Status Epilepticus Management

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DISCLOSURES

FINANCIAL DISCLOSURE
- Nothing to disclose

UNLABELED/UNAPPROVED USES DISCLOSURE
- Will be indicated where applicable

Learning Objectives

At the end of this presentation, participants should be able to improve patient outcomes by being able to:

- To describe the diagnosis and treatment of status epilepticus
- To illustrate the importance of identifying non-convulsive seizures
- To review and describe the role of continuous EEG monitoring to assess for seizures and to identify the source of encephalopathy in ICU patients
Status Epilepticus

- Classically defined as a single seizure lasting >30 min or multiple seizures without a return to baseline
- Operational definition: seizure lasting >5 minutes, based on pathology demonstrating neuronal injury
- Dx: does not require an EEG if presence of clinical correlate
- Tx: 0.1 mg/kg lorazepam over 2-3 divided doses
  - 20 mg/kg phenytoin (or fosphenytoin) at 50mg/min; second bolus of 10mg/kg
  - Levetiracetam (not FDA approved for this use)
  - Intubate
  - Start midazolam infusion
  - Other options: phenobarbital, propofol, pentobarbital, many others

OUMC Status Epilepticus Protocol
Suboptimal treatments
- Waiting too long to administer the entire 0.1 mg/kg lorazepam
  - Ask nurse to bring entire dose into room
- Switching between lorazepam, diazepam, midazolam
- Stopping phenytoin/fosphenytoin bolus due to hypotension
  - Slow down the infusion rate
- Administration of valproic acid following phenytoin/fosphenytoin
  - Will not be able to achieve therapeutic level
Status Epilepticus

Suboptimal treatments (cont)
- Giving phenobarbital to a non-intubated patient who is not on phenobarbital as an outpatient
- Can cause acute respiratory arrest
- Use of lorazepam or diazepam infusions in place of midazolam infusion
  - Can cause propylene glycol toxicity due to diluent
- Being too conservative
  - Not pushing free phenytoin level to 2.5
  - Not putting the patient on maintenance doses of the antiepileptic drug once status epilepticus is resolved
  - Not checking free phenytoin level in critically ill patient

Non-convulsive Status Epilepticus (NCSE)

Non-convulsive seizures are common
- Most seizures in the ICU cannot be detected clinically
  - Columbia database (Hirsch, LJ, NCS Board Review Course 2008)
    - 92% sz in adults in ICU have no clinical correlate
    - 75% sz in children in ICU have no clinical correlate
  - Towne, et. al Neurology 2000
    - 8% of patients in mixed med-surg ICU were noted to have non-convulsive seizures on routine 30 min EEG

Importance of Recognition & Rapid Treatment of Non-convulsive Seizures

Mortality is strongly linked to seizure duration and delay to diagnosis of NCSE (Young et al. 1996)
- 36% mortality when NCSE was diagnosed < 30 minutes of onset
- 75% mortality when diagnosed > 24 hours
- NCSE lasted <10 hours, 10% died
- NCSE lasted >20 hours, 85% died
Importance of Recognition & Rapid Treatment of Non-convulsive Seizures

- Seizures after intracranial hemorrhage (ICH) were associated with a significant increase in mass effect and shift on serial CT scans, independent of the size of the hemorrhage (Vespa et al. 2003)

Neuronal Injury

- Studies measuring neuron-specific enolase as a marker for neuronal death found the greatest elevations in critically ill pts with a history of NCSE (DeGiorgia et al. 1995)
- Seizures alone without concomitant brain injury also caused elevations in neuron-specific enolase

Patients Most at Risk for Non-convulsive Seizures

<table>
<thead>
<tr>
<th>Admission diagnosis</th>
<th>n</th>
<th>Any seizure</th>
<th>WNL</th>
<th>NCSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eclampsia-related seizures</td>
<td>51</td>
<td>17 (33)</td>
<td>16 (31)</td>
<td>18 (35)</td>
</tr>
<tr>
<td>CNS disease</td>
<td>26</td>
<td>10 (38)</td>
<td>9 (35)</td>
<td>6 (23)</td>
</tr>
<tr>
<td>Bone tumor</td>
<td>14</td>
<td>12 (85)</td>
<td>11 (79)</td>
<td>3 (18)</td>
</tr>
<tr>
<td>Post-neurosurgery trauma</td>
<td>13</td>
<td>3 (23)</td>
<td>3 (23)</td>
<td>1 (8)</td>
</tr>
<tr>
<td>Hypoxia/ ischemia encephalopathy</td>
<td>28</td>
<td>5 (19)</td>
<td>4 (14)</td>
<td>4 (14)</td>
</tr>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>20</td>
<td>18 (90)</td>
<td>19 (95)</td>
<td>14 (70)</td>
</tr>
<tr>
<td>Traumatic brain injury</td>
<td>51</td>
<td>8 (15)</td>
<td>9 (18)</td>
<td>4 (8)</td>
</tr>
<tr>
<td>Traumatic encephalopathy</td>
<td>58</td>
<td>3 (5)</td>
<td>4 (7)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Unexplained decrease in GCS*</td>
<td>59</td>
<td>15 (25)</td>
<td>16 (27)</td>
<td>5 (8)</td>
</tr>
<tr>
<td>Intracranial hemorrhage</td>
<td>46</td>
<td>4 (9)</td>
<td>6 (13)</td>
<td>8 (17)</td>
</tr>
<tr>
<td>Subdural hematoma</td>
<td>66</td>
<td>4 (6)</td>
<td>7 (11)</td>
<td>4 (7)</td>
</tr>
<tr>
<td>Overall</td>
<td>220</td>
<td>21 (95)</td>
<td>20 (91)</td>
<td>18 (82)</td>
</tr>
</tbody>
</table>

Data are given as n (% of patients with the admission diagnosis).

* Although EEG monitoring was initiated for the detection of unexplained seizures or unexplained decrease in level of consciousness in all ICU patients, unexplained decrease in level of consciousness was the primary admission diagnosis in these 59 patients.

**EEG = electroencephalogram; GCS = Glasgow coma score; WNL = within normal limits; NCSE = nonconvulsive status epilepticus; LOC = level of consciousness.
cEEG Monitoring in the ICU

- Unless pt. is back to baseline, must order continuous EEG (cEEG) on all pts. after resolution of status epilepticus as 20-48% will continue to have electrographic status epilepticus despite absence of clinical activity (NCSE) (DeLorenzo, et al Epilepsy 1998, Dennis, et al Neurosurgery 2002)

- Limited utility of routine EEG in ICU, as less than 20% of seizures are captured in first 20 minutes of cEEG studies (Claassen, et al. Neurology 2004)

- Recommend 24 hours of monitoring in encephalopathic patients and 48 hours of monitoring in persistently comatose patients

Duration of Monitoring with cEEG

![Chart showing the duration of cEEG monitoring.

- Recommendation: 24 hours of monitoring in encephalopathic patients and 48 hours of monitoring in persistently comatose patients.

Routine EEG vs. cEEG

- Pandian et al. 2004 retrospectively evaluated 105 pts in the NICU with routine EEG at the start of all of their prolonged video cEEG studies.

<table>
<thead>
<tr>
<th>EEG Method</th>
<th>No. of Patients</th>
<th>Seizures Detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine EEG</td>
<td>42 (99.5%)</td>
<td>80.0%</td>
</tr>
<tr>
<td>Video cEEG</td>
<td>52 (99.6%)</td>
<td>89.2%</td>
</tr>
<tr>
<td>Combined</td>
<td>25 (99.6%)</td>
<td>97.2%</td>
</tr>
</tbody>
</table>

*Data from Pandian et al. 2004*
Routine EEG vs. cEEG (cont.)

- Hirsch and Krull 2004 used cEEG in pts with refractory SE being treated with a pentobarbital–induced coma over several weeks
  - Electrographic seizures arose out of a burst-suppression pattern and even a completely suppressed background

Summary

- Be aggressive in treating patients with status epilepticus (kindling theory)
- Monitor patients with continuous EEG when status epilepticus has resolved and the patient remains encephalopathic
- Consider continuous EEG when the etiology of the encephalopathy is unclear or when the encephalopathy is out of proportion to the medical conditions

Thank you!