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Profile on status epilepticus, clinical features and lab parameters and outcome in pediatric intensive care

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ABSTRACT

Background: Status Epilepticus is a major medical and neurological emergency. Despite advance in treatment, it is still associated with mortality and morbidity. The objective of the study was to estimate the profile of status epilepticus on clinical features, lab parameters and outcome of the children admitted in pediatric intensive care.

Methods: Children between 1 month to 18 years who were fulfilling the definition of status epilepticus and who were admitted in PICU in Sri Ramachandra Medical Center were included in the study. All the children who met inclusion criteria were taken for the study. history and physical examination was done for all the children with blood samples, CSF samples, urine sample, computerized tomography scan, EEG details were collected after getting informed consent.

Results: Among 50 children 60% were in the age group were less than 5 years ,22% were between 6-10 years ,14% were between 11-15 years and 4% were above 16 yrs. The mean age group was 5.74 years (SD±4.75). Incidence was higher in males (54%) when compared to females (46%). Forty-seven children (94%) were brought to casualty with status epilepticus whereas three children developed SE in hospital. CSF study was done among 19 (38%) of the children in which CSF was found normal among 16(84%). CT scan/MRI brain findings were abnormal in (34%) and normal in 10 (66%) patients. Epilepsy was the most common diagnosis noted in 29 (58%) patients and febrile seizure was second common etiology noted in 12 (24%) in this series. In this series 47 (94%) patients were treated and discharged home, 2 (4%) patients died and one patient went against medical advice without follow up.

Conclusions: Status epilepticus is one of the common neurological emergency which requires admission to PICU. In our study epilepsy is one of the most common causes of status epilepticus. Early and appropriate treatment with anticonvulsants and use of mechanical ventilation may improve the outcome.

Keywords: Children, Investigations, Outcome, Status epilepticus

INTRODUCTION

Status Epilepticus is a major medical and neurological emergency. Despite advance in treatment, it is still associated with mortality and morbidity. The longer the status epilepticus is present, more difficult is the control and more is the risk of permanent neurological damage; immediate intervention is required whenever the patient has status epilepticus. Status Epilepticus is defined as a

continuous convulsion lasting longer than 30 mins or the occurrence of serial convulsion between which there is no return of consciousness, but there have been proposals to revise the definition, some authors consider even 10 mins of seizure without regain in consciousness can be considered as status epilepticus. Animal studies have shown that neuronal injury can occur with seizure activity lasting more than 30 min inspite of managing the airway and circulation.

Status epilepticus is a condition which will not terminate spontaneously and requires immediate intervention and ventilation. Aggressive therapy, has its own risk and therefore must always be weighed against the possible benefits when treating a less than urgent from of this condition.

Incidence of status epilepticus

The incidence of status epilepticus, etiological factors, presentation, response to treatment and final outcome differs from various geographical distribution and from center to center. However, there is not much published data either population based or hospital-based studies from the Indian subcontinent.¹

Population based epidemiological studies have indicated that the mortality of status epilepticus in the general population is almost 22 % in children and can be as high as 30 % in elderly.²⁻⁴ Several factors have been shown to contribute to mortality and morbidity of status epilepticus which includes seizure duration, age, type of seizure, and the time of onset of treatment. Understanding the pathophysiology and response to the treatment may provide important insights into decreasing the mortality and morbidity associated with this condition.⁴

Status epilepticus define as a continuous convulsion lasting longer than 30 mins or the occurrence of serial convulsion between which there is no return of consciousness, but there have been proposals to revise the definition, some authors consider even 10 mins of seizure without regain in consciousness can be considered as status epilepticus.1 The 30 mins duration is done on animals which showed neuronal injury after 30 mins of seizure even after maintaining the airway and circulations. Status epilepticus can occur in any type of seizure activity, but the true emergency among all type is GTCS type although any seizure type should be terminated as quick as possible.5 Aggressive therapy, has its own risk and therefore must always be weighed against the possible benefits when treating a less than urgent from of this condition.

Refractory SE

The question is when SE becomes refractory. Although there is no standard definition, most authors consider SE refractory when adequate doses of a benzodiazepine and phenytoin fail to terminate it. Some other authors have required phenobarbital as well. Duration of SE prior to treatment appears to be an important factor.

Mortality and Morbidity⁵

Morbidity and mortality from status epilepticus seem to be related to three factors:

• CNS damage due to the underlying illness or acute insult causing the status epilepticus.

- CNS damage caused by repetive electrical discharge of the seizure itself.
- Systemic and metabolic factors related to repeated GTCS type of seizures.

Death associated with status epilepticus is associated with the underlying cause rather than seizure itself.

Studies have shown that seizures lasting for more than 60 to 90 mins may result in neuronal death in those with epilepsia partialis continua.⁵⁻⁷ Prolonged memory deficits have been recorded after complex partial status epilepticus, some studies have reported that prolonged febrile and afebrile seizure occurring between 6 monts to 7 years resulted in damage to the hippocampus and thereby resulting in complex partial seizure.^{5,8}

The systemic and metabolic effects of repeated GTCS type of seizure involves cardiovascular, respiratory. Renal, metabolic and ANS.

The group with generalised convulsion includes patients with

- Tonic
- Clonic
- Tonic clonic
- Clonic tonic clonic (Myoclonic)

Secondary generalised tonic clonic seizure or generalised ictal events associated with a postictal transient or persistent focal neurological deficit were considered generalised with focal features.

Status Epilepticus can also be classified based on their etiology i.e. the etiological classification of status epilepticus includes:⁹

- Acute Symptomatic
- Remote Symptomatic
- Remote Symptomatic with an acute precipitant.
- Progressive Encephalopathy
- Febrile
- Cryptogenic (Idiopathic)

Pathophysiology

Exact pathophysiology of seizure is unknown some studies which has been done in animals and few in humans shows, in considering the pathophysiology of status epilepticus, three general principals have been described:

- Status epilepticus appears to have a distinct natural history and evolution
- The more prolonged status epilepticus becomes, the more intractable is it to effective treatment.⁵
- The more prolonged the status epilepticus, the more
- likely it is associated with a poor prognosis.

Natural history of status epilepticus

EEG stages

In the initial stage, the EEG shows discrete seizures with interictal slowing. As the condition continues, the discrete seizure pattern first begins to wax and wane and then evolves into a stage of continuous ictal discharges. If seizure persist, ictal discharges are interrupted by flat periods in EEG background, and in end stage, paroxysmal bursts of epileptiform discharges arise out of a flat background.^{5,10,11}

Motor Stages

At the start, patients usually undergo discrete seizure that correspond to the discrete episode of ictal discharge on the EEG. As the seizures continues, the seizure may wax and wane and then merge into continuous generalised clonic activity that also is reflected in the EEG, subsequently, motor activity may begin to diminish even though seizure activity continuous to show on EEG.

In the last stage of Status Epilepticus, motor activity may actually disappear but the EEG continues to show periodic epileptiform activity.

- Discrete seizure with interictal slowing.
- Waxing and waning of ictal discharges.
- Continuous ictal discharges.
- Continuous ictal discharges punctuated by flat periods.
- Periodic epileptiform discharges on a flat background.

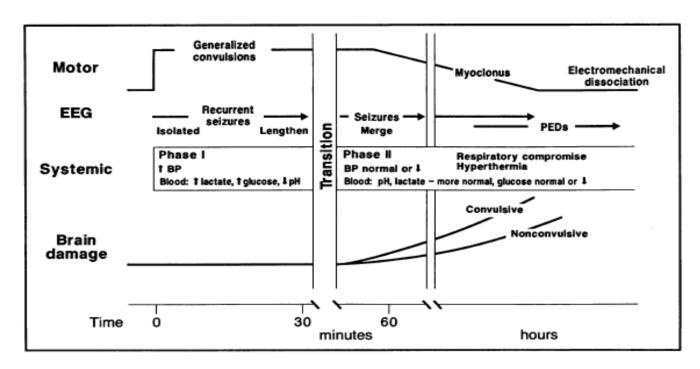


Figure 1: Systemic and metabolic changes during seizure activity.

Systemic and metabolic changes

There are many metabolic and systemic events which has been reported in status epilepticus: which has been divided into two phases. The first phase usually lasts about 30 minutes and is associated with an increase in blood pressure with each seizure, a serum glucose levels and acidosis. As the transition into the second phase at about 30 mins occurs, the blood pressure tends to return to normal, the patient may even become hypotension and no longer response with an increase with the duration of seizure.

Systemic effects of status epilepticus

Lungs

Due to both metabolic and respiratory acidosis, the pH of arterial blood gases (ABG) is often found to be below normal in SE.¹²

Heart

The sympathetic overdrive can cause tachycardia. In a study by Boggs, potentially fatal arrhythmias were reported in 58% of the patients.

Muscle

As a result of continued seizure activity, conversion to anaerobic metabolism contributes to lactic acidosis.

Blood chemistries

De-margination of neutrophils occurs with the stress of seizing. In patients without underlying infection, elevated white blood cell counts (above the upper laboratory limit) can be present.

Blood pressure

The initial phase of SE results in an increased systemic blood pressure with an increase in peripheral vascular resistance as the status becomes prolonged, the blood pressure will normalize or even begin to fall with resultant hypotension.

Temperature

As the seizure progresses, the body's core temperature elevates. Aminoff and Simon looked at the temperature of 90 patients in SE. Of these, only 8 had temperatures below 98°F, only 3 had fever secondary to known infection, and over 40 had temperatures above 100.5°F, (with two of the temperatures up to 107°F).

Respiratory rate

The patient in SE often has a transient change in respiratory rate and tidal volume. Investigation to be done in status epilepticus. 13,14

Lab Studies

Obtain laboratory studies based on age and likely etiologies.

- CBC
- RFT, LFT, Sr Electrolytes
- Urine r/e
- Culture Sensitivity for blood and urine.
- Blood glucose level using glucometer
- Calcium and magnesium levels, particularly in neonates
- ABG levels
- Toxicology screen
- Anticonvulsant levels (if indicated by history of ingestion or existent therapy)

Imaging Studies

- Stabilize all children before CT scanning or other imaging studies are performed obtain imaging studies based on likely etiologies.
- Cervical spine radiographs, if potential trauma

- A head CT scan is the best diagnostic imaging study, particularly if the following are suspected:
 - Hemorrhage
 - Midline shift
 - Mass lesion if a tumor or abscess or metastasis or head trauma is suspected
 - In patients with a bleeding diathesis or coagulopathy
 - All alcoholics
 - All HIV-positive or immunocompromised patients
 - Any focal neurological signs
- MRI is not a diagnostic tool, unless it is immediately available and the child's cardiorespiratory status is stable.^{15,16}

Other tests

- Electroencephalography
 - For unremitting status epilepticus
 - Usually performed in a critical care setting,
 - EEG. 17,18

Role of electroencephalography

Electroencephalography (EEG) is extremely useful, but underutilized, in the diagnosis and management of status epilepticus. ^{3,4,19,20} Although overt convulsive status epilepticus is readily diagnosed, EEG can establish the diagnosis in less obvious circumstances. Researchers in one study used EEG to diagnose status epilepticus in 37 percent of patients with altered consciousness whose diagnosis was unclear on the basis of clinical criteria. ¹⁹ A surprising number of patients had no clinical signs of status epilepticus, and EEG was necessary to establish the diagnosis.

EEG also can help to confirm that an episode of status epilepticus has ended, particularly when questions arise about the possibility of recurrent episodes of more subtle seizures. In another study, investigators monitored patients for at least 24 hours after clinical signs of status epilepticus had ended.²⁰ They found that nearly one half of their patients continued to demonstrate electrographic seizures that often had no clinical correlation. The investigators concluded that EEG monitoring after presumed control of status epilepticus is essential for optimal management.

Patients with status epilepticus who fail to recover rapidly and completely should be monitored with EEG for at least 24 hours after an episode to ensure that recurrent seizures are not missed. Monitoring also is advised if periodic discharges appear in the EEG of a patient with altered consciousness who has not had obvious seizures. Periodic discharges in these patients suggest the possibility of preceding status epilepticus, and careful

monitoring may clarify the etiology of the discharges and allow the detection of recurrent status epilepticus.

METHODS

Children between 1 month to 18 years who were fulfilling the definition of status epilepticus and who were admitted in PICU in Sri Ramachandra Medical Center were included in the study after taking parental consent. Children less than 1 month and more than 18 years and where the duration of seizure cannot be documented correctly were excluded. It is a prospective observational study undertaken in Sri Ramachandra Medical Center. History was obtained to ascertain the duration of seizures. The detailed history was recorded on a preformed proforma. Physical examination of the children was carried out and patients were investigated as per their clinical diagnosis. Patients were treated according to the protocol for the treatment of status epilepticus. Patients were followed up till discharge. Statistical analysis was done using SPSS software.

RESULTS

Among 50 children 60 % were in the age group were less than 5 years ,22 % were between 6-10 years ,14 % were between 11-15 years and 4% were above 16 yrs. The mean age group was 5.74 years (SD±4.75). Incidence was higher in males (54%) when compared to females (46%). Forty-seven children (94%) were brought to casualty with status epilepticus whereas three children developed SE in hospital. The duration since onset of seizure was between 30-60 minutes among 45 (90%) children at presentation to the hospital and more than 60 minutes among 5(10%) of the children. Generalized tonic clonic seizure were observed in 33 (66%), tonic seizure was observed in 7 (14%), myoclonic jerk noted in 1 (2%) and focal seizure was noted in 9 (18%) of the children. Prehospital treatment was received by 23 (46%) of children whereas 27 (54%) did not received any prehospital treatment. Midazolam, diazepam, lorazepam and phenytoin were used as anticonvulsants prior to hospital admission. About 36 (72%) of the children developed SE for the first time. Among children who already had previous episode of seizure 6 (12%) were on single drug therapy, 6 (12%) were on two drugs and 2 (4%) were on three drugs therapy for seizure control daily. The drug compliance was adequate in 85% of the children. Only 11(22%) children had temperature of more than 100 degree Fahrenheit. Family history of seizure was present in 13 (26%) of children. Developmental delay was noted among 13 (26%) children whereas developmental milestones were normal among 37 (74%) of children. In 30 (72%) children SE was controlled after using two anticonvulsants, 10 (20%) of the children required three anticonvulsants for seizure control whereas 4 (8%) required more than three anticonvulsants for seizure control. Mechanical ventilation was needed among 10 (20%) children. CSF study was done among 19 (38%) of the children in which CSF was found normal among

16(84%). CT scan/MRI brain findings were abnormal in (34%) and normal in 10 (66%) patients. Epilepsy was the most common diagnosis noted in 29 (58%) patients and febrile seizure was second common etiology noted in 12 (24%) in this series. In this series 47 (94%) patients were treated and discharged home, 2 (4%) patients died and one patient went against medical advice without follow up.

DISCUSSION

The reported incidence of Status epilepticus in children in Indian subcontinent is variable. A total of 50 children were admitted during the study period.

The incidence of status epilepticus in our study was more in patient between less than 5 years (60 %), a study by Gulati S found the similar type of result i.e. children <5 years of age had 56% of SE.¹ Predominant involvement of younger age group has been reported previously.^{2,21,22}

The reason for this predominance in younger children is not clearly known, probably mechanism for control of seizure activity are fragile in younger children and may get distributed with minimal abnormalities in neurofunctions.

In present study, the sex distribution shows slightly higher incidence of status epilepticus in males than females. Although they were almost in equal propotions, many other studies done both in pediatrics and adults shows similar type of results Gulati S observed 22 (70%) patients out of 31 were male. Sachi found male predominance of 55%. The exact reason for male predominance is not clearly understood. ²³

In present study out of 50 children ,47 children (94%) were brought to casualty for primary complaints of status epilepticus and only 3 children (6%) were admitted for some other complaints other than status epilepticus and developed status epilepticus during the hospital stay. Two children admitted as epilepsy 1 child was admitted for viral fever and developed febrile status. In hospital seizure was also seen in other studies.²⁴

In present study 90% of children were brought to the casualty with seizure of 30 to 60 mins within the onset of seizure, Sachin Admuthe found that 74.07% of children was brought to casualty within 1 hour of onset of seizure. ²³

It was observed that GTCS type of seizure is the commonest of all 4 types (66%) similar incidence was observed by Kwong KL 54% were generalized tonic clonic seizure, Gulati observed that 63.3% were generalized tonic clonic seizure.^{1,25}

After GTCS type of seizure; focal seizure is the commonest type which came to 18%. Gulati S observed 26.6% were focal. Myoclonic jerks had the least of 2%

which was similar to the same study done by Gulati by 6 %. In present study, it was observed that 46% received prehospital treatment; and 54 % didn't received any prehospital treatment.

Out of 50 patients, 12% of the total patient received Diazepam; following Diazepam, Inj. Phenytoin was commonly used (8%). The similar type of result is noticed in a study done by Gulati S. Other studies used a combination of midazolam and phenytoin (70%). Following that in our study lorazepam was commonly used in 4% of children. Some of the unpublished studies also found that a combination of midazolam and phenytoin is widely used. 15-18

Out of 50 children 36 (72%) never had previous episode of seizure and 14 children (28%) had previous history of seizure. This data is quite variable from center to center; Eliana Garzon found that 59.4 % are known epileptic and 40.5% are not epileptic but Sachin Admuthe found that 37.04% are epileptic and remaining are non-epileptic.^{23,26} Gulati observed that 53.3% are epileptic¹

In present study 26% had family history of seizure and 74% did not have any family history of seizure. In present study 26% of children had mild to severe form of developmental delay and 74 % of children had normal mile stone. In a study done by Gulati 25% had developmental delay. In present study 2% of children had Cerebral palsy and in a study done by Gulati 10% of children had Cerebral palsy.

In current study 72% of children had first episode of seizure presenting as status epilepticus. The remaining 12% were on single AED and 12% were on 2 AED and 4% were on more than 2 drugs. The drug dosage is adequate in 85% of the patient and the dosage is inadequate as per kg body weight in 15% of the patient. We are not able to do drug levels for all the patient; because of loading dose of anticonvulsants has been given before collecting the samples for drug level. The most commonly used AED is Phenytoin, Phenobarbitone and sodium valproate. Seventy four percent of the patient had normal temperature and 22% were febrile, having temperature more than 100°F and remaining having temperature of less than 98°F. The presence of low number of hyperthermic cases probably explains the low cases of febrile status.

Out of 50 children, 36 (72%) children received a combination of midazolam and phenytoin and 10 (20%) children received more than 2 drugs. 1 child (2%) received a second half loading dose of phenytoin to control the seizure, and the remaining children received a first dose of Phenobarbitone, and 4 (8%) received an additional anticonvulsant to control the seizure. Gulati mostly used a combination of diazepam and Phenytoin, further 10 (20%) of children needed more than 2 anticonvulsants to control the initial seizure. The most commonly used next AED is Phenobarbitone. Sachin

Admuthe study says that 30% of children required more than 2 drugs to control the seizure activity. ²³ In current study 5 (10%) children needed Midazolam and/or Propofal infusion to control the seizure. Judith C study says that 26% of patient required infusion of AED to control the seizure; He used Midazolam and Sodium valproate infusion. Many other centers have also used Sodium Valproate infusion. ^{2-4,6,8}

In current study, there was totally of 4% mortality. In a study done by Gulati s the mortality 30%. Judith found that overall mortality is 6%. Kwong KL had a mortality of 11 %.²⁵ There is a decrease in mortality rate, done in recent studies; this may be probably because of usage of newer anticonvulsants and of mechanical ventilators. 94% of the total children were discharged without any neurological deficit.

In current study, out of 50 children 28 (56%) had epilepsy, following that febrile status was the commonest 12 (24%). SOL was 6%. Encephalitis and Meningitis each had 4%; 1 child had Vasculitis, Hypoxic encephalopathy and neem oil poisoning. Status epilepticus due to neem oil poisoning has been reported previously in Ramachandra study.^{27,28} A case report has been done in adult, post hanging status epilepticus.²⁹ Encephalitis has been treated with anti-viral drugs and anti oedema measures. Only 8% of the total population needed electrolyte correction (Bicarbonat and/or Calcium).

Lumbar puncture was done to 19 patients out of which 15 were normal; 2 patients had CSF c/s positive and 2 had HSV positive. Neuroimaging was done to 15 patients out of which 10 were normal. 3 patients had space occupying lesion; 1 patient had congenital anomaly and 1 had ischemia of cerebral arteries. EEG was done in 19 patients out of which 16 patient had seizure activity.

CONCLUSION

Status epilepticus is one of the common neurological emergency which requires admission to PICU. In our study epilepsy is one of the most common causes of status epilepticus. Early and appropriate treatment with anticonvulsants and use of mechanical ventilation may improve the outcome.

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Institutional Ethics Committee

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