

# TRAUMAS



## HEMORRHAGE

Hemorrhage is the more or less severe loss of blood caused by a flesh wound. The greater the amount of blood loss, the higher the risk and the severity of the ensuing shock.

There are three types of hemorrhage:

### Capillary

Minimal blood loss: a few drops of blood are leaking from a very superficial injury.

### Venous hemorrhage

Blood flows continuously.

### Arterial

Blood is exiting the wound by irregular streams, because it is propelled by the heart's beats.

**The severity of a hemorrhage is directly related to:**

- venous or arterial bleeding;
- the point of origin of the bleeding;
- the amount of blood lost;
- the age and the weight of the victim;
- the general physical state of the victim.

### Note

Any ruptured tissue or blood vessel can cause a hemorrhage susceptible of provoking a state of hypovolemic shock.

If the victim has been bitten, for example by an insect or an animal, the hemorrhage must be controlled and medical help must be called to evaluate the risk of infection as well as the needs for immunisation.

Treating a hemorrhage requires latex, vinyl or nitrile protection gloves to avoid contracting blood-borne diseases or diseases spread by other organic liquids (e.g. HIV, Hepatitis B and C, etc.) even though the risk of transmission is very low.

### Did you know?

Certain circumstances can make hemorrhages difficult to control.

The victim can suffer from a blood clotting anomaly. The absence of clotting factors can be severe, since they are necessary to stop the bleeding. These persons will generally inform you of their condition or will be wearing a MedicAlert bracelet; it is not necessary to check with every hemorrhage victim.

Another, more likely situation is that the victim uses an anti-clotting medication (e.g. Coumadin, Pradaxa, Xarelto etc.) for a specific health condition. Make sure to ask the victims – they will usually be able to inform you of such medication usage.

For more details concerning hemorrhages and their particular situations, see the article *Comment cesse normalement une hémorragie?* in the *Alerte Plus* magazine, spring/summer 2013 edition.

## SPINE INJURIES

The spine is comprised of a series of vertebrae stacked on one another. These vertebrae form the bone structure that protects the spinal cord. A fracture on the spine must therefore be treated in a particular way.

The majority of spinal fractures happen in the cervical and lumbar regions, i.e. the most mobile regions of the spine. These regions can bend to absorb shocks suffered by the spine.

### Causes

Any direct or indirect shock to the spine which forces it to bend beyond its limits.

For example:

- a fall of a certain height;
- a ski accident;
- a dive in shallow waters;
- an abrupt stop in a car.

## Signs and symptoms

There are three pathophysiological mechanisms responsible for the signs and symptoms of medullar injuries: rupture, compression and spinal ischemia, or a combination thereof.

The spine can thus be severed or even compressed, either by a crooked bone or by an accumulation of blood between the spinal cord and the vertebra. The symptoms may vary depending on the region of the injury.

This lateral view of a section of the spine illustrates a severance of the spinal cord at the lumbar level. The symptoms are anesthesia and paralysis of inferior limbs. If the victim survives the accident, they could become paraplegic (paralysis of inferior limbs).



This lateral view of a section of the spine (left) illustrates medullar compression at the cervical level. The symptoms are anesthesia and paralysis of the whole body, starting from the neck (tetraplegia). If the compression is light, it can manifest as weakness in all four limbs (paresis), or even by the absence of any symptom.

This lateral view of a segment of the spine (right) illustrates a fracture without direct damage to the spinal cord at the cervical level. This situation does not immediately cause apparent symptoms; however, if a hematoma, i.e. an accumulation of blood, forms between the spine and the injured vertebra, the same symptoms as those described above will be observed, because of compression. In the event of a bad movement, this type of fracture can sever the spine – thus the importance of immobilizing victims susceptible of having spinal trauma.



## Signs and symptoms of a spinal cord injury:

- presence of a local deformation of the vertebra (strange position);
- possibility of swelling or coloration at the cervical or lumbar level;
- local pain in the spine;
- possible presence of a muscular tension (cervical or lumbar muscles) or muscular spasms in the 4 limbs;
- partial paralysis of the lower and/or upper limbs, manifested by a decrease in muscle strength (paresis);
- total paralysis of upper and/or lower limbs;
- strange sensations, such as tingling, formication, etc. (paresthesia);
- if the fracture is located at the cervical level, it can lead to a respiratory arrest, since the nerves controlling the diaphragm (phrenic nerves), the main breathing muscle, are located in this section of the spinal cord.

## HEAD INJURIES: HEAD AND FACE TRAUMA

Head and spinal injuries have to be carefully taken care of, due to the extreme fragility of the brain and of the spinal cord. Furthermore, since these injuries are often hidden, it is important that the rescuers make sure to be well aware of the circumstances of the accident and the nature of the shock in order to apply adequate treatment.

## Cranio-cerebral trauma

Cranio-cerebral trauma (or CCT) are traumas that cause a destruction or dysfunction of the cerebral cells, i.e. the neurons and their projections (called axons) are damaged by a shock between the brain and the skull. These can be caused by a direct hit to the head (which may or may not cause a skull fracture), by a penetrating object or by a simple mechanism of acceleration, deceleration and/or rapid rotation of the head.

CCTs are classified according to different categories, depending on their gravity (for example light CCT – or LCCT – severe CCT or SCCT, etc.) and on different specific criteria described in the medical literature. Many different conditions can be found among CCTs. Sometime, when talking about light CCT (LCCT), we use the old terminology, such as the notion of concussion or contusion. However, in order to be able to claim that a victim is suffering from a concussion, various medical tests must be conducted. Consequently, a rescuer is not in a position to confirm that a victim is actually suffering from a concussion – they should only infer that the victim is suffering from a cranio-cerebral trauma.

A concussion happens when the brain has been violently shaken inside the skull. It usually comes with a short loss of consciousness and there are usually no signs or symptoms associated with specific or localized cerebral damage. Damages are usually temporary. In the case of a contusion, there is a presence of focal signs, i.e. it is possible to indicate one or many precise zones where the brain has been injured. A contusion can lead to multiple disorders which can cause morbidities. This type of injury is thus more serious than the concussion and requires a longer convalescence.

Different types of skull fractures exist, depending on the CCT mechanism. The skull is often fractured following a direct hit, such as after a fall or an impact from a blunt object which bruises or injures without cutting. The base of the skull, on the other hand, is usually fractured by an indirect force, such as an impact on the lower mandible or landing a fall on the feet without softening it by bending the knees.

During a CCT, it may happen that some blood vessels become damaged and burst inside the skull. The phenomena creates a cerebral hemorrhage, often in the form of a hematoma, i.e. a contained and localised collection of blood. Since the brain is a fragile structure occupying the totality of the skull's space, hemorrhages cause an increase of pressure, highly damaging to the cerebral structures' normal functioning. This phenomenon is called intracranial pressure (ICP). The brain can thus be compressed by the hemorrhage. It is imperative that the hematoma be drained to avoid this type of problem, hence the importance of rapidly transporting the victim to a medical center. A hematoma can even induce a cardiorespiratory arrest by compressing certain cerebral structures, such as the brain stem.

Different physical signs uncovered during the examination can suggest a possible cerebral compression. Some of the signs can be detected by examining the victim's pupils. Pupils of unequal size (one small and the other one dilated) or not reacting to light indicate a cerebral compression. It is important that the first responder 1) attentively observes, during their primary survey, the pupils of a CCT victim, and 2) that they check them often afterwards. Any change in the victim's state requires a thorough examination by a doctor.

Fractures at the base of the skull are mostly responsible for hemorrhages, which often come with bleeding from the nose or auditory canals.



The brain affected by a hemorrhage



The brain in its normal state

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### **Comeback and physical activity**

After a CCT, the victim must progressively come back to the physical activity, once the symptoms have completely disappeared. A medical evaluation is recommended before resuming the activity. Only once ALL symptoms have disappeared for at least 24 hours can the person start to progressively resume the activity, by closely following the steps described below. Furthermore, they must wait a minimum of 24 hours without symptoms between each of the steps. If the symptoms reappear, the person must go back to the preceding step and resume progression only 24 hours after the last symptoms.

#### **Steps for resuming the physical activity**

- Step 1 :** Rest (avoid any type of physical or intellectual activity);
- Step 2 :** Light aerobic exercise (walking or stationary bicycle). No resistive exercises (e.g. weight training);
- Step 3 :** Specific sports activity (e.g. racing, skating, etc.);
- Step 4 :** Skill exercises without contact. Weight training exercises to be undertaken progressively;
- Step 5 :** Return to regular training, including possibility of contacts;
- Step 6 :** Return to the field

A person who suffered a CCT can remain vulnerable to another trauma, even if the impact is more minor. Each CCT must be medically evaluated. A premature comeback, i.e. before the symptoms have disappeared completely, can worsen the CCT or extend its duration. It can also increase the risk of more severe injuries by affecting the physical abilities and reduce reaction time. Even if they have no apparent signs or symptoms, CCTs must be taken seriously and evaluated by qualified personnel, because they can have long term consequences if not properly treated.

### **Awakening and drowsiness**

A CCT victim can become drowsy in the hours following the trauma. Contrarily to popular belief, it is not contraindicated to let them sleep; however, they must be observed and woken up intermittently to ensure their level of consciousness is stable and is not deteriorating. If the person is difficult to wake up or if they are not waking up at all, they must be immediately brought to a medical center for examination.

### **Second impact syndrome**

Second impact syndrome occurs when a person is the victim of a second instance of head trauma before having completely recovered from the first one. This is a relatively rare situation, but potentially extremely severe following a CCT. This syndrome is frequent in the field of sports. The pathophysiological

mechanism is not very well understood, but it brings about a fast swelling of the brain with a high morbidity and death rate.

## FACIAL INJURIES – RUPTURE OF THE TYMPANIC MEMBRANE

Different mechanisms can cause a rupture of the eardrum: a barotrauma, a direct trauma caused by the penetration of a foreign body (e.g. a cotton swab) inside the external ear canal, an indirect trauma caused by a blast (e.g. a slap on the ear, a deflagration caused by an explosion, thunder), an infection (e.g. otitis media) or, more rarely, a burn on the eardrum. Barotraumas are caused by a disequilibrium between pressures inside and outside of the tympanic membrane, creating a rupture. This can happen, for example, when pressure balance is not restored in the middle ear during an underwater dive. Since the pressure exerted on the eardrum increases with depths (Boyle's law), the latter can rupture.

### Signs and symptoms

- Sudden pain in the ear;
- Light bleeding;
- Decrease or loss of hearing;
- Possible balance problems;
- Vertigo.

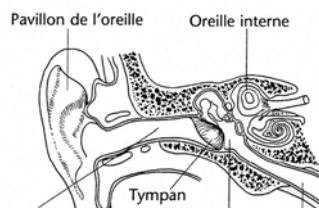
### Treatment

- Cover the ear with a sterile gauze;
- Tilt the head on the side of the bleeding ear, to allow for blood to flow out of the ear;
- Transport the victim to a medical center.

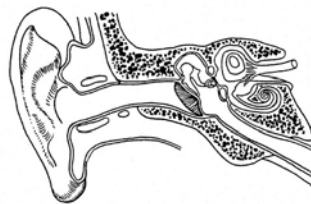
The vast majority of these perforations are very painful, but self-resolve after a few months. Most of the victims are followed by an ENT anyway.

### Prevention

During a deep water dive, the pressure exerted on the eardrum must be balanced. This can be done by swallowing or by performing the Valsalva maneuver. Despite these basic precautions, the eardrum can rupture when the Eustachian tube is obstructed (for example, if the diver has a cold). Never forget that a tympanic perforation can also occur in a pool and even during a pressure change on a plane.



*The water pressure and the decrease in the air's volume create an exaggerated bulge in the tympanic membrane towards the inside.*



*By increasing the pressure inside the middle ear, the pressures are balanced once again and the eardrum can regain its usual position.*

In order to prevent eardrum perforation, we suggest that instructors teach the Valsalva maneuver to their candidates before their first immersion in the deep end, and to have them practice it beforehand at different depths before the simulation exercise.

The **Valsalva maneuver** consists of increasing the pressure in the pharynx by expiring air out of the lungs while closing the mouth and pinching the nose. This simple maneuver allows divers, among others, to restore balance in the internal pressure.

## NASAL FRACTURE

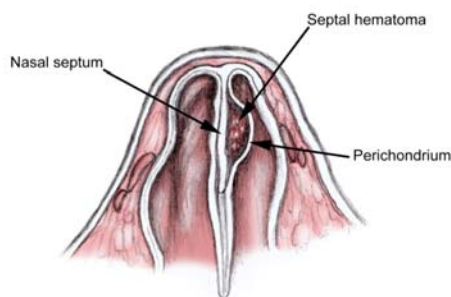
Nasal fractures are common and represent around 40% of all facial fractures. Sports and traffic accidents, as well as physical altercations are the most frequent causes. Nasal fractures can be isolated or accompanied by other facial traumas.

The nose is comprised of an upper part, the nasal bones, and a lower part, the cartilage. The latter is mobile, thanks to the facial muscles surrounding the nose. The two parts of the nose can thus suffer fractures due to trauma; it is primordial to obtain detailed information concerning the trauma.

When a nasal fracture is suspected, it is important to look for traumas that are potentially more severe and to make sure that there is no cervical trauma or any other fracture of the facial bones. It is thus primordial to perform a medical evaluation on any facial trauma victim when an underlying fracture is suspected. This evaluation has two parts: internal evaluation and external evaluation.

Unfortunately, the external examination can sometimes prove to be quite difficult because of a sizable edema, whose extent must be duly noted. It is important to also evaluate the rest of the facial bones by looking for bruises around the nose or the periorbital region, and around the flesh wounds. Applying ice can help reduce the size of the edema and the intensity of the pain during transportation to a medical center.

One of the complications of nasal fracture is a septal hematoma, i.e. an accumulation of blood around the nasal septum, the medial partition between the two nasal cavities. It must be subject to a medical evaluation shortly, since it must be urgently drained to avoid necrosis of the cartilage.



### Signs and symptoms

- Cracking;
- Bruise;
- Profuse bleeding;
- Local pain and possibility of deformation at the fracture area.

### Treatment

- Stop the bleeding by exerting a direct pressure at the fracture area;
- Pinch the nose with the thumb and index fingers, just above the nostrils (at the junction of the bone and the cartilage) if pain allows it;
- Pay close attention to the vital signs;
- Apply ice for 10 to 15 minutes every hour to reduce the pain and minimise the edema;
- Transport the victim to a medical center;
- If there are already signs of septal hematoma, an immediate medical evaluation is required.

**In case of discrepancy between the original and the translation, the original version in French will prevail.**