Minireview Article

Neonatal Neurological Examination and Clinical Practice

Abstract:
The purpose of a neurological examination of the newborn is to determine a normal neurological condition and to detect possible defects. This includes assessment of the central and peripheral nervous system and observation of posture, muscle tone, strength, reflexes and symmetry. Abnormal assessments may indicate neurological disorders. As a rule, the neurological examination of a newborn differs depending on the gestational age. Systematic physical examinations usually detect the defects. Early identification is crucial. As plasticity is greater in early life. Despite developments in neuroimaging and neurophysiological technologies, clinical neurological examinations still have their own importance. Early neurological examination results can save time in diagnosis and the implementation of effective treatments. For example, there is a therapeutic window of six hours or less for performing therapeutic hypothermia. In these cases, the neurological assessment alone is crucial.Neurophysiological technologies can be difficult due to immaturity and reduced myelination in neonates. The aim of this article is to provide readers with a better understanding of the concepts of neurological assessment of neonates.

Keywords: Neonate,Neurology,Gestationalage,Neonatalrefluxes,Tone,Neurological Examination.

Introduction:

The neurological examination of newborns is informative, cost-effective, and time-saving and helps with early diagnosis and the implementation of therapies. There are many standard neurological objective assessment tests and scales available with good sensitivity and specificity [1]. The neonatal neurological examination is a cornerstone in the assessment of a neonate's neurological function. Compared to other systems, The neurological examination is also simple, and the neurological examination will give more accurate information. . Early recognition of abnormal findings is compulsory in some conditions; we should make early decisions, like recognition of subglacial hemorrhage, differentiation of clavical injury, and brachialplexus injury. General body movements will detect the cerebral palsy with The sensitivity for detecting CP was 97.6%, with a specificity of 95.7%. This will explain how important the neurological examination is [2]. This chapter aims to introduce the concepts of neonatal neurology and to cover uncommon conditions that are routinely not covered. We covered important and conceptual aspects of the neurological

examination. This is a brief review and will not replace a complete neurological examination.

History:

Birth histories for three generations need to be taken. Particularly more autosomal recessive disorders will occur through consanguinity. For this reason, it is best to find out about consanguinity. It is better to find the age of the parents, as the father's age is associated with Marfan syndrome, and both parents ages may increase the incidence of Down syndrome. A history of fever or infection is needed to rule out TORCH infections, and a history of hyperthermia may cause neural tube defects. It is also advisable to ask about any other routine history regarding TT immunization, iron, and folic acid intake. A history of TT may be useful in the differential diagnosis of catalepsy, even though neonatal tetanus is eliminated. Periconceptual folic acid is important as the neural tube forms during the early days.

It is best to ask for a polyhydramnios history, as it is observed in some neurological cases like NTD and SMA. Polyhydramnios and IUGR may indicate a baby problem. Also,IUGR and oligohydramnios indicate fetal distress or placental problems. Therefore, it is preferable to ask about the fetal movements. It is also better to ask for exposure to radiation and drugs in the first trimester. In addition, a delay in labor may indicate anencephaly. Early antenatal scans may be useful for neural tube defects such as the lemon and banana signs. Enlarged cisterna magna may be associated with autism, and we can diagnose early hydrocephalus through ultrasound.

The timing of the initiation of oral feeding and breastfeeding usually tells us about a history of asphyxia. Some babies may cry excessively in cases of asphyxia. It is better to know the cause of asphyxia, whether it is an acute event like uterine rupture or cord prolapse or a chronic event like the cord around the neck. If acute events cause basal ganglia injury, the baby's tone is normal despite severe asphyxia. In these cases, the brainstem is usually involved, leading to swallowing problems and irregular respiration. In chronic cord entailment conditions, parasagittal injury, which is a watershed area in terms of babies, will occur; in severe cases, the flexion tone of the upper limbs will decrease. In severe cases, as brain edema will be more common on the third to fourth day, sudden death may occur despite the baby being on the ventilator [3].

The general examination will start from head to toe. White, bland color; babies may have phenylketonuria or albinism. A type of phenylketonuria may mimic cerebral palsy. The diamond-shaped anterior fontanel at the junction of the coronal and sagittal sutures measures 1–4 cm in a full-term neonate. The triangular-shaped posterior fontanel, located at the junction of the lambdoidal and sagittal sutures, is small, admitting only the tip of a finger. We should measure the diagonal because

we can't make a tip in a straight line. Enlarged squamopetrosal sutures indicate an early sign of hydrocephalus. The fontanelle should be checked from posterior to anterior; check for the absence of pulsations, which indicate raised ICT. Head circumference measurements usually take three times the average by the overlapping method. Babies born to insulin-dependent diabetic mothers typically have a low head circumference. Enlarged head circumference is usually a late sign of hydrocephalus, as in neonates with a lack of myelin and increased water content, the white matter becomes very thin by CSF pressure before the increase in head circumference. [4]

Caput is usually firm in consistency, but usually we see some minimum fluid consistency because of an underlying subgaleal hematoma. Subgalial hematoma, a usually dangerous condition, can accumulate in the whole blood of the baby. Each cm increase in head circumference will accumulate 40 ml of blood, which is why continuous monitoring is needed.[5] Sometimes, subgaleal hemorrhage becomes hard because of the organization of the blood. That is why it is preferable to see the nape of the neck and protruding ears. Cephalohematoma appears after the 2nd and 3rd days after Caput's disappearance. Since it's usually hard and bilateral because of the pressure of the iliac bone, it will cause prolonged jaundice.

All term babies will have tremors, but it is better to differentiate them from fasciculation, which, though rare, will disappear with the movement of the tongue.

Palmar and planter creases: better observe if less means antenatal asphyxia. Arthrogryposis, a high-arched palate, overriding sutures, and a cortical thumb indicate intrauterine asphyxia. [6] If the sacral dimple is more than 2 mm in diameter and 5 cm away from the anus, it is better to rule out spinal neurological problems.

More than two whorls are in the head, and there is a chance of parenchyma problems. Occipital hair will usually be in the telogen phase; it is usually lost in the cerebral palsy child. A cleft palate and any central body lesions indicate pituitary abnormalities. In pituitary abnormalities, growth is usually normal. It is better mentioned here. A low chin may be the first sign of the Pierre-Robenson sequence; always look for a U-shaped cleft palate. While esotropia and exotropia are normal, horizontal eye deviation usually indicates seizures.

Palmar-plantar creases show the mobility of the baby except for the vertical one between the great toe and 2nd finger. It formed due to the folding of the foot. A

capillary hemorrhage in the face is better to follow, even though there may not be cerebral problems,as most of the neurological problems will be normal at birth. Nasolabial folds will be preserved in the absent lingular iris, not facial nerve palsy. Flexion of the big toe also indicates stress. In hypotonic babies, the lateral aspects of the thigh also touch the ground. A straight umbilical cord may indicate asphyxia, stillbirth, and spinal muscular atrophy. Check for neurocutaneous markers. It is always better to observe the movement of the shoulder joints as they are supplied by 5, which also supply the diaphragm, open or closed mouth, and lower diaphragmatic retractions. All these indicate the inigrity and development of the nervous system. If an open mouth is usually present in preterm neonates, as tone will progress from caudo cephalic, a closed mouth will indicate readiness for paladai feeding.

Proximal extremity weakness is common in congenital myopathies, and limb anomali es can arise if the disease develops in utero. Undescended testis may be a sign of SMA. The semian crease also indicates hypotonia. Any extremely preterm babies' open eyes may indicate intraventricular hemorrhage, but nowadays, after antenatal steroids, we do not see them commonly. Irregular respirations with limb palsy usually indicate diaphragmatic palsy. i Grasp reflex will lost n klumpysplasy due to C8,T1motor nervs injury unlike erbsplasy.

Gestational Age Assessment: Foot Length, Vascularity of the Anterior Lens, Last Menstrual Period, and Ballard Score are used for gestational age assessments. Though first-tri-mister ultrasonography is more accurate, Ballard scores are usually accurate for plus or minus 2 weeks. This score is based on passive tone, as active tone will change as per state. Passive flexion tone will increase in the caudocephalic direction. Flexion of the lower limb will be 32 weeks, and the upper limb will be 34 weeks. Ballard scoring can be done for up to 7 days. In insulin-dependent diabetic mothers, babies' physical growth will be more than neurological. In intrauterine growth-restricted babies, neurological maturity will be greater, but physical maturity scoring will decrease.

Pathophysiology: Both the physiology of structural and functional development need to be understood for a better understanding of neurological examination. Myelination begins in the brainstem around the 29th week of pregnancy and progresses cephalad (upwards) to the cerebral hemispheres by the 42nd week of pregnancy. Early myelination of the motor-sensory roots and the brainstem enables neonatal reflexes such as sucking and autonomic functions such as heart rate and respiration. The cephalocaudal tone progression is associated with increased myelination of subcortical motor circuits originating in the brainstem. Up to 40 weeks of caudocephalic flexor tone will be increased, and after that, the progression of extensor tone will occur in the cephalocaudal direction due to the maturation of modern cortical areas. [7]. The passive tone is usually maintained by the brainstem.

The active tone will change depending on the sleep state or the influence of the drugs. That is why only passive tone is used in the Ballard scoring system.[7]

In preterm, the frontal lobe is a non-vital organ, which is why blood supply will go away to other lobes in low blood supply situations.[8] MCA territory usually does not affect the lower limbs. In the preterm watershed area, the periventricular area causes periventricular leukomalacia. Visual fibers and trunk fibers will be affected, which is why these babies are unable to sit but can stand because of stiff legs. In term babies, the parasagittal area will be affected, which is why the upper limbs are extended. [9]

As the final area of the posterior cerebral artery blood flow, the occipital lobe is usually affected by hypoglycemia due to deep sulci and gyri. If the thalamus is injured, many dysfunctional outcomes will occur. The brainstem and upper part cause respiratory problems to occur. The lower part of the brainstem causes swallowing abnormalities. A mid-brain injury causes a pupillary problem. Even though the calcarine cortex is involved, they can see, but functional and field defects will be there. Functions usually develop in the order of touch, balance, taste, smell, hearing, and sight. As a rule, we should stimulate the baby in the same order.

Neurological examination: Newborns are usually tested on stage 4 of the Brazelton scale. Prechtl, 1982, described 5 stages: (1) “deep sleep,” (2) “light sleep,” (3) “quiet alert,” (4) “active alert,” and (5) “crying. He used these to differentiate between normal and abnormal babies. He mentioned these responses as spontaneous responses to stimuli. Brazelton and Nugent (1995) added the 3rd stage as drowsy.

Brazelton considers babies' capacity to control stimulus levels through the use of state s of consciousness in adapting to their environment. In babies,
autonomic, motor, organization of state, and responsiveness states will develop according to gestational age. [10]

Extremely premature infants respond with changes in their vital signs as they are usually in an autonomic state. Babies usually change slowly from one state to the next. When the baby is sleeping, if we touch the baby, a motor wave comes from head to toe; if we repeatedly touch the baby before the completion of the motor wave, then the baby will wake up and come to the next stage. But in cases of severe asphyxia where the cortex is damaged, the baby will change from a sleeping state to a crying state rapidly.

Cortical Sensation: An irritable newborn is one who becomes upset and cries in response to minor stimuli and cannot be soothed. Lethargic newborns are unable to pay attention. Habituation usually develops after approximately 30 weeks. Hearing habituation tests the temporal lobe function; sight habituation tests the occipital lobe; and touch habituation tests the parietal lobe. After the baby has been crying for 15

seconds, consolability assesses the indicated cortex function. A cerebral-plasy child is usually resistant to consolability. Cuddliness also tests cortical function.
Babies preferentially position their heads to the right because of the dominant left cerebrum.

Cranial nerve examination: As usual, the olfactory sensation is more primitive, which helps in breast crawling. It is usually tested by smelling any odor and observing the response of the face. It is usually present after 32 weeks but may vary as per the development of babies, as some babies, particularly IUGR babies, will have early neurological maturation. Vision usually develops late, then continuously matures after birth. Preterm neonates are myopic, and term neonates are hypermetropic. Their focal length is approximately between the baby's eyes in the lap and the mother's length. They are also color blind; they prefer the human face. The menace reflex is more useful to test the eyesight. If the menace reflex suddenly doesn't push the hand, it will stimulate the trigeminal nerve.

3rd, 4th, and 6th nerves are usually tested by eyeball movements, though in a severe case of hydrocephalus, the sunsetting sign and pressure on the longest 6th nerve will usually develop after one month. The trigeminal nerve is usually tested by the rooting reflex. Facial nerves are usually tested when a baby is crying, as the nasolabial fold may be normal in some babies. Forehead wrinkling is also better to observe. Forceps delivery, Nasolabial folds preserved in absent lingularioris, tongue symmetry, and fasciculations usually test the hypoglossal nerve. The eighth nerve is usually tested in response to distal sound. The spinal accessory nerve is usually tested by the prominence of the sternocleidomastoid nerve. Swallowing usually tests the fifth, seventh, glossopharyngeal, vagus, and hypoglossal nerves, but this reflex may develop late after 34 weeks. It is better to remember that reflexes can be accelerated if trained in preterms. It is also better to test every component of the mixed nerve.

Motor examination: Hypotonia is defined as decreased muscular resistance to passive stretching. Weakness is defined as a reduction in muscle power.
The ability to apply force is defined as strength. [11] Hypotonia with normal strength will be present, like congenital hypotonia, but not
vice versa. Posture, flexibility, passive tone, and active tone are typically used to mea sure tone. The heel-to-ear test, popliteal angle, scarf sign,
and other methods are commonly used to assess passive tone. Active tone is usually tested when the baby is awake in supine, pull-to-sit, standing, and prone positions. In the pull-to-sit position, head lag indicates hypotonia. The stretch reflex in the shoulder girdle is triggered when holding the newborn with the arms extended. This makes it impossible to correctly interpret the active reaction at neck level in the pull-

to-sit position. Holding the newborn at the shoulders is crucial to separate the axial activity since the trapezius, the primary neck extensor muscle, has numerous joints. If we lift the hypotonic baby, it feels slippery. Maintaining the neonate in an upright sitting position while observing the drop of the head to the front or back is another frequent methodological error. Due to the weight of the head, this only permits measurement of passive tone in the extensor and flexor muscles. Fallen limbs and head suspension in prone suspension indicate severe hypotonia. If the upper limbs are hypotonic and extended, the hip joints are very loose. Usually, this indicates severe chronic asphyxia due to a parasagital injury. These babies may suddenly die after 72 hours due to maximum edema at that time. That's why no prognosis is to be explained to the patient until 72 hours, since they may suddenly collapse. Hyperirritability and hypotonia on day 1 indicate mild hypoxia. Usually, ventral incurvation is greater than dorsal incurvation. In CNS abnormalities, dorsal curvature is greater than ventral. In hypotonia, both increased. Central hypotonia was less common than peripheral hypotonia.

Fisting the cortical thumb, seen in chronic hypoxia due to parasagital injury, usually involves the thumb because of the large representative in that area. In neonates, early writhing movements occur in the first 2 months. After 2-3 months, fidgety movements will appear. [12] The absence of these movements, particularly fidgity movements, indicates cerebral palsy. Tendon reflexes develop early in the lower limb. They are difficult to elicit, particularly upperlimb reflexes. The deep tendon reflex area is broader, so we can elicit the reflex by tapping a larger area rather than a precise area. A sustained clonus is abnormal.

During the testing of passive tone, do not put hands on the testing muscle and do not overstretch. But in the scraf sign demonstration, it is better to push the upper arm to avoid the effect of arm recoil. Any myoclonic jerks indicate structural changes in the infant brain. Isolated clonic seizures indicate intraventricular hemorrhage. In term babies, tonic seizures usually indicate increased intracranial pressure.

There are more than 200 neonatal reflexes, and they usually disappear as age increases because our neocortex usually suppresses these reflexes. All these reflexes are usually not centered in the spinal cord. It is in the brainstem and midbrain. That's why, unlike classical spinal reflexes, they will take time. Moro reflexes we will observe in monkeys. Sometimes, babies come with encephalopathy. Moro reflex differentiates between asphyxia and kernicterus, as kernicterus babies show the threatening appearance of their faces.

One thing I want to mention is that in the palmar grasp reflex, there is no role for the thumb, as the thumb is a more mature and mostly represented organ in the human

cortex. The grasp reflex is present in Klumpke's palsy, whereas it is absent in Erb's palsy. We will observe crossed extensor reflexes due to a lack of precision.

Amiel-Tison Neurological Assessment The examination will measure the passive and active tone at 40 weeks of gestational age. Training is not needed. The examination will be conducted in only 5 minutes. But it have poor prediction unless combined with head ultrasound findings. This test can be done for up to 36 months. [13] The HINE (Hammersmith Neonatal and Infant Neurological Examinations) are simple, scoreable, standardized clinical neurological examinations for infants between 2 and 24 months of age. [14]

Sensory system examination: Sensory systems are usually tested with a cotton swab from head to toe. Each sensory dermatome is difficult to test. But specific and large sensory dermatomes can be tested; for example, if we touch the lateral side of the sole (s1), it will give birth to a babinski reflex, and if we touch medially, it will give rise to a grasp reflex (L5-S2). Deep pain causes structural and functional changes in the brain. As usual, patients will feel more pain, but if they are not responding, we can check for vital signs.

Conclusion:

In spite of many advances, nervous system examinations are still mandatory. It played an important role in predicting cerebral palsy. There are enough scores that clinically measure accuracy. As plasticity will decrease as age increases, early detection is needed. Unlike other systems in the nervous system, clinical examination is, most of the time, very useful for early detection.

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