Hypoxic Ischemic Encephalopathy (HIE) in a developing country and the evolution of monitoring with cerebral oximetry ($rSO_2$).

Regional oxygen saturation monitoring during a neonatal seizure due to HIE

Case Overview

A term (39 weeks) infant was admitted to the neonatal unit with an assessment of moderate HIE; this was based on birth history (sentinel event), lab investigation and clinical parameters. The infant met the criteria for cooling and was initiated on induced hypothermia. As part of the monitoring during cooling an amplitude-integrated EEG (aEEG) was put on the infant along with a Sensmart X-100 tissue oximetry monitor which at present is not part of standard of care. During admission the patient developed seizures, had a prolonged hospital stay and was discharged home after 16 days. The monitoring of this infant revealed some interesting correlation between clinically observed seizures, seizure activity on aEEG (Fig 1) and a drop in cerebral $rSO_2$. (Fig 2)

Clinical assessment

A term infant born via normal vaginal delivery after a prolonged second stage of labor was noted to have fetal distress and meconium stained liquor. The mother was well during her antenatal care with no other co-morbidities. After delivery the infant required resuscitation with T-piece resuscitator and chest compressions. The Apgar scores were documented as one at one minute, three at five minutes and four at ten minutes.

Post resuscitation the infant was assessed for induced hypothermia using the modified TOBY criterion (1). A blood gas was done which showed a pH = 6.84, pCO$_2$ = 22.9 mmHg, pO$_2$ = 89.8 mmHg, Base deficit = 33.1 and HCO$_3$ = 5.5. The patient’s neurological status was assessed using a Thompson score with a total of 11 - Moderate encephalopathy (according to the Sarnat and Sarnat classification). Induced hypothermia was initiated after two hours post-delivery.

aEEG and NIRS findings

During admission the patient’s aEEG (Brainz aEEG Monitor, Natus) and $rSO_2$ (SenSmart Model X-100, Nonin Medical Inc.) were monitored. The electrical activity on the aEEG showed a discontinuous electrical pattern with burst suppression (Fig 1). The $rSO_2$ baseline reading on the right and left fronto-temporal region measured 78% and 85% respectfully.

Outcome

The infant developed seizures during the hospital stay, requiring phenobarbital. The patient was discharged home with follow up arranged as an outpatient.

Operative Monitoring

We monitored the patient during induced hypothermia with the SenSmart Model X-100 tissue oximetry device, an aEEG, pulse oximetry and cardiorespiratory monitoring. The use of tissue oximetry in the monitoring of HIE was compelling and may possibly be used in predicting neurological outcome. Another interesting point was the correlation between the drop in cerebral $rSO_2$ during seizures with that of clinical seizures and abnormal tracing on the aEEG.

Fig1: Amplitude integrated EEG (aEEG) recordings (a): Patient’s aEEG activity showing discontinuous background pattern low margin ≤ 5 µV and upper margin ≥ 10 µV with burst suppression and loss of sleep wake cycle. (b): aEEG during a clinical seizure.
Hypoxic Ischemic Encephalopathy (HIE) in a developing country and the evolution of monitoring with cerebral oximetry (rSO$_2$).

Regional oxygen saturation monitoring during a neonatal seizure due to HIE of neurodevelopmental outcome in asphyxiated infants. In our case the high rSO$_2$ baseline could correlate with adverse neurodevelopmental outcome. The combination of aEEG and tissue oximetry (NIRS) can be used to assess the hemodynamic changes during seizures (3). Larger studies still need to be conducted with regards to the use of rSO$_2$ monitoring in neonates with HIE. In our setting, the potential which is yet to be explored is whether this combination can be used to predict or identify seizures more accurately, and better predict neurodevelopmental outcomes.

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What the Nonin SenSmart System Showed

Fig 2 and Table 1 show the drop in the rSO$_2$ during the seizure. There was an approximate drop of 52% and 45% in the right and left frontotemporal regions respectfully from the baseline prior to the onset of the seizure.

Discussion

In this case we used cerebral tissue oximetry as an added modality in the monitoring of an infant with HIE. In a paper by Gina Ancora et al (2) it was shown that this modality could be used as a predictor of neurodevelopmental outcome in asphyxiated infants. In our case the high rSO$_2$ baseline could correlate with adverse neurodevelopmental outcome. The combination of aEEG and tissue oximetry (NIRS) can be used to assess the hemodynamic changes during seizures (3). Larger studies still need to be conducted with regards to the use of rSO$_2$ monitoring in neonates with HIE. In our setting, the potential which is yet to be explored is whether this combination can be used to predict or identify seizures more accurately, and better predict neurodevelopmental outcomes.

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Table 1: rSO$_2$ measurements during a clinical seizure.

<table>
<thead>
<tr>
<th></th>
<th>Right fronto-temporal region</th>
<th>Left fronto-temporal region</th>
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<tbody>
<tr>
<td>Baseline (rSO$_2$ at the time of seizure)</td>
<td>87%</td>
<td>84%</td>
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<tr>
<td>Seizure activity</td>
<td>&lt;35%</td>
<td>&lt;39%</td>
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<tr>
<td>Drop from baseline</td>
<td>−52%</td>
<td>−45%</td>
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References