SEIZURES IN CRITICALLY ILL PATIENTS

Essay

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By

Ahmed Essam Mohammed
M.B.,B.Ch.

Under Supervision of

Prof. Dr. Azza Mohamed Shafik Abd el Mageed
Professor of Anesthesiology and Intensive Care
Faculty of Medicine - Ain Shams University

Dr. Hanan Mahmoud Farag
Assistant Professor of Anesthesiology and Intensive Care
Faculty of Medicine - Ain Shams University

Dr. Mohamed Mohamed Abd El Fattah
Lecturer of Anesthesiology and Intensive Care
Faculty of Medicine - Ain Shams University

Faculty of Medicine
Ain Shams University
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List of Abbreviations

EEG	**Electroenchephalogram**
NMDA.....	**N-methyl-D-aspartate**
GABA.....	**Gamma amino butryric acid**
SE	**Status epilepticus**
MGLUR.....	**Metabotropic glutamate receptors**
AMPA	**Alpha-amino-3-hydroxy-5-methyl-isoxazolepropionic acid**
AED.....	**Antiepileptic drugs**
CNS	**Central nervous system**
NCSE.....	**Non convulsive status epilepticus**
GTC.....	**Generalized tonic clonic**
CT.....	**Computed-tomography**
BMT	**Bone marrow transplantation**
VPA	**Valproiec acid**
PHT	**Phenytoin**
FPHT.....	**Fosphenytoin**
FDA	**Food and drug administration**
VNS	**Vagus nerve stimulation**
ICU.....	**Intensive care unit**
AAN.....	**American academy of neurology**
SAH.....	**Subarachnoid hemorrhage**
ICH.....	**Intracranial hemorrhage**
MEG.....	**Magnetoencephalography**
SPECT	**Single photon emission computed tomography**
NAA.....	**N- acetyl- aspartate**
BOLD.....	**Blood oxygen level dependent**

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INTRODUCTION

Over the past several decades, a collective attempts has been made to define the precise circuity of brain elements important in seizure expression, together with the physiological mechanisms that ignite these paroxysms. Such answers, in theory,would provide the necessary clues to successfully inhibit and prevent the ictal process.Nature, of course,prevent our attempts to simplify the human condition, and perhaps the most unsettling physiological limits is our inability to comprehend the details of brain function ***(Niedermeyer et al.,1993).***

We still remain appreciably uneducated about the fundamental physiology of the transitions from normal brain excitation to ictal behavior. Seizures may occur in any individual, given the appropriate triggers. Our brains normally have a covering of inhibition that aids in protecting us from paroxysmal excitation. When a person is stricken with critical illness, such protective measures become less effective; given additional neurological injury such as trauma, ischemia, or inflammation, these protective measures work even less well. Coupled with the different physiological derangements that commonly occur in the ICU setting, our risk for seizures becomes unsettling high ***(Mirski et al., 2008).***

Epilepsy is a disorder of the brain characterized by an enduring predisposition to generate epileptic seizures, and epileptogenesis is the development of a neuronal network in

which spontaneous seizures occur. Epilepsy affects the whole age range from neonates to elderly people, and has varied causes and manifestations, with many distinct seizure types, several identifiable syndromes that is poorly classified until now ***(Engel et al., 2001).***

Epilepsy is the condition of recurrent spontaneous seizures arising from aberrant electrical activity within the brain. While anyone can experience a seizure under the appropriate pathophysiological conditions, epilepsy suggests an enduring alteration of brain function that facilitates abnormal neuronal firing ***(Chang and Lowenstein, 2003).***

The aberrant electrical activity that underlies epilepsy is the result of biochemical processes at the cellular level promoting neuronal hyperexcitability and neuronal hypersynchrony. However, a single neuron, discharging abnormally, is insufficient to produce a clinical seizure, which occurs only in the context of large neuronal networks. Cortical and several key subcortical structures are involved in generating a seizure ***(Avanzini and Franceschetti, 2003).***

An early view that disruption of the normal balance between excitation and inhibition in the brain result in seizure generation is now thought to be an over-simplification; the function of the brain depends on cooperation between disparate networks that is probably mediated through oscillations within these networks. Cortical networks generate oscillations, for which inhibitory

neurons, neuronal communication (e.g., synaptic transmission), and intrinsic neuronal properties (e.g., the ability of a neuron to maintain burst firing) are crucial. The occurrence of epileptic activity might be an emergent property of such oscillatory networks. Transition from normal to epileptiform behavior is probably caused by greater spread and neuronal recruitment secondary to a combination of enhanced connectivity, enhanced excitatory transmission, failure of inhibitory mechanisms and changes in intrinsic neuronal properties ***(Ward and Jefferys, 2003).***

Although non- convulsive seizures and non- convulsive status epilepticus were first described more than 100 years ago; this diagnosis is often missed in ICU patients. Continuous EEG monitoring is the only reliable means to rule out non-convulsive seizures or non-convulsive status epilepticus in stuporous or comatose patients, and without continuous EEG monitoring early diagnosis and appropriate treatment are often delayed. Thus, it has become clear that the majority of seizures in ICU patients is clinically not visible and will be missed without continuous EEG recording ***(Hirsch, 2004).***

There are a wide variety of possible symptoms of seizures, depending on what parts of the brain are involved. Many, if not all, types of seizures cause loss of awareness and some cause twitching or shaking of the body ***(Pollack, 2006).***

A seizure may be related to a temporary condition, such as exposure to drugs, withdrawal from certain drugs, a high

fever, or abnormal levels of sodium or glucose in the blood. If the repeated seizures do not happen again once the underlying problem is corrected, the person does not have epilepsy. In other cases, injury to the brain (for example, stroke or head injury) causes brain tissue to be abnormally excited. In some people, problem that is passed down through families (inherited) affects nerve cells in the brain, which leads to seizures. ***(Spenser, 2007).***

Antiepileptic drugs are the mainstay of epilepsy treatment. Non- pharmacological treatments are feasible only in a few selected cases and usually after antiepileptic have failed. Non- pharmacological options include curative surgery, palliative surgical procedures, and the ketogenic diet.***(Sheth et al., 2005).***

Overall, antiepileptic drugs are effective in 60-70% of individuals. The aim of antiepileptic treatment is to control seizures as quickly as possible without adverse effects ***(Sander, 2004).***

Improved seizures control is likely to reduce morbidity and mortality associated with continuing seizures, especially convulsive attacks. Death or permanent brain damage from seizures is rare. However, seizures that last for a long time or two or more seizures that occur close together (status epilepticus) may cause permanent harm. Death or brain damage

are most often caused by prolonged lack of breathing, which causes brain tissue to die from lack of oxygen. There are also some cases of sudden, unexpected death in patients with epilepsy ***(Elson, 2008).***

AIM OF THE WORK

The aim of the work is to determine:

The possible causes of seizures among critically ill patients, the new updates in the diagnosis and management of these seizures and how can prophylaxis against these seizures be done depending on clear understanding of basic pathogenesis of seizures.

DEFINITIONS AND CLASSIFICATIONS

Definitions:

Definition of seizure:

A seizure is a transient symptom of excessive or synchronous neuronal activity in the brain. It can manifest as an alteration in mental state, tonic or clonic movements, convulsions, and or various other psychic symptoms (such as déjà vu). The medical syndrome of recurrent, unprovoked seizures is termed epilepsy, but seizures can occur in people who do not have epilepsy ***(Noachtar and Peters, 2009).***

Definition of Epilepsy

Epilepsy is a chronic neurological disorder characterized by recurrent unprovoked seizures. These seizures are transient signs and/or symptoms of abnormal, excessive or synchronous neuronal activity in the brain ***(Schaefer and Wyllie, 2007).***

Epilepsy is a condition where nerve cells in one area of the brain, or in multiple areas of the brain, signal abnormally to each other. In a normal brain, signaling between nerve cells is required for communication and is used to carry out all processes in the body, such as movement. When nerve cells abnormally fire, they can cause a seizure. While one seizure can occur under certain conditions in anybody, epilepsy is a condition where somebody has multiple seizures. These individuals will require medication and other means to control their seizures ***(Fisher et al., 2005).***

Definition of Aura:

An aura is a distinct perception – either visual, motor, sensory, or psychological - felt around the time a seizure occurs. Although an aura may signal a seizure because it usually happens a few seconds before a seizure occurs, an aura and a seizure may be separated by as much as an hour. Auras are not experienced with all types of seizures. They are mostly seen in individuals who suffer from complex or generalized seizures. Additionally, auras vary from person to person, and can manifest in a number of ways ***(Rossetti and Kaplan, 2010).***

Status epilepticus:

Status epilepticus is defined as a continuous state of seizures, or multiple seizures, without return to baseline, resulting in observable or even subjectively perceived sensory, motor, and/or cognitive dysfunction for at least 30 minutes. However, seizures usually last only a few minutes; therefore, those lasting 20 minutes, 10 minutes, or even 5 minutes are likely to persist, and functionally represent status epilepticus ***(Lowenstein et al., 2003).***

Classifications:

Many classifications have been done for seizures. The first accepted one was International League Against Epilepsy (ILAE) which was done in 1981 then newer classifications have been done till the most recent one which is international classification of seizures in 2010. Seizures are classified into two major groups

which are partial seizures and generalized seizures. Partial seizures originate as abnormal electrical discharges that are confined to a focal or restricted part of the cerebral cortex. They are subdivided into simple partial seizures (without impairment of the level of consciousness) and complex partial seizures (with impairment of the level of consciousness) and partial seizures with secondary generalization (a partial seizure that evolves into a generalized convulsive seizure). Generalized seizures arise from bilateral, symmetric and synchronous electrical discharges involving the entire cerebral cortex which may or may not be accompanied by muscle contractions ***(Holmes, 2010).***

International Classification of Epileptic Seizures (Holmes, 2010):

I- Partial seizures

A. Simple partial seizures

1. With motor signs:
    a. Focal motor without march.
    b. Focal motor with march (Jacksonian).
    c. Versive(cognitive) .
    d. Postural .
    e. Phonatory.
2. With somatosensory or special-sensory symptoms:
    a. Somatosensory.
    b. Visual.

c. Auditory.

d. Olfactory.

e. Gustatory(emotionally).

f. Vertiginous.

3. With autonomic symptoms or signs.

4. With psychic symptoms:

a. Dysphasia .

b. Dysmnesic.

c. Cognitive.

d. Affective(reactive).

e. Illusions.

f. Structured hallucinations.

B. Complex partial seizures:

1. Simple partial seizures at onset, followed by impairment of consciousness:

a. With simple partial features.

b. With automatisms.

2. With impairment of consciousness at onset:

a. With impairment of consciousness only.

b. With automatisms.