

Advances in perinatal care over the last few decades have resulted in dramatic increases in survival rates for newborn infants, particularly those born prematurely or with some degree of encephalopathy. For these infants, neurological status is a major concern to both parents and clinicians, and the improvement of long-term neurological outcomes has become one of the major goals of modern neonatology. These concerns have created the need for tools to detect and quantify brain injury, as a means of assisting in clinical decision making as well as predicting long-term outcome.

Introducing the BRM Brain Monitor

Close surveillance of brain function at the bedside is achievable with the BRM Brain Monitor. It is designed for continuous use in the NICU environment, allowing clinicians to monitor and record real-time neurological information 24 hours per day. The BRM Brain Monitor can help clinicians detect changes and abnormalities in cerebral function, guide medical management and identify infants in need of further neurological investigations and clinical intervention.

The BRM Brain Monitor displays bilateral amplitude-integrated EEG (aEEG) with simultaneous real time raw EEG. This combination of data allows for easy recognition of overall brain activity, identification of artifacts, and gives clinicians the ability to confirm seizure activity from each cerebral hemisphere. When used in conjunction with other clinical data, and in combination with traditional neurological assessment, the BRM Brain Monitor is a unique and powerful tool to aid in the assessment and management of infants at risk of brain injury in the NICU.

Amplitude-integrated EEG provides a time-compressed trend of the minimum and maximum levels (amplitude) of the brain's electrical activity. Abnormal aEEG traces can be used to identify patients who require further neurological workup, and normal traces may be used to reassure families of the likelihood of good long-term neurological outcome for their infant.

Background pattern recognition and prediction of neurological outcome

Studies using traditional multi-channel EEG have shown that marked changes in the level and frequency of EEG activity after ischemic injury can be predictive of the extent of neurological deficit. The pathophysiologic EEG changes associated with brain injury evolve through latent and delayed phases that occur over a period of several days. Therefore, prolonged monitoring during the first week of life can be extremely valuable.

Since aEEG is derived from the raw or unprocessed EEG, similar changes in aEEG have also been shown to correlate to the infant's neurological state and prognosis. Normalization of aEEG recordings has been associated with more favorable outcomes than those with persistently abnormal recordings. The longer the period of monitoring, the more accurately the severity of brain injury can be assessed with aEEG bedside monitors.

In the past studies have primarily focused on the predictive value of aEEG in term infants with hypoxic ischemic encephalopathy. However, more recently researchers have demonstrated a wider application in the encephalopathic infant, regardless of etiology (e.g. meningitis).

Although neonatal MRI studies are the optimal neurodiagnostic examination to determine the extent of cerebral injury, the difficulties in accessing the MRI suite are numerous and often insurmountable for NICU staff. In a recent study, it was demonstrated that a relationship existed between aEEG lower amplitudes and severity of cerebral injury on MRI imaging. Findings like these give NICU clinicians even greater confidence in the predictive value of aEEG in the neonatal population.

Clinical Application

Neonatal seizures are one of the main signs of cerebral dysfunction. Unfortunately diagnosis is challenging due to their subtle presentation. Video-EEG studies have documented that more than 50% of neonatal seizures are subclinical in nature. The BRM simultaneously displays both the raw EEG and corresponding aEEG traces. The availability of both recordings on the BRM allows for confirmation of clinical seizures and identification of subclinical seizure-like events in real time. The ability to review the raw EEG trace is essential for accurate event validation. The timely recognition of untreated seizures can aid in more effective antiepileptic management.

The BRM Brain Monitor also assists clinicians with identifying those patients who are most likely to benefit from new neuroprotective therapies, such as hypothermia. Hypothermia may improve outcomes in infants with hypoxic ischaemic insults either at the time of birth or in the early neonatal period. Of historical interest to note is the link between the BRM and selective head cooling investigations; both were initially developed together at the Liggins Institute in New Zealand.

The presence of sleep states has long been recognized as a marker of neurological maturation and well-being. Studies have demonstrated cyclic changes in aEEG coincide with observable changes in neonatal sleep states. The availability of aEEG at the bedside in the NICU will allow clinicians to gain further insight into the impact of the NICU environment, and of protective, developmental interventions on the developing brain and on the emergence of sleep patterns.

Neonates receiving extracorporeal membrane oxygenation (ECMO) are also at risk for hypoxic ischemic insults. The aEEG has now been shown to be useful in detecting acute neurological complications during ECMO as well as assessing the background electrical activity of the brain.

Therefore....see inside...

The BRM is not only a practical tool to be used in association with clinical assessment and neurodiagnostic assessments. It also provides clinicians with the unique opportunity to gain further insights into the impact of neurointensive interventions on neonatal brain function, and optimize care to ensure the best outcome for their patients.

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