The Role of EEG in the Emergency Room

H. Hooshmand and Marilyn Maloney

The application of EEG in the diagnosis and management of emergency room patients has not been a standard practice. The use of EEG in the emergency room is not an academic exercise, and it should be encouraged because of its practical clinical indications. It is a well accepted clinical practice to obtain an emergency EKG from any patient who complains of chest pain, regardless of the cause. It is just as imperative to differentiate between different types of seizure disorder, or serious neurological illnesses by application of EEG. For convenience, as well as economic purposes, it has been traditional to obtain an EEG on patients after they have been transferred or discharged from the emergency room. These patients are usually scheduled to have an EEG a few days later. However, the same patients have already been started on medications for presumptive, but not proven neurological illnesses. At times, not having had the information obtained from the EEG, the diagnosis can be wrong or misleading.

The application of EEG in the emergency room can be quite helpful in the care of neuropsychiatric emergencies such as seizure disorder, head injuries, toxic-metabolic encephalopathies, or acute psychoses. It is not only helpful to arrive at a more accurate diagnosis, but the EEG can be helpful in the treatment of some of these patients.

Material

The following is a report of our experience with the application of EEG in the emergency room, to underscore the role of EEG in the evaluation of acute neuropsychiatric patients. From July, 1974, through July, 1979, 112 emergency room EEG recordings were performed in two hospitals at an average of one EEG per month in each hospital (Table 1).

Results

I Seizure Disorder

The application of the EEG in the emergency room can be most helpful in the diagnosis and management of seizure disorder.

A Conversion reaction

EEG is helpful in the diagnosis of conversion reaction. This diagnosis is not made by exclusion, but is made positively by obtaining an EEG during and after a hysterical seizure. The characteristic of the patients with conversion neurosis is that they are highly suggestible. This characteristic helps the electroencephalographer demonstrate that the patient can go into and out of a "seizure" only with the power of suggestion, with the simultaneous EEG recording showing no abnormalities. In our study of intractable seizures, among 186 patients previously treated with multiple anticonvulsants, 6% were proven to be suffering from hysterical seizures. Many of these patients could have been diagnosed accurately if the EEG was applied at the time of the admission of the patient to the emergency room.

B Difficult to diagnose seizures

Many patients with infrequent clinical and EEG seizure manifestations have already been started on anticonvulsants in the emergency room before they arrive at the EEG laboratory a few days later. This makes it most difficult to

H. Hooshmand, M.D., and Marilyn Maloney are from the Neurological Institute, 2800 South Ocean Drive, Vero Beach, Florida 32960.

Requests for reprints should be sent to Dr. H. Hooshmand at the above address.

TABLE 1: EEG in the Emergency Room

Diagnosis	EEG Contributory	EEG Non-contributory	EEG Changed Initial Diagnosis	Total
Head injury	43	1	31*	44
Toxic-metabolic	24	2	17	26
Alcohol withdrawal seizures	21	1	16	22
Hysterical seizures	3	0	3	3
	91 (96%)	4 (4%)	67 (71%)	95 (100%)

* e.g., contusion vs. concussion

arrive at any accurate diagnosis because of the EEG record being affected by the medications.

An EEG done in the emergency room shortly after the patient has had a seizure can show a post-ictal slowing, focal abnormality, or sharp transient activity, when previous recordings may have been repeatedly normal - missing any of the infrequent interictal epileptiform discharges (Fig. 1).

Patients suffering from limbic seizures can be most difficult to differentiate from those with emotional disturbances such as hysterical or catatonic attacks. EEG may be the only diagnostic tool to arrive at an accurate diagnosis (Fig. 2).

EEG can be helpful in differentiating seizure disorders with focal abnormalities (e.g., focal post-ictal delta activity) from those with nonfocal abnormalities due to lower threshold seizures (e.g., alcohol withdrawal seizures or toxic encephalopathies). This information is obviously important in clinical management of the patients.

C Alcohol withdrawal seizures

Many patients arrive at the emergency room after an alcohol withdrawal seizure, hysterical seizure, or a syncopal attack. On the basis of the history obtained by the emergency room physician such patients are started on medications such as phenytoin and barbituates, only to have an EEG a few days later (e.g., a delay from Friday evening to Monday morning). Such patients are given potentially dangerous, unnecessary medications because of inaccurate diagnosis.

II Head Injury

The question of cerebral contusion versus cerebral concussion can be realtively easily settled by obtaining an EEG in the emergency room, or during the first day of the patient's hospitalization. In the latter condition, a normal EEG is expected; whereas in the case of cerebral contusion, the patient would most likely show focal or multifocal slowing on the EEG. These findings definitely have prognostic medical-legal significance, and would be missed if the EEG is done several days later. The patients with severe head injury not uncommonly show negative CT (computerized tomography) Scan. In our experience, many patients with severe head injuries and cerebral contusion may have very abnormal EEGs in the face of a negative CT Scan.

In the past five years, the CT Scan - among 426 patients suffering from cerebral contusion in our experience - was abnormal in only 21% of the patients, whereas the EEG was abnormal in 86%.

Inversely, the presence of a spike transient in the EEG recording immediately after a head injury, would suggest the presence of a preexisting cerebral disturbance unrelated to the acute trauma.

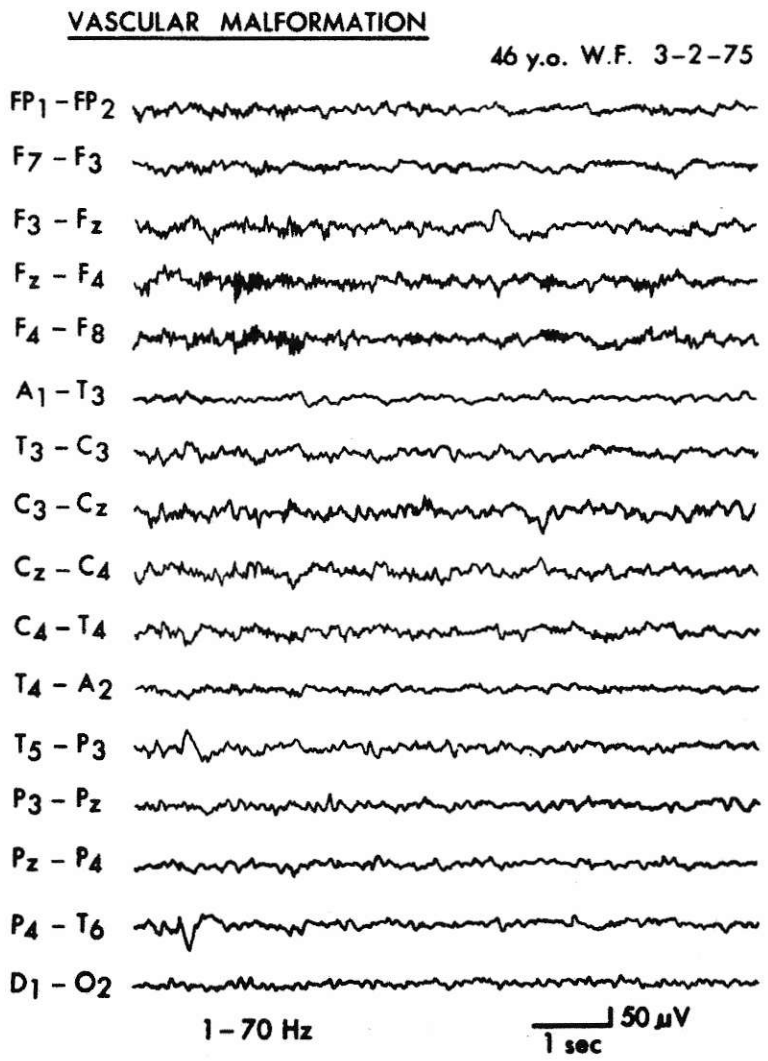

Figure 1: Focal beta as the only infrequent EEG manifestation in emergency room. CT normal. Angiography and surgery revealed right cingulate gyrus AV malformation. Previous EEGs were normal.

III Toxic-metabolic Encephalopathy

A severely agitated patient in the emergency room may be suffering from toxic-metabolic encephalopathy, psychotic agitation, or a co-existing cerebral lesion. EEG may be the only test at times to differentiate such conditions (Fig. 3). Toxicologic blood and urine screening tests are quite helpful in the diagnosis of such patients, but certain drug screening results can take a few days before they are reported by the laboratory.

The EEG not only can be helpful in the diagnosis of toxic-metabolic encephalopathies, but the simultaneous recording with the use of intravenous (IV) antidotes of toxic agents can be helpful in the management of such patients. For example, patients with an overdose of antidepressants or benzodiazepines show a rapid response to IV injection of physostigmine (Fig. 4, 5).

Discussion

In difficult to diagnose neuropsychiatric patients EEG can be indispensable in the emergency room.

Arguments can be raised against the use of

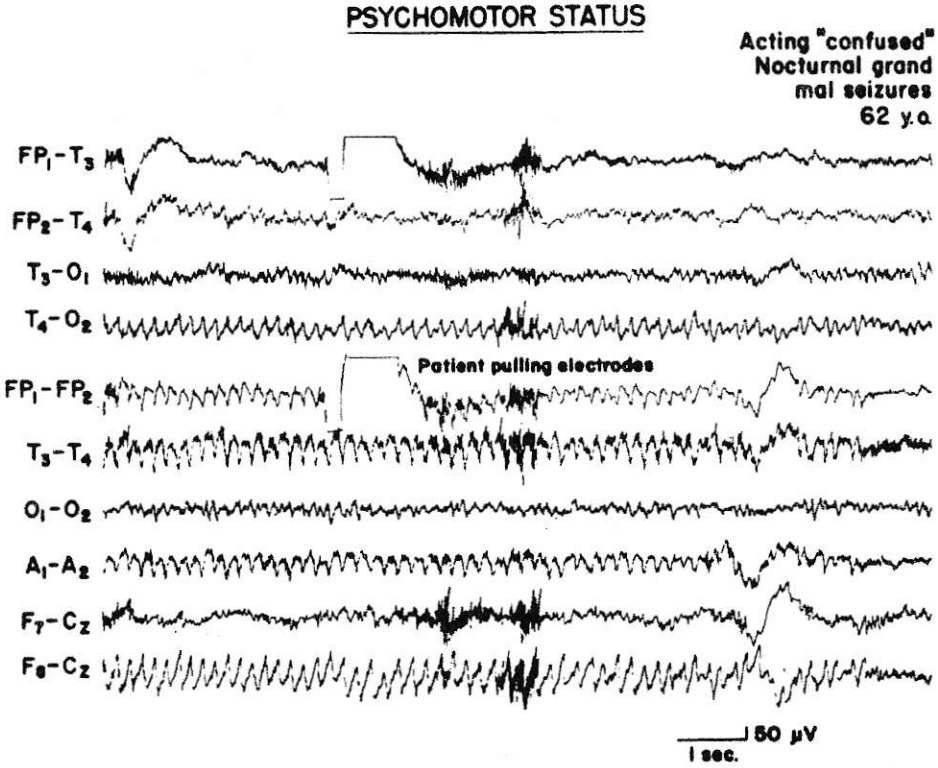

Figure 2: EEG can be most helpful in differentiating between limbic seizures and emotional disturbances. Continuous generalized psychomotor variant discharges in a patient with psychomotor status.

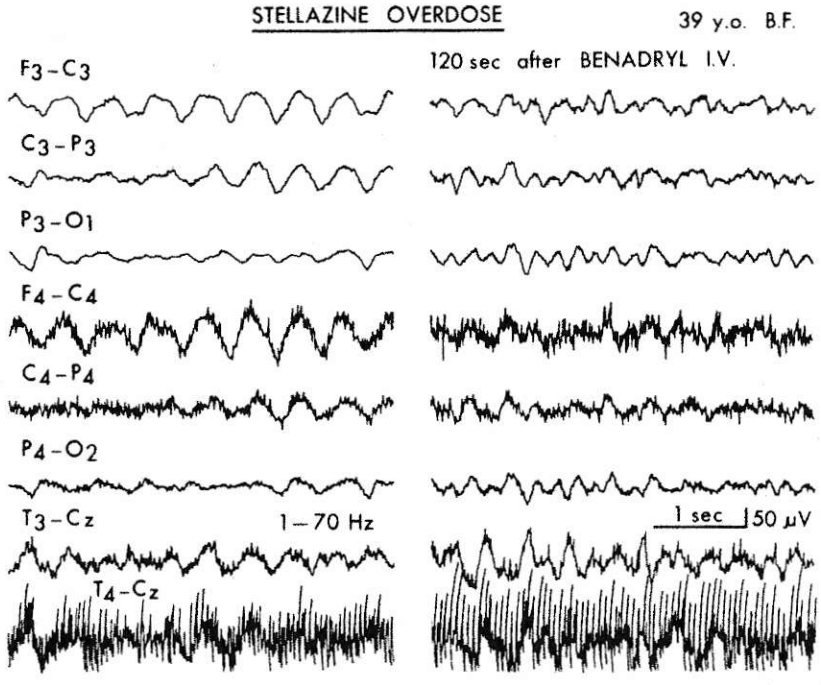

Figure 3: Clinical and EEG improvement after injection of IV Benadryl in a psychotic patient with phenothiazine overdose.

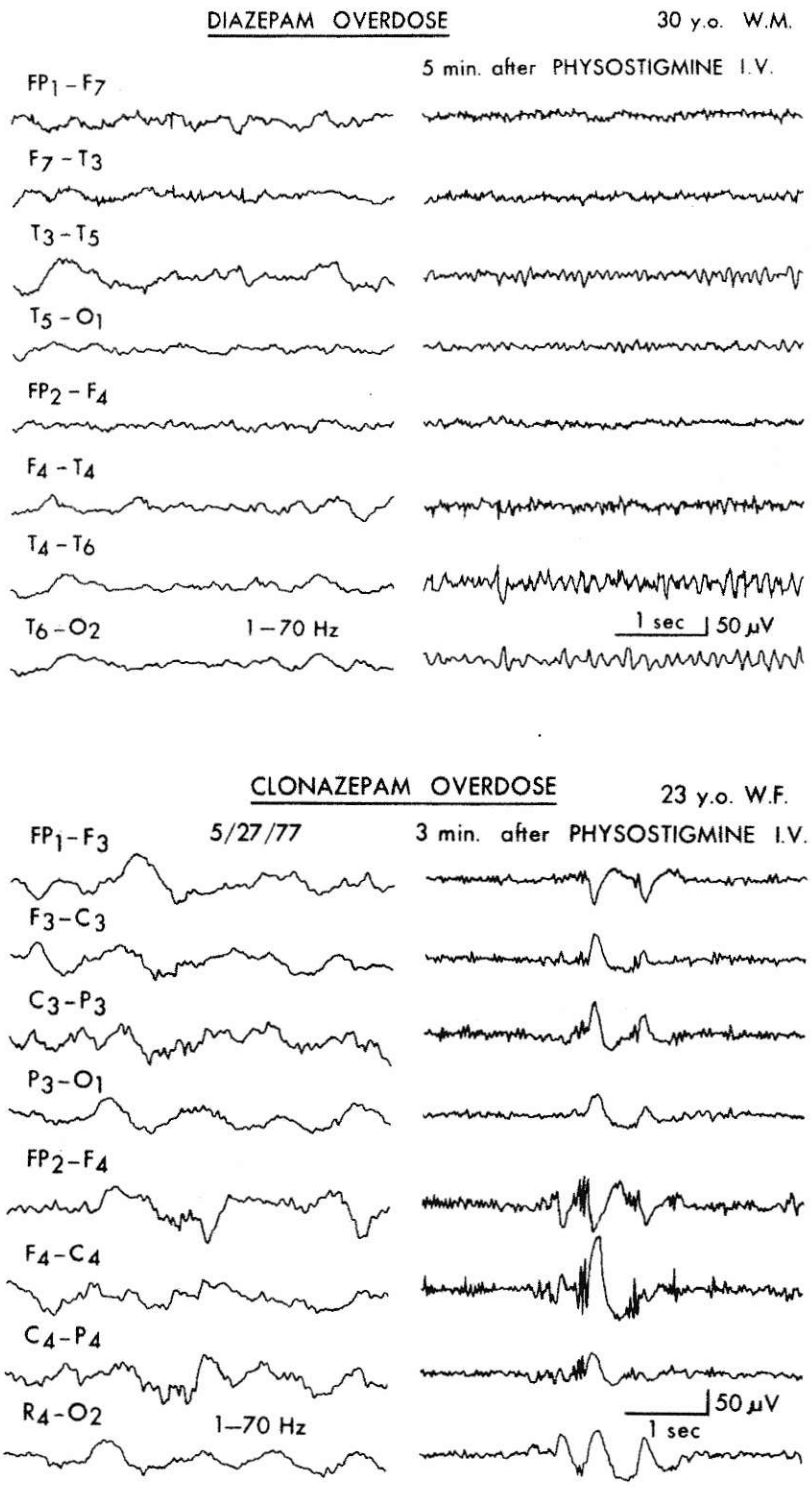

Fig. 4 & 5. Almost immediate clinical and EEG improvement after injection of IV physostigimine in patients with questionable head injury vs. drug overdose.

EEG in the emergency room regarding its cost and its diagnostic yield.

Of the 95 EEG recordings, 91 were diagnostic, or contributed to the clinical diagnosis. This contribution was in the form of either an abnormal or normal EEG in situations where the end results could not usually be predicted. The importance of accurate diagnosis makes it imperative to resort to emergency use of laboratory tests realizing that the tests may add to the cost of the medical care.

The cost efficiency of emergency EEG is quite reasonable when compared to more costly and more customarily used tests such as CT Scan. In the same two emergency rooms where this study was carried out, an average of 8 emergency CT Scans per emergency room per month were performed (practically 8 to 1 as compared to the number of EEGs). The cost of such a test is definitely higher than the EEG, and it does not provide the information obtained by the EEG. A vivid example is subdural hematoma vs. cerebral contusion. The former is best diagnosed with the use of CT, and the latter is more accurately diagnosed with the use of EEG.

It is recommended that the use of EEG as an important neurophysiological test should be encouraged in the emergency room to arrive at more accurate diagnosis and management of neuropsychiatric patients.

Summary

Our experience with the use of EEG in the diagnosis and management of acute neuropsychiatric patients in the emergency room is reported. The importance of the role of EEG in the diagnosis of different types of seizure disorders, toxic-metabolic encephalopathies, acute psychoses, and head injuries is emphasized. In many conditions EEG may be the only diagnostic tool to help the physician to arrive at an accurate diagnosis and management of the patient. The cost efficiency is more practical than other more expensive and more customarily used tests such as CT Scan, and the information obtained cannot be reproduced by such other tests.