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The Use of Electroencephalography in Forensic Evaluations

William H. Campbell MD MBA

It is known that seizures, particularly partial complex seizures, can have prominent affective, behavioral, and cognitive components thereby mimicking mental disorders. Accordingly, electroencephalography, the most specific laboratory test for seizures, is frequently obtained as part of the forensic evaluation of individuals with episodic signs and symptoms that suggest the possibility of an underlying seizure disorder. However, proper interpretation of a diagnostic study requires knowledge of its limitations.

Electroencephalograms (EEGs) obtained in the interictal period contain abnormalities that support, but do not prove, a diagnosis in up to 80% of individuals with seizure disorders. However, about 20% of individuals with seizure disorders have normal interictal EEGs. Thus, normal interictal EEGs do not exclude a diagnosis of seizures. Moreover, approximately 15% of the normal population have nonspecific EEG changes, such as a slow wave or an occasional sharp wave or spike. Thus, the accuracy (i.e., sensitivity, specificity, positive predictive value, and negative predictive value) of EEGs is limited. However, the value of this study can be enhanced through the use of specific maneuvers that evoke characteristic EEG abnormalities. These include hyperventilation (contraindicated in cerebrovascular disease and in children with sickle cell disease),

photic stimulation with a stroboscopic light, and sleep deprivation. In approximately 15% of individuals with seizure disorders, the sleep-deprived EEG reveals abnormalities not apparent in routine studies.

Test parameters

In certain individuals with seizure disorders, specially placed electrodes will reveal abnormalities that are not detected by ordinary scalp electrodes. These include anterior temporal scalp, nasopharyngeal, and sphenoidal electrodes. Nasopharyngeal electrodes are inserted through the nostrils and placed in the posterior pharynx where they are separated from the medial surface of the temporal lobe by the thin sphenoid bone. This location is considerably better for detecting EEG abnormalities than the scalp, where there is a relatively large distance between the electrodes and the medial surface of the temporal lobe (the origin of approximately 80% of partial complex seizures). Sphenoidal electrodes are inserted through the skin and directed toward the lateral, external surface of the sphenoid wing, where they approximate the inferior surface of the temporal lobe. Although electrodes have been surgically implanted in the dura, subdural space, or cerebral cortex to pinpoint a seizure focus in certain individuals, this approach is rarely used due to its level of invasiveness.

Intensive EEG-video monitoring

consists of several days of continuous, split-screen videotaped clinical and EEG recordings of seizures, changes in behavior, and effects of sleep. Serum concentrations of anticonvulsants and relevant physiologic data can be monitored and correlated with seizures. EEG-video monitoring has become the gold standard for diagnosing, classifying, and determining the frequency of seizures; evaluating patients for epilepsy surgery; treating individuals who appear to have refractory seizures; and identifying disorders that mimic seizures, particularly pseudoseizures. Quantitative EEG analysis (QEEG), also known as EEG brain mapping, consists of topographic displays and comparisons of the EEG of an individual with a seizure disorder to normal EEG data. At present, this technique is primarily used as a research tool and lacks the necessary reliability for use in forensic evaluations.

Forensic cautions

Given this information, how should one proceed with the forensic evaluation of someone with a suspected seizure disorder? Currently, the standard has been to order a single sleep-deprived EEG. We know that this approach will not only identify nonspecific abnormalities in individuals without seizure disorders (i.e., the specificity of the test is limited), it will also fail

to correctly identify a significant number of individuals with seizure disorders (i.e., the sensitivity of the test is also limited). However, we also know that intensive EEG-video monitoring is impractical in the majority of settings.

A practice that is frequently overlooked in clinical evaluations is that objective data have a tendency to be viewed as having greater validity than subjective information. Accordingly, the results of a single EEG are likely to be viewed as definitive, even though the data do not support such a conclusion. In fact, the only unequivocally positive finding would be the documentation of epileptiform activity in the presence of the signs and symptoms related to the current charges. It appears that we are at risk of violating an old saw: "If a test is not going to change what you will do, then don't order it." With regard to forensic evaluations in particular, the introduction of standard EEG results into the evaluation, whether normal or abnormal, is likely to raise more questions than it is to provide answers. At worst, it may confuse the fact finders and serve to undermine one's credibility as a

diagnostician.

The prudent solution to this problem is to focus on the clinical evaluation. Specifically, the focus should be on the data obtained from a thorough assessment of the frequency, intensity, and context of the relevant signs and symptoms, as this information is more likely to be relevant to the legal questions at hand. This does not mean to say that there is no role for the EEG in forensic evaluations, only that this role should be clarified.

In summary, the following recommendations seem prudent:

1. An EEG should only be obtained in those cases where the index of suspicion for an underlying seizure disorder is high (i.e., the EEG is not being used as a general screening tool).
2. That special maneuvers (i.e., hyperventilation, photic stimulation, and sleep deprivation) and electrodes (i.e., anterior temporal scalp, nasopharyngeal, and sphenoidal) are used to maximize the yield of the EEG (this can be discussed with the consulting neurologist in advance of the procedure).

3. In those cases where the EEG fails to demonstrate unequivocally positive results, the limitations of the study should be clearly stated in the forensic report and during testimony.

References

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Dr. Campbell is a resident in psychiatry at the Yale University School of Medicine. He will be undertaking a forensic residency at Yale next academic year.