

# PREDICTIVE VALUE OF MULTIMODALITY EVOKED POTENTIALS IN TERM ASPHYXIATED NEWBORNS

**Thesis**

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## *Abstract*

Hypoxic-ischemic events may cause permanent brain damage, and it is difficult to predict the long-term neurological outcome of survivors. Multimodality evoked potentials using flash visual, somatosensory, and brainstem auditory evoked potentials may assess the cerebral function in term neonates.

The aim of the present study is to determine the predictive value of multimodality evoked potentials in term asphyxiated infants with respect to the neurodevelopmental outcome.

The study was conducted on 30 asphyxiated infants and 15 normal controls in order to predict the neurological outcome.

There was a statistically highly significant association between the VEP and neurodevelopmental outcome on one hand ( $p=0.000$ ) and SSEP results and neurodevelopmental outcome on the other hand ( $p=0.000$ ). However, the BAEP results revealed no statistical significance with the neurodevelopmental outcome ( $p>0.05$ ).

Sensitivity of SSEP and VEP was 96.4% and 90.5% respectively. Specificity of SSEP and VEP was 79.8% and 70% respectively.

This study confirmed that both flash visual evoked potentials and somatosensory evoked potentials are more accurate as prognostic indicators for term neonates.

***Key words :*** Neonatal - Asphyxia -Multimodality Evoked – Potentials.

## *List of Abbreviations*

<b>ABR</b>	Auditory Brainstem Response
<b>BAEPs</b>	Brainstem Auditory Evoked Potentials
<b>BAER</b>	Brainstem Auditory Evoked Response
<b>CA</b>	Conceptional Age
<b>CFM</b>	Cerebral Function Monitor
<b>CNS</b>	Central Nervous System
<b>CP</b>	Cerebral Palsy
<b>CS</b>	Caesarean Section
<b>CT</b>	Computerized Tomography
<b>CTG</b>	Cardiotocogram
<b>DD</b>	Developmental Delay
<b>DIC</b>	Disseminated Intravascular Coagulation
<b>EEG</b>	Electroencephalography
<b>Epi</b>	Epilepsy
<b>FHR</b>	Fetal Heart Rate
<b>Foc</b>	Focal
<b>fVEP</b>	Flash Visual Evoked Potential
<b>GA</b>	Gestational Age
<b>GABA</b>	Gamma Amino Butyric Acid
<b>HI</b>	Hypoxic-Ischemic
<b>HIE</b>	Hypoxic-Ischemic Encephalopathy
<b>HII</b>	Hypoxic-Ischemic Insult
<b>Hypot</b>	Hypotonia
<b>ICH</b>	Intracranial Haemorrhage

<b>IVH</b>	Intraventricular Haemorrhage
<b>Jit</b>	Jitteriness
<b>LED</b>	Light Emitting Diode
<b>Msec</b>	milliseconds
<b>MLS BAER</b>	Maximum Length Sequence BAER
<b>MRI</b>	Magnetic Resonance Imaging
<b>MRS</b>	Magnetic Resonance Spectroscopy
<b>NAA</b>	N-acetylaspartate
<b>NIRS</b>	Near Infrared Spectroscopy
<b>NO</b>	Nitric oxide
<b>PET</b>	Positron Emission Tomography
<b>PROM</b>	Premature Rupture of Membranes
<b>PVL</b>	Periventricular Leucomalacia
<b>RI</b>	Resistance Index
<b>SD</b>	Standard Deviation
<b>SEPs</b>	Somatosensory Evoked Potentials
<b>SIADH</b>	Syndrome of Inappropriate Antidiuretic Hormone Secretion
<b>SPECT</b>	Single Photon Emission Computed Tomography
<b>SSEPs</b>	Short-latency Somatosensory Evoked Potentials
<b>Sub</b>	Subtle
<b>Ton</b>	Tonic
<b>μvol</b>	microvolt
<b>VEP</b>	Visual Evoked Potential
<b>VI</b>	Visual Impairment

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## *Introduction*

Birth asphyxia is a prenatal event, in serious cases leading to a dismal outcome with risk of death or permanent sequels (*Milsom et. al., 2002*).

Perinatal asphyxia is an insult to the fetus or newborn due to lack of oxygen (hypoxia) and/or lack of perfusion to various organs. It is associated with tissue lactic acidosis. It is accompanied by hypoventilation and maybe associated with hypercapnia (*Evans and Levene, 1999 and Auorora and Snyder, 2004*).

Perinatal asphyxia is also defined as it is the state in which placental or pulmonary gas exchange is compromised or cases altogether, typically producing a combination of progressive hypoxaemia and hypercapnia (*Vannucci and Palmer, 1997*). If the hypoxaemia is severe enough initially peripheral tissues (muscle and heart) and ultimately brain tissue will develop an oxygen debt, leading to anaerobic glycolysis and the production of lactic acidosis. The lactic acid diffuses into the blood stream causing metabolic acidosis. Ischemia in the newborn typically arises from antecedent systemic hypoxia-acidosis, with its depressant effect on cardio-vascular function, or from occlusive vascular function or from occlusive vascular disease (*Volpe, 2001*).

The insult causing asphyxia may be primarily antepartum 51% of cases, intrapartum in 40% and postpartum in 9% (*Mbweza, 2000*).

The clinical neurological sequelae in the immediate neonatal period following perinatal asphyxia are referred to as hypoxic-ischaemic encephalopathy (HIE). HIE was originally described by *Amiel-Tison* in **1969** and there have been numerous studies since then.

Hypoxic-ischemic (HI) events may cause permanent brain damage, and it is difficult to predict the long-term neurological outcome of survivors (*Scalais et. al., 1998*).

Several methods have been used for the early prediction of neurological outcome after perinatal asphyxia. These methods include estimation of hypoxic-ischemic encephalopathy based on clinical assessment and imaging techniques (*Levene et. al., 1985*).

Neuroimaging techniques such as computed tomography, ultrasonography, and magnetic resonance imaging provide information about the morphology of the nervous system without assessing its function (*Scalais et. al., 1998*).

This can be done by electrophysiological techniques including flash visual evoked potentials (fVEP) and somatosensory evoked potentials (SEP) (*Scalais et. al., 1998*).

They are an easy, noninvasive and early aid in the assessment of systemic or neurological diseases involving somesthetic, visual and auditory pathways without demanding cooperation from the infants. In addition, they could be easily performed during spontaneous sleep following feeding, not requiring any sedation (*Mercuri et. al., 1994; Majnemer et. al., 1999*).

Flash visual evoked potentials reflect the hemispheric structures, somatosensory evoked potentials reflect different levels of neuraxis and brainstem auditory evoked potentials (BAEPs) reflect the cochlea and the brainstem auditory pathways. The use of one modality gives only a focal cerebral assessment, because it only looks at the visual, sensory or

auditory pathway; while multimodality evoked potentials gives a more global assessment (*Scalais et. al., 1998*).

Multimodality evoked potentials have been employed not only to assess the sensory pathways but also as a marker of global neurological status and these in formulating prognosis of global neurological outcome. In full-term newborns very good results have been achieved employing longitudinal assessment of fVEP and SEP . Normal neonatal SEPs are consistently related with normal neurodevelopmental outcome, wherever abnormal fVEPs are prognostic indicators of abnormal outcome. Repeated measurements of both increases the accuracy of the prognosis (*Mercuri et. al., 1994*).

A review of the literature revealed that brainstem conduction abnormalities in auditory brainstem evoked potentials are associated with neuromotor impairment. Visual evoked potentials are highly accurate in predicting neurologic deficit in early childhood in asphyxiated term neonates. Sensitivity and specificity are consistently high for somatosensory evoked potentials in term newborns (*Anand et. al., 1991; Majnemer and Rosenblatt, 1996; and Jiang et. al., 2000*).

## *Aim of the Work*

This study aims precisely at analyzing and determining the predictive value of multimodality evoked potentials with respect to the studied neurological and developmental outcome in asphyxiated neonates at 3 months of age.