Multimodality evoked responses in the neurological assessment of the newborn

Abstract In recent years increased attention has been devoted to evoked potentials (EP) in newborns. This paper reviews the literature and data from our research group in an attempt to assess the diagnostic and prognostic value of evoked responses in the first weeks of life and their use in different age-specific clinical conditions. The results show that EP are a very sensitive measure of the integrity of the sensory pathways. They make it possible to follow normal physiological maturation and the abnormalities of development resulting from neurological lesions. Repeated measurements of visual evoked potentials and somatosensory evoked potential are prognostically useful in term infants, but seem much more limited in preterm newborns in predicting neurodevelopmental outcome.

Key words Evoked potentials Newborn infants · Longitudinal studies

Abbreviations ABR auditory brainstem response · CH congenital hypothyroidism · EP evoked potentials · GA gestational age LED light emitting diode · SEP somatosensory evoked potential TH thyroid hormone · VEP visual evoked potential

Introduction

Evoked potentials (EP) have been widely used in childhood and their usefulness in monitoring central and peripheral neurological development is well known. They are an easy, non invasive and early aid in the assessment of systemic or neurological diseases involving somesthetic, visual and auditory pathways. In this paper their use in neonatology will be discussed, with special reference to normative data and to a series of age-specific abnormal conditions.

The following issues are addressed:

anatomical and electrophysiological maturation clinical indications in neonatology age-related methodological problems.

We aim to provide a critical analysis of the value and the limitation of evoked responses in the study of the maturation of the nervous pathways and in the clinical assessment of neurological abnormalities in the newborn.

Anatomical and electrophysiological maturation

EP, recorded from the body’s surface are the result of central and peripheral neural sources and of the integrity of all the structures composing the different pathways.

Their maturation reflects the development of the neural generators. Changes in preterm infants are due to myelination and to the development of synapses and their neurotransmitters. Myelination in the CNS occurs mostly after 40 weeks gestational age (GA) and is responsible for some of the changes of the EP during the first 2 years of life (Fig. 1).
Maturation of the sensory pathways in pre and postnatal life

Auditory brainstem response (ABR)

The earliest sensory pathway to mature is the auditory system. After the 25th week of gestation, it becomes possible, when using high intensity auditory stimuli (> 70 db), to recognize the presence of waves I, III and V [18, 22]. ABRs are usually recorded from a vertex electrode referenced to the mastoid ipsilateral to the stimulation. Weekly measurements in these preterm infants show progressive reduction of the peak latencies, the appearance of waves II and IV and maturation of the morphology. The maximal change is between 29 and 36 weeks GA. After 40 weeks the morphology of the responses is already similar to that of adults, but the peak latencies are longer. They will show a progressive decrease, mostly in the first 2 years of life.

In full-term newborns the ABR consists of the typical seven peak pattern. Each peak represents the action potential of one or more generators. From animal experiments and from pathological findings in adults [43, 63], peak I is thought to be generated in the acoustic nerve and

Somatosensory evoked potential (SEP)

Data are usually obtained from stimulation of the median nerve. Recording electrodes are usually placed on C3’ and C4’ (2 cm posterior to C3 and C4 in the 10–20 system), over the controlateral somatosensory area for the upper limbs. The reference electrode is placed in a midline frontal position and the neutral one on the forearm. A very slow negative wave, preceded by a small positive peak, is seen in preterm infants before 30 weeks of GA [39]. The latency...