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Sensory Exam

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Overview

Source:Tracey A. Milligan, MD; Tamara B. Kaplan, MD; Neurology, Brigham and Women's/Massachusetts General Hospital, Boston, Massachusetts, USA

A complete sensory examination consists of testing primary sensory modalities as well as cortical sensory function. Primary sensory modalities include pain, temperature, light touch, vibration, and joint position sense. Sensation of the face is discussed in the videos Cranial Nerves Exam I and II, as are the special senses of smell, vision, taste, and hearing. The spinothalamic tract mediates pain and temperature information from skin to thalamus. The spinothalamic fibers decussate (cross over) 1-2 spinal nerve segments above the point of entry, then travel up to the brainstem until they synapse on various nuclei in thalamus. From the thalamus, information is then relayed to the cortical areas such as the postcentral gyrus (also known as the primary somatosensory cortex). Afferent fibers transmitting vibration and proprioception travel up to medulla in the ipsilateral posterior columns as fasciculus gracilis and fasciculus cuneatus, which carry information from the lower limbs and upper limbs, respectively. Subsequently, the afferent projections cross over and ascend to the thalamus, and from there to the primary somatosensory cortex.

The pattern of a sensory loss can help to localize the lesion and determine the diagnosis. For example, testing the primary modalities allows the examiner to distinguish between a length-dependent peripheral neuropathy (e.g., in diabetic patients), a radiculopathy from a possible cervical or lumbar herniated disc, or a dermatomal sensory level (e.g., in a spinal cord lesion).

In order to localize the sensory deficit, knowledge of neuroanatomy and the peripheral nervous system is crucial. When seeing a patient with a peripheral sensory deficit, it can be helpful to think about what nerve root(s) may be involved. A spinal nerve root arises from every spinal segment and consists of both a sensory dorsal root and a motor ventral root, which provide innervation to a specific dermatome and myotome, respectively. There are 31 paired spinal nerve roots: eight cervical, 12 thoracic, five lumbar, five sacral, and one coccygeal.

For example, the C5 through T1 roots form a network called the brachial plexus that controls movement and sensation in the upper limbs, including the shoulder, arm, forearm, and hand. The brachial plexus gives rise to the radial, median, and ulnar nerves. The median nerve carries sensation from all fingers except the fifth finger and half of the fourth, which are carried by the ulnar nerve. These nerve territories extend proximally on the palmar side of the hand. The ulnar and radial nerves carry sensory information from the dorsal side of the hands.

In the lower extremities, T12-L4 form the lumbar plexus, and L4-S4 form the sacral plexus. These plexi give rise to peripheral nerves. A few of these peripheral nerves are the femoral, obturator, and sciatic nerves (motor and sensory) and the lateral femoral cutaneous nerve (sensory only). The sciatic nerve gives rise to the tibial and common peroneal nerves. Use of a dermatomal and peripheral nerve map can be helpful in localizing sensory dysfunction in both the upper and lower extremities.

If primary sensory modalities are normal, cortical sensation (or higher order aspects of sensation) can be tested as well. Cortical sensation is tested when there is reason to suspect a disorder of the brain. Cortical sensory testing can assist with localization of nervous system disorders. The cortical sensory examination includes tests for tactile localization (extinction), stereognosis, graphesthesia, two-point discrimination, and point localization. Cortical sensory testing is not routinely done during a screening neurological examination.

Procedure

In a screening sensory examination, light touch, pain, and vibration are tested in the feet. The sensory examination is expanded in a patient with a complaint referable to the nervous system, or if other components of the examination are abnormal.

1. Primary sensory testing

Begin primary sensory testing by asking the patient if there is any change in sensation in the body. The patient can describe and demarcate the sensory changes to aid in the evaluation.

1. Light touch
    1. Using the tip of your finger or a piece of cotton, touch rather than stroke the patient's skin. Ask the patient to close eyes and tell you when the touch is felt.

2. Pain
    1. Explain that you will be touching the patient with either the sharp or dull end of a safety pin, but it should not hurt.
    2. With the patient's eyes closed, touch the hand, thumb and fingers with the sharp end of the pin but include a dull stimulus as well. With each touch, ask the patient to determine if the stimulus is "dull" or "sharp." Then move up the arm using the same technique.
    3. Repeat on the other hand and arm, and compare between the sides.
    4. Repeat pinprick on the anterior side of the chest wall and compare the sides.
    5. Test the pain sensation in the lower extremities, beginning distally in the feet and comparing between symmetric areas on the two sides of the body and between the distal and the proximal areas.

6. If an area of numbness is found on the patient, begin testing at the numb area and work outward. Instruct the patient to say "yes" when feeling the normal pinprick sensation. Try to assess if there is a dermatomal pattern of sensory loss, which may be seen with a peripheral nerve injury.

3. Temperature
Use the tuning fork as a cold stimulus to test temperature sensation. Test tubes containing warm and cold water could be used as stimuli, but this is not usually done. Temperature sensation should replicate the findings found on the pain sensation examination. Typically only one or the other is performed.
    1. Test the temperature sensation by touching the patient's skin with the tuning fork over the extremities in the same way the pain sensation is tested.
    2. Compare between the sides and between the proximal and distal areas of the same extremity.

4. Vibration
    1. Use a low-pitched tuning fork of 128 Hz and strike the tines against the heel of your hand to produce a vibration.
    2. Place the stem of the tuning fork on the patient's great toe,
    3. Ask the patient to tell you when the vibration is no longer felt. Let the vibration fade until the patient no longer detects it, then apply the tuning fork to your own thumb to see if you still feel any vibration. To make the vibration decrease faster, run your finger along the tines to dampen the vibration.
    4. If the patient cannot feel the vibration in the toes at all, repeat the test by placing the fork over the medial malleolus and, if not felt there, move the fork over the patella.
    5. Record the most distal level where the stimulus is felt.
    6. Compare the two sides.
    7. If there was decreased vibration appreciation found on examination of the lower extremities, test if the vibration can be appreciated in the fingers.

5. Proprioception
    1. Hold the patient's large toe on the sides and demonstrate the test by moving the toe upward and downward while saying, "This is moving it up, and this is moving it down."
    2. Then instruct the patient to close the eyes and to correctly identify the direction as you move the toe up and down in a random order.
    3. Repeat the same on the other side. If the patient cannot correctly identify movements of even large excursions, attempt to move the foot up and down around the ankle joint.
    4. Normally, people are able to identify even a few degrees of movement. If any indication of abnormality is present, test the position sense in the fingers at the metacarpophalangeal joints.

2. Cortical sensation

1. Tactile localization (double simultaneous stimulation; extinction).
    1. With the patient's eyes closed, ask the patient to localize where you have touched. Initially, touch the side that you are concerned may have a deficit to confirm that sensation to light touch is intact. Then, simultaneously touch both sides and ask the patient to identify where and how many places were touched.
    2. Touch the patient on one arm and then simultaneously on both arms. Do the same with the legs.
    3. Extinction of the stimulus on one side may be a sign of a lesion in the contralateral parietal cortex.
    4. If there are suspected lesions of the sensory cortex, additional testing may be performed, including two-point discrimination, point localization, and looking for any asymmetry of optokinetic nystagmus.

2. Stereognosis tests the patient's ability to identify a common object (e.g., nickel, dime, quarter, penny, key, paper clip) placed in the hand.
    1. Ask the patient to close the eyes and then identify the small object in the hand. The patient may move the object around in the hand to feel it.
    2. Test the other hand in the same way. Importantly, the patient may not transfer the object from hand to hand. The patient should be able to identify it with one hand at a time. Patients should be able to differentiate coins, so it is not an acceptable answer to say "coin." The patient should be able to correctly determine a "nickel" or "quarter."

3. Graphesthesia tests the ability to identify numbers or letters drawn on the patient's hand.
    1. Ask the patient to close the eyes. Use the blunt end of a pen to draw a large rendition of a number from 0-9 on the patient's palm. Make sure that the number is facing the patient and not you.
    2. Ask the patient to identify the number. Allow several trials.
    3. Test the hand that you think is not affected first. Then, repeat on the other side. Inability to correctly identify numbers may be indicative of a lesion in the contralateral parietal cortex.

Summary

The sensory part of the neurological examination is the most subjective portion of the exam, and requires a patient's cooperation and full effort. It requires vigilance on the part of the examiner to make sure the patient is providing accurate and honest answers. Be suspicious of sensory findings that do not fit anatomical patterns, or those that may not correlate with the more objective findings seen on the other sections of the neurological examination.

Any abnormal results of the sensory examination need to be correlated with the results of the other parts of the neurological examination to determine the pattern of abnormality. Abnormalities of reflexes may provide a level in the nervous system that may be confirmed by a pattern of a dermatomal sensory level, which helps to localize a lesion.