unlikely to offer information of value in caring for the patient . Given the limited nature of the EEG resource, it is critical that inappropriate referrals be avoided. This NPSZ Advisory will also offer recommendations on training needs for optimal interpretation. It is important to recognize that inadequate training among persons interpreting EEG is most likely to result in "over interpretation" in which normal variants are interpreted as representing abnormalities that require treatment

METHODS

A comprehensive search without language limitations was completing using "*EEG*" OR "*electroencephalography*" with the limitation of *"guideline"* in Pub Med from 1994 to 2010. Abstracts were reviewed and full-content of the articles were reviewed where the information seemed applicable to our search for guidelines on the conduct and use of EEG in the inpatient or outpatient settings. Guidelines for other technologies (*e.g.* evoked potential, continuous EEG monitoring) or settings (*e.g.* intra-operative monitoring) were excluded. Where an authoritative body developed multiple guidelines for the conduct of EEG over the study period, only the most recent guideline was retrieved. Information delineating strong clinical indications for EEG were abstracted

and provided in evidence tables. This information was then placed in the Zambian/UTH context to develop formal recommendations (guidelines).

RESULTS

Eighty-nine articles were identified. Many reports repeatedly emphasized the importance of recognizing that epilepsy is a clinical diagnosis and that EEG is not required for making the diagnosis or initiating treatment. EEG offers significant value in several settings. See Table 1. There is also clear evidence to indicate that EEG is not indicated in several clinical settings. See Table 2.

Table 1: Indications for EEG

Citation	Indication	Findings	Zambian/UTH Local Relevance
Indian Academy of Pediatrics[5]	Neonatal seizures	A 60-minute, portable recording may be helpful in recognizing subclinical seizures	Limited capacity and stationary nature of the UTH EEG makes this a low priority unless/until a second EEG unit is available. Note that neonatal EEG requires a particularly high level of training and skill for interpretation [6].
Indian Academy of Pediatrics[5]	Initial evaluation of all children representing with an "episodic event"	No evidence provided	Not evidence-based and impractical for a resource limited setting
Indian Academy of Pediatrics[5]	In the child with uncontrolled epilepsy receiving treatment.	EEG helps in reclassifying the syndrome. Idiopathic generalized epilepsies may require specific antiepileptic drugs (AEDs) for a good clinical response.	The complex nature of the presentation and prognosis requires a neurologic evaluation in addition to an EEG. Therefore, such children should have a full neurologic assessment prior to EEG rather than an EEG referral.
Indian Academy of Pediatrics[5]	In children with unexplained cognitive, neurobehavioral or scholastic deterioration;	An EEG may help in diagnosis of specific disorders like SSPE[1], or epileptic encephalopathies including electrical status in slow wave sleep (ESES), and nonconvulsive *status epilepticus*.	The complex nature of the presentation and prognosis requires a neurologic evaluation in addition to an EEG. Such children should have a full neurologic assessment prior to EEG rather than an EEG referral.
Indian Academy of Pediatrics[5]	Children with unexplained coma or persistent coma after a seizure	Must rule-out non-convulsive status epilepticus (NCSE)	An important consideration since NCSE is known to be common in children with cerebral malaria[7], treatment is available and failure to treat may increase mortality and long-term neurologic morbidity. EEG should be obtained urgently in any child with coma from malaria or unexplained coma.

Indian Academy of Pediatrics[5]	Progressive, catastrophic childhood epilepsies	Provides important insights into treatment and prognosis.	The complex nature of the presentation and prognosis requires a neurologic evaluation in addition to an EEG. Therefore, such children should have a full neurologic assessment prior to EEG rather than a direct EEG referral.
The International Federation of Clinical Neurophysiology [8]	Neonatal seizures	Guidelines for neonates at 25-50 weeks gestational age.	Limited capacity and stationary nature of the UTH EEG makes this a low priority unless/until a second EEG unit is available.
Italian League against Epilepsy[9]	EEG should be performed within 24 hours after a seizure	Offers some prediction of whether future seizures are likely and if focally abnormal may indicate the need for neuroimaging	While this might be ideal, there are insufficient EEG resources to routinely provide this service.
Royal College of Paediatrics and Child Health's	Review of their recommendations found that EEG recommendations were based upon very low level evidence or simply good clinical practice recommendations and not evidence.		
American Academy of Neurology, Child Neurology and American Epilepsy Society [10]	First non-febrile seizure in children	EEG provides prognostic information regarding the risk of recurrent seizure	In our resource limited setting for children with a non-febrile seizure, EEG is indicated only if the seizure is prolonged or the child has another underlying chronic problem .
American Academy of Neurology & American Epilepsy Society [11]	First unprovoked seizure in adults	Routine EEGs with epileptiform activity is present in 23% and is predictive of recurrent seizure	While this might be ideal, there are insufficient EEG resources to routinely provide this service.
French Consensus Conference [12]	EEG in emergency situations	EEG is essential for the management of nonconvulsive and subtle *status epilepticus*	EEG should be obtained urgently in any patient with unexplained coma, prolonged coma or persistent obtundation.

[1] SSPE=subacute sclerosing panencephalitis

Table 2: Clinical Indications for which EEG is NOT Recommended

Citation	Indication	Findings
Indian Academy of Pediatrics[5]	There is no place for routine follow-up EEGs in patients with epilepsy who are doing well.	----------
American Academy of Neurology [13]	Cerebral palsy	Not recommended unless there is evidence of epilepsy or an epilepsy syndrome
Italian League against Epilepsy[9]	EEG should be performed within 24 hours after a seizure	Offers some prediction of whether future seizures are likely and if focally abnormal may indicate the need for neuroimaging
American Academy of Pediatrics [14]	EEG is not recommended in the evaluation of febrile seizure in the neurologically normal child	Abnormal EEGs in neurologically normal children who have had a febrile seizure are not predictive of later epilepsy
Expert group [15]	Screening for epilepsy in children with autism	There is insufficient evidence to support such screening
Netherlands Society of Neurology [16]	Chronic recurrent headache without associated neurologic abnormalities	Unlikely to provide any additional insights and may have incidental findings that could lead to further unnecessary testing or treatment
American Academy of Neurology and Child Neurology Society [17]	Children and adolescents with recurrent headaches	EEG is not recommended. Even in children found to have paroxysmal EEG changes the risk of seizures is negligible
French Consensus Conference [12]	EEG in emergency situations	EEG is not useful emergently after a transient loss or alteration of consciousness or a focal non-febrile, neurological transient or permanent deficit
European Federation of Neurological Sciences Task Force[18]	Non-acute headache	EEG is not routinely indicated in the diagnostic evaluation of headache patients
American Academy of Neurology and Child Neurology Society [19]	Child with global developmental delay	EEG is not recommended as part of the initial evaluation unless there are historical features suggestive of epilepsy or a specific epileptic syndrome

NPSZ Recommendations:

Indications for EEG

1. Epilepsy--the propensity for recurrent, unprovoked seizures is a clinical diagnosis made based upon history-taking from the patient, family and/or other observer of suspected events. The physical examination may further support or refute the diagnosis of epilepsy. EEG is not required to make a diagnosis of epilepsy and treatment can and should be initiated without EEG in patients who are experiencing recurrent, unprovoked seizures.
2. An urgent EEG is indicated in all unconscious patients suspected of non-convulsive status epilepticus or subclinical seizures. This includes comatose or obtunded inpatients of unclear etiology especially those in whom seizures preceded the onset of coma.
3. While EEGs obtained after a first unprovoked seizure might offer insights into recurrence risk and/or the need for further neuroimaging, insufficient EEG resources are presently available to offer this service.
4. In children or adults with epilepsy which fails to respond to standard treatments and/or seizures and progressive neurologic problems, EEG may be warranted but this should be obtained through a neurologic consultation since such a consultation is needed to fully evaluate and assess such patients.

Quality Recordings

To assure an acceptable quality of EEG recordings, the technician(s) should receive training by skilled technicians using standardized montages and following the recommended minimal technical requirements for performing clinical EEG. Ideally, such training would occur in an environment as similar to UTH's as possible. Inquiries have successfully identified laboratories in Malawi and Uganda where a Zambian technician could receive training. Minimal requirements include at least 21 channels in the 10-20 International System or modified 10-20 system and records must be of at least 25 minutes duration. Brief outpatient records providing only 8 channels and/or only 5-6 minutes of recording are insufficient for assisting in the evaluation of a seizure disorder and are not recommended.

Quality Interpretation

To optimize EEG interpretation, opportunities for refresher training sessions in EEG interpretation are needed for UTH clinicians who have previously received training in EEG but who have not utilized the skill recently. University Teaching Hospital (UTH) post graduates, primarily those in Paediatrics and Internal Medicine, would also benefit from training in EEG interpretation. Such training could be formal EEG educational courses offered through annual meetings held by neurological societies in Europe, the US and the UK as well as meetings held less frequently in South Africa. In addition to international training opportunities, EEG interpretation can also be optimized by offering onsite training at UTH. Onsite training opportunities will be made available in 2011. Any training provided will be developed to assist the trainee in adhering to recommendations for the optimal production of EEG reports .

Quick Reference Summary Table

1. EEG is not necessary for the diagnosis of epilepsy. If a patient is experiencing recurrent seizures, treatment should be initiated. Treatment should not be delayed to obtain an EEG.
2. EEG only provides information about what the brain is doing at the time of the recording. This means that EEG recordings may be completely normal, even in people who have epilepsy.
3. Sometimes people without epilepsy can have abnormal EEGs. This is especially true for people with migraine headaches and/or certain psychiatric disorders. An abnormal EEG must be considered in the clinical context and should not be reviewed in isolation.
4. EEG utilization at UTH will prioritize inpatients with possible subclinical seizures or nonconvulsive status epilepticus.
5. People with seizures that fail to respond to standard treatments and/or individuals with

seizure disorders plus progressive neurologic problems should be referred for a full neurologic assessment, not just an EEG. Outpatient EEG referrals will be made by the specialist who sees the patient, if an EEG is determined to be needed.

6. A sufficient quantity of the prescribed medication should be provided to last until the patients next scheduled review date. Requiring patients to return more frequently than is necessary for collection of medications reduces adherence and adds additional barriers to care-seeking

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