european standards of care for newborn health

Topic Expert Group: **Medical care and clinical practice**

Neurological monitoring in the high-risk infant: clinical neurological evaluation

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Target group

- Term and preterm infants at risk for brain injury:
  - Infants with hypoxic-ischaemic encephalopathy (HIE)
  - Infants with encephalopathy for other causes (e.g. metabolic)
  - Infants with suspected or verified seizures
  - Infants requiring intensive care and/or surgery
  - Infants with suspected/confirmed congenital central nervous system (CNS) anomalies
- Parents

User group

Healthcare professionals, neonatal units, hospitals, follow-up teams, and health services

Statement of standard

In order to improve evaluation and outcomes of newborn infants at risk of brain injury, management includes neurological monitoring using a structured, age-appropriate neurological assessment and a range of devices to evaluate brain haemodynamics, oxygen transport, brain function, and imaging, as well as long-term follow-up of neuro-motor function as required.

Rationale

Infants requiring neonatal intensive care constitute a high-risk population for developing brain injury, particularly full term and preterm infants exposed to hypoxia-ischaemia, CNS infections, or with congenital anomalies.

Early recognition of disturbed brain function or structural brain injury is important in the institution of preventive or treatment strategies, and appropriate follow-up. Early detection of neurological compromise, such as encephalopathy or seizures, is associated with better management of these conditions. (1–4)

The patient history, a structured neurological examination and repeated clinical observations form the basis of evaluation. After discharge, standardised follow-up and assessment of neurological, motor, cognitive and behavioural function are the mainstay of monitoring, to identify sequelae of perinatal brain injury (see TEG Follow-up & continuing care). Early identification of impaired function will improve clinical management and long-term functional outcomes. (5–10) Parental questionnaires can be combined with formal motor assessment in high-risk populations. (11) Motor assessment tests should be validated in their specific cultural settings. (12)

Benefits

Short-term benefits

- Early identification of neuromotor impairments (5–8)

Long-term benefits

- Improved long-term neuromotor outcomes (8)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are informed by healthcare professionals about the role of clinical neurological evaluation and the importance of neurological follow-up.	B (High quality)	Patient information sheet
For healthcare professionals		
2. A unit guideline on comprehensive clinical neurological evaluation and the use of technological investigation is adhered to by all healthcare professionals. (see TEG Medical care & clinical practice) (5–9)	A (High quality) B (High quality)	Guideline
3. Specific training on clinical neurological evaluation of high-risk infants is attended by all responsible healthcare professionals. (5–7,9)	A (High quality) B (High quality)	Training documentation
4. Teams with a focus of interest on neuro-critical care, including neonatologists, neurologists, neuro-physiologists, nurses, radiologists, radiographers, and physicists are established.	B (High quality)	Guideline
For neonatal unit		
5. A unit guideline on comprehensive clinical neurological evaluation and the use of technological investigation is available and regularly updated. (5–9)	A (High quality) B (High quality)	Guideline
For hospital and follow-up team		
6. Specific training on clinical neurological evaluation of high-risk infants is attended is ensured. (5–7,9)	A (High quality) B (High quality)	Training documentation
7. Facilities for clinical neurological evaluation of high-risk infants are provided.	B (High quality)	Audit report
8. An interdisciplinary team for neuro-critical care of high-risk infants in the NICU is supported.	B (Moderate quality)	Audit report

9. An organised follow-up programme for high-risk infants including neurological, motor and behavioural assessments is established.	B (High quality)	Guideline
For health service		
10. Pregnant women with fetuses with identified neurological problems and high-risk newborn infants are transferred to centres with appropriate clinical neurological evaluation systems and expertise. (see TEG Birth & transfer) (13)	A (High quality)	Audit report, guideline
11. Follow-up programme for high-risk newborn infants, including neurological, motor and behavioural assessments, as well as parental questionnaires is ensured.	B (High quality)	Guideline
12. Benchmarking of long-term neurological outcomes of high-risk infants is established. (11,14)	A (High quality) B (High quality)	Audit report

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
N/A	
For healthcare professionals	
N/A	
For neonatal unit	
N/A	
For hospital	
N/A	
For health service	
N/A	

Getting started

Initial steps
For parents and family
• Parents are verbally informed about the role of clinical neurological evaluation and the importance of neurological follow-up.
For healthcare professionals
• Attend training on clinical neurological evaluation of high-risk infants.

- Identify leading healthcare professionals with a focus of interest on neonatal neurological evaluation.

For neonatal unit

- Develop and implement a unit guideline comprehensive clinical neurological evaluation and the use of technological investigation.
- Develop parental information material on clinical neurological evaluation and the importance of follow-up also including parent perspectives.
- Provide resources for specific training on the various neonatal neurological examination tools.

For hospital

- Support healthcare professionals to participate in training on clinical neurological evaluation of high-risk infants.

For health service

- Create systems to effectively transfer high-risk infants to NICUs with appropriate neuro-monitoring systems and expertise.
- Establish a follow-up programme for high-risk newborn infants including neurological, motor and behavioural assessments as well as parental questionnaires.

Description

The standardised clinical neurological examination constitutes the basis of the evaluation of high-risk infants and should be performed repeatedly in the acute phase and later on in infants at risk for neurodevelopmental sequels.

In the neonatal intensive care unit (NICU)

- Neurological assessment should be performed repeatedly in term and preterm infants with overt or suspected clinical signs from the central and/or peripheral nervous system, including seizures. Several validated methods are available for term (1,5,6) and preterm infants (7–9), including for example the Dubowitz Neurological Assessment of the Preterm and Full-term Infant (5,7), the neurological assessment by Amiel-Tison (6), the Assessment of Preterm Infants' Behaviour (APIB) (15), Neonatal Intensive Care Unit Network Neurobehavioural Scale (NNNS) (16), Prechtl's Assessment of General Movements (GMs) (17), and other. (8,9,18)
- Moderately preterm and term infants with hypoxic-ischaemic encephalopathy (HIE), including infants subjected to therapeutic hypothermia, should be repeatedly assessed during the first days of life to produce gradings of encephalopathy using Sarnat criteria or Thompson scores. (1–3)
- Neonatal pain/comfort assessmentsare used for repeated assessments of infant behaviour during, intensive care and pain should always be excluded as a potential cause of abnormal behaviour in infants. (19)

Long-term outcomes

First two years after birth

Several neurodevelopmental and neuropsychological tests have been developed for postnatal evaluation of high-risk infants in different countries and hence in different languages. Some of them have been translated and validated in different (but not all) languages, making in some way, general recommendations very difficult. Accordingly, the following description is based on relatively largely adopted tests but might require some adaptations, depending on the considered part of the world. It is

important to remember that a translated test must be validated prior to its generalised use.

- The follow-up should aim at early diagnosis and categorisation of neurodevelopmental problems, including cerebral palsy, motor function, hearing and vision impairments, alongside medical problems such as feeding problems, growth and respiratory function.
- Systematic neuro-motor evaluation can be valuable using well validated tests, such as the Alberta Infant Motor Scale (AIMS) (20), and the Peabody Developmental Motor Scales. (21)
- The clinical neurodevelopmental evaluation should be combined with other assessment methods as required and which may include cerebral ultrasound and MRI, NIRS, aEEG/EEG, EEG, hearing tests, ophthalmological and genetic testing, as appropriate.

Evaluation around 2 and 5-5½ years of age
Long-term follow-up should be offered to infants with a significant risk of developing long-term neurodevelopmental sequels, and who could benefit in their function and quality of life from early detection and special intervention/training for these sequels. High-risk groups include: extremely preterm infants (gestational age <28 weeks), severely growth restricted infants, infants with morphological brain injury (intraventricular haemorrhage grade 3-4, periventricular leukomalacia, stroke, posthaemorrhagic ventricular dilatation, malformations), infants with moderate-severe HIE including infants who needed hypothermia treatment, infants with severe encephalopathies of other causes (e.g. kernicterus, seizures due to hypoglycaemia, metabolic diseases), central nervous system infection and severe neonatal morbidities (e.g. major surgery, sepsis, necrotising enterocolitis, need for nitric oxide or extracorporeal membrane oxygenation). (11,14)

There seems to be some international agreement that 2 and 5-5½ years of (corrected for prematurity, when relevant) age are suitable for evaluation of high-risk infants. These age levels have been chosen since children with adverse development, including cerebral palsy, benefit from early diagnosis and training by physiotherapists. The standardised age-groups also allow for better international comparisons of outcomes.

The present standard has a focus on neurological and motor assessment which should be combined with evaluation of cognitive, behavioural and psychiatric outcomes (see TEG Follow-up & continuing care). Several methods are available, e.g. the Bayley Scales of Infant and Toddler Development (BSID) (22) and the Brunet-Lezine assessment in the younger children. (23) Neurological examination should be performed in a standardised way (24), and e.g. the Movement Assessment Battery for Children (Movement ABC) (25) and other motor assessment tests can be used for evaluation of motor function, including developmental coordination disorders (DCD). Cognitive testing is often done with the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) or the Wechsler Intelligence Scale for Children (WISC).

Categorisation of motor outcome should preferably be done according to the Gross Motor Function Classification System (GMFCS) (26), which also facilitates international comparisons of outcomes. Hand function in children with cerebral palsy can easily be classified with the Manual Ability Classification System (MACS) (27), also in children younger than 4 years.

Follow-up at 2 years should include:

Neurological and neurodevelopmental testing, including cognition and language (e.g. BSID, Brunet-Lezine or equivalent). Assessment of motor function (e.g. Peabody, Movement ABC). Behavioural and autism screening as required (see TEG Follow-up & continuing care).

Follow up at 5-5½ years should include:
Neurological testing (standardised) and motor function (e.g. Movement-ABC) cognitive function (WPPSI IV or WISC), behavioural tests. Reading and writing evaluation at school age (see TEG Follow-up & continuing care).

For infants at risk of developing motor deficits it is recommended to have a dedicated paediatric physiotherapist present during follow up visits for motor assessments (preferably using standardised test). Hand function should preferably be assessed in conjunction with motor assessment in children with suspected or deviant motor function. (28)

A high proportion of children with morphological brain injury develop cerebral visual impairments, including preterm infants with white matter injury, term infants with stroke or other perinatal brain injury. In order to optimise long-term outcomes by early support of visual functioning in compromised children, it is recommended to screen children with known perinatal brain injury for cerebral visual impairments. (29)

Source

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