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REVIEW/MISE AU POINT

The electroencephalogram of the full-term newborn: Review of normal features and hypoxic-ischemic encephalopathy patterns

Électroencéphalogramme du nouveau-né à terme : aspects normaux et anomalies observées dans l'encéphalopathie hypoxo-ischémique

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Full-term newborn;
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Summary
Objective. — The objective of this study is to specify, by reference to the normal newborn, the current contribution of the electroencephalogram (EEG) to the diagnosis and prognosis of hypoxic-ischemic encephalopathy (HIE) in the full-term newborn. Both digitized traditional EEG and cerebral function monitoring will be considered.
Discussion. — A good knowledge of the EEG features of the sleep-wake cycle (SWC) is a prerequisite. We first describe the main features of normal and pathological EEGs. Very early recordings (before 6 hours of life) are needed to indicate any required neuroprotective (hypothermia) and other (sedation, anticonvulsivants) treatments.
Conclusions. — Between the normal or near-normal tracings, which are associated with a good prognosis, and the very pathological ones (inactive, paroxysmal), which are associated with a poor vital or neurological prognosis, the interpretation of ''intermediate'' tracings — mainly represented by other types of discontinuous tracings — must take into account characteristics such as bursts and discontinuities, postnatal age, evolution of successive tracings, and treatments.

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MOTS CLÉS
Nouveau-né à terme ;
Normes ;
Monitoring ;
EEG ;
AEEG ;
Épilepsie ;
Encéphalopathie hypoxo-ischémique ;
Pronostic

Résumé
But de l'étude. — L'objectif de ce travail est de préciser, en se référant au nouveau-né bien portant, les apports actuels de l'électroencéphalogramme (EEG) chez le nouveau-né à terme souffrant d'encéphalopathie hypoxo-ischémique. Les aspects normaux et pathologiques sont décrits lors de l'utilisation de la technique traditionnelle enrichie de la numérisation, ainsi que pour les techniques de monitorage.
Discussion. — Une bonne connaissance de l'organisation des cycles veille-sommeil, en relation avec l'EEG, est indispensable. Des enregistrements très précoces (avant six heures de vie) sont indispensables afin de poser les indications de traitements neuroprotecteurs (hypothermie) ou pharmacologiques (sédation, antiépileptiques).
Conclusions. — Entre les tracés normaux ou proches de la normale, associés à un bon pronostic, et les tracés très pathologiques (inactifs, paroxystiques), associés à un mauvais pronostic vital ou fonctionnel, des tracés « intermédiaires » — représentés surtout par d'autres types de tracés discontinus — doivent être interprétés en tenant compte des caractéristiques des bouffées et des discontinuités, de l'âge postnatal de l'enfant, de l'évolution des tracés successifs et des thérapeutiques.

Introduction

The electroencephalogram (EEG) remains a valuable tool for the management of full-term neonates having suffered foetal asphyxia.

Colette Dreyfus-Brisac and Nicole Monod identified the main characteristics of EEG in full-term newborns from observations made over 24 years in infants born in Baudelocque, Port-Royal and Saint-Antoine hospitals in Paris [21,54,56]. Descriptions of EEG in children with birth asphyxia were rapidly added to those of healthy children [22,55].

These observations are still valid today. However, the knowledge and the techniques have been enriched over time, with in particular, the development of integrated amplitude EEG (aEEG).

The description of EEG abnormalities cannot be dissociated from their relations with the neurodevelopmental outcome. The studies are heterogeneous, but all aim to define criteria for distinguishing, as early as possible, children who have a ''good prognosis'' — i.e. who will lead a life without disability — from children who will die or suffer from sequelae of variable severity.

This review presents the EEG patterns of healthy and full-term newborns with hypoxic-ischemic encephalopathy (HIE).

Semeiology of EEG

In clinical practice, the EEG analysis is visual; it is a step-by-step assessment, as a function of the newborn's behaviour, defined by polysomnographic criteria [16], increasingly complemented by video recording.

The first step consists of an overall assessment of both changes in EEG activity over the recording duration and anterior-posterior differentiation.

In a second step, the rhythms and patterns are analysed on the different parts of the scalp, in each state of vigilance, as well as their reactivity to stimuli, particularly auditory.

Sleep-wake cycles: polysomnographic criteria

Up to 8 weeks post-term, sleep represents 90—92% and wakefulness (W) 10% of the nycthemeron. Three main states of sleep follow one another during the nycthemeron: active sleep (AS), quiet sleep (QS) and transitional sleep (TS).

Wakefulness

In this state, breathing and heart rate are nearly always rapid and irregular. Two types of wakefulness exist: agitated and calm. In calm wakefulness, the child's eyes are open with exploratory movements; however, it is almost never observed in a 60 minutes recording.

Active sleep represents 50 to 60% of the nycthemeron

It is characterized by very frequent and stereotyped body movements, occurring every 3 to 5 minutes and lasting from a few seconds to over a minute. These include facial expressions, fine finger movements and segmental limb movements.

There is no chin electromyographic (EMG) activity.

Rapid eye movements are very common. Respiratory rate (30 to 60/min) and heart rate (120 to 150/min) are both irregular and fast. Brief respiratory pauses are possible; they last less than 12 seconds.

As their EEG aspects are not identical, one can distinguish two types of active sleep (AS).

Active sleep 1 (AS 1) follows wakefulness and precedes quiet sleep; active sleep 2 (AS 2) follows quiet sleep.

Quiet sleep represents 40% of the nycthemeron

There is no body activity except short jerks. The face is inexpressive except for periodic, regular, ''non-nutritive'' sucking movements and jitteriness of the chin. The chin EMG activity is not constant.

There are no eye movements. Breathing and heart rates are regular and slower than in active sleep. The respiratory pauses are rare and longer than in active sleep without exceeding 15 seconds.