

## **Hypoxic Ischaemic Encephalopathy**

### **Description**

Hypoxic Ischaemic Encephalopathy (HIE) is one of the leading causes of morbidity and mortality among neonates in the world. Neonatal HIE, in a clinical context, is a significant pre-cursor to neurodevelopmental disorders and disability. Major disorders include cerebral palsy, epilepsy and developmental delay.

HIE can lead to two major neurological events:

- Primary neuronal damage: Inhibition of energy-producing molecular processes due to an asphyxia related event, leading to compromised cellular integrity.
- Secondary neuronal damage: an inflammatory response and cell necrosis or apoptosis 72 hours or more after the insult

Hypoxia - the deprivation of oxygen from the brain - can be caused by infant asphyxiation via the umbilical cord and other conditions during pregnancy, such as an event of maternal hypovolemic shock or cord prolapse. Hypoxia at birth leads acutely to loss of cell function, cell damage and even cell death: a direct cause of HIE. The presence of cell death, or necrosis of brain tissue, is evident mainly in areas of high metabolic activity, namely, the basal ganglia and the cerebral cortex. The presence of the brain injury due to hypoxia, causes cerebral blood pressure and blood flow to fall below critical levels, diminishing the supply of oxygen to the brain causing ischaemic effects such as blood acidosis.

HIE occurs in 1-6 per 1000 live term births in developed countries. Most infant death occurs within the first week of life, with some infants with severe neurologic disabilities dying in their infancy from aspiration pneumonia or systemic infections.

### **Treatments**

Current clinical management of this condition after initial resuscitation ranges from treatments such as fluid management to avoid hypo/hyperglycaemic effects on the brain, adequate ventilation and perfusion, treatment of seizures via drug therapy, and rapidly cooling infants to induce hypothermia. The regime for clinical management for treatment of HIE aims to stabilise the condition to firstly achieve a homeostatic balance by slowing down chemical processes in the body, and the generation of toxic substances. Moreover, it aims to identify the extent of the injury to the brain, establish longer term benefits by providing therapy and ultimately reducing the risk of further brain damage.

However, these treatments can be hit and miss, as the severity of the condition can be unknown at the diagnostic level, making the clinical assessment of such an injury considerably difficult. Current measures of assessment have thus far proved to be inaccurate and less effective in classifying the severity of the disease. HIE is also time limited, with chances of recovery or developing permanent brain damage dependent on treatment measures within the first 24 hours of life.

To supplement current treatment measures, the electroencephalogram (EEG), which is a commonly used measure of the brain's electrical activity at the scalp via the attachment of electrodes, is an established clinical tool used to monitor progress following post-birth hypoxia. The use of EEG has improved diagnosis of HIE and the ability to choose which infants require accelerated treatment, although clear diagnostic features remain to be found. The benefits of an EEG measurement allows for a rapid capture of the electrical activity around the brain's major functional areas, such as the cerebral cortex, visual centres and temporal (cognitive) processing areas.

### **Prognosis**

HIE outcome depends on the severity of the acute encephalopathy, where patient response to clinical management largely determines the overall risk of death and severe handicap. Measurement of EEG offers information on markers of abnormality when detected in the first few days of life. After initial HIE diagnosis, EEG can provide important prognostic information, even in babies treated with hypothermia. The presence of seizures, a direct pre-cursor of epilepsy, is an ominous sign where the risk of poor neurological outcome is distinctly greater in such infants, particularly if seizures occur frequently and are difficult to control. Current medical research is providing valuable information in improving the prediction of clinical outcome of HIE and strongly influencing clinical management of asphyxiated infants.