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Effect of Inpatient Electroencephalography on Clinical Decision Making: EEG Is More Valuable Than Findings Suggest

To the Editor:

We read with interest the findings of the retrospective investigation of the role of electroencephalography (EEG) in the treatment of hospitalized patients by Harmon and colleagues in the December 2013 issue of *The Journal of the American Osteopathic Association*.[1] In their cohort of 200 inpatients, EEG was found to rarely contribute to clinical decision making and in no case resulted in a change in diagnosis or management. We have some concerns that if the findings are not viewed in the context of the overall value of EEG, these results may lead clinicians to believe that EEG is not as useful a diagnostic modality as was previously believed and could result in decreased orders for EEGs when clinically appropriate.

Although EEG ordered apart from specific indications may not always contribute to clinical decision making, there remain many instances in which EEG is a valuable clinical tool. For example, EEG remains the most useful laboratory test for the classification of seizures and specific epileptic syndromes.[2] A generalized seizure and a partial seizure with rapid secondary generalization may be very difficult to distinguish clinically, but the seizure type may be readily determined with an EEG if a recording is made during the onset of a seizure. In some cases, EEG may be the only modality that can conclusively distinguish a seizure from a pseudoseizure. Although computed tomography and magnetic resonance imaging are now generally used to assess focal lesions, focal slowing visible on EEG recordings can sometimes reveal pathology in a specific brain region that would not be detected on structural imaging.[2]

In addition, EEG is one of the most helpful modalities available for diagnosing and monitoring delirium. The fluctuating state of awareness in delirium is accompanied by characteristic EEG changes, and the varying levels of a patient's attention parallel the slowing of background EEG rhythms.[3] To some degree, the same type of findings may apply to patients in a coma; in some such cases, continuous or frequent EEG monitoring in the intensive care unit setting may be of value.[4] Slowing of EEG rhythms that accompany dementia can also progress as dementia advances, providing a modality for monitoring disease severity. Electroencephalography may also be quite useful for conclusively distinguishing dementia from pseudodementia (a syndrome in which dementia is mimicked by depression or other psychiatric disorders).[2]

Quantitative EEG, the transformation of selected EEG activity such as frequency or voltage by Fourier analysis into numeric values, which are often mapped, was not considered in the study. Quantitative EEG may provide valuable information in several clinical conditions. For example, quantitative EEG has been shown to be useful in the assessment of mild traumatic brain injury, even in the absence of brain abnormalities on magnetic resonance images.[5] Quantitative EEG analysis of frequency and mean theta power may be sensitive to the early presence of subjective cognitive dysfunction and might be useful in the ini-

tial evaluation of patients suspected of having dementia, as well as in estimating the degree of cognitive deterioration over time.[6] In addition, there is some evidence that distinctive electrophysiologic profiles may be associated with different psychiatric disorders.[7]

It should be noted that because the study by Harmon and colleagues[1] involved only inpatients undergoing EEG, the implications of the results cannot be extended beyond hospitalized patients. In our experience, a large percentage of EEGs—possibly the majority—are performed on outpatients. Therefore, it is important for physicians to consider that these findings may not be applicable to patients who undergo EEG as a whole.

Part of the problem with EEG is that the EEG signal is quite sensitive to many variables (eg, metabolic, vascular, endocrinologic) that affect central nervous system function. As a result, EEG findings are often nonspecific. However, this aspect of EEG should not cause clinicians to avoid using EEG in situations in which it could be helpful. As suggested by Harmon and colleagues,[1] clearer guidelines for the use of EEG should be promulgated. We agree that further education regarding indications for EEG is needed to reduce health care costs, but physicians must continue to use this valuable diagnostic modality when appropriate. Certainly, as the authors suggest, further research on the effectiveness of EEG (particularly, in our opinion, quantitative EEG, which has much unexplored clinical potential) is warranted. (doi:10.7556/jaoa.2014.091)

Roy R. Reeves, DO, PhD

Professor of Psychiatry and Neurology, University of Mississippi School of Medicine, Jackson; Chief of Psychiatry, G.V. (Sonny) Montgomery VA Medical Center, Jackson, Mississippi

Mark E. Ladner, MD

Assistant Professor of Psychiatry, University of Mississippi School of Medicine, Jackson

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To the Editor:

I found the recent report by Harmon and colleagues on inpatient electroencephalography (EEG) very interesting.[1] The authors concluded that "inpatient EEGs rarely contributed to clinical decision making and in no case resulted in a change in diagnosis or management."[1] Thus, the question that remains is whether inpatient EEG is useless. In fact, the study was retrospective, and there are many factors that could not be controlled. I believe it is important to consider the rational use of investigation.[2] In other words, similar to any investigation in medicine, the inpatient EEG should be used only if there is indication. Harmon and colleagues[1] did not determine whether all cases had fulfilled indication. The inpatient EEG can be very useful—if the physician has been well educated on proper procedures and indications. (doi:10.7556/jaoa.2014.092)

Viroj Wiwanitkit, MD (hons)

Visiting professor, Hainan Medical University, China; Visiting professor, University of Nis, Serbia

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Response

I appreciate the comments of Reeves and Ladner[1] and Wiwanitkit.[2] The use of electroencephalography (EEG) has been widely debated throughout the literature. In our investigation,[3] which was limited to standard inpatient EEG, 96% of the EEGs performed did not change or contribute to clinical decision making. At this time, there are no national guidelines for EEG use, and EEGs are being employed for a wide spectrum of conditions, including altered mental status, epilepsy, seizure rule-out, syncope, cerebrovascular accident, and traumatic brain injury.

The shortfall of EEG is its low diagnostic sensitivity (25%-56%) and slightly higher specificity (78%-98%).[4] Even in the presence of a normal EEG, patients

can have a multitude of seizure disorders failing detection,[4] while an abnormal EEG can correlate with specific underlying brain pathologies, such as Creutzfeldt-Jakob disease[5] or burst suppression patterns.[6] Although burst suppression patterns often correlate with poor prognoses, they do not point to any specific disease pathology and can be seen in traumatic brain injury and metabolic encephalopathy alike.[6]

The utility of EEG has, however, been demonstrated in intraoperative monitoring during carotid endarterectomy.[7] Additionally, there have been evidence-based reviews published on its benefit in the evaluation of pediatric neurologic disorders[8] and the management of newly diagnosed epilepsy.[9]

In the 2013 clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit (ICU), put forth by the American College of Critical Care Medicine, EEG was recommended (+1A; high quality, strong recommendation in favor of the intervention) to monitor nonconvulsive ICU patients with known or patients suspected of having seizure disorders or to titrate electrosuppresive medications in patients with elevated intracranial pressures.[10] At our institution, in accordance with these guidelines, continuous EEG is used most commonly in patients with traumatic brain injuries, intracerebral hemorrhages, and cerebrovascular accidents to guide treatment.

Our study[3] was limited to standard 23-channel, 30-minute recordings and cannot be extrapolated to include the utility of video EEG, 24-hour continuous EEG, or quantitative EEG. Regarding standard 23-channel, 30-minute EEG recordings, my coauthors and I believe that the level of utility is reflected in the appropriateness of ordering. In our study[3] there were 8 cases (4%) in which EEG was performed that supported clinical decision making. In each of the EEGs with abnormal findings, indication for ordering EEG was consistent with the clinical practice guideline recommendations[10] for use in ICU patients.

Unfortunately, 24% of our population had EEG performed for syncope, whereas previous studies[11,12] have clearly shown that EEG was not valuable in treating patients with syncope. Smith et al[13] examined appropriate use of EEG in comparison to the United Kingdom national guidelines for the use of EEG and found up to 40% of EEGs had been ordered inappropriately.

In the current political climate, I believe now more than ever, we as physicians are going to be asked to justify our health care expenditures. With a paucity of guidelines for EEG use, the responsibility falls to the physician to determine clinical utility. The goal of our study[3] was to bring to light the common indications at our institution for ordering EEGs and the relatively small impact they had on clinical judgment in these cases. (doi:10.7556/jaoa.2014.093)

Laura A. Harmon, MD

Department of Internal Medicine and the Center for Diabetes and Metabolic Disorders, Texas Tech University Health Center-Permian Basin, Odessa

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