

Neurology Examination

Learnpediatrics.com Narration

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Introduction

Welcome to the Learn Pediatrics screening neurologic exam. This is an exam that is often viewed with trepidation by non-neurologists, due to fears about the complexity of many of the special tests. While it is true that some of the techniques require advanced training or equipment, most can easily be performed by general physicians in the office setting.

In this video we will demonstrate an approach to examination that will highlight key techniques and allow you to feel comfortable examining children with neurologic concerns.

There are 6 components of a neurologic exam that we will review.

These are:

1. the systemic exam
2. mental status
3. cranial nerves
4. the motor exam
5. the sensory exam and
6. the cerebellar exam, including observation of gait.

How much time and detail is dedicated to each area varies with the presenting complaint

Systemic exam

The neurologic exam begins when the patient just enters the room. With toddlers especially watching the child when they don't realize they are being observed can give you valuable information.

Begin with a full set of growth parameters plotted on an age appropriate chart. These include height, weight and head circumference. To measure the head circumference, a tape measure is placed on the occiput and brought anteriorly to just above the eyebrows. Three measurements should be done and the average of these taken as the head circumference. A smaller or larger than normal head circumference can be a sign of underlying pathology. For example, a small head circumference or microcephaly can occur with intrauterine infections or chromosomal abnormalities. A large head circumference, or macrocephaly can be the first sign of hydrocephalus. Head circumference should be measured at every physician visit until children reach the age

of 3. If a child's head measures outside of the normal curve, the head circumferences of both parents should also be taken to identify the possibility of a benign familial pattern.

All the body systems should be at least afforded a screening exam. Nearly any systemic abnormality can be associated with impaired neurologic functioning. In this section we will describe a few of the key findings to look for. Particular attention should be given to the cardiac exam. Children with cardiac conditions are more susceptible to neurologic injuries such as strokes.

On abdominal examination note any hepatic enlargement which may be a sign of an underlying metabolic disease.

The neck should be examined to ensure that it is supple and that no meningismus is present. Specific physical tests for meningeal irritation include Kernig's and Brudzinski's tests: Kernig's exam is usually performed with the patient supine and the knees flexed. An attempt to straighten the knees is made. The inability to extend the patient's knees beyond 135 degrees without causing pain constitutes a positive Kernig's sign. Brudzinski's neck sign is performed by placing one hand behind the patient's head and the other on the chest while the patient lays supine. One hand flexes the patient's head towards the chest while the other restrains the patient from rising. Flexion of the lower extremities (hips and knees) constitutes a positive sign.

As the skin and CNS both develop from ectoderm during embryogenesis, a full exam of the skin should be undertaken. Hyperpigmented lesions such as café au lait spots of neurofibromatosis and hypopigmented lesions such as ash-leaf spots in tuberous sclerosis are best seen with a Woods lamp. The woods lamp exam is performed using a black light to look at the entire surface of the skin.

Also examine the back for scoliosis or a patch of hair which may indicate an undetected vertebral anomaly.

Mental Status Exam

The neurologic mental status exam is designed to test the various components of higher brain function.

This encompasses functions such as memory, thought perception, understanding and intellect. The psychiatric mental status exam will not be covered here.

The assessment of mental status must be tailored to the age of the patient. For younger children, screening can be done by assessing whether the child has met the appropriate developmental milestones. Young children are best examined through observation of play and by careful questioning of parents. A history of loss or plateauing of developmental milestones is a red flag that must not be ignored and needs to be investigated fully.

For children seven years or older, a more formal screening test such as the Folstein mini-mental status exam may be used. Modified versions of the mental status exam are available for children.

The components of the mini mental status exam are designed to allow evaluation of cortical function. Higher functions usually require integration of several areas. It is therefore difficult to state that a problem with one test corresponds directly to an abnormality of a specific area of the cortex. Accepting therefore that it is an oversimplification, we will try and identify which general area of the cortex is being examined with each test.

Orientation questions test several areas at once including language, attention and memory

Attention and working memory is primarily coordinated by the frontal lobes. Other components of frontal lobe function include motivation, behaviour, and executive function such as would be tested by ability to follow a multistep command. Mathematical calculations are primarily controlled by the parietal lobe.

Naming of objects requires integration of several areas but can be used in conjunction with visual field testing, and naming of colours to identify problems with occipital lobe function.

Naming of objects by tactile recognition requires functioning parietal lobes as it is the primary location for the interpretation of somatosensory information. The dominant parietal lobe is responsible for planning motor functions. Visual spatial organization is also controlled by the parietal lobe and can be tested for by ability to copy a design.

Memory, especially declarative memory, is a function of the temporal lobes and their connections to the hippocampus and limbic systems. Again, the distinction between where the frontal lobe contribution to memory ends and the Temporal lobe takes over is quite indistinct.

Language and speech centers are located in the temporal and frontal lobes. On the dominant side, Wernicke's area is located on the superior temporal gyrus. This is the primary centre for receptive language and abnormality of this area manifests as a fluent aphasia where comprehension is impaired and speech, while clear, is often meaningless. Broca's area on the inferior frontal gyrus is responsible for language expression. Patients with problems here are able to comprehend speech but have difficulty forming words. Problems with the non-dominant hemisphere can manifest as difficulties with the rhythm of speech.

Cranial Nerve Exam

Abnormalities of cranial nerves are often helpful in identifying problems in brainstem function.

The three areas of the brainstem, the midbrain, the pons and the medulla each have corresponding cranial nerves originating from them. Cranial nerves 3 and 4 start at the midbrain, 5 through 8 in the pons and 9 to 12 in the medulla. Cranial nerves 1 and 2 start in the cortex.

Only cranial nerve 4 truly crosses the midline and so problems with the other cranial nerves localize to the ipsilateral side.

Cranial nerve 1, the olfactory nerve, is purely sensory and is rarely tested in the screening exam. If there are any concerns raised in the history of a change in taste or smell each nostril should be tested separately using a non-noxious smell such as mint, orange or vanilla. The ability to smell the substance is more important than the ability to identify it correctly.

Cranial nerve 2, the optic nerve carries all sensory visual information to the cortex. The first step in examining CN2 is to determine the visual acuity of each eye. This can be done with a wall mounted Snellen chart or with a handheld card. There are also age appropriate charts with pictures for younger children. If the child wears corrective lenses they should wear them during the visual acuity testing. Once the acuity is determined, colour vision is tested. Proper colour discrimination requires the presence of normal cone function. If you do not have a formal colour vision test, you may ask the child to identify a green object and a red object.

Pupillary response to light tests cranial nerve 2 for the afferent portion and cranial nerve 3, the efferent. Shine the light directly at the pupil and watch for direct as well as consensual response. The swinging flashlight test is done to test for a relative afferent pupillary defect. This test is done by shining the light first at one eye then the other and watching for a change in pupillary size. If one pupil is larger with direct stimulus than with consensual response, then that eye has less light perception than the other.

Fundoscopy is a very important component of the cranial nerve 2 exam. The optic disc, vessels, retinal background and fovea should be visualized for abnormalities. This can be quite challenging in children requiring speed and creativity in distraction techniques. If there is concern about abnormal findings, a dilated exam should be performed. To examine the child's right eye, use your right eye and hold the fundoscope with your right hand. Similarly, use your left eye and left hand to examine the child's left eye.

Finally, visual fields are tested. There are several methods to this test that are equally effective. The key is to ensure that all four quadrants are tested in each eye at their outer limits. More accurate formal perimetry testing is available if a problem is identified. Field deficits can be used to localize problems to pre- or postchiasmal, optic tract, optic radiation or occipital cortex.

Cranial Nerves 3, 4 and 6: Cranial nerve 4, the Trochlear nerve, and cranial nerve 6, the Abducens nerve, are tested together with the motor component of cranial nerve 3

through testing of eye movements. Cranial nerve 4 controls the superior oblique muscle and cranial nerve 6 the lateral rectus. Cranial nerve 3 controls all other muscles of extraocular movement. Ensuring that cranial nerve 6 is intact is of particular importance in cases of suspected increased intracranial pressure. Due to its long length, cranial nerve 6 is often one of the first nerves affected as pressure increases.

Start by inspecting the child's head position to ensure that it is straight when both eyes are looking forward and that no ptosis is present. Have the patient follow a finger or object to the extremes of the visual fields to test Pursuit eye movement. This is best done using an H shaped pattern. At the end of this pattern, test convergence by having the child focus on a finger as it is brought close to the child.

Saccades are tested by having the child alternate their focus rapidly between 2 objects in both the horizontal and vertical planes. In both saccadic and pursuit movement, watch for nystagmus in the extremes of gaze.

Cranial nerve 5, the Trigeminal nerve, has both sensory and motor components. The sensory component can be tested using light touch and temperature bilaterally on the forehead, cheeks and chin to examine all three of the peripheral divisions – V1, the ophthalmic division; V2, the maxillary division and V3, the mandibular division.

Testing the muscles of mastication as well as for the absence of the jaw jerk examines the motor component. Cranial nerve 5 also carries sensory information from the cornea via the V1, thus carrying afferent information of the corneal reflex, while cranial nerve 7 carries the efferent component.

The functions of cranial nerve 7 can be summarized as Face, Ear, Taste, and Tear. Specifically, the facial nerve innervates the muscles of facial expression, the stapedius muscle of the ear, taste to the anterior 2 thirds of the tongue and the parasympathetic supply of the lacrimal glands. The muscles of facial expression have an interesting pattern of innervation in that the upper portion of the face is innervated by both the right and left cranial nerve 7 while the lower half is entirely the Ipsilateral nerve.

Cranial nerve 8, the Auditory nerve, is screened by testing hearing. If hearing in one ear is decreased, the Rinne and Weber tests can be done to distinguish a conduction versus sensori-neural deficit. The Rinne test compares conduction of sound in air with that of bone. A tuning fork is first held in front of the ear and then held to the mastoid process. Bone conduction is louder in conductive problems while sensori-neural deficits yield the same result for both or perhaps slightly louder for air conduction. In the Weber test, a tuning fork is placed on the top of the head. If hearing improves in the deaf ear, a conductive problem is present while if true sensori-neural deafness exists, there will be no change.

In the screening exam, cranial nerve 9 the glossopharyngeal nerve and cranial nerve 10 the vagus are tested together via the gag reflex. The afferent component is carried by cranial nerve 9 and the efferent by cranial nerve 10. Cranial nerve 9 also carries taste

from the posterior 1 third of the tongue and autonomic innervation of the salivary and parotid glands. Speech and pronunciation tests are also done to tests the recurrent branch of the laryngeal nerve of cranial nerve 10 in conjunction with aid from cranial nerves 5, 7 and 12. Cranial nerve 12, the Hypoglossal nerve, control tongue movement and is tested at the same time and 9 and 10. When the child's tongue is at rest in the mouth, the tongue should also be inspected for fasciculations.

Lastly, the spinal accessory nerve, cranial nerve 11 is tested through its control of the sternocleidomastoid and trapezius muscle.

The motor exam

There are 3 components of the motor system tested during the screening exam: muscle strength, tone and reflexes including the presence or absence of pathologic reflexes. In the screening exam, testing all three modalities in first the upper extremity and then the lower extremity can help save time and can help localize abnormalities if they are present.

The anatomy of the motor system can be separated into upper motor neuron, and lower motor neuron components. The upper motor neuron includes the corticospinal tract and connections to brainstem motor nuclei. The motor system is also strongly influenced by the basal ganglia and the cerebellum. Classically, lesions of the upper motor neuron present as loss of muscle strength and dexterity distal to the injury, a Babinski sign, increased tone and hyperreflexia.

Remembering that the corticospinal tract crosses at the pyramidal decussation, Upper Motor Neuron lesions will present with contralateral deficits for lesions above the pyramids and Ipsilateral deficits for lesions of the spinal cord. Spinal cord lesions will also present with lower motor neuron findings at the level of injury due to damage to the ventral root or ventral nerve at that level. Lower motor neuron lesions result in muscle fasciculations and atrophy, loss of strength, decreased tone and absent deep tendon reflexes.

Begin the physical exam by inspecting the limbs for symmetry, muscle bulk and posture.

Tone can be assessed by passively taking the limb through the range of motion. Spasticity, an upper motor neuron sign, is felt as an increase in tone that varies with the force applied and the velocity of movement. Rigidity is increased tone that does not vary with velocity or position.

The strength of each muscle group should be tested and graded from zero to five

Deep tendon reflexes are graded from zero to four. Examine the Biceps (C5/6), brachioradialis (C5/6), triceps (C7), and finger flexor (C8) reflexes.

We will now move on to lower extremity testing. Start by assessing strength beginning with hip flexion, extension, abduction and adduction. Then proceed with knee flexion

and knee extension. Continue with ankle dorsiflexion, extension of the great toe and ankle plantar flexion. As with the upper extremities assess for tone. In the lower limbs it is important to examine for clonus, a rhythmic series of muscle contractions present if there is increase tone.

Next examine the lower extremity reflexes. This can be done lying down or sitting up. Proceed with the patellar reflexes and the ankle reflexes.

Then assess the plantar response by stroking the lateral edge of the patient's sole in a J stroke from heel to toe using a blunt object such as the handle of a reflex hammer. The normal response is for all toes to flex, called a flexor plantar response. When there is an upper motor neuron lesion an abnormal reflex occurs where the great toe extends and the other toes fan out. This is known as an extensor plantar response or Babinski sign. Finally, test for crossed adduction.

The Sensory Exam

Sensory information is carried to the post-central gyrus of the cerebral cortex in 2 major pathways: The dorsal column, which crosses at the level of the medulla and the Spinothalamic pathway, which crosses almost immediately upon entering the spinal cord. Both of these pathways carry light touch sensation and thus light touch using a cotton swab or other soft object can be used as a screening exam. Proceed by targeting specific dermatomes and test both upper and lower extremities. It is important to note that if an abnormality is found, the other components of the dorsal column and the Spinothalamic tracts must be tested.

The Spinothalamic tract carries pain and temperature sensation and so can be tested using sharp vs. dull and warm vs. cold testing. Start distally and work proximally.

Temperature can be done using warm and cold test tubes of water, or more practically, a tuning fork can be used.

The dorsal column carries vibration sense. To test vibration sense, place your finger below the joint being tested and have the patient state when they feel the vibration stop. Again, start distal and work proximal comparing right to left.

The dorsal column is also responsible for carrying position sense, or proprioception to the parietal lobe. Isolate one joint and perform small movements to test this. It is important that the patient describe WHERE the distal joint was moved TO and not the position that the joint finished in.

After testing sensation in the upper extremities, remember to test light touch, vibration and proprioception in the lower extremities.

Lastly, parietal lobe function can be further tested using graphesthesia and stereognosis. Graphesthesia is the ability to identify numbers or shapes drawn on the skin. Stereognosis is the ability to identify objects placed in the hand.

2 point discrimination can be tested by using calipers or a paper clip. The finger tips should be able to distinguish 2 points at 2-4 mm separation.

The Cerebellar exam

The final part of the neurological exam is assessing the cerebellum. The finger to nose test is performed to test for dysmetria which manifests as over or under shooting the target. In order to fully test the cerebellum's ability to modify movement, it is important to have the patient move through the full range of motion and reach complete extension.

The cerebellum processes information from other areas of the central and peripheral nervous system to provide precise timing for co-ordinated, and smooth movement of all skeletal muscles.

Rapid alternating movement is used to test for Dysdiadochokinesia. Be sure that the child lifts their top hand completely off the bottom one between each touch. Observe the patient's rhythm and accuracy.

Lesions of the cerebellum manifest as Ipsilateral disorders of fine movement, equilibrium, posture and motor learning.

The equivalent test in the lower extremity is the heel to shin test and the heel tap. Again, be sure to go through the complete range of motion. Observe the patient for accuracy and tremor while completing the heel to shin test.

Balance, position sense and proximal muscle weakness is tested with the feet together, arms extended, fingers splayed and eyes closed. Watch for drift of the arms away from the midline as well as pronation. This test can also be abnormal in situations of increased ICP.

Lastly, have the patient walk demonstrating normal gait. Have the patient walk on their toes assessing S1 and on their heels assessing L5. Then have the patient walk heel to toe assessing their tandem gait forward and backwards.

Conclusion

This concludes the screening neurologic examination in a child.