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Status Epilepticus Diagnostic and Management Approach in Emergency Department

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ABSTRACT

Status Epilepticus (SE) is a condition that arises from existing neurological disorders, including epilepsy syndromes. It refers to a state of incessant clinical and/or electrographic seizure activity, or recurrent seizure activity within 5 minutes during which the patient does not recover to a normal level of consciousness between seizures. It is also a medical emergency with a high complication rate. The Medline, PubMed, Embase, NCBI, and Cochrane databases were searched for studies of patients with SE. The incidence, etiology, and management options were analyzed. The reason why it is best to broadly classify SE as convulsive and nonconvulsive is that there are many types of seizures as there are types of SE. The complications likely to arise are both medical and neurological, as well as immediate and delayed. Neurological complications include recurrent status epilepticus and progression to chronic epilepsy. Patients with refractory status epilepticus are also likely to exhibit permanent neurological damage caused by abnormal and prolonged electrical activity in the brain, which induces hyper-metabolic activity. This is why it is recommended to begin treatment before the patient has even reached the hospital.

Keywords: *Anticonvulsants, Refractory status epilepticus, Status epilepticus, Seizures, Neurological damage, Epilepsy*

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INTRODUCTION

SE comes from core neurological disorders, like syndromes of epilepsy. The contributory element appears to be, at this point in research, the most important determinant regarding SE outcomes and prognosis. Status epilepticus (SE) represents a serious challenge to modern epileptology and neurology (Lowenstein & Alldredge, 1998). The operational definition of Status epilepticus (SE) has changed over the past few decades. The state in which a patient experiences unceasing clinical and/or electrographic seizure activity, or repeated seizure activity during 5 minutes or more without recovery to a normal level of consciousness between seizures is known as Status Epilepticus. It is a medical emergency and is likely to lead to permanent brain damage or death.

Status epilepticus (SE) is connected with high mortality, if not morbidity (Lowenstein & Alldredge, 1998), and is a medical emergency with a high complication rate. Different studies present mortality as being particularly high, between 3% and 50%. Refractory status epilepticus (that does not respond to treatment) may lead to death in over 76% of cases in elderly patients (Logroscino *et al*., 2002). Status epilepticus can be grouped into the non-convulsive, convulsive, myoclonic, or focal motor. All of these could also become refractory status epilepticus which concerns the state of the patient when their seizures continue for a long period despite antiepileptic medication. These seizures can be convulsive or non-convulsive and do not respond to initial medication. The most conventional pediatric neurological emergency is Status epilepticus (Matricardi *et al*., 2019; Won *et al*., 2019).

MATERIALS AND METHODS

We used the PubMed index for the drafting process of relevant reports, and the following keywords used in the mesh (("status

epilepticus " [Mesh]) AND ("Diagnosis" [Mesh]) OR ("Treatment" [Mesh])). For the incorporation criteria, the articles were included based on one of the following: status epilepticus treatment and diagnosis elimination criteria were other articles that did fit in the criteria by not having any of the incorporation criteria results in their heading.

Out of the most clinically relevant out of 1,202 articles indexed in the previous two decades, around 90 publications were chosen and their full texts were evaluated. After a thorough examination, a total of 31 of the 90 were included. Using reference lists from the recognized and linked studies, additional research and publications were found. Where it was relevant, expert consensus recommendations and commentary were added to help practicing physicians assess chest pain most simply and practically possible.

Classification of status epilepticus

Due to the versatility of the types of SE, it becomes a complex procedure to find a proper classification method for it. However, it is best to classify SE broadly as convulsive SE and nonconvulsive SE, by using electroclinical features. Convulsive SE (CSE) presents with convulsions and can be classified into clonic SE, tonic-clonic SE, myoclonic SE, and tonic SE .The most common is the generalized tonic (Shorvon, 1994). Nonconvulsive SE (NCSE), on the other hand, manifests as near-continuous or continuous generalized electrical seizure activity where the patient exhibits an altered mental status, as opposed to the physical convulsions noted in generalized tonic-clonic status epilepticus. This type of seizure refers to uncharacteristic mental status, insensitivity, ophthalmic motor irregularities, recurrent electrographic seizures, and not responding to anticonvulsants (Shorvon, 1994; Khan & Karim, 2020). CSE may evolve into NCSE, or NCSE may arise on its own.

Epidemiology

Status epilepticus shows its peaks in the senior and childhood years, which means it has a bimodal distribution. Indeed, the highest risk of SE is in the infants below one year and the senior citizens above 60 years old with the highest percentage of 40% occurring below the age of 2 years. The incidence is much more prevalent in males and its rate ranges between 7 to 40/100,000 persons yearly. Also, a notable percentage of both adults and children who have status epilepticus have a history of epilepsy (16% to 38% for children, 42% to 50% for adults). SE appears to be more prevalent among men, infants, and the elderly irrespective of geographic prompts (Hauser, 1990). Additionally, death during hospital admission or within 30 days (short-term mortality) of status epilepticus ranges from 7.6 to 22%, across all age groups. The highest is amongst the elderly (Jobst *et al*., 2019).

Risk factors and etiology

An existing seizure disorder such as epilepsy, central nervous system infection, and cerebrovascular disease are the main specific causes of SE. However, other etiological factors include a family history of seizure disorders, a genetic/inherited disorder, use and abuse of alcohol during pregnancy, a history of traumatic brain injuries, and a recent change in seizure or epilepsy medicine (or failure to take seizure or epilepsy medicine as prescribed) (Bethune *et al*., 1993).

Other potential acute processes include

- Patients with epilepsy are the highest risk group, especially without anti-epileptic drug levels. These patients make up 42% of patients with SE;
- (CNS) Central nervous system infections (encephalitis, meningitis, intracranial abscess), or preceding damage to the CNS;
- A stroke history;
- Alcohol and/or drug abuse and withdrawal symptoms (drugs like benzodiazepines, barbiturates, alcohol)
- Metabolic disease and abnormalities (hypoglycemia, hyponatremia, hypocalcemia, hepatic encephalopathy, and inborn metabolism errors in children);
- Hypoxia of the CNS (which has high morbidity of 60-70%);
- brain tumors;
- In children under 2 years, brain infections in conjunction with fever, with or without prior history of epilepsy;
- Head trauma (without or with intracranial bleeding)
- Cerebrovascular accidents
- Hypertensive emergency;
- Autoimmune disorders;

In more than 50% of all cases, (particularly in the elderly) cerebrovascular involvement is present (Annegers *et al*., 1979). Also, SE persistence is mostly seen in children with CNS disease no matter the etiology but recurrences only develop in 4% of children who develop SE after a high fever or unknown causes. Genetic factors could also be responsible for the higher concordance of SE among monozygotic twins.

Symptoms and signs

A high level of catecholamines in the blood characterizes the first stage of convulsive SE (CSE), which results in hyperadrenergic stimulation and stress on body systems because of extreme motor movements and intense/prolonged brain electrical activity. Symptoms of Convulsive status epilepticus include jerking muscle spasms of the arms and legs, confusion, mental impairment, or loss of consciousness, falling, difficulty breathing, inability to move (paralysis), or weakness that lasts for hours to days after the seizure (Maganti *et al*., 2008; Farrukh *et al*., 2020).

Symptoms of nonconvulsive status epilepticus involve daydreaming, staring, or a confused state, subtle movements or twitching in the eye or face, hallucinations, paranoia, agitation or aggression, delusions, psychosis, laughter, nausea or vomiting, and tremors (Maganti *et al*., 2008). As such, nonconvulsive seizures can be easily misdiagnosed and may only be identified with the help of an electroencephalogram (EEG).

Diagnosis

Neuroimaging should be used to identify a potential etiology in the clinical diagnosis of status epilepticus. In most cases, a head CT (computed tomography) scan is sufficient. Pediatric patients require an MRI (magnetic resonance imaging) to spot malformations, thus also requiring sedation. An EEG should also be obtained and monitored for diagnosis. If the patient has a seizure disorder, anti-epileptic drug levels should be obtained, alongside all other relevant information (Walton, 1993).

Complications

The complications likely to arise are both medical and neurological, as well as immediate and delayed. Respiratory failure, cardiac damage because of catecholamine surge, hypoventilation, cardiac arrhythmia, aspiration pneumonia, hypoxia, pulmonary edema, fever, and leukocytosis are some of the common medical complications observed in patients (Walton, 1993).

Neurological complications include recurrent status epilepticus and progression to chronic epilepsy. In cases of refractory status epilepticus, permanent neurological damage can be seen. Indeed, this is caused by prolonged, abnormal electrical activity in the brain.

Due to increased neural stimulation, hyper-adrenergic stimulation causes heart and blood vessel injuries. This is likely to cause acute or chronic cardiac arrhythmias and hypertension, with preexisting atherosclerosis or other cardiovascular issues as major risk factors. Fever is present 80% of the time and rather than being caused by infection, it is caused by extremely high muscle activity levels. A manifestation of brain atrophy and chronic encephalopathy in 6-15% of cases could be as a result of cerebellar, cortical, and hippocampal damage (Hocker, 2015). Epilepsy will develop in about 40% of these patients. Researchers in this field conclude that after 30 to 60 minutes of SE, acute necrosis of the neurons occurs (Fountain, 2000). While these abnormal manifestations are likely to correct themselves, increased seizure activity could cause additional pathological states directly correlated, including hypotension, pulmonary edema, hypoglycemia, myocardial dysfunction, refractory acidosis, and sustained high body temperature (Walton, 1993). This is why supporting a normal body temperature is vital all the while maintaining perfusion to the organs. Indeed, extended hyperpyrexia and hypotension are the causes of multi-organ dysfunction.

Treatment

Episodes of SE must be treated as soon as possible, as the longer it continues the more refractory to remedy it becomes whilst increasing the chances of difficulties. It would therefore make a significant difference in the outcome to begin treatment for SE before the patient has even arrived at the hospital.

Status epilepticus must be resolved by simultaneously assessing and managing circulation, breathing, and airway, as well as administration of the first-line antiepileptic drug (AED) treatment of choice. While maintaining support for the patient's cardiovascular and respiratory status, shutting down the seizure activity is paramount, (Müllges, 2019). To ensure an open airway, the patient's head must be positioned and at any time it may be necessitated to initiate rapid sequence intubation (Uppal *et al*., 2019).

Treatment includes

- Providing oxygen;
- Monitoring of heart rate, oxygen saturation, breathing rate, and blood pressure levels;
- Obtaining vascular access;
- If present, hypoglycemia treatment, and bedside blood glucose verification (it is necessary to administer thiamine before dextrose if the patient displays thiamine deficiency);

The most common antiepileptic drug are benzodiazepines are. Lorazepam is preferred because of its rapid onset (no more than 2 mg per minute) and it is dosed at 0.1 mg/kg IV. If lorazepam is not available, diazepam should be used at 0.15 mg/kg IV up to a ceiling of 5 mg per minute. , A repeat dose may be administered 3 to 5 minutes later, If seizures do not resolve. Intravenous administration is preferred (Uppal *et al*., 2019).

Antiepileptic drugs should be given together with benzodiazepines. The clinician can choose from levetiracetam (40 to 60 mg/kg up to a total of 4500 mg over 15 minutes), fosphenytoin phenytoin (20 mg/kg up to 25 to 50 mg/minute), (20 mg/kg phenytoin equivalents [PE] up to 100 to 150 PE/minute), and valproic acid (30mg/kg at up to 10 mg/kg/minute but with raised concerns on children under two years as there is a risk of hepatotoxicity) (Uppal *et al*., 2019). If the seizure does not abort after the second dose of benzodiazepines, it must be treated as refractory status epilepticus. By continuously infusing an antiepileptic drug such as pentobarbital, an intravenous (IV) infusion of thiopental, midazolam, or propofol (however propofol in children creates the risk of propofol infusion syndrome and should not be used), this ought to be treated (Müllges, 2019). Status epilepticus infected patients should be ushered to the ICU in the hospital.

CONCLUSION

SE is a serious clinical emergency and needs to be handled in an orderly and organized manner (Sutter *et al*., 2018). Patients must be treated as SE if they display persistent generalized seizures beyond 5 minutes. Treatment must be initiated as soon as the patient is observed, preferably before the patient even reaches the hospital (Cherian & Thomas, 2009) to prevent the seizure from resisting medication. Those patients that are unphased by the first-line drugs (lorazepam and fosphenytoin in most instances) must be considered RSE and dealt with accordingly. They should be moved to intensive care services where second-line drugs (barbiturates or benzodiazepines) should be administered, along with continuous EEG monitoring and ventilator support. If intubation proves impossible/cannot be materially done, the patient can be treated with medications that do not sedate him, such as intravenous valproate, levetiracetam, or oral topiramate.

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