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**Mini Review**

# Management of Status Epilepticus in Adults for the Acute Physician

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## Abstract

Generalized convulsive status epilepticus is a neurological emergency and defined as a generalized tonic/clonic motor activity (seizure) which continues for more than five minutes or series of seizures which occur without regaining function in between. Common causes for Generalized convulsive status epilepticus are structural brain injury like head injury, stroke, brain tumor, or cerebral anoxia. Noncompliance with antiepileptic medications or rapid withdrawal due to poor absorption from acute illness like diarrhea or vomiting is another common cause, withdrawal from alcohol or benzodiazepines in patients who consume these chemicals daily is a well-known cause for GCSE.

**Keywords:** Status epilepticus; Seizure; Structural brain injury; Cerebral anoxia.

**Abbreviations:** GCSE: Generalized Convulsive Status Epilepticus; FMSE: Focal Motor Status Epilepticus; EEG: Electroencephalogram; NCSE: Nonconvulsive Status Epilepticus; MRI: Magnetic Resonance Imaging.

## Introduction

Generalized convulsive status epilepticus (GCSE) is a neurological emergency and defined as a generalized tonic/clonic motor activity (seizure) which continues for more than five minutes or series of seizures which occur without regain of function in between [1]. Early treatment is mandatory as mortality is one in five in patients presenting with GCSE [2]. Common causes for GCSE are structural brain injury like head injury, stroke, brain tumor, or cerebral anoxia. Noncompliance with antiepileptic medications or rapid withdrawal due to poor absorption from acute illness like diarrhea or vomiting is another common cause, withdrawal from alcohol or benzodiazepines in patients who consume these chemicals daily is a well-known cause for GCSE. Metabolic causes for GCSE are severe hyponatremia, extreme levels of glucose, low calcium levels, and organ failure like hepatic or renal encephalopathies.


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Acute physicians should be aware of some antibiotics that can lower the seizure threshold, like penicillin, carbapenems, and quinolones [3]. Theophylline and lithium have a very narrow therapeutic index and raised levels can provoke a GCSE.

Encephalitis (viral, Hashimoto or autoimmune) is an important cause of GCSE, autoimmune encephalitis can be associated with a paraneoplastic syndrome, multiple sclerosis and lupus vasculitis are common cause of newly presented GCSE in young females [4,5]. GCSE presents with bilateral tonic/clonic motor activity with loss of consciousness, while patients with focal motor status epilepticus (FMSE) presents with jerking movements in one area of the body with preserved consciousness (unless generalized) and FMSE is more suggestive of a focal lesion in the brain as the source of status epilepticus. Other type of status epilepticus is myoclonic which presents with rapid but lower amplitude of jerking and tonic status epilepsy which presents with more sustained posture and slower jerking [6].

Electroencephalogram (EEG) is very helpful during the attack if available, also, if the jerking activity has stopped after a GCSE but the conscious level has not recovered for a longer period than expected with post ictal status EEG can help in diagnosing nonconvulsive status epilepticus (NCSE) if present which requires urgent treatment [7].

Urgent non contrast CT scan of the head is indicated if the GCSE felt to have a focal origin followed by generalization or if GCSE is new without a clear provoking factor. Magnetic resonance imaging (MRI) is superior to CT head for the diagnosis of structural lesions in brain when the cause is not known, and better in showing the damage occurred in the brain if any like oedema if the patient is more stable [8]. It is worth mentioning that a rare cause of stroke can present with status epilepticus, a stroke in the basilar artery can present with convulsive or nonconvulsive patterns [9]. Goals for treating GCSE are maintaining a patent airway, oxygenation, and perfusion as in any medical emergency, stopping the seizure to prevent brain injury and treating causes of GCSE is another priority in treatment. Continuous monitoring including oxygen levels, blood pressure and ECG monitoring.

While benzodiazepine is prepared, one or two large cannulas should be inserted and routine blood sent including electrolytes, toxicology screen, and HCG if applicable. Venous blood gas is essential to provide a rapid result of lactate and glucose levels. If severe hypoglycemia is found, intramuscular glucagon if no intravenous route available or 25 g of dextrose intravenously and choice of solution depends on availability (50 ml of 50%, 100 ml of 20 %, or 200 ml of 10%) as rapid infusion with Thiamine 100 mg of thiamine in case if associated malnourishment like in alcohol dependent patients [10].

There is a role for pyridoxine in patients who are refractory to treatment and risk of isoniazid toxicity [11]. Benzodiazepines are still considered first line therapy in GCSE, most commonly used ones are lorazepam intravenous route, diazepam rectal route, and midazolam buccal, intramuscular, or even nasal routes [12]. Second line treatment is advisable even if the seizure has stopped, the rationale is second line medications should


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prevent recurrence of seizures when benzodiazepine effect has weaned off, unless the cause of GCSE has been dealt with (like severe hypoglycemia). Common second line medications are valproate, Fos phenytoin, and levetiracetam [10].

It is vital to load with the adequate dose of benzodiazepine as underdosing is a common problem in the management of GCSE leading to prolonged seizure activity increasing the risk of brain injury [13].

Loading dose of lorazepam is 0.1mg/Kg and usual current practice if to provide 4 mg initially at a rate of 2 mg/min and if the seizure activity is still ongoing for 3 minutes or more then further dose of lorazepam is given, if lorazepam is not available then diazepam 0.15 mg/Kg up to 10 mg initially and again followed by 10 mg if seizure activity is not terminated after 3-5 minutes [10]. If intravenous access is not available, 10 mg midazolam initially via previously mentioned routes is advisable [14]. Second line agents are levetiracetam with a loading dose of 60 mg/Kg maximum 4.5 g and infused over fifteen minutes, valproate loading dose is 40 mg/Kg maximum 3 g which can be infused over four minutes, or Fos phenytoin loading dose 20 mg/Kg and infused at a rate of 100 mg/minute. Worth mentioning that levetiracetam dose requires reduction in severe renal failure while valproate is relatively contraindicated in liver failure as it can potentially cause hyperammonemia hepatic encephalopathy [15].

Lacosamide is a relatively recent antiepileptic medication which showed efficacy in treating NCSE but requires a cardiac monitor and is contraindicated in cardiac patients with 2nd or complete degree heart block [16,17].

In refractory GCSE after optimal loading dose of benzodiazepines and second line antiepileptics usually a continuous infusion of midazolam, phenobarbital, or propofol by the anesthetic team with mechanical ventilation and EEG monitoring (to rule out NCSE) is the last step in optimum management.

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