Case Presentation

A 72-year old woman is brought to the ED by EMS with altered behavior and unusual movements. She was preparing for bed when she was noted to be acting in a peculiar manner. The patient is unable to speak and is having jerking muscular movements.

The patient has no history of seizures. There is a history of stroke two years previously with residual mild right-sided hemiparesis. There is no history of trauma. The patient has a history of hypertension and takes a diuretic.

On physical examination her vital signs are blood pressure 120/80, pulse 90, respiratory rate 14, temperature 99, pulse oximetry 98% saturated on supplemental oxygen. She appears alert with her eyes open but is unable to speak. She does appear to look towards the examiner when questions are asked but is unable to follow commands and gives no clear sign of understanding the commands. The right side of the patient’s face, her torso, and her right upper extremity are having a continuous rhythmic motion [see video].

Cranial nerves appear intact with the exception of facial twitching. Deep tendon reflexes are difficult to obtain because of movements.

Questions:

1. Is the patient having a seizure? What type?
2. What is a basic classification of seizure types?
3. What is status epilepticus and when is status epilepticus a medical emergency?
4. When is an EEG indicated in the emergency department?
Is the patient having a seizure? What type?

It is important to recall that there is a differential diagnosis of recurrent movements that include the following:

- Nonepileptic (psychogenic) seizures
- Repetitive abnormal posturing (extensor, flexor)
- Tetanus
- Neuroleptic malignant syndrome
- Rigors due to sepsis
- Myoclonic jerks
- Tremors
- Hemiballism
- Involuntary movements

Having considered a differential diagnosis, we may say that this patient is having partial motor status epilepticus with complex symptomatology (see following discussion).

What is a basic classification of seizure types?

Clear classification schemes for seizures exist. The current preferred terminology makes use of several key words and modifiers and is based on video-EEG documentation. "Partial" is used to describe isolated phenomena that reflect focal cortical activity, either evident clinically or by electroencephalogram (EEG). The term "simple" indicates that consciousness is not impaired. For example, a seizure visible as a momentarily twitching upper extremity which subsides would be termed a simple partial seizure with motor activity. Additional modifiers are added to note the specific area of the body involved, for example, upper extremity or lower extremity. Partial seizures may have motor, somatosensory, psychic, or autonomic symptoms.

The term "complex" denotes an alteration of consciousness associated with the seizure. "Generalization" is a term used to denote spread from a focal area of the cortex, either evident clinically by EEG, to involve all areas of the cortex with resulting generalized motor convulsion. From careful studies, it is known that in adults the most common seizure type is one of initial activation of one area of the cortex with subsequent spread to all areas of the cortex; frequently this occurs too quickly to be appreciated by bedside observation.

The other major grouping of seizure types is for generalized seizures which may be termed convulsive or nonconvulsive. On EEG, all areas of the cortex are activated at once with generalized seizures. This is seen with absence seizures, myoclonic seizures, and some other seizure types.

Sometimes physicians are so focused on the common tonic-clonic seizure type that other types of seizures escape detection. The fundamental definition of a seizure is abnormal motor, sensory, or psychic phenomena caused by abnormal cerebral electrical activity. It is conceivably possible that any type of behavior may represent seizure activity. It is usually this recurrent behavior that triggers investigation for a possible seizure disorder. Fairly commonly encountered are seizures of frontal or temporal cortical origin with non-classical motor movements. The patient may show some seemingly organized motor
activity without the usually in-phase jerking movements more typical of generalized seizures. Also complicating the problem is that clouding or alteration of consciousness may occur without complete loss of consciousness. Again, these have been exhaustively documented by video-EEG techniques.

The emergency physician must avoid being too rigid in his definition of seizures; the axiom that "not all seizures shake" needs to be remembered. The emergency physician must play probabilities in an educated manner--this behavior is likely a seizure, this behavior is unlikely to be a seizure--and may at times be unable to diagnose some unusual events.

At times the typical aura of a generalized convulsive seizure persists without any associated motor movements. Recall that the aura actually represents ongoing seizure activity limited to a focal area of the cortex; in this case the abnormal electrical activity associated with the seizure does not spread or generalize to the entire cerebral cortex but remains localized and persists in one abnormal focus.

Accurate description of a seizure should include any aura reported by the patient, any specific initial motor manifestations, a description of the tonic phase, if present, and a description of the clonic phase with duration. Post-ictal characteristics, including duration, should be documented as well. An accurate description is preferable to using jargon.

What is status epilepticus and when is status epilepticus a medical emergency?

A publication by the World Health Organization defined status epilepticus as “a condition characterized by an epileptic seizure that is sufficiently prolonged or repeated at sufficiently brief intervals so as to produce an unvarying and enduring epileptic condition.” Typically, status epilepticus is defined as 30 minutes of continuous seizure activity or a series of seizures without return to full consciousness between the seizures. This definition is imprecise and investigators in the area often use their own criteria. Note that these definitions are based on clinical observations rather than EEG or any other physiologic monitoring. Many feel that pathophysiologic studies suggest that a shorter period of seizure activity causes neuronal injury and makes seizure self-termination unlikely and suggest 20 minutes or briefer times define status epilepticus. A consensus panel states that aggressive treatment for generalized convulsive status epilepticus should be initiated when a seizure has persisted 10 minutes and further states that patients still seizing on arrival to the emergency department should be aggressively treated. Other investigators note that the chance of a seizure self-terminating without interventions decreases as the seizures continue for as short a period as 4 minutes. A series of patients with frequent secondarily generalized tonic-clonic seizures documented by video-EEG monitoring revealed that the mean duration of seizures was 1 minute and that seizures that stopped spontaneously terminated within 2 minutes; they urged intravenous anticonvulsant drug administration for generalized tonic-clonic seizures lasting greater than 2 minutes. The implications of this shortened time definition are great for emergency services; most dispatches for seizures should be treated as status epilepticus if the patient is continuing to seize at the time of EMS arrival.

One useful way to sort status epilepticus(SE) is to divide SE into a classifications similar to seizures. The term “simple” in this scheme implies that an isolated area of the cortex is involved with resulting focal motor phenomena, sensory, special sensory, or other phenomena with full consciousness preserved. Again, the term “complex” in seizure classification means that consciousness is altered. The term “generalized” means that the abnormal electrical activity involves all areas of the cortex; motor movements are typically seen but notable exceptions exist as describe below.
One seizure type may evolve into another seizure type. For example, a simple motor seizure may evolve into a complex partial seizure with altered consciousness; at times this state may persist for hours or days with minimal or no associated motor activity; the terminology for this would be “partial complex status epilepticus.”

Absence seizures (also known as petit mal) are a primarily generalized seizure type involving all cortical areas at once; this is typically a seizure disorder of childhood with a characteristic EEG pattern. At times, absence seizures may persist with minimal motor movements and altered consciousness for hours or days. Absence status epilepticus and complex partial status epilepticus are often grouped under the term “nonconvulsive status epilepticus” and are referred to at times as twilight or fugue states.

There is controversy in the term “nonconvulsive status epilepticus (NCSE).” NCSE has been used to describe the absence of convulsive seizures with EEG activity indicating that electrical generalized seizures were continuing diffusely throughout the cortex as well as the twilight states described above. Currently, nonconvulsive status epilepticus is best reserved for absence status epilepticus and partial complex status epilepticus. The term “subtle status epilepticus” is more correctly used to indicate patients that have evolved from generalized convulsive status epilepticus or are in a comatose state with epileptiform activity.

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Table—Clinical classification of status epilepticus (including both primary and secondarily generalized seizures)

- Overt generalized convulsive status epilepticus (continuous convulsive activity and intermittent convulsive activity without regaining full consciousness)
  - convulsive (tonic-clonic)
  - tonic
  - clonic
  - myoclonic

- Subtle generalized convulsive status epilepticus following generalized convulsive status epilepticus with or without motor activity

- Simple status epilepticus (consciousness preserved)
  - simple motor status epilepticus
  - sensory status epilepticus
  - aphasic status epilepticus

- Nonconvulsive status epilepticus (consciousness impaired; twilight or fugue state)
  - petit mal status
  - complex partial status epilepticus

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Extensive animal studies and more limited pathologic work in humans following generalized tonic-clonic status epilepticus (GCSE) consistently demonstrate neuronal damage. The cause of the CNS damage has
been a question investigated through the past 25 years. Significant physiologic changes accompany GCSE. Temperature varies in patients with status epilepticus, but there is a tendency for hyperpyrexia (infectious causes excluded) which is thought to follow the vigorous muscle activity of status epilepticus; this may be greater than 41 C. Hypertension, tachycardia, cardiac arrhythmias, and hyperglycemia are among the systemic effects caused by the marked increase in catecholamines that accompany GCSE. Lactic acidosis is common after a single generalized motor seizure and resolves with termination of the seizure. Profound metabolic acidosis in status epilepticus has been reported with pH<7.1. Many of these systemic responses are thought to result from the catecholamine surge that follows a seizure and accompanies generalized convulsive status epilepticus; the above effects are seen early in the course. Increased pulmonary transcapillary fluid flux may lead to pulmonary edema though this is thought to occur from mechanisms unrelated to the increased sympathomimetic activity. With prolonged generalized convulsive status epilepticus, a variety of clinical responses including hypotension, hypoglycemia, rhabdomyolysis, and CNS damage from ischemia and other processes occurs. Cerebral metabolic demand increases greatly with GCSE; however, cerebral blood flow and oxygenation are thought to be preserved or even elevated early in the course of GCSE. In an experimental model, a divergence between sympathetic activity and cardiovascular response was noted when catecholamine levels remained elevated for hours but hypotension developed. Systemic hypotension that occurs with prolonged generalized convulsive status epilepticus may contribute to the late development of cerebral ischemia as perfusion diminishes but cellular energy demand remains high.

Experiments in paralyzed and artificially ventilated animals with many of the systemic metabolic changes manipulated and controlled yielded the conclusion that neuronal loss after focal or generalized status epilepticus is linked to the abnormal neuronal discharges and not simply to the systemic effects of GCSE.

Table-RATIONALE FOR AGGRESSIVE TREATMENT IN STATUS EPILEPTICUS
1. The longer generalized convulsive status epilepticus persists, the harder it is to control

2. Neuronal damage is primarily caused by continuous excitatory activity, not systemic complications of generalized convulsive status epilepticus.

3. Systemic complications of seizure activity, particularly hyperpyrexia, may exacerbate neuronal damage.

4. Every seizure counts in terms of making generalized convulsive status epilepticus more difficult to control and for causing neuronal damage.

Table-Classification of status epilepticus according to need for immediate aggressive treatment

STATUS EPILEPTICUS REQUIRING IMMEDIATE, AGGRESSIVE TREATMENT
Continuous generalized convulsive activity with impaired consciousness lasting greater than 5 minutes*
Serial seizures without return to full consciousness between seizures

Subtle generalized convulsive status epilepticus- coma with minimal or no associated motor activity †
-consider if post-ictal state is not improving in 20 minutes*
-may evolve from generalized convulsive status epilepticus
STATUS EPILEPTICUS THAT POSSIBLY BENEFITS FROM AGGRESSIVE TREATMENT
(evidence of CNS injury from seizures is not as clear)
complex partial status epilepticus (twilight or fugue state)†

STATUS EPILEPTICUS REQUIRING TREATMENT—NO DATA TO SUGGEST TIME OF STOPPING IS CRITICAL TO PREVENT CNS DAMAGE
Absence status epilepticus (spike-wave status epilepticus)†
simple motor status epilepticus (epilepsia partialis continua)†

*time is arbitrary; see text for details
†EEG may be required for diagnosis

When is an EEG indicated in the emergency department?

Are there clinical conditions that are time-critical and when information obtainable only from an EEG will immediately influence management and outcomes?

Recommendations have been made to obtain emergency EEG for persistent altered consciousness, refractory status epilepticus, pharmacologically managed sedation and coma, and for the diagnosis of viral encephalitis as well as for a variety of other clinical conditions including coma and brain death.

The most compelling argument for emergent EEG is for the detection of generalized convulsive status epilepticus that may have evolved into subtle status epilepticus with continuing abnormal electroencephalographic discharges. A sequence of EEG evolution has been observed by some investigators in clinical and experimental studies of GCSE progressing from discrete EEG seizure activity to periodic epileptiform discharges on a flat background; these changes seem to parallel bedside observations of continuous seizure activity evolving into subtle GCSE. The concern is that the ongoing electrical seizure activity may cause cell injury even in the absence of convulsive movements and with conventional advanced live support. A recent trial examining treatments for generalized convulsive status epilepticus employed EEG early in the clinical course and found that 25% of patients had evidence of continuing electrical seizures when generalized convulsions were thought to have been terminated by bedside observation.(Treiman) This “subtle status epilepticus” was regarded as an evolution of suboptimally treated or nonterminated convulsive status epilepticus. Others have noted that nonconvulsive status epilepticus may persist after control of generalized convulsive status epilepticus and suggest that EEG monitoring be immediately available after the control of convulsive status epilepticus.(DeLorenzo) Continuous EEG monitoring for patients with status epilepticus that is refractory to optimal doses of a benzodiazepine and phenytoin is recommended as well.

The detection of nonconvulsive status epilepticus in comatose patients in intensive care units is another area of active research. In comatose patients without clinical signs of seizure activity, up to 8% met criteria for nonconvulsive status epilepticus in one study. These studies were performed on patients in intensive care units with continuous EEG-monitoring techniques. The application of these studies to patients in emergency departments and impact of any treatment on patient outcome remains unclear.

In spite of recommendations, a recently published multicenter survey of management of patients with seizures revealed that EEG was uncommonly performed in ED’s and only rarely in the ED for the indication of status epilepticus. Most EEG’s were performed at one institution in the study likely reflecting local practice pattern.
A survey of medical directors of accredited North American clinical EEG laboratories and directors of facilities offering accredited EEG fellowships revealed that the majority of facilities required neurologic consultation or other specialized consultation before emergent EEG could be obtained. The survey revealed no clear consistency between centers regarding which clinical syndromes were appropriate for emergent EEG study. Furthermore, a response time from request of approximately 3 hours stands beyond ideal availability for treatment of time-critical conditions.

Local access to neurologic and electroencephalographic expertise, access to technical personnel and equipment, other technical considerations, and local practice patterns limit performance of EEG’s in the emergency departments. The widespread practice of neurologic consultation prior to obtaining an EEG seems reasonable and is likely to continue given that EEG interpretation is a specialized province within the specialty of neurology. Emergency physicians should be encouraged to seek prompt neurologic consultation including possible performance of an EEG in patients without improving consciousness after termination of generalized convulsive status epilepticus, in seizing patients requiring neuromuscular blockade for critical care management, in patients with refractory status epilepticus, when suspicion of subtle status epilepticus exists, or in patients with persistent altered mental status or coma when nonconvulsive status epilepticus is prominent in the differentiable diagnosis.

Classic review article of pathophysiology and status.


PURPOSE: The study reviewed emergent cases of nonconvulsive status epilepticus (NCSE) to evaluate causes of diagnostic and management delay and examined frequent diagnostic features suggestive of NCSE. METHODS: In a retrospective study, we assessed the clinical presentation of 23 patients with one or more NCSE episodes, their medical history, EEG, and antiepileptic drug (AED) treatment. We also evaluated causes of diagnostic delay in patients referred to the emergency room (ER) in confusional states. RESULTS: There was considerable overlap in clinical features of patients with complex partial SE (CPSE) and generalized nonconvulsive SE (GNSE). Delays in seeking medical attention were common. Diagnosis was significantly delayed in 10 patients. Three cases illustrate the possible markedly different presentations of NCSE. CONCLUSIONS: NCSE often goes unrecognized or is mistaken for behavioral or psychiatric disturbance. The pleomorphic clinical presentation of NCSE indicates that EEG and a therapeutic trial of AEDs afford the best diagnostic measures in acute waxing and waning confusional states associated with agitation, bizarre behavior, staring, increased tone, mutism, or subtle myoclonus. Comment-emergency physician bashing paper; does point out that odd behaviors from nonconvulsive status epilepticus can confound physicians.


Early case series of 10 cases "stupor coma" following termination of GCSE; points out the differential diagnosis of post-ictal state and postconvulsive status with altered mental status.


BACKGROUND AND METHODS: Although generalized convulsive status epilepticus is a life-threatening emergency, the best initial drug treatment is uncertain. We conducted a five-year randomized, double-blind, multicenter trial of four intravenous regimens: diazepam (0.15 mg per kilogram of body weight) followed by phenytoin (18 mg per kilogram), lorazepam (0.1 mg per kilogram), phenobarbital (15 mg per kilogram), and phenytoin (18 mg per kilogram). Patients were classified as having either overt generalized status epilepticus (defined as easily visible generalized convulsions) or subtle status epilepticus (indicated by coma and ictal discharges on the electroencephalogram, with or without subtle convulsive movements such as rhythmic muscle twitches or tonic eye deviation). Treatment was considered successful when all motor and electroencephalographic seizure activity ceased within 20 minutes after the beginning of the drug infusion and there was no return of seizure activity during the next 40 minutes. Analyses were performed with data on only the 518 patients with verified generalized convulsive status epilepticus as well as with data on all 570 patients who were enrolled. RESULTS: Three hundred eighty-four patients had a verified diagnosis of overt generalized convulsive status epilepticus. In this group, lorazepam was successful in 64.9 percent of those assigned to receive it, phenobarbital in 58.2 percent, diazepam plus phenytoin in 55.8 percent, and phenytoin in 43.6 percent (P=0.02 for the overall comparison among the four groups). Lorazepam was significantly superior to phenytoin in a pairwise comparison (P=0.002). Among the 134 patients with a verified diagnosis of subtle generalized convulsive...
status epilepticus, no significant differences among the treatments were detected (range of success rates, 7.7 to 24.2 percent). In an intention-to-treat analysis, the differences among treatment groups were not significant, either among the patients with overt status epilepticus (P=0.12) or among those with subtle status epilepticus (P=0.91). There were no differences among the treatments with respect to recurrence during the 12-hour study period, the incidence of adverse reactions, or the outcome at 30 days.

CONCLUSIONS: As initial intravenous treatment for overt generalized convulsive status epilepticus, lorazepam is more effective than phenytoin. Although lorazepam is no more efficacious than phenobarbital or diazepam plus phenytoin, it is easier to use. Comments: One of the few randomized trials in treating status epilepticus. Bottom line: benzodiazepines are good; phenytoin alone less good. Surprising number of patients with “subtle” status epilepticus--electrical storm by EEG without clinical manifestations. BUT--is this group comparable to the ED population?

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Nonconvulsive status epilepticus (NCSE) is a form of status epilepticus (SE) that is an often unrecognized cause of coma. OBJECTIVE: To evaluate the presence of NCSE in comatose patients with no clinical signs of seizure activity. METHODS: A total of 236 patients with coma and no overt clinical seizure activity were monitored with EEG as part of their coma evaluation. This study was conducted during our prospective evaluation of SE, where it has been validated that we identify over 95% of all SE cases at the Medical College of Virginia Hospitals. Only cases that were found to have no clinical signs of SE were included in this study. RESULTS: EEG demonstrated that 8% of these patients met the criteria for the diagnosis of NCSE. The study included an age range from 1 month to 87 years. CONCLUSION: This large-scale EEG evaluation of comatose patients without clinical signs of seizure activity found that NCSE is an underrecognized cause of coma, occurring in 8% of all comatose patients without signs of seizure activity. EEG should be included in the routine evaluation of comatose patients even if clinical seizure activity is not apparent.

Young GB; Jordan KG; Doig GS: An assessment of nonconvulsive seizures in the intensive care unit using continuous EEG monitoring: an investigation of variables associated with mortality.

Of 49 patients with nonconvulsive seizures studied with continuous EEG monitoring, the overall mortality was 33% (16/49). Of the 23 patients with nonconvulsive status epilepticus (NCSE), 13 died (mortality 57%). Individual variables significantly associated with mortality were age, presence of NCSE, seizure duration, hospital and NICU length of stay, and delay to diagnosis and etiology (acute illness versus remote symptomatic). With multivariate logistic regression, only seizure duration (p = 0.0057, OR = 1.131/hour) and delay to diagnosis (p = 0.0351, OR = 1.039/hour) were associated with increased mortality. Acute symptomatic cases could not be adequately classified as either absence, simple, or complex partial status epilepticus when the impairment of consciousness arose form the initial illness. Current classifications of status epilepticus are inadequate for such cases.


A few of the series of papers on refractory generalized status epilepticus and “nonconvulsive” or “subtle” status epilepticus. When do the seizures stop? Can we tell at the bedside? If the person is not starting to awaken in 20-30 minutes the possibility of continuing sub-clinical seizure activity should be considered.


EEG is the single most important test in diagnosing epilepsy and related conditions. We urge immediate EEG for patients with persistent, unexplained, altered consciousness. In our prospective study, 37% of patients referred for emergency EEG had combined EEG and clinical evidence of SE that was not tonic-clonic that would have gone undetected without EEG. In some cases, EEG provides useful diagnostic information or clarifies the severity of brain dysfunction in comatose patients. Finally, EEG is essential in monitoring patients who require pentobarbital coma for refractory SE.


Policies of administration and availability of EEG offered during nonbusiness hours vary widely among EEG laboratories. The authors surveyed medical directors of accredited EEG laboratories (n = 84) to determine the ranges of availability and clinical indications for approval of continuously available emergent EEG (E-EEG). Of 46 respondents, 37 (80%) offered E-EEG. Two centers recently lost funding for E-EEG. Availability was not associated with the total number of EEGs performed annually. The mean estimated response time from request to expert interpretation was 3 +/- 4 hours (range, 1-24 hours). The five clinical indications for which most respondents approved E-EEGs were possible nonconvulsive status epilepticus (100%), treatment of status epilepticus (84%), cerebral death exam (81%), diagnosis of convulsive status epilepticus (79%), and diagnosis of coma or encephalopathy (70%). Respondents disagreed widely when asked which clinical situations merited E-EEG, with some approving all requests and others denying all except for nonconvulsive status epilepticus. The wide range of current practice suggests that research focused on outcomes of aggressive, EEG-aided patient evaluation and treatment are needed to define better the costs and benefits of a continuously available EEG service.


This article reviews established, emergent, and potential applications of continuous EEG (CEEG) monitoring in the Neuroscience Intensive Care Unit (NICU) and Emergency Department. In each application, its goal as a neurophysiologic monitor is to extend our powers of observation to detect abnormalities at a reversible stage and to guide timely and physiologically sound interventions. Since this subject was reviewed 5 years ago, the use of CEEG monitoring has become more widespread. In a modern NICU, it is no longer novel to have CEEG data contributing to management decisions. A well-trained CEEG monitoring team is important for its optimal implementation. In the diagnosis and management of convulsive and nonconvulsive status epilepticus, its value appears established. It is finding benefit in the early diagnosis and management of precarious cerebral ischemia, including severe acute cerebral infarctions and post-SAH vasospasms. In comatose patients, it can provide diagnostic and
Seizure Classification, Status Epilepticus Classification, And Emergent EEG

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prognostic information which is otherwise unobtainable. More recently, it has been found advantageous for targeting management of acute severe head trauma patients. Networking technology has facilitated the implementation and oversight of CEEG monitoring and promises to expand its availability, credibility, and effectiveness. The maturing of CEEG use is reflected in preliminary efforts to assess its cost benefit, cost effectiveness, and impact on patient outcomes. Comment-wave of the future? Time will tell.


Study Objectives: Patients with seizure disorders are common in the emergency department (ED), yet little is known regarding the management of these patients. The study was performed to define the frequency of patients with seizure disorders in the ED patient population and to determine possible seizure etiologies, characteristics of diagnostic activities, treatments, and dispositions.

Methods: Twelve ED's monitored all patients with a chief complaint related to seizure disorders presenting to ED's for 18.25 days (5% of the calendar year) in late 1997 and used prompt retrospective chart review to gather information. Results: Of the 31,508 patients that presented to these 12 ED's during the study period, 368 (1.2%) had complaints related to seizures. 362 charts were available for analysis and make up the study population. 257 (71%) utilized EMS for transport and care. Advanced care including intravenous access, laboratory work, cardiac monitoring, or oxygen administration was utilized in 304 (84%) patients and antiepileptic drugs were given in 199 (55%) patients. Ethanol or low antiepileptic drug levels were implicated as contributing factors in 177 (49%) of patients. New onset seizures were thought to be present in 94 (26%) patients. Status epilepticus occurred in only 22 (6%) patients. Ninety-eight (27%) of all patients were admitted to the hospital.

Conclusions: Patients with presenting complaints related to seizures are frequent in the ED population and make considerable demands on EMS and ED resources. Six percent of patients with a seizure-related presentation were in status epilepticus and over one-quarter of all patients required hospitalization. Comment-a snapshot of what was happening in a few ED’s over a period of a couple of weeks. Refractory status not seen; EEG’s rarely done.
Questions:

1) A 60 year old man has an episode where he “feels strange” followed by a generalized tonic clonic seizure. How is this event best described?
   
   a) Focal seizure  
   b) Primary generalized seizure  
   c) Partial seizure with secondary generalization  
   d) Absence seizure  
   e) Myoclonic seizure  

2) Indications to consider an emergent EEG include all of the following except:

   a) Persisting “postictal” period without improvement  
   b) Pentobarbital coma in a patient in status epilepticus  
   c) Acute onset psychosis in a 50 year old man with a seizure history and no psychiatric history  
   d) All of the above  
   e) None of the above  

3) Which of the following statements best describes an “aura”

   a) A sensation that occurs before a seizure begins  
   b) A focal seizure  
   c) Another name for a petit mal seizure  
   d) Occurs after a complex partial seizure  
   e) Indicates a temporal lobe lesion  

4) The differential diagnosis of a patient with persisting altered mental status after a generalized seizure include all of the following except:

   a) Ongoing nonconvulsive status epilepticus  
   b) Hypoglycemia  
   c) Drug effect from AED administration  
   d) Intracranial catastrophe  
   e) All of the above  

Answers:

1 – c, 2 – d, 3 – b, 4 - e