Pediatric and Infant Neurologic Examination

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History:
-As with adults, careful and accurate neurologic history is the most important part
-Discussing onset of symptoms in chronological order is often helpful
-Other characteristics:
- Frequency
- Duration
- Static, progressing, or improving
- Acute, subacute, or chronic

-ROS
-Birth history

Gestational age, complications during pregnancy (including infections), maternal drug and alcohol use, Apgar scores, problems during delivery e.g. meconium, and feeding difficulties.

PMHX: immunization status, accidents, chronic medical problems;

Espec pertinent to szs—head trauma, febrile szs, status epilepticus, meningitis

Medications (when discussing szs, include previous AEDs and response)
Developmental milestones (may use the Denver II)
Family history: epilepsy, neurocutaneous syndromes, migraines, neurodegenerative disorders, etc

General Physical
1. Height, weight, blood pressure, and head circumference.
-Rule of thumb for head circumference is the 3 & 9 rule.

AGE	head circumference
newborn	35 cm
3 month	40 cm
9 month	45 cm
3 yo	50 cm
9 yo	55 cm

2. General appearance, including dysmorphology.
3. Skin exam: neurocutaneous lesions (ash leaf spots (TS), cafe au lait spots (NF), angiomas (SW), axillary freckling (*?*), adenoma sebaceum (*?*), or shagreen patches (*?*).
4. Location of the hair whorl (can signify presence of cerebral malformations) and appearance of palmar creases (*which genetic syndrome*?)
5. Quality of scalp hair, eyebrows, and nails. Friable, kinky hair may signify Menkes kinky hair disease that is associated with mental retardation and optic atrophy.
6. Exam of the midline of the back and neck for sacral dimples, tufts of hair, or other signs of spinal dysraphism.
7. Comparison of thumbnail sizes and their convexity. Abnormalities may signify a growth disturbance, which may be a sign of hemiparesis.
8. Presence of unusual body odor, which is present in some inborn errors of metabolism.
9. Hepatosplenomegaly .

Neurologic Examination of the Child.

General tips

1. Use items such as a tennis ball, small toys (including a toy car), bell, and an object that will attract the child's attention (like a pinwheel).

2. Do not wear a white coat.

3. Postpone uncomfortable tasks until the end, such as head circumference, funduscopy, corneal and gag reflexes, and sensory testing.

4. Make the most of every opportunity to examine the child. See how he or she plays, taking into account handedness and motor deficits.

5. Examine the younger child in the parent's lap. Be patient and wait for the child the make the first move before touching him or her. Give the child a toy to establish rapport.

1) The Skull

- microcephaly, macrocephaly, craniosynostosis (or premature closure of the cranial sutures)
- Prominence of scalp veins = increased ICP.
- Flattening of the occiput = hypotonia
- Prominence of the occiput may signify Dandy-Walker syndrome
- Ridging of the cranial sutures--sign of craniosynostosis
- Percussion of the skull showing areas of tenderness—osteomyelitis
- Macewen (cracked pot) sign = sutures are separated, may indicate increased ICP
- Anterior fontanelle is bulging (*see how it changes based on infant's position while sitting up or laying down, and while crying or content*) = increased ICP
- Auscultate the skull using the bell of the stethoscope in six locations for bruits: globes, the temporal fossae, and retroauricular or mastoid areas
    - Intracranial bruits are heard in many cases of angiomas, often accompanied by a palpable thrill. They can also be heard in anemia, thyrotoxicosis, and meningitis.

2) Cranial nerves

CN I (olfactory) appears at 5 to 7 months of age.

CN II (optic) can be tested through various means

-Funduscopic exam for appearance of the optic disk, macula, and retina

-Visual acuity

- Vision chart
- In a younger child, offer toys of various sizes

- Optokinetic nystagmus
    - Rotate a striped drum or draw a strip of cloth with black and white squares in front of the eyes
    - Optokinetic nystagmus can be elicited starting 4 to 6 months of age
    - Confirms cortical vision
    - Supports the integrity of the frontal/parietal lobes and visual fields.

-Visual fields in children less than a year of age

- Have one examiner attract the attention of the child to a toy/shiny metal object after which another examiner in back of the child brings another toy into the

field of vision, noting the location at which the child turns his or her head towards this second toy

-The blink reflex appears at about 3 to 4 months. Present in about 50% at 5 months and 100% of children at 12 months.

CN III, IV, and VI (oculomotor, trochlear, abducens) (LR6SO4).

-extraocular movements

-pupillary size and reaction to light.

Pupils may be large and not responsive to light in babies earlier than 30 weeks

-The Doll's eyes phenomenon can also be used to assess extraocular movements in a comatose patient with an intact brainstem.

-In conscious patients, the cortical input “overrides” the Doll's eyes phenomenon.

-cold calorics. In order to do this test, 5 mL of ice water is squirted into the external ear canal in *comatose* patients or 0.5 mL in alert, awake patients, and the action of the eyes are noted.

-There are three possible responses to this test.

1) comatose patient with an intact brainstem, the eyes move in the direction of the stimulus.

2) alert, awake patients, there is nystagmus with the quick component in the opposite direction of the stimulus.

3) without a functioning brainstem, there is no movement of the eyes when cold calorics are performed.

***One needs to remember that cold calorics test vestibular function (CN VIII).

CN V (trigeminal)

-sensation of the face.

-temporalis and masseter muscles can test the motor roots of this cranial nerve. --corneal reflex also checks the ophthalmic branch of CN V.

CN VII (facial nerve)

-facial asymmetry.

-Taste in the anterior two-thirds of the tongue is innervated by the chorda tympani branch of VII, and can be checked by applying salt or sugar solutions by cotton-stick applicators.

CN VIII (auditory) cochlear and vestibular function can be tested by the child's response to a bell or by recalling a whispered word or number. Noting the eye movements after turning the infant several times in a clockwise and counterclockwise direction can check vestibular function.

CN IX, X (glossopharyngeal, vagus)

-uvula and palate.

-If there is a vagal nerve problem, the uvula will deviate toward the unaffected side, and the palate will move away from the affected side.

-The gag reflex actually tests parts of IX and X

--IX is the afferent sensory limb (sensory to the back of the pharynx)

--X controls the muscles of the pharynx and elevation of the palate.

CN XI (spinal accessory)

-turn his/her head against resistance, sternocleidomastoid muscle.

CN XII (hypoglossal)

-tongue deviates toward the affected side.

Motor System

Observing the child's posture and simple maneuvers such as retrieving a ball or running outside the examination room can check motor integrity. The following grading system can be used for assessing muscle strength:

0 - No muscle contraction
1 - Flicker or trace of contraction
2 - Active movement without gravity
3 - Active movement against gravity
4 - Active movement against gravity and resistance
5 - Normal strength (for age, keeping in mind that you as the examiner may be stronger)

pronator sign - sensitive test to assess the strength for the upper
Barré sign. having the child keep both knees at right angles while lying prone. Strength of the flexors of the knee

Cerebellar function

how a child reaches for and manipulates toys can check for coordination.
FFM, FTN, RAM, or rapid tapping of the foot can assess for dysdiadochokinesia

Romberg test - test of proprioception (dorsal columns).

Sensory –

-pinprick, light touch, position, and vibration sense
-Object discrimination, which tests for higher cortical functions, can be done using coins, paper clips, or rubber bands.

Reflexes.

Jaw jerk (CN V)
biceps (C5-6)
triceps (C6-8)
brachioradialis (C5-6),
patellar (L2-4)
ankle (S1-2).
Babinski's sign - pyramidal tract dysfunction
+ Babinski's sign = dorsiflexion of the great toe and fanning of the toes. Can be normal up to 1 year of age so symmetry is the important feature to look at below 1 year. May be seen after a seizure.

Clonus - maintaining dorsiflexion of the foot. Sustained clonus is abnormal at all ages

Neurological examination of the infant.

1) Posture and muscle tone
2) Primitive reflexes
3) Age invariable items.

Posture and muscle tone.

1) resting posture -observing the infant undressed. The infant should have flexion of the elbows, hips, and knees (varying with age). Hypertonia in the extremities decreases after 3 months of age, with the upper extremities then the lower extremities. At the same time, tone in the trunk and neck increases.
2) passive tone - determining resistance of passive movements of the joints while the infant is awake and not crying. One can do this by flapping the hands and feet, and by other maneuvers. The scarf sign is where the arm is pulled across the chest and if the elbow passes the midline, then hypotonia is present.
3) active tone - traction response up to 3 months of age. The infant's hands are held with the examiner's thumbs in the infant's palms, and the fingers around the wrists. The infant is slowly pulled to a sitting position. Normally the elbows flex and the neck raises the head. If hypotonia is present, then the head lags backward, then as the erect position is assumed, the head then drops forward. If hypertonia is present, the head is maintained backwards.

Primitive reflexes.

-present from the time of birth
-represents spinal reflexes until the infant becomes older and higher cortical functions suppress them.

Vertical suspension. The infant is suspended by holding the chest with both hands and lifting the patient in an upright position, with the legs dangling.
Scissoring or hyperextension of the legs is seen= spasticity is present; consider cerebral palsy

Horizontal (ventral) suspension (Landau reflex) - Infant is held prone with the examiner's hand under the trunk, is gently lifted upwards. Normally, the spine extends a little so that the eyes are looking just below the horizontal. If the body collapses into an upside down "U" shape, then hypotonia is present.

Segmental medullary reflexes.

sucking reflex -afferent fibers of CN V and IX
-efferent fibers of CN VII, IX, and XII.

Moro reflex.

-head hyperextended, falling back about 3 centimeters in relation to the trunk.
A normal response is seen when the infant opens his hands, extends and abducts the arms, and then brings them together, followed by a cry. It is present in all newborns and disappears before the age of 6 months.

Tonic neck response. (AKA fencer's stance)

-this reflex can be elicited when the head is turned to the side while the rest of the body lies flat on the table. A normal response is extension of the arm and leg on the side that the head is turned, and flexion of the arm and leg on the opposite side (similar to a fencing stance). Abnormal responses occur when this response is sustained or if it occurs differently when the head is turned to the right or left (i.e., the response is not the same when tested on both sides). It usually disappears about 6 to 7 months of age.

Palmar and plantar grasp reflexes.

They are performed by applying gentle pressure to the palm or sole. An abnormal response occurs when this response is absent before 2 to 3 months of age or asymmetric. The palmar grasp reflex should disappear by 6 months; the plantar by 9 to 10 months.

Parachute response.

The infant is suspended horizontally with the face down, and is brought quickly down toward the floor, making sure that the infant is firmly held. A normal response should be seen at 8 to 9 months and consists of arms extended and hands open.

Reflex placing and stepping responses.

Reflex placing is seen when the dorsum of the foot is placed against the edge of the examination table. Reflex stepping is seen when the sole of the foot is placed on the table, and the infant appears to be walking. This reflex disappears at about 4 to 5 months of age.

Questions

1. Name the steps involved of the older child's neurological examination.
2. Name five primitive reflexes.
3. What extraocular muscles are innervated by abducens and trochlear nerves?
4. What does optokinetic nystagmus signify? When can it be performed in an infant?
5. What is the pronator sign? What does it test for?
6. In what two instances can a positive Babinski's sign be seen in normal patients?

References

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2. Menkes JH, Sarnat HB, and Moser FG. Introduction - Neurologic Examination of the Child and Infant. In: Menkes JH, Sarnat HB (eds). Child Neurology, sixth edition. 2000, Philadelphia: Lippincott Williams & Wilkins, pp. 1-32.
3. Inaba AS. Personal communication, 1999.
4. Tottori M. Personal communication, 2001. A black sheet paper is used and multiple strips of white tape (about 2 cm wide) are attached so that there are alternating strips of black and white. A photocopy of this is made and is then wrapped around an empty soda can. A straight piece of metal, such as from a dressing hanger, is used to pierce the top and bottom parts of the can and is thus the handle to rotate the drum.
I would like to thank Dr. Yoshio Futatsugi for his review of this chapter. His assistance is greatly appreciated.

Answers to questions

1. Examination of the skull, cranial nerves, strength, cerebellar function, sensory, and reflexes.
2. Ventral suspension, horizontal suspension (Landau reflex), Moro reflex, tonic neck response (fencer's stance), palmar and plantar grasp reflexes, parachute response, reflex placing and stepping responses.
3. Lateral rectus and superior oblique muscles, respectively.
4. Signifies that cortical vision is intact, in addition to showing the integrity of the frontal and parietal lobes, and visual fields. It can be performed at about 4 to 6 months of age.
5. When the arms are lifted, a positive sign is when an arm is hyperpronated with the elbow flexed. It tests for strength of the upper extremities, and a positive sign signifies weakness.
6. In newborns up to 1 year of age and sometimes in patients just after a seizure.