3. Head and neck trauma

Head trauma

Craniocerebral injury is one of the common causes of hospitalization of a patient after trauma.

X-ray diagnostics in traumatic changes of the head is nowadays considered obsolete. It remains possible to use X-ray to detect radiodense foreign bodies (e.g., in the orbit before MRI; otherwise, in acute conditions such as trauma with suspected foreign body in the orbit, CT is always indicated).

CT is considered the gold standard in imaging of traumatic changes. The advantages of CT are particularly high sensitivity for skeletal injuries and detection of bleeding. CT is a widely available and quick examination.

Limitations of CT include low detection of small lesions without bleeding (eg. small contusions) and early stages of hypoxic-ischemic changes that may accompany trauma. Cerebral edema may be difficult to assess on CT scan.

Note: Cerebral edema appears on CT as narrowing of the external cerebrospinal fluid spaces and ventricles, blurring to complete loss of gray and white matter differentiation, and herniation of brain tissue (according to the localization of edema, we divide herniation into subfalcine, transtentorial, and tonsillar). These are relatively late signs of cerebral edema, and therefore, in more severe cranial trauma, intracranial pressure is measured by a sensor inserted intracranially. Edema is shown on CT as hypodense (water has a lower density than brain tissue), fresh bleeding as hyperdense (iron in hemoglobin absorbs X-rays significantly more than the elements forming the surrounding tissues; X-ray absorption depends on the proton number, density of the substance, and the thickness of the layer).

Non-contrast CT examination should be performed whenever the presence of intracranial traumatic changes is suspected (evaluated on the basis of clinical examination and history – e.g., according to GCS).

CT allows selection of patients who must be hospitalized and who may have to undergo surgery.

Intracranial hemorrhage:

- extra-axial: epidural hematoma, subdural hematoma, subarachnoid hemorrhage
- intra-axial: intracerebral hematoma

Contrast-enhanced CT of the head – CT angiography – is rarely performed. It is required in patients with suspected vascular injuries – e.g., pseudoaneurysm, dissection – typically in patients with penetrating injuries, fractures of the skull base and cervical spine.

MR imaging has limited relevance in acute trauma patients. The reasons are, among other things, the well-known limitations of MRI – long examination time requiring patient cooperation, movement artifacts, MR incompatibility with other instruments that may be introduced in the patient (ventilator, monitors, presence of foreign metal bodies, etc.). Although MRI provides a high tissue contrast (for example, it can better detect small contusions without macroscopic hemorrhage), compared to CT it does not provide information in the acute phase that would fundamentally affect the therapeutic management of an injured patient.

In the second period, after stabilization of the patient's condition, MR can be used to confirm suspicion of diffuse axonal injury (DAI), in which multiple small lesions of nerve pathways are found in typical locations in the brain tissue (at the white-gray matter interface, in the corpus callosum, in brainstem and cerebellum).

Note: Usually, the diagnosis of DAI is made only when the originally sedated patient is awakened, when an extensive neurological finding does not correlate with a relatively small finding on imaging methods. We perform MR to confirm DAI only exceptionally in case of diagnostic uncertainty.

Neck trauma:

X-rays of the cervical spine are among the frequently requested examinations.

On the one hand, the examination is easily accessible, but its main limits often include poorly displayed craniocervical and cervicothoracic transition (C7 is often not visible due to summation with the shoulders, inaccurate projections in patients with limited cooperation / patient's condition, etc.).

However, X-rays of the cervical spine are still considered reliable enough to rule out severe traumatic changes. In particular, the negative predictive value of well-executed images is very high. Therefore, they are still indicated.

CT imaging is also among the accessible, easy, and quick to perform methods, with a higher sensitivity in detection of skeletal injury than X-ray, but at the cost of higher doses of ionizing radiation (side effects depend on the dose in the irradiated neck - especially irradiation of the thyroid) - therefore, CT should not be performed in all patients without selection.

Unlike X-rays, CT is able to visualize some soft tissues injuries.

CT of the cervical spine is also indicated:

- in case impossibility of standardized X-rays, in case of a suspicious X-ray finding, to specify the extent and degree of cervical vertebra injury. It can done even with a negative X-ray if clinical suspicion of trauma persists. The sensitivity of CT in vertebral injuries can reach 100%. The limitation for CT is injury of the discoligamentous complex of the cervical spine, where the gold standard is magnetic resonance imaging.

The associated vertebral artery injury that we see in transverse process fractures is confirmed by CT angiography of the carotid arteries.

MRI

MRI is generally indicated when findings on CT do not fully explain the clinical problems (e.g. quadriparesis). Indications may include suspected injury to the **discoligamentous apparatus** or **spinal cord** (suspicion of spinal cord injury is one of the indications for acute MR), as well as in case of suspected **bleeding in the spinal canal,** such as epidural hematoma.

Limitations - general contraindications of MRI, length of examination (patient must lie on his back).

Among the most common pathological findings on MRI in trauma are discoligamentous injuries (acute disc herniation, injuries of the anterior and posterior longitudinal ligaments), less often spinal cord contusion and epidural hematoma.

Additional notes on cervical spine injuries

The upper cervical spine (C0-2) consists of the occiput (C0), atlas (C1), and axis (C2). The injuries located here represent about 1/3 of all injuries of the cervical spine. They are most often caused by traffic accidents, falls from great heights, or jumps into the water. Due to the anatomical differences of the individual segments, the types of injuries are completely different. In general, there are fractures of individual segments or injury of their mutual relationship (luxation injury).

- Occipital condyle fracture
- Atlantooccipital dislocation - a rare injury with a fatal course
- Atlas fractures (Type I anterior arch fracture, Type II posterior arch fracture, Type III combined anterior and posterior arch fracture (Jefferson), Type IV massae lateralis fracture, Type V transverse process fracture)
- Traumatic atlantoaxial instability
- Odontoid fractures (fracture of dens axis) by Anderson and D'Alonzo (Type I - fracture of apex dentis - shearing mechanism, dens in contact with the foramen magnum, avulsion of alar ligaments. Type II - fracture of the dens not affecting body C2, unstable. Type III - fracture line extends into the body C2, relatively stable)
- Traumatic spondylolisthesis C2 (7% of all cervical spine injuries in patients of all ages (even the youngest patients)) is called hangman's fracture. Classification: Effendi I - stable non-dislocated fracture, C2/3 intervertebral disc uninjured. Effendi II - C2 body dislocated forward, C2/3 disc rupture. Effendi III - Type II + unilateral C2/3 dislocation.

Injury of middle and lower cervical spine C3-C7

Injury to the middle and lower cervical spine represent 80% of all C-spine injuries. With degenerative changes, minimal trauma is sufficient to injure the spinal cord (the vertebral canal is often narrowed by degenerative changes and the spinal cord "has nowhere to dodge"). The most common injury is at the C5/6 level (degenerative changes also most often develop first in this level). Neurological symptoms accompany these injuries in 60-75%.