

THE DUBOWITZ NEUROLOGICAL EXAMINATION OF THE FULL-TERM NEWBORN

Lilly Dubowitz,¹ Daniela Ricci,² and Eugenio Mercuri^{1,2*}

¹Department of Paediatrics, Hammersmith Hospital, Imperial College, London UK,

²Child Neurology Unit, Department of Paediatrics, Catholic University, Rome, Italy

In an ideal world, each neonate should have a comprehensive neurological examination but in practice this is often difficult. In this review we will describe what a routine neurological evaluation in the full-term neonate should consist of and how the Dubowitz examination is performed. The examination has been used for over 20 years and can be easily performed in a short time as the recording sheet provides simple instructions together with simple diagrams to make the recording and the scoring easier. We will also indicate how the examination can be used to identify infants with neurological abnormalities, describing clinical signs which can help to differentiate infants with peripheral neuromuscular disorders from those with central nervous system involvement. The correlation between clinical and imaging findings in infants with neonatal brain lesions will also be reported. Finally we will briefly describe how and when to apply an optimality scoring system in a research setting.

© 2005 Wiley-Liss, Inc.
MRDD Research Reviews 2005;11:52–60.

neurological impairment and recovery, a number of the items were found difficult to elicit, while others, although easily

Key Words: neonatal examination; preterm infants; perinatal brain lesions; optimality score

At the time when we developed our examination in 1981, most current examinations focused on specific aspects of neurological function. The French school mainly assessed tone and primitive reflexes [Andre-Thomas et al., 1960; Saint-Anne Dargassies, 1977; Amiel-Tison and Grenier, 1980], while others concentrated more on various aspects of behavior [Brazelton, 1973; Prechtl, 1977; Casaer, 1979; Prechtl et al., 1997]. Another problem has been that, although these methods have brought considerable advance to the assessment of the newborn, they required experienced staff with special training and often took a considerable time to perform and thus were poorly suited for routine use. Our aim was to develop a more general examination which would encompass various aspects of neurological function, such as behavioral states, tone, primitive reflexes, motility, and some aspects of behavior. We aimed for our examination to be quick and practical, easy to perform and to record, and applicable in the first few days of life even to preterm infants in an incubator. This would mean that it could be easily used as a component of the routine clinical evaluation of both preterm and full-term newborn infants.

The assessment has been used for over 20 years in both clinical and research settings and has recently been updated according to the experience collected during those years [Dubowitz et al., 1998, 1999]. While we found that the basic scheme proved to be very successful, in particular in relating lesions to neurological patterns and documenting longitudinal

Fig. 1. Item assessing posture.

If further help is required, more detailed instructions and practical tips, are available in the manual [Dubowitz et al., 1999], where the test procedures and its application are more fully described.

INTERRATER RELIABILITY

The examination can be easily performed following the instructions. The interrater reliability is above 96% even with inexperienced staff [Dubowitz et al., 1999; McGready et al., 2000].

DESCRIPTION OF TEST PROCEDURE

The assessment is best performed two-thirds of the way between feeds when the infants are more likely to be in an optimal state. Preterm infants on continuous feeding (intravenous or alimentary) can be examined at any time.

After uncovering the infant, the examination should start with a period of observation. During this, the posture of head, trunk, and extremities and spontaneous movements can easily be assessed. The observation should also include any abnormal pattern of movements of the respiratory muscles and the possible presence of joint contractures. At this stage the infant should also be inspected for the evidence of any trauma or malformations. These findings should be listed as "other signs" at the end of the proforma. Head circumference and size of the fontanel should be also noted on the proforma.

Posture and Tone

P e
After gently uncovering the infant and taking off or loosening the diaper while the infant is lying in the supine position, head in midline, the predominant posture in a quiet state should be recorded (Fig. 1).

i b e is assessed by noting the tone of the limbs in the supine position and in ventral suspension and by the response to traction of the upper and lower limb with the infant lying in the supine, head in the midline (Fig. 2). To elicit arm

traction the arm is pulled slowly to a vertical position by the wrist. The resistance and the angle of flexion at the elbow is noted when the shoulder lifts from the surface. Leg traction is elicited by raising the leg into vertical position by gentle traction on the ankle. The resistance to this maneuver and the angle of flexion at the knee are noted when the buttock becomes elevated. Both arm and leg traction are tested separately in each limb.

T k a d e c e are evaluated by assessing (a) *head c* in the sitting position, (b) *head ag* while the infant is pulled to the sitting position, and (c) the *e f h e head a d k i e a - e i* (Fig. 3).

ead c in the sitting position is elicited by placing the infant into a sitting position and holding it there by encircling the infant's chest with the examiner's hand, then allowing the head either to fall forward (head control 1) or backward (head control 2). The infant's ability to raise the head to vertical is noted.

ead ag is elicited by grasping the infant's wrists and gently pulling the infant from the supine toward the sitting position. The response of the head to this maneuver is noted.

P e f h e head a d k i e - a e i is tested by suspending the infant in the prone position by a hand under the chest. Posture of the head in relation to the trunk is scored and the amount of flexion in the arms is also noted. The diagram most resembling the position of the trunk should be circled and any deviation of head or limb posture from the diagram in the proforma should be drawn on the diagram.

a a i f e

Posture and tone are age dependent, reflecting the increase in flexor tone in the limbs and in axial tone with increasing maturity. Flexor tone of the neck muscles can be demonstrated from about 28 weeks' gestation onward but good extensor tone in the neck muscles often cannot be demonstrated until term.

When examined at term age, preterm infants tend to have less flexor tone in the limbs than full-term infants. The range of scores is lower both on traction and recoil, especially in the upper limbs. The assessment of head control in the sitting posture shows less extensor tone in the neck compared to full-term infants [Mercuri et al., 2003].

A e e f e a e

It is important that the items assessing tone are evaluated not only individually but also compared to each other in order to identify possible patterns of distribution of tone (Fig. 4). This will help to establish, for example, whether the infant has generalized hypotonia or only poor axial tone (reduced trunk and head control). While the former may also be associated with systemic illness, central nervous system (CNS) involvement, and neuromuscular disease, the latter is more often a marker of CNS involvement.

In the revised version of the examination we included four new items assessing differential tone in order to highlight some aspects that, in our experience, are very different in full-term and preterm infants with brain lesions compared to the normal infant and hence are very important to assess [Mercuri et al., 1999].

P e d i a c e f e e e c a e d e e. This is assessed comparing ventral suspension and head lag or neck flexor and extensor muscles in the two items assessing head control.

Relative increase in the neck extensor muscles compared to the flexor ones is often associated with hypoxic-ischemic lesions, meningitis, or increased intraventricular pressure.

iff e i a d i b i f e i e a d e i b. This is assessed comparing tone of upper and lower limbs (Fig. 5).

Abnormal patterns of leg tone are often observed in infants with breech presentation or in normal crying infants. If noted in a quiet infant at any

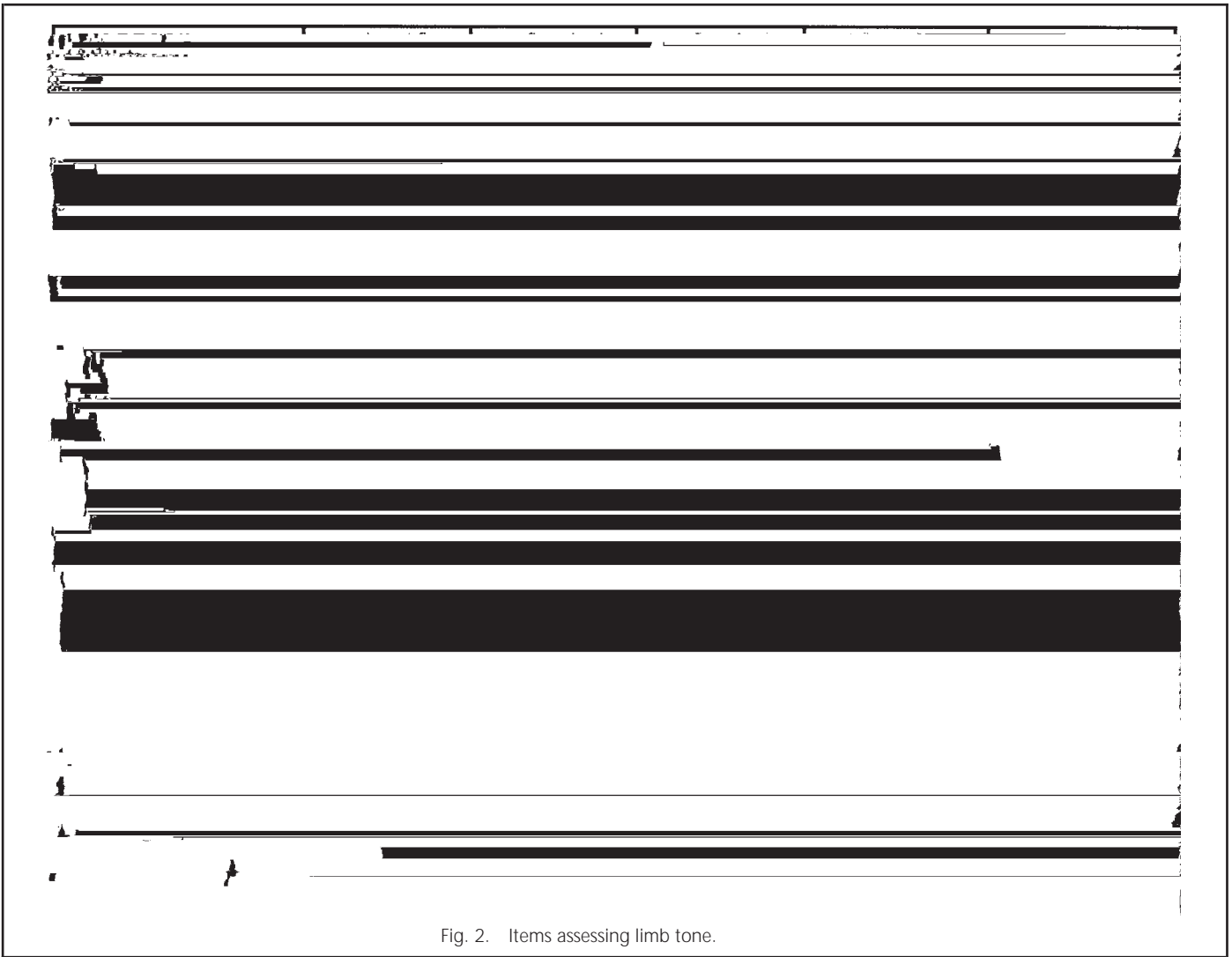


Fig. 2. Items assessing limb tone.

gestation it should raise the suspicion of CNS pathology. This sign can be associated with a number of conditions, such as the onset of an intraventricular hemorrhage or periventricular leukomalacia, and is often observed in full-term infants with hypoxic-ischemic encephalopathy who have severe basal ganglia lesions on brain MRI.

Reactive popliteal angle. This is assessed comparing popliteal angle and leg traction (Fig. 6).

A tight popliteal angle associated with relatively poor resistance on leg traction can be observed in infants with breech presentation. A disproportionately tight popliteal angle compared with the rest of the leg tone is frequently found in association with germinal matrix or intraventricular hemorrhages.

Reflexes

Eliciting primitive reflexes has been regarded as an important compo-

nent of the neurological assessment of the newborn. However, in our experience, reflexes cannot reliably identify infants with neurological abnormalities, as abnormal reflexes can be observed in normal infants and normal reflexes can also be found even in grossly abnormal infants. We have therefore decided to retain only the reflexes that we considered to be the most useful for our purpose (Fig. 7) [Dubowitz et al., 1999].

Palmar grasp

Palmar grasp is present from 27 and 28 weeks' postmenstrual age and becomes much stronger with increasing maturity.

Plantar grasp is present from 26 weeks' postmenstrual age and becomes only slightly stronger with increasing maturity.

Plantar flexion can be observed generally from 34 weeks' postmenstrual age and becomes more pronounced in the following 2-4 weeks.

Spontaneous opening of the hands at 25-27 weeks' postmenstrual age only consists of the opening of the hands. With increasing maturity, extension and abduction of the upper extremity can be noted, followed by some adduction at the shoulder from 33 to 34 weeks' postmenstrual age. The adduction gradually becomes stronger.

Spontaneous sucking is already present at 27-28 weeks' gestation but during the next few weeks it becomes more powerful and better coordinated with swallowing. By 32-34 weeks a normal infant should be able to feed orally.

Movements

These are best observed with the infant in the supine, preferably while awake and quiet. Observations should be carried out throughout the examination and scored when the most suitable state is achieved. Both quality and quantity of spontaneous movements are noted (Table 1). It is also important to

high pitched cry also reflect an abnormal neurological state.

auditory behavior

Even prior to 32 weeks' gestation, some preterm infants can focus on a target but they are usually not yet able to track. After 32 weeks many of them are able to track horizontally or vertically and by 36 weeks many of them can track even in an arc.

A response to an auditory stimulus can be elicited from 27 to 28 weeks' postmenstrual age and becomes stronger with increasing gestational age.

When examined at term age, preterm infants have more variable responses

lesions. This allowed us to recognize that certain brain lesions are often associated with specific patterns of neurological signs.

*- e i fa i h e a a e ce ha a-
h* . In full-term infants, perinatal events are frequently associated with neonatal encephalopathy. Increased extensor tone in the legs and flexion in the arms or a prevalent extensor tone in the neck and trunk muscles are usually associated with diffuse lesions involving the cortex, the white matter, and the basal ganglia. These findings are even more important considering that these lesions are generally associated with the most severe motor and global outcome [Mercuri et al., 1999].

STRENGTHS AND BENEFITS

In conclusion, one of the benefits of the examination is that it includes a variety of aspects of neurological function and can therefore provide a quite detailed profile of the neurological status of the infant assessed.

Another benefit is the easy repeatability of the examination. As the examination can be completed in approximately 10 minutes, it can be easily repeated in infants in whom there is a suspicion of neurological abnormalities. This will allow the examiner to not only confirm the persistence of the findings but also to follow their evolution. ■

REFERENCES

- Aiel-Tison C, Grenier A. 1980. Evaluation neurologique du nouveau-ne et du nourisson. Paris: Masson.
- Andre-Thomas A, Chesni Y, Saint Anne Dargassies S. 1960. The neurological examination of the infant. Clinics in Developmental Medicine, Vol. 1. United Kingdom: Heinemann.
- Brazelton TB. 1973. Neonatal behavioural assessment scale. Clinics in Developmental Medicine, Vol. 50. London: Spastics International

Medical Publication/W. Heinemann Med. Books.

Casaer P. 1979. Postural behaviour in newborns infants. Clinics in Developmental Medicine, Vol. 72. United Kingdom: Heinemann.

Dubowitz L, Dubowitz V, Mercuri E. 1999. The neurological assessment of the preterm and