

**Gomel State Medical University**  
**Department of Neurology and neurosurgery**

**Lecture**

**THEME 3. DIAGNOSTIC METHODS OF  
NEUROLOGICAL DISORDERS. FOCAL  
NEUROLOGICAL SYNDROMES**

*The faculty of general medicine*

**Lesions of the precentral gyrus result in spastic contralateral monoparalysis or monoparesis.**

**The left hemisphere lesion (at concerning right-handed people) may often cause motor and sensory aphasia.**

# Functions of the brain

## Frontal lobe

behaviour  
intelligence  
memory  
movement

## Parietal lobe

intelligence  
language  
reading  
sensation

## Occipital lobe

vision

## Temporal lobe

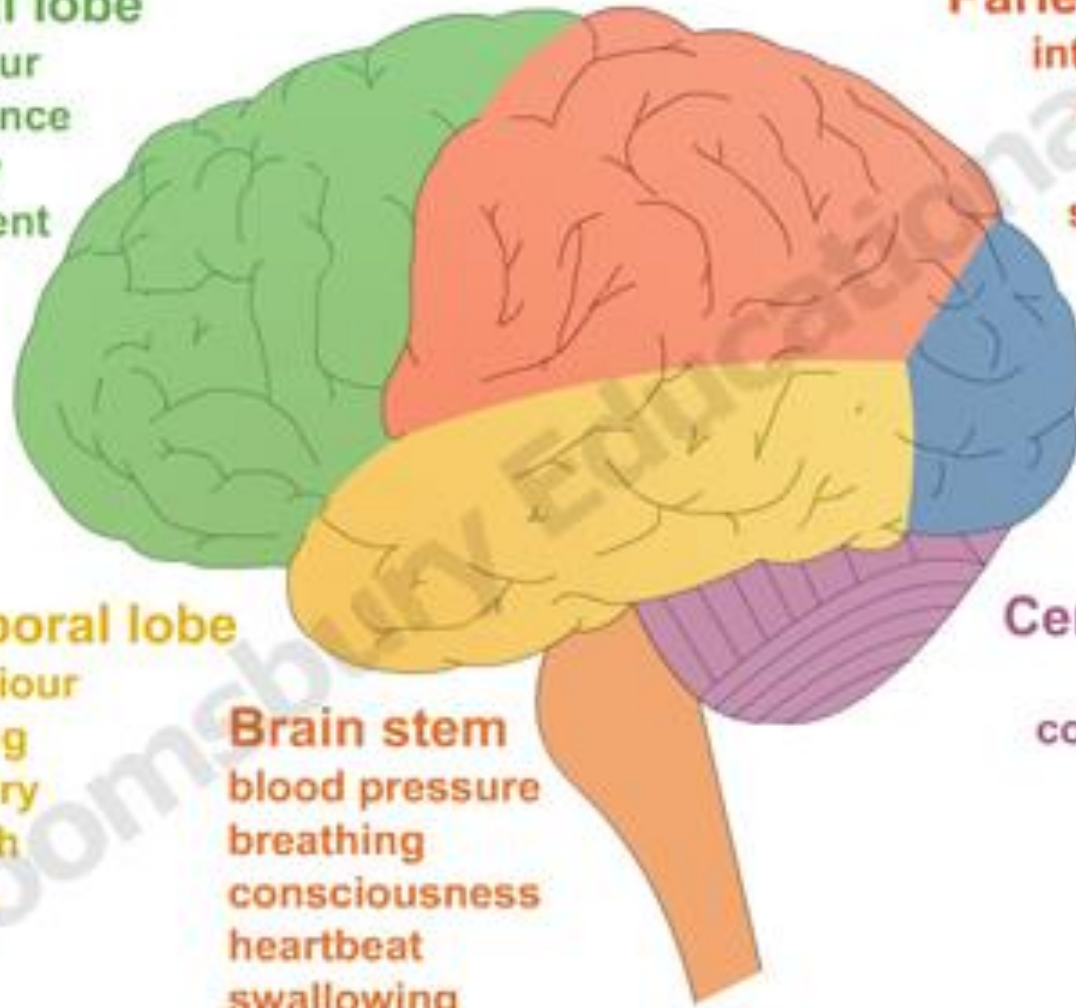
behaviour  
hearing  
memory  
speech  
vision

## Brain stem

blood pressure  
breathing  
consciousness  
heartbeat  
swallowing

## Cerebellum

balance  
coordination



**The irritation of a the primary motor area induces focal motor seizures (in a hand or in a foot). These are the symptoms of jacksonian epilepsy that may become generalizable.**

**The internal capsule lesion induces the following signs on the opposite side of the body:**

- **spastic hemiplegia;**
- **weakness of face muscles below the forehead and the tongue deviation as the result of the corticobulbar tract lesion;**
- **Wernicke-Mann typical posture and gait.**



**The pyramidal tract lesion in the brainstem(cerebral peduncle, pons, medulla) induces spastic hemiplegia on the opposite side of the body as the result of the motor decussation on the border of the medulla oblongata and spinal cord. The motor cranial nerve nuclei are damaged too. The damage induces alternating paralysis: there is the cranial nerves lesion on the ipsilateral side and spastic hemiplegia on contralateral.**

# **Focal neurological signs of the brainstem lesions**

***Weber's syndrome* is characterized by paralysis of the oculomotor nerve on the same side as the lesion and spastic hemiplegia on the side opposite the lesion . The lesion is usually unilateral and affects several structures in the midbrain including corticospinal fibers and oculomotor nerve fibers.**



***Benedikt syndrome* is caused by a lesion in the tegmentum of the midbrain and cerebellum, involving nucleus ruber and oculomotor nerve fibers. The signs are the following:**

- **an oculomotor nerve palsy on the same side as the lesion.**

**On the contralateral side:**

- **cerebellar ataxia including tremor;**
- **hemichorea;**
- **hemiballismus.**

***Parinaud's Syndrome*** is a cluster of abnormalities of eye movement and pupil dysfunction, characterized by:

- **Vertical gaze palsy.**
- **Pseudo-Argyll Robertson pupils: accommodative paresis ensues, and pupils become mid-dilated and show light-near dissociation.**
- **Convergence-Retraction nystagmus: attempts at upward gaze often produce this phenomenon. On fast up-gaze, the eyes pull in and the globes retract.**
- **Eyelid retraction (Collier's sign).**
- **Conjugate down gaze in the primary position: «setting-sun sign».**

***Millard-Gubler syndrome* is a lesion of the pons inferior part:**

- **Ipsilateral Bell's palsy.**
- **Contralateral spastic hemiplegia.**

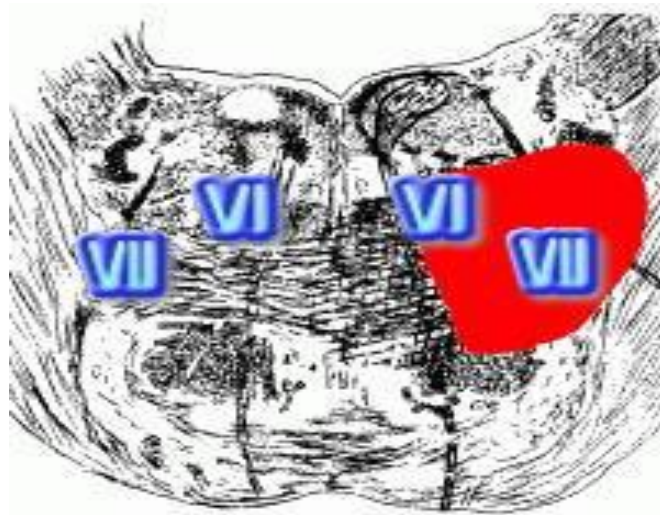


## ***Foville's syndrome***

**Unilateral lesion in the dorsal pontine tegmentum in the caudal third of the pons**

**Signs are the following:**

- **Contralateral hemiplegia.**
- **Ipsilateral Bell's palsy, due to cranial nerve VII involvement.**
- **Ipsilateral rectus muscle palsy due to cranial nerve VI involvement.**



## ***Raymond Syndrome***

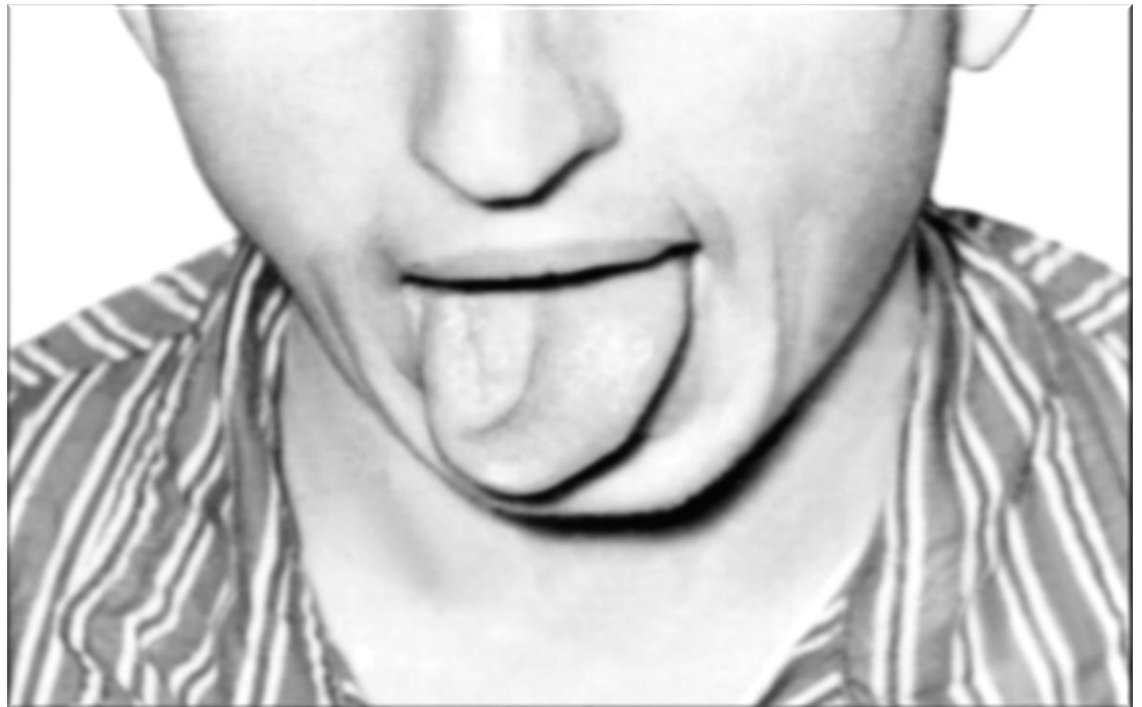
**represents a unilateral lesion of the ventral medial pons:**

- **Ipsilateral rectus paresis, due to cranial nerve VI involvement.**
- **Contralateral hemiplegia, due to pyramidal tract involvement.**

***Jackson Syndrome* — unilateral half-lesion in the inferior part of the medulla**

**Signs are the following:**

- **Ispilateral peripheral-type tongue palsy.**
- **Contralateral hemiplegia.**



***Avellis syndrome* — the ipsilateral cranial nerves IX, X and XII lesion.**

**Signs are the following:**

- **Ipsilateral paralysis of soft palate, larynx and pharynx;**
- **contralateral hemiplegia.**

***Schmidt's syndrome* — cranial nerves IX, X, XI and XII lesion.**

**Signs are the following:**

- **Ipsilateral paralysis of the soft palate, veil of palate, vocal ligament, larynx, half of the tongue, and the sternomastoid and trapezius muscles;**
- **pharinx hypesthesia;**
- **dysphonia;**
- **contralateral hemiplegia.**



***Wallenberg Zakharchenko's syndrome*** — it is the clinical manifestation resulting from occlusion of the posterior inferior cerebellar artery (PICA) or one of its branches.

**Signs are the following:**

- **ipsilateral laryngeal, pharyngeal, and palatal paralysis: dysphagia, dysphonia, diminished gag reflex;**
- **ipsilateral Horner's syndrome;**
- **ipsilateral cerebellar and vestibular signs including ataxia, dysmetria (past pointing), dysdiadokokinesia, vomiting, vertigo, nystagmus;**
- **ipsilateral loss of pain, and temperature sensation on the face;**
- **contralateral deficits in pain and temperature sensation from body (limbs and torso).**

**Postcentral gyrus lesion induces all types of sensation loss on the opposite side of the body. Often occurs monoanesthesia: medial part of the gyrus lesion leads to the upper monoanesthesia, the upper part of the gyrus lesion leads to the lower monoanesthesia. For the cortex lesion the distal parts of the limbs are usually involved.**

**The irritation of the precentral gyrus induces seizures of parasthesia on the opposite side of the body. They are the Jacksonian epilepsy manifestation and may result in generalized seizures.**

**Lesion of the posterior limb of the internal capsule, where the cortico-spinal and thalamo-cortical tracts are located , invokes «the syndrom of three hemy->»:**

- hemiplegia;**
- hemianesthesia;**
- hemianopsia.**

**Rarely, hemyataxia.**

**The thalamus lesion induces «the syndrom of three gemy-» on the opposite side of the body:**

- hemyanesthesia;**
- hemyanopsia;**
- hemyataxia.**

**Often, the thalamus lesion causes peculiar thalamic pain on the opposite side of the body- hemyalgia and hyperpathia. One can feel severe cold sense or burning. The pain is hard to treat.**

**Sometimes the pain becomes stronger in a state of rest and decreases during motion.**

# **Symptoms of the cerebellum lesion**

**The main cerebellum functions are:**

- regulation of the muscle tone;**
- posture;**
- coordination.**

**Gait disorder: the manner of standing is abnormal; the patient walks in a straddle manner, with his body swaying. The patient staggers, reels, and lurches on walking and even fall down towards cerebellum defect.**





**An intentional tremor which is brought on by action and ceases at rest is also characteristic. An intentional tremor is observed at movement, at performance of the finger- nose and the heel- knee test.**

**The patient is asked to keep his eyes close and to touch the tip of his nose with his index finger or the tip of doctors finger with open eyes.**

**The closer to the purpose, the more distinct the tremor of a finger or a hand becomes.**

**Performance of the heel-to-knee test. The patient is asked to lie down and to run the heel of one foot down the shin of the other leg, and then to bring the heel back up to the knee and start again. And to repeat with the other leg.**

**Nystagmus: usually appears when the eyes conjugately deviated to either lateral field, upward or downward. In the cerebellar damage nystagmus has the fast component maximal toward the side of the cerebellar lesion.**

**The adiadochokinesis is revealing by the rapid alternating movements testing: e.g., pronation and supination (the patient's successive movements are clumsy and irregular in time on the side of the cerebellum lesion).**

**Hypermetria is an abnormal form of dysmetria characterized by a dysfunction of the power to control the range of muscular action and causing movements that overreach the intended goal of the affected individual. It is easily examined by following test: the patient hold his hands with the palms extended forward up then quickly turns hands with palms downwards. On the side with cerebellum lesion this movement is carried out with superfluous rotation of a hand.**

**While performing the heel-to-knee test the patient puts his foot above a knee and touches a hip (a hyperflexion phenomenon).**

## ***Pointing test***

**The patient is asked to point at a fixed object with index finger with the eyes open and then closed. With eyes open the patient holds his arm upwards and then lowers it to a horizontal position, so that it points at the investigator's index finger. In damages of cerebellum there are disturbances of coordination and the patient points past.**

**Scanning speech, also known as explosive speech, is a type of ataxic dysarthria in which spoken words are broken up into separate syllables, often separated by a noticeable pause, and spoken with varying force.**

**Hypotonia-decreased muscle tone, which can be examined by the Stewart-Holmes test.**



Gait ataxia with  
"tandem" gait



Finger-finger test  
(intention tremor)



Dysdiadochokinesis



Postural test for position  
sense



Dysmetria (hypermetria)



Rebound phenomenon



Test for gaze-evoked nystagmus



Saccades; gaze-evoked and rebound nystagmus



**Symptoms, signs and localization of the motor tract lesions are the following:**

***A peripheral nerve lesion or involvement of >1 ventral root:***  
**complete paralysis of any particular girdle or extremity muscle, since each of these muscles is innervated by more than one ventral root.**

**A sharp border of a sensory loss in an extremity suggests peripheral nerve rather than root involvement.**

**Cervical, brachial, lumbar and sacral plexuses lesions induce the:**

- flaccid palsy;**
- sensory disorders;**
- pain.**

**Symptoms of the nerve trunks lesions are the same as the corresponding peripheral nerves lesion (in definite combination).**

**The anterior horn and anterior root, cranial nerves motor nucleus lesions cause:**

- segmental flaccid palsy without pain and sensory disorders;**
- lesions of the lower motor neuron and CN motor nucleus induce muscle fibrillations and fasciculation's.**

**The posterior root lesion induces:**

- segmental sensory loss;**
- lancinating pain.**

**The activation of latent human herpesvirus in the spinal ganglions is characterized by herpetic eruption in the cutaneous areas along the course of affected nerves, and associated with neuralgic pain (herpes zoster).**

# **Lesion of the posterior horn of the spinal cord induces:**

- **segmental sensory disorders: loss of pain and temperature sensation, normal proprioceptive sensation (dissociation of sensation);**
- **pain.**

**Lesion of the gray commissure  
(where the decussation of the  
spinothalamic tract takes  
place):**

- symmetric segmental  
dissociation of sensation: loss  
of pain and temperature  
sensation, normal tactile and  
proprioceptive sensibilities.**

**Lesion of the dorsal columns  
(Goll's and Burdach's fascicles )  
induces sensory changes below the  
lesion on the same side:**

- loss of proprioceptive sensibility;**
- paresthesia;**
- sensitive ataxia.**

**The most frequent causes:  
neurosyphilis (tabes dorsales) and  
B<sub>12</sub> deficiency anemia (funicular  
myelosis).**

# **Lesions of the lateral columns:**

- **central palsy on the side of the lesion just below it;**
- **loss of pain and temperature sensation 2-3 segments below the lesion on the opposite side.**



**Brown-Sequard syndrome follows the lateral hemisection of the spinal cord.**

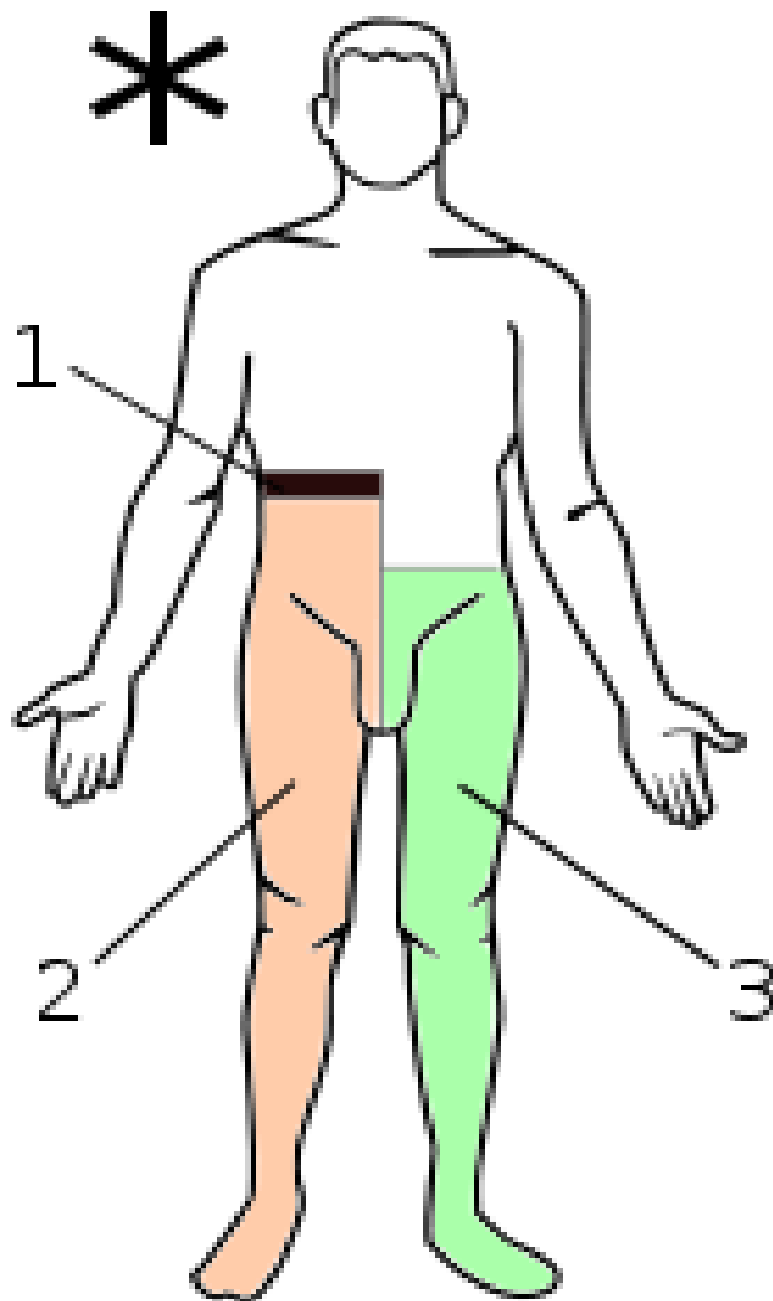
**Ipsilateral signs are the following:**

- **spastic paralysis below the level of the lesion;**
- **loss of tactile discrimination, vibratory, and position sensation below the level of the lesion;**
- **segmental hypesthesia.**

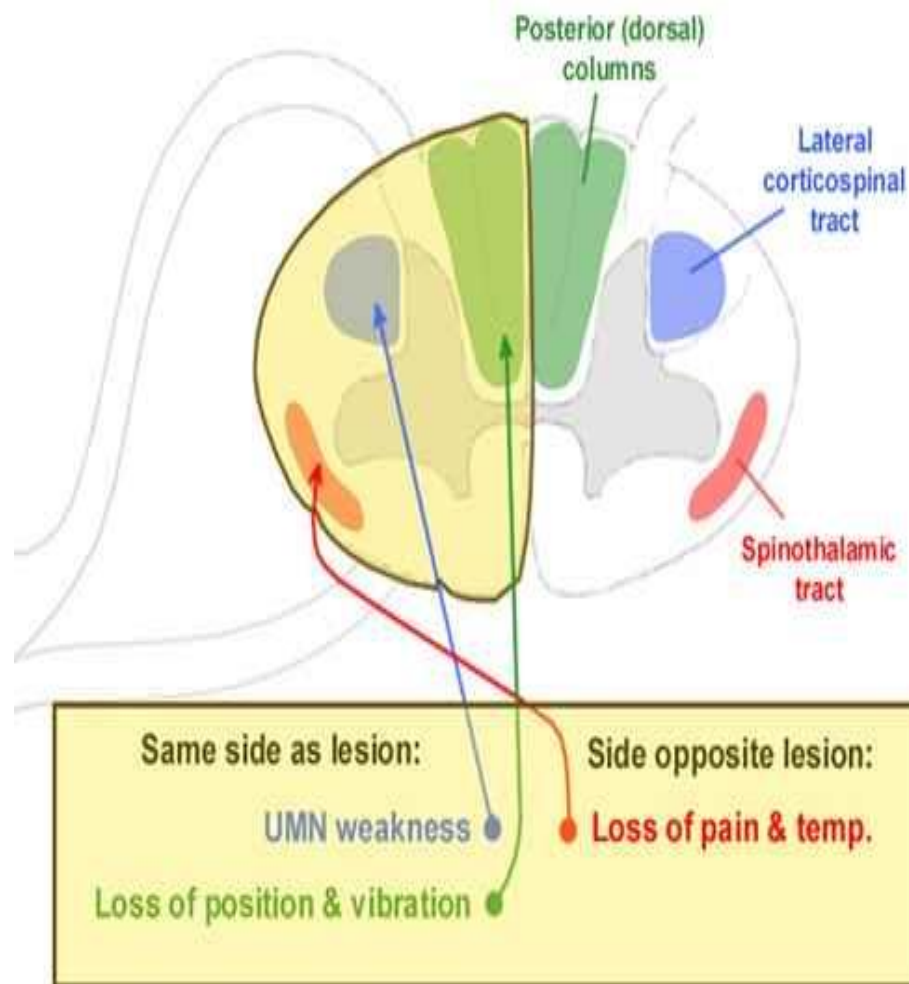
**The major contralateral feature:**

- **loss of pain and temperature sensation 2-3 segments below the level of the lesion (because of crossing of the spinothalamic tracts which mediate these modalities).**

**At the level of the lesion, some segmental motor or sensory signs may occur if the lesion damages dorsal or ventral roots.**



## Brown-Sequard Syndrome of Spinal Cord Hemisection



# **Complete transection of the spinal cord induces:**

- spastic tetra- or paraparesis;**
- loss of all types of sensation below the uppermost level of the lesion;**
- bladder, bowel and genital dysfunction.**

## **Symptoms of the C<sub>1</sub>-C<sub>4</sub> segments lesion:**

- **spastic palsy below the lesion (tetraplegia);**
- **flaccid palsy of the head and neck muscles and diaphragm;**
- **sensory loss below the lesion;**
- **bladder, bowel and genital dysfunction;**
- **lancinating pain in the neck.**

## **Symptoms of the C<sub>5</sub>-Th<sub>1</sub> segments lesion (cervical intumescence):**

- **flaccid palsy of the hands;**
- **spastic palsy of the legs;**
- **sensory loss below the lesion;**
- **bladder, bowel and genital dysfunction;**
- **Horner's syndrome.**

## **Symptoms of the Th3-Th12 segments lesion:**

- **spastic palsy of the legs;**
- **sensory loss below the lesion;**
- **bladder and bowel dysfunction;**
- **trophic changes in the lower part of the body and legs.**

## **L1-S2 segments lesion (lumbar enlargement):**

- **flaccid palsy of the legs;**
- **sensory loss in legs and saddle region (paranesthesia);**
- **bladder and bowel dysfunction.**

## **Conus medullaris ( $S_{III}$ – $S_V$ ) lesion:**

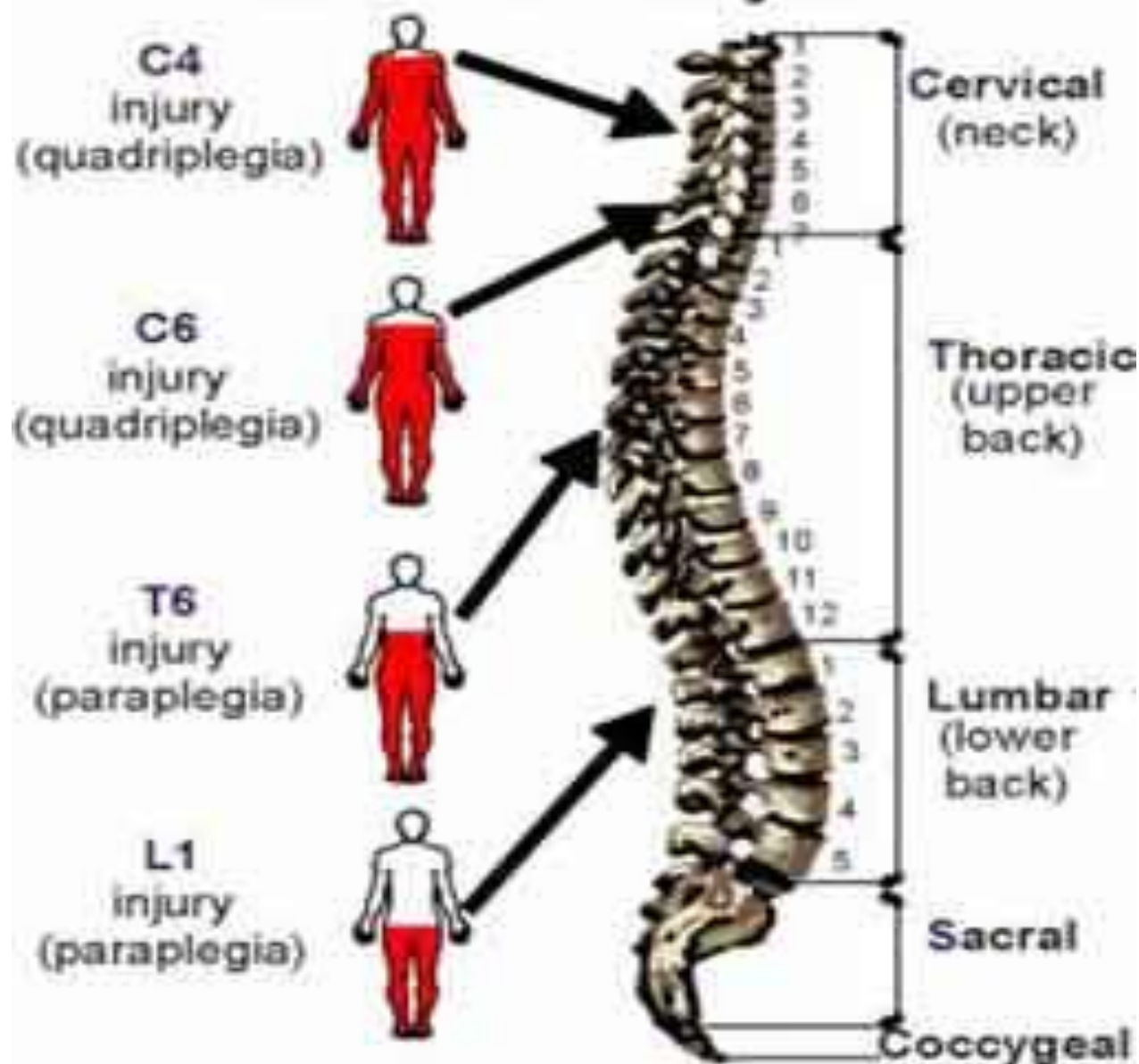
- **sensory loss in saddle region;**
- **lower neuron type of bladder dysfunction;**
- **trophic changes in sacral region;**
- **absence of paralysis.**

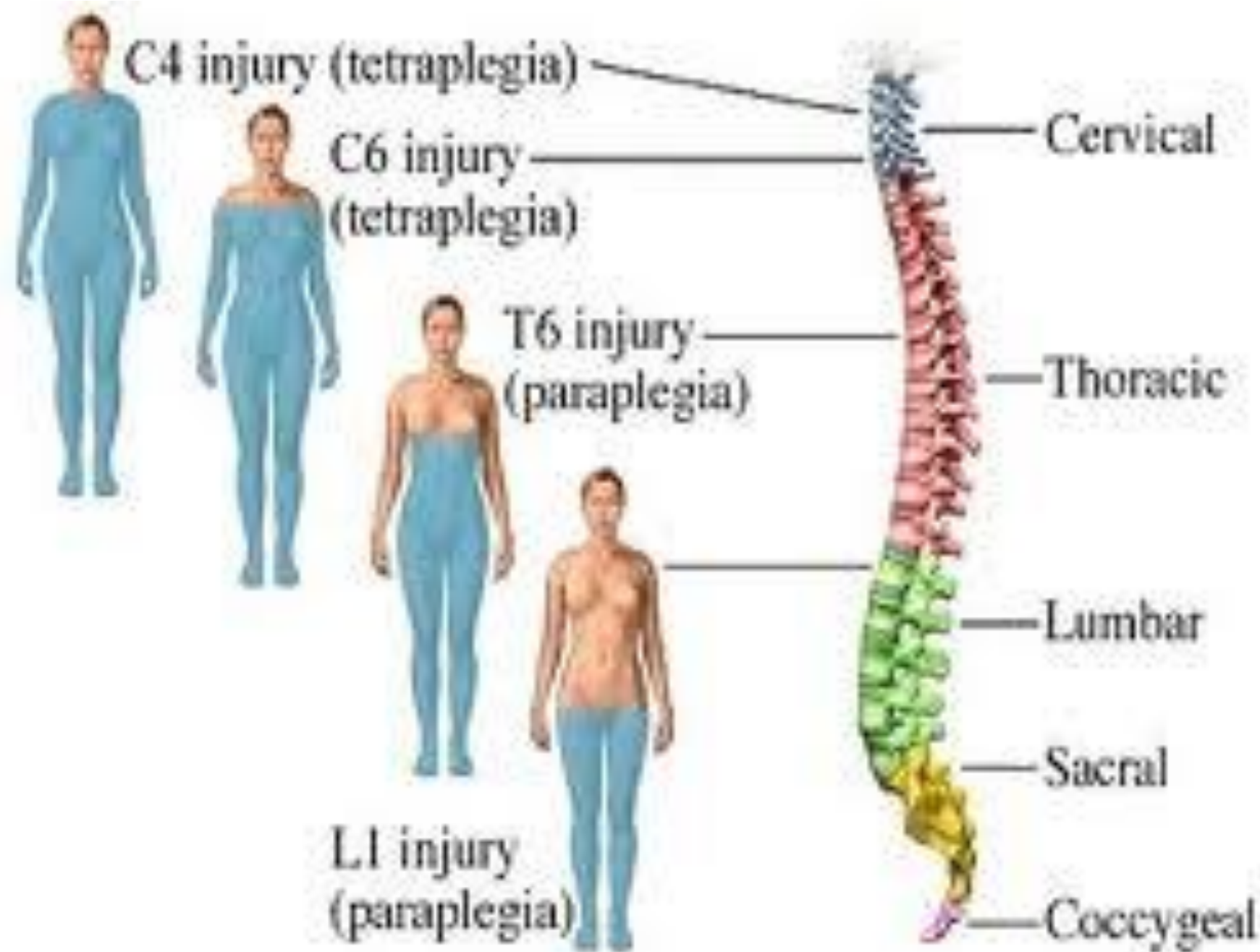
## **Cauda equina ( $L_2$ – $S_5$ ) lesion:**

- **flaccid palsy in legs;**
- **sensory loss in legs, buttocks and saddle;**
- **lancinating pain;**
- **stretch symptoms;**
- **lower neuron bladder dysfunction.**



# Levels of Injury and Extent of Paralysis





# Diagnosing of neurological disorders

## *Skull radiography (craniography) and spinal radiography*

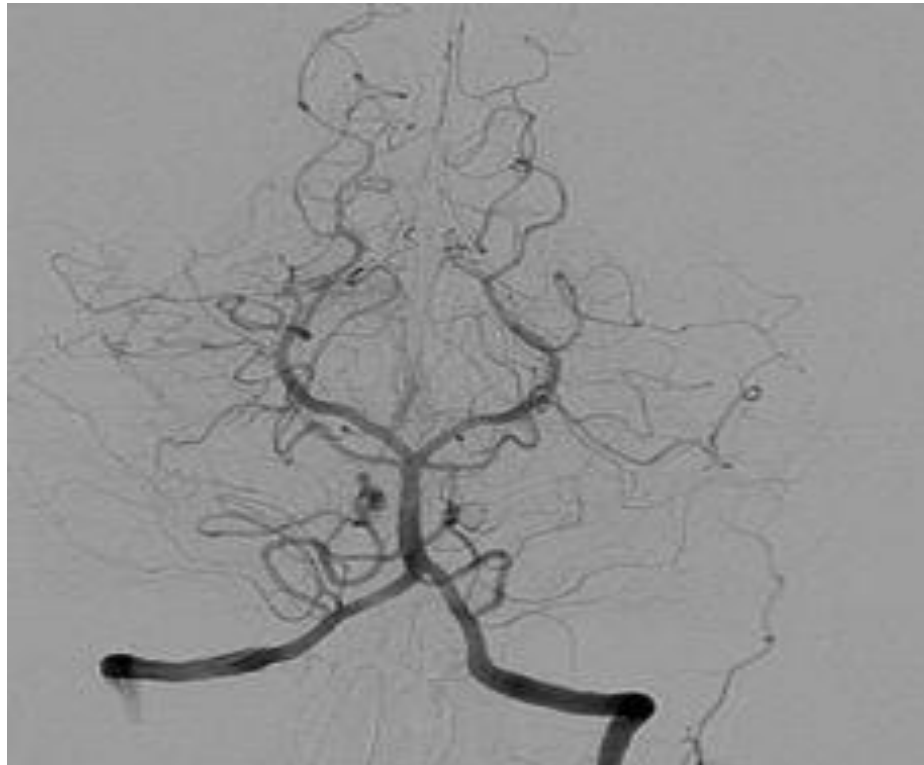
### **Indications:**

- **spine injury and traumatic brain injury;**
- **space-occupying lesions;**
- **degenerative and destructive changes of the brain, skull and vertebrae;**
- **hydrocephaly.**

# ***Cerebral and spinal angiography***

## **Indications:**

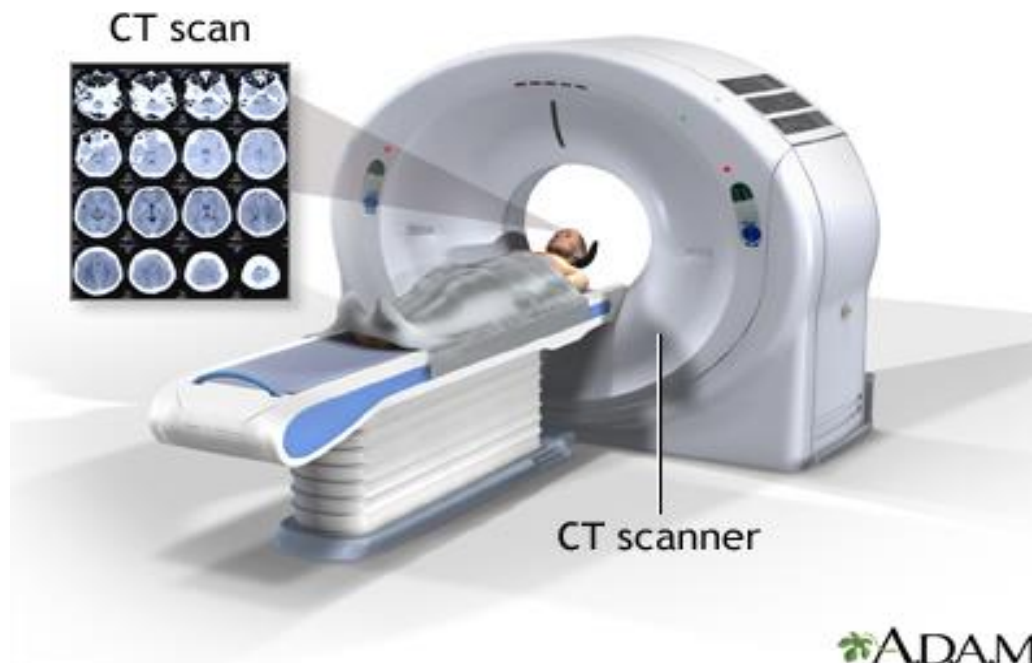
- **saccular aneurysm or arteriovenous malformation of cerebral and spinal vessels;**
- **planning of the operative approach and possible tumor excision.**

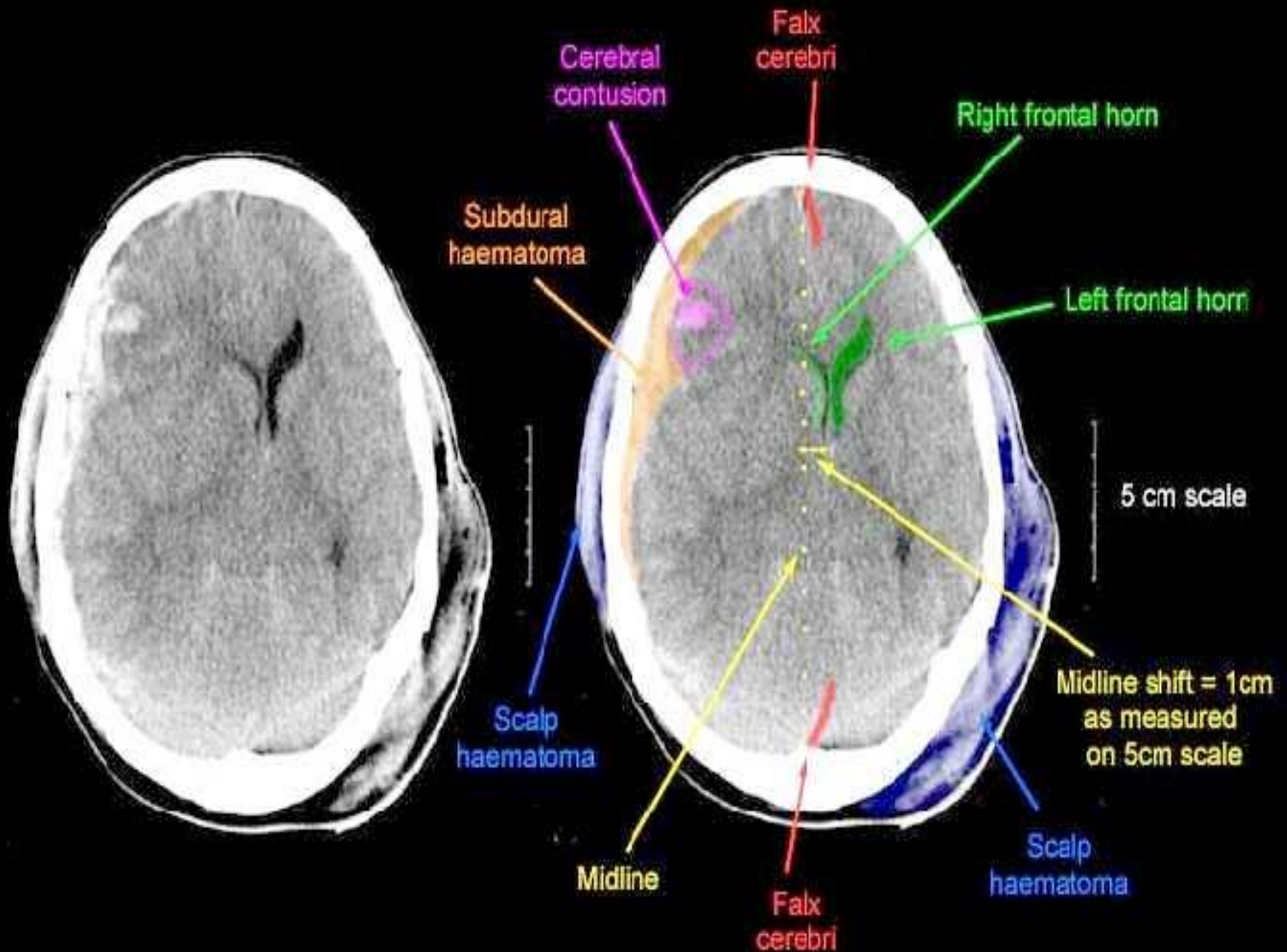


# ***X-ray computed tomography (CT)***

## **Indications:**

- **examination of head tissues, skull bones, brain matter, CSF circulation;**
- **cerebral angiography.**



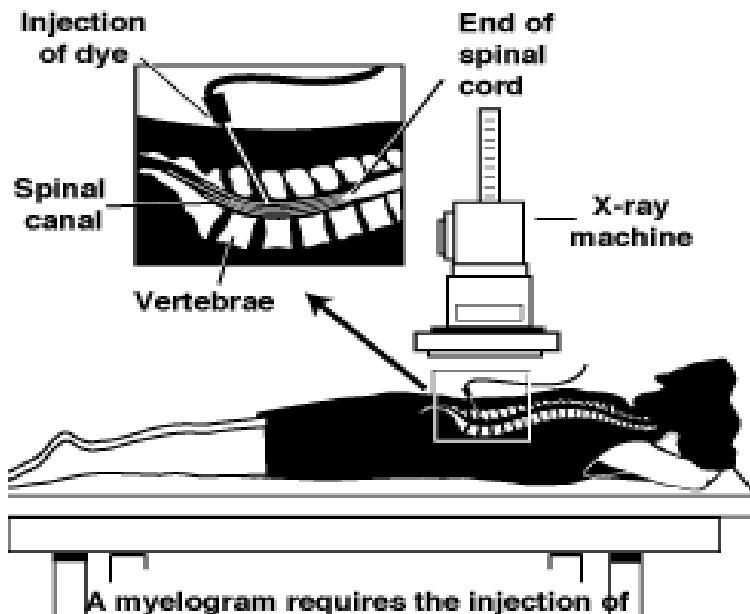




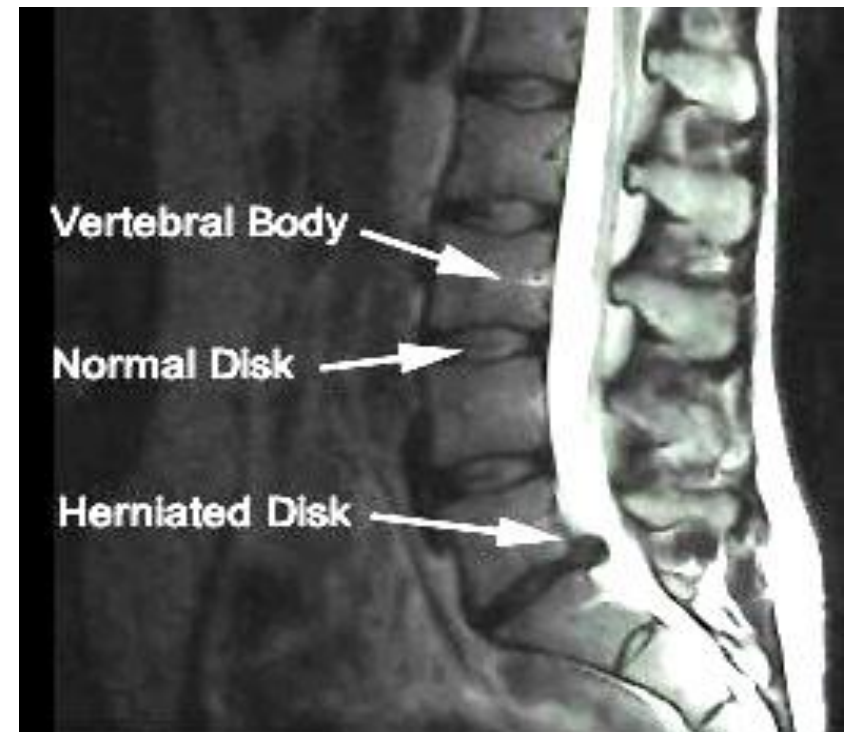
# ***Myelography is often used if there are some contraindications for MRI***

## **Indications:**

- **Herniated disc, Tumors with compression of the spinal cord;**
- **diagnostic of postoperative cicatricial adhesions.**



A myelogram requires the injection of dye into the spinal canal under x-ray guidance. The dye is usually injected in the lower back region (lumbar) and in some cases, in the neck (cervical) area.





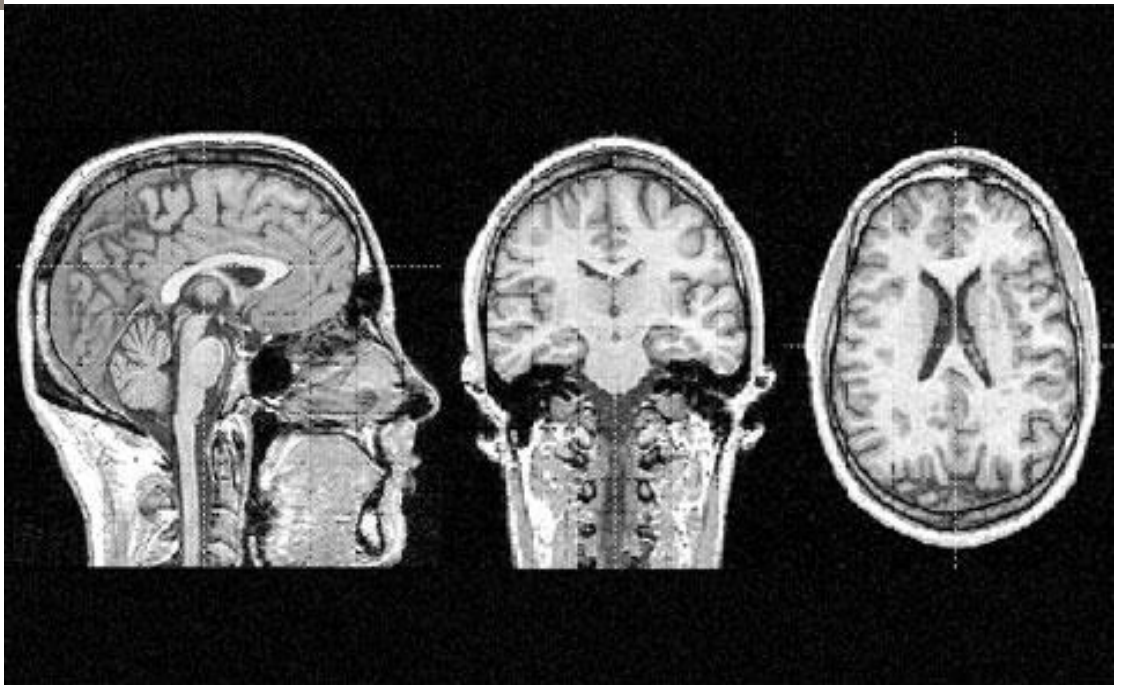
**CT-myelogram sagittal shows the expanding intraspinal low-density mass surrounding by myelogram contrast**



# ***Magnetic resonance imaging (MRI)***

## **Indications:**

- **cerebral and spinal tumors;**
- **vascular disorders, cerebral and spinal malformations;**
- **infectious and neurodegenerative disorders;**
- **parasitic diseases;**
- **cranial trauma;**
- **spinal disorders;**
- **inflammatory cerebral and spinal diseases.**



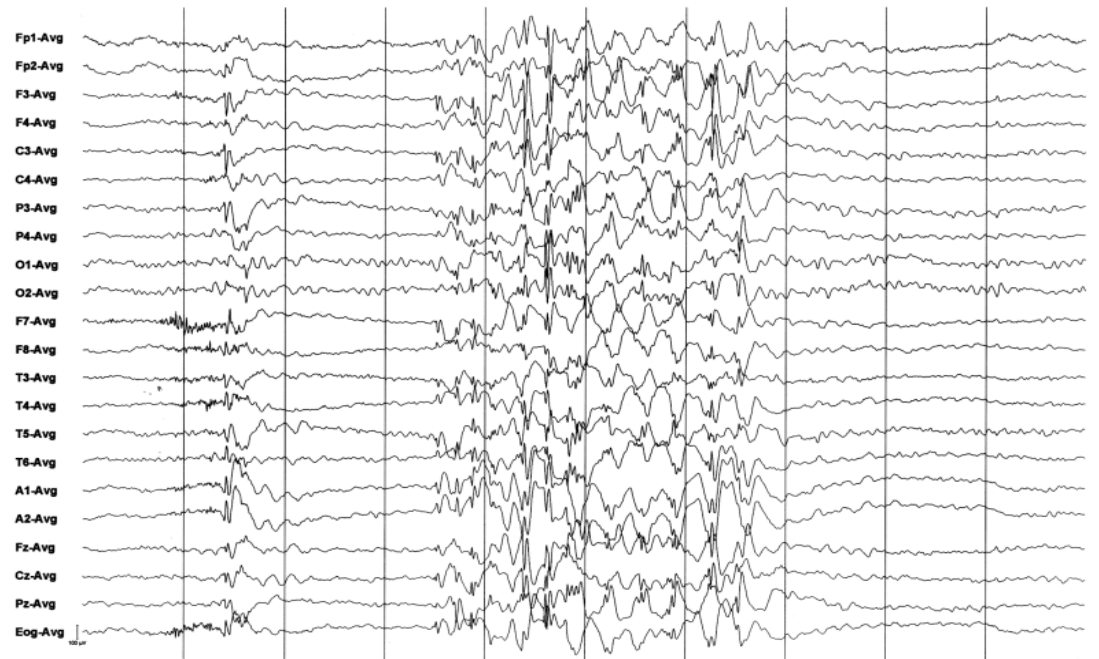
***Electroencephalography*, or EEG, is a neurological test that uses an electronic monitoring device to measure and record electrical activity in the brain.**

**The EEG is a key tool in the diagnosis and management of epilepsy and other seizure disorders. It is also used to assist in the diagnosis of brain damage and disease .**

**An EEG may also be used to monitor brain activity during surgery and to detect brain death.**

**There are four basic types of brainwaves: alpha, beta, theta, and delta.**

**The EEG readings of patients with epilepsy or other seizure disorders display bursts or spikes of electrical activity.**



***Electroneuromyography (EMG)* is an electrical recording of muscle activity.**

**Indications:**

- **Myasthenia;**
- **peripheral nerves lesion;**
- **myodystrophy;**
- **amyotrophic lateral sclerosis**



***Echoencephalography*** is a diagnostic technique during which pulses of ultrasonic waves are beamed through the head from both sides, and echoes from the midline structures of the brain are recorded graphically; shifts from any midline may indicate a centrally placed mass.

