BIBLIOGRAPHY


SSG.

Cerebral Function Monitor

Overview

The Cerebral Function Monitor (CFM), or amplitude-integrated EEG (aEEG), is a device for monitoring background neurological activity. It uses a single, bipolar or frontal lead (three electrodes) to obtain an EEG signal. This signal is filtered, rectified, and semi-logarithmically compressed. The output is displayed at a very slow chart speed, 1 mm per minute, giving a trace as seen in the accompanying examples. As a result of this processing, the output is no longer a regular EEG signal but is, rather, a representation of the overall electrocortical background activity of the brain. A high reading indicates a high level of activity. A low value indicates low activity.

Applications

The CFM was first developed in the late 1960s for use in monitoring adults undergoing surgery, suffering from head trauma, or in a coma. In the mid 1980s researchers in Sweden and the Netherlands began investigating its use in neonates. Since that time a number of studies have been conducted in Europe and the United States investigating its use in premature infants and other intensive care applications.

Because of its simplicity and ease of training there is increasing use of the CFM in the NICU. The CFM allows clinical personnel without in-depth knowledge of EEG to quickly determine global neurological status and monitor this status long-term. This is similar to the use of pulse oximetry and EKG to evaluate oxygenation and cardiac status.

New Digital CFM

The Olympic CFM 6000 digitally records the CFM signal and has the ability to simultaneously display the raw EEG for any portion of the CFM trace to aid in positive identification of seizure activity.

Analysis

A clinician can quickly learn to read CFM tracings. Initially it is easy to use the systematized approach introduced by Naquieb et al., from the Imperial College of London. It is based on noting the upper and lower margins and mean of the main band of activity of the CFM trace. Using these measurements a clinician can predict the severity of outcome for infants at risk for HIE as well as learn to detect seizures. With more practice and experience, the clinician will begin to recognize various patterns as shown in the Atlas of Amplitude-Integrated EEG in the Newborn, by Hellström-Westas, de Vries, and Rosen, from the Netherlands.

Abbreviations

aEEG, amplitude-integrated electroencephalography

CFM, cerebral function monitor

EKG, electrocardiogram

HIE, hypoxic-ischemic encephalopathy

NICU, neonatal intensive care unit

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Examples

The following traces show examples of traces that might be obtained from normal infants and those who have suffered varying degrees of neurologic insult. With a basic understanding of the nature of the traces presented here, a clinician can immediately begin to use the CFM to evaluate infants. The traces are provided courtesy of Dr. Denis Azzopardi, Imperial College London, School of Science, Technology, and Medicine, United Kingdom. For more examples and a self-training exercise, contact Olympic Medical and request a copy of the Olympic CFM 6000 Clinical Guide.

Normal Trace
Note the variation in the amplitude indicating sleep-wake cycling. The upper margin of the band of activity is above 10 microvolts (µV). The lower margin is above 5 µV.

Moderately Abnormal
In an infant with mild to moderate asphyxia, the trace flattens with the loss of sleep-wake cycling. The upper margin may be unchanged, increase due to irritability, or decrease due to the severity of the injury. In any case it will remain above 10 µV. The lower margin drops below 5 µV.

Severely Abnormal
This trace is from an infant that suffered a severe asphyxial insult. Note the very narrow, suppressed band of activity with spikes indicating burst suppression.

Examples, continued

Severely Suppressed with Seizures
This is an example of a severely asphyxiated infant with suppressed background and frequent seizures.

Figure 4. Severely Suppressed with Seizures

Severely Suppressed with Seizures and Administration of Phenobarbital
The trace shows a severely suppressed background with frequent seizures. Phenobarbital was administered at the point indicated. Approximately 45 minutes later, the seizures stopped. Note that the suppressed trace following the end of the seizures represents the underlying condition of the brain and is not just a result of the drug. Within about 1 hour, the upper margin of the trace begins to increase and short seizures are seen.

Figure 5. Severely Suppressed with Seizures and Administration of Phenobarbital

Status Epilepticus
This is an example of the sawtooth pattern seen in status epilepticus. It is produced as the brain rapidly moves in and out of seizure.

Figure 6. Status Epilepticus