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

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

IVH	Intraventricular Haemorrhage
Jit	Jitterness
LED	Light Emitting Diode
Msec	milliseconds
MLS BAER	Maximum Length Sequence BAER
MRI	Magnetic Resonance Imaging
MRS	Magnetic Resonance Spectroscopy
NAA	N-acetylaspartate
NIRS	Near Infrared Spectroscopy
NO	Nitric oxide
PET	Positron Emission Tomography
PROM	Premature Rupture of Membranes
PVL	Periventricular Leucomalacia
RI	Resistance Index
SD	Standard Deviation
SEPs	Somatosensory Evoked Potentials
SIADH	Syndrome of Inappropriate Antidiuretic Hormone Secretion
SPECT	Single Photon Emission Computed Tomography
SSEPs	Short-latency Somatosensory Evoked Potentials
Sub	Subtle
Ton	Tonic
µvol	microvolt
VEP	Visual Evoked Potential
VI	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 lactacidosis. The lactic acid diffuses into the blood stream causing metabolic acidaemia. 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.