Blunt injuries to internal organs

Injuries to internal organs due to blunt force can be caused by direct or indirect mechanisms.

Blunt injuries to internal organs

Brain

The nature of a blunt force brain injury corresponds to the size of the area that is applied to the head. The effect of a small area will rather result in a locally limited and circumscribed injury.

Concussion

A concussion (*commotio cerebri*) is more often caused by blunt force over a large area, which apparently leads to reversible damage to the neuron membranes. This functional state, with immediate onset, has no morphological basis. Vasomotor and vegetative symptomatology appears. The duration of unconsciousness indicates the severity of the injury. Headaches, nausea, vomiting and amnesia for the duration of the injury are also characteristic. Post-concussion syndrome is also common..

Cerebral contusion

In contusion of the brain (*contusio cerebri*), numerous blood clots appear in the cortex and white matter. These signs of bleeding can be found not only in the places of impact (*coup*), but also on the opposite side (*contrecoup*). In the localization of contrecoup, haemorrhages occur especially often in the elderly, which is mainly due to reduced flexibility of the skull which means it flattens less during impact. Brain tissue is more sensitive to the negative pressure at the site of the contrecoup than to the positive pressure that is present at the site of the coup. In the posterior fossa, cranial negative pressure does not occur, because it is immediately equalized due to the suction of cerebrospinal fluid from the spinal canal.

Cerebral contusion with subdural hemorrhage and fractures - CT image

Tools with a smaller surface area cause a defect mainly at the point of contact and on the opposite side only in case of higher intensity. With **large surface area tools**, multiple injuries in both locations are common. There are also deep contusions, which manifested by bleeding mainly into the corpus callosum, the white matter of the frontal and temporal lobes, the basal ganglia, the brain stem and the cerebral ventricles. The course of the injury is also affected by secondary changes, which are related to impaired circulation and the development of brain swelling. These are hypoxic damages, manifested only after a certain period of time after the trauma. The formation of diffuse cerebral edema and intracranial hypertension leads to occipital and temporal conus.

Diffuse axonal injury

Diffuse axonal injury, often combined with contusion injury, is a common cause of death in craniocerebral trauma. Quantitative disorders of consciousness are thought to be caused by a functional or structural disruption of the brainstem-cortex connection. Prolonged coma is most likely related to severe and extensive axonal injury. The diagnosis of this pathology in the early phase (10-14 hours after the trauma) is based on the finding of expansion, swelling and, above all, rupture of axons (can be demonstrated by Palmgren staining). At autopsy, the changes manifested as hemorrhagic lesions mainly in the white matter of the hemispheres, the corpus callosum, in the vicinity of the third ventricle and in the dorsolateral quadrants of the midbrain at the entry points of the upper cerebellar peduncles. CT and NMR examinations are used for diagnosis. Traumatic intracranial extracerebral hemorrhages include: subarachnoid, subdural, and epidural hemorrhages.

Subarachnoid hemorrhage

Subarachnoid hemorrhage is a very common finding in brain contusions. However, the extent of this bleeding is usually not immediately threatening the patient's life. It occurs mainly on the convexities of the brain in the form of hematomas of various sizes. Rarely, it also has an arterial origin (injury of the basilaris or vertebral artery), which is caused by a sharp blow to the lower part of the face with excessive tilting and rotation of the head. Arterial bleeding spreads rapidly and death occurs very quickly. In the differential diagnosis, we think of spontaneous rupture of aneurysms.

Subdural hemorrhage

Subdural hemorrhage is more common than epidural and has acute, subacute or chronic forms. It is caused by injury to **bridging vessels** as a result of blunt force, which can be of lesser intensity (without contusion and skull fracture). **Acute subdural hemorrhage** occurs most often with more serious head injuries at the same time as contusion of the brain. Manifestation is intracranial hypertension in the first days after the trauma. To save life, trepanation with aspiration of blood effusion is necessary. A small hematoma can be absorbed or turn into a **chronic subdural hematoma**, which gradually becomes encapsulated, forming a bag with filling (subdural hygroma). The enlarging hygroma sac can be fatal!

Epidural hemorrhage

Vzniká nejčastěji poškozením ***a.meningea media*** nebo jejích větví při fraktuře lebky (méně často ethmoidální arterie, splavy či diploické vény). Nejčastější lokalizace krvácení je v temporální krajině. Doba latence po traumatu bývá výrazně kratší než u krvácení subdurálního. Zraněný umírá zpravidla do deseti hodin. Krevní výron může mít až 200 g. V této problematice dochází často k diagnostickým omylům a to zejména u opilých lidí s nepatrným nálezem poranění hlavy a může tak dojít k fatálnímu prodlení v poskytnutí nutného chirurgického ošetření.

Subarachnoid hemorrhage - CT image

It is most often caused by damage to the **medial meningeal artery** or its branches during a skull fracture (less often ethmoidal artery, venous sinuses or diploic veins). The most common localization of bleeding is in the temporal region. The latency period after trauma tends to be significantly shorter than for subdural hemorrhage. The casualty usually dies within ten hours. Hematomas can weigh up to 200 g. Diagnostic errors often occur, especially in drunk people with minor finding of head injuries, and this can lead to a fatal delay in providing the necessary surgical treatment.

Thorax

Rib fractures, lung, heart and pericardium injuries occur most often in this area.


Subdural hematoma - CT image

Ribs

Their fractures occur directly or indirectly. Often in the elderly. Indirectly, a rib fracture can occur, for example, even when coughing. Fractures are less common in children and younger people. Complications can be lung injury, pneumothorax,...

Lungs

Blunt violence injuries are caused directly by compression of the chest, fragments of ribs or indirectly - for example, upon impact in falls from a height. Strong compression of the chest, especially in young people (even without a rib defect), can lead to lung damage. Focal contusions and intrapulmonary hematomas can also occur even without pleural damage. A hemothorax or pneumohemothorax occurs when the pleura is torn. Rupture of one of the branches of the bronchi leads to penetration of blood into the lumen and subsequent aspiration of blood.

Heart

The injury is caused either by direct force exerted on the heart area or by compression of the chest in the sagittal direction. Tears can be partial, affecting mainly the epicardium and endocardium, or complete (more common on the right heart), affecting the ventricle or atrium. Rapid bleeding is fatal and death occurs within minutes due to cardiac tamponade. Partial or complete ruptures of the septum, heart valves and papillary muscles can also occur. Blunt violence to the cardiac landscape can lead to a **cardiac contusion** (*contusio cordis*) which leads to focal bleeding into the heart muscle. If the patient survives, the contusion will heal with a scar. **Cardiac concussion** (*commotio cordis*) rarely leads to death, rather it manifests itself in functional disorders.

Thoracic aorta

The injury most often occurs above the valves and in the arch after the connection of the large neck vessels (i.e. at the point of fixation) as a result of compression of the chest (*being caved in, ran over*, *crushed*). Cracks occur that are complete (affecting the entire wall) or partial. A dissecting aneurysm may also occur.

Abdominal organs

Liver

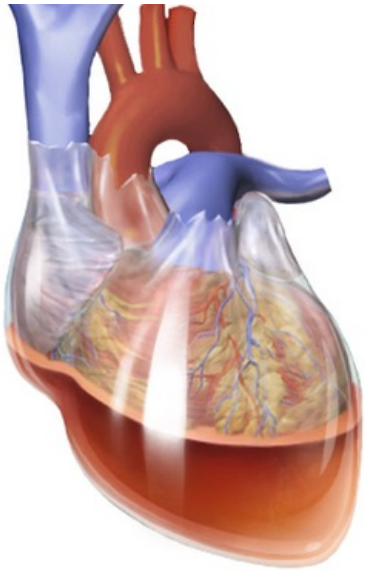
They are the most frequently injured organ in the abdominal cavity. The mechanism of injury is either a direct application of force to the liver landscape or an indirectly by falls on another part of the body. The capsule is torn, especially on the upper surface of the right lobe, and **subcapsular hematomas** appear, which are often symptomless (and therefore dangerous). If the subject is not at rest, there is a risk of rupture of the capsule and hemoperitoneum. So we are talking about two-stage ruptures, which can have a significant latency. Tears of the liver can be superficial and deep. Part of the liver can be torn off or the liver is torn into several parts of different sizes or even crushed (e.g. when run over). Central fissures of the liver are mainly seen in children and young people. Iron

Spleen

Injury to the spleen is common. The mechanisms of formation are again direct or indirect. A spleen enlarged by a pathological process (e.g. infection) is not very resistant and its damage can also occur spontaneously. Injuries manifested by cracks in the capsule, which extend to different depths into the tissue. An intraparenchymal hematoma can also form, which when enlarged can also spread subcapsularly, which can cause necrosis of the capsule, which can later lead to hemoperitoneum. The situation is similar to that of two-stage liver tears, and there is a risk that the injury will not be detected in time. Sometimes the vessels of the spleen in the hilum region are ruptured or the spleen is completely detached from its attachment. Iron

Kidneys

Due to their location, their injuries are not that frequent. Direct injuries are caused by impact to the kidney area or compression of the kidney simultaneously with pressure on the 12th rib. When falling from heights onto the lower part of the body or to the side, they can be injured indirectly. When lifting a heavy load, the kidneys can be injured by the sudden sharp contraction of the abdominal and lumbar muscles. The injury can manifest as a rupture of the renal capsule, a subcapsular hematoma, or a rupture of the capsule and tissue simultaneously or rupture of the calyces and pelvis. Tears often occur in the hilum and go across the kidney, the entire kidney can get torn. This occurs when the kidneys are excessively displaced outwards, often when falling on the back, jumping from a height, and being run over. Patients with kidney injury are at risk of bleeding into the retroperitoneum, shock and infection.



Cardiac tamponade

Stomach

The injury most often occurs when the stomach is full and blunt force is applied on the abdomen or the lower part of the chest, which sharply presses the stomach against the vertebrae. Ruptures usually occur on the back wall between the lesser and greater curvature and can also affect the entire stomach wall (all its layers). The patient is at risk of bleeding, shock and peritonitis.

Small and large intestine

Intestinal injuries are most often caused by direct violence applied on the abdominal region. An indirect mechanism is rare and it is most often a fall from a height. The entire wall or just the serosa or mucosa can be bruised. Contusions or tears of the mesentery often occur simultaneously and it can even separate from the intestine. Contusion of the mesentery can lead to thrombotisation of its vessels! At the site of intestinal contusion, hematomas occur, leading to subsequent necrosis of the wall and perforation of the intestine.

Pancreas, Bladder, Urethra and Abdominal Aorta

Injury to these organs and structures rarely occurs in blunt trauma to the abdomen. Blunt force to the epigastrium can injure the pancreas and cause a bruise or tear, often other abdominal organs are injured at the same time. Pancreatic injury has a high mortality rate. The affected person is at risk of hemoperitoneum, necrosis of the pancreas, formation of pseudocysts, infection, peritonitis. The urinary bladder (sometimes with the urethra) is often injured by fragments of the pubic bone or by excessive tension of its wall during the separation of the symphysis, which is mainly at risk of infection.

Skeletal system

Fractures and luxations of the bones of the limbs appear, as well as fractures of the rest of the skeleton. The mechanisms are both direct and indirect. According to the nature of the fracture together with other injuries, it is often possible to conclude that it was an accident. If soft parts and skin are injured at the same time as a fracture, open fractures occur. Fractures of the limbs, unlike fractures of the trunk and skull, are usually recognized on examination by deformation, abnormal mobility and crepitation. Fractures of the skull can be recognized by indirect signs, such as, for example, a racoon eyes (periorbital ecchymosis), which occurs mostly in fractures of the anterior cranial fossa. Bleeding from the ears with a fracture of the middle cranial fossa and bleeding from the mouth/nose with a fracture of the posterior and anterior cranial fossa. For those who died as a result of a traffic accident, the easiest way to detect all fractures is an X-ray examination of the whole body.

In closed fractures, there is sometimes significant blood loss that can lead to severe shock. Estimated blood loss from a forearm fracture is 150–200 mL, arm 200–400 mL, lower leg 500–600 mL, thigh 1,000–1,500 mL, and pelvis 1,000–2,000 mL.

Skull fractures

The mechanism is direct and indirect violence.

A blunt object on a small surface creates fractures at the site of violence, which often have the shape of a tool. Fragments can be driven into the skull cavity (*depressed fracture*). Straight cracks often emerge from the centre of the fracture, these are important for determining the priority of wounds (if there are more wounds). A fissure proceeding from a later-formed fracture ends in a fissure that arose earlier. Rectilinear slit-like cracks or **fissures** are created by the impact of a blunt object with a large area and run in the direction of the violence from the place of violence to the base of the skull. E.g. violence to the occipital region may be manifested by a fissure extending to the foramen magnum or may extend to the middle or anterior cranial fossa. In case of violence from the side to the temporal region, the fissure runs transversely through the middle cranial fossa (it can also cross to the other side via the Turkish saddle). When violence is applied to the places of the greatest curvature of the skull, multiple fractures of the concentric arrangement can occur, thus creating a so-called **terrace-like fracture**.

A typical indirect fracture of the base of the skull is the collapse of the roofs of the orbits, which is caused by the effect of blunt force on the occipital region. It is also common to break the foramen magnum when falling on the buttocks or as a result of violence acting on the vertex of the head. Preservation of the atlanto-occipital connection can lead to bone avulsion in the vicinity of the foramen magnum. A fracture of the base of the skull by an indirect mechanism can also be caused by force from below on the chin, when the force (if there is no fracture) is transferred to the base of the skull at the places of the temporomandibular joint. Brainstem injury often occurs at the same time. We can encounter these fractures mainly in frontal collisions during traffic accidents, when the victims are unseated passengers who hit an obstacle with their chin.

Spine

Direct fractures or luxations occur from impact on the back from a fall, being ran over or compression. Indirect fractures occur as a result of sudden strong bending or rotation of the spine. These mechanisms can be combined. **Fractures of the cervical spine** in the C_4–C_7 region are caused by excessive flexion. On the contrary, the C_1–C_3 region is affected when the head is tilted excessively. The dens axis breaks with excessive extension, less often with excessive flexion of the head. A contusion of the spinal cord occurs if the ligament is torn prior. transversus. **Fractures of the thoracic spine** by direct violence are caused by impact on the back. By an indirect mechanism, vertebral spinous processes can be torn off as a result of a sharp muscle contraction (e.g. *lifting a heavy object*, *tetanic convulsions*) or during an impact in the direction of the long axis of the spine (usually accompanied by its flexion). **Lumbar spine fractures** occur mainly at its transition to the thoracic spine (Th_{12} to L_2 fractures are the most common). These are mostly indirect fractures that occur during a fall (on the legs or buttocks). The transverse processes of the lumbar vertebrae are often broken by the pull of the muscles during strenuous work or during spasms.

Pelvis

Pelvic fractures occur as a result of falling from a height, being run over, buried under etc. The **iliac wing** is broken by direct force (*Duverney's fracture*). The **thorn of the hip bone** or the **hump of the ischial bone** can be torn off by pulling the muscles, i.e. by an indirect mechanism. In the case of violence from the front, side or buttocks, a fracture of the **pubic bone** occurs. The fracture line can be transverse or oblique, and sometimes the ischial bone can also be broken at the same time. A fracture of the **sacrum** occurs directly - by impact, and the fracture line has a transverse course. A comminuted **acetabular fracture** of the can occur due to force on the trochanter, and with great force the femur head penetrates into the small pelvis (so-called central dislocation of the femur). The heaviest fracture of the pelvis is a vertical fracture, resulting from violence from the side to the pelvic region (the fracture line runs from top to bottom through the entire pelvis, the so-called *Malgaigne fracture*). In the case of these larger fractures, the victim is at risk of significant bleeding and shock, and later, during long-term hospitalization in bed, especially in the elderly, pneumonia and thromboembolic complications.

Links

Related articles

- Blunt injuries
- Bone fractures
- Brain contusion

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