



FIRST AID IN **CAVES**

GUIDE



Speleological Association of Slovenia

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FIRST AID IN CAVES

GUIDE

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HINT

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INTRODUCTION

Caving is an activity undertaken in environments that are extreme for human beings. Cavers walk through a humid and cold environment of eternal darkness, overcoming a number of obstacles (straits, rockfalls, canyons, pits). These adventures are often several hours or even days away from the surface. Rope techniques are used to overcome vertical barriers and the ground beneath caver's feet is often slippery and unstable. If cavers lack knowledge and experiences, are in poor physical or mental condition, insufficiently plan their trip, or are affected by other objective causes, their risk of accident and injury, or even death, in a cave is very high.

Fortunately, the statistics on accidents in caves show that caving is a relatively safe activity. The small number of accidents among cavers is probably due to a relatively low number of people engaged in this activity and a low frequency of people visiting the underground world. Knowing the risk factors and how to manage them is crucial for the prevention of caving accidents.

If a caving accident occurs, it may have serious implications due to all the factors listed above. The health condition of the injured person may deteriorate very quickly in a cave compared to the same injury sustained somewhere aboveground. It also takes

longer for a rescue team to arrive in a cave than, for example, in the mountains. In order to make a call to emergency telephone number in the first place, it is often necessary to leave the cave first and reach the surface. The response time of the cave rescue team should be added to this, in particular as the physician on duty might have at the same time other emergencies to attend to. Upon arrival at the cave's entrance, which is often very remote, it is first necessary to organize a rescue operation and secure the access to the injured person. It takes several hours at best for the cave rescue team to reach the injured person or even over a day at worst.

Therefore, it is mandatory for cavers to be familiar with first-aid measures. We would like to emphasize, that the uninjured cavers at the accident site are those who can do the most for the injured colleague at the site of accident. A careful assessment of the situation, evaluation of all risk factors and their management, as well as timely examination and care of injured persons, including their appropriated protection against the environment factors, will significantly increase their chances of survival. However, we regret to note that caving schools do not pay enough attention to this topic. The aim of this manual is to highlight the essential steps and first-aid measures to be followed in the event of most common caving accidents. All cavers should be familiar with these measures.

As the authors of this manual, we are keen on providing updated knowledge on first aid with the hope that readers are well prepared but will never actually have to use it.

EMERGENCY RESPONSE PROCEDURE

In case of accident, you should not react impulsively. Reactionary behaviour can further jeopardize the injured person, other party members and even you. First, you should assess the situation. Then you should ensure your own safety and, if necessary, remove the injured person from the dangerous area. When you have found a safe location, examine the injured person to determine the extent of injuries and to give proper first aid. Once the first aid has been provided, place the injured person in a comfortable position and protect them from the environment factors. If enough people are present at the site of accident, send for help at least two cavers. Ensure that they are familiar with passages of cave system and the way out. If alone with the injured person, depending on the situation, assess whether it is better to stay with the injured person or to search the help and leave the injured person alone. Make a decision while taking into account the severity of the injury and possibility that someone aboveground has been informed of the situation. Once aboveground, call emergency telephone number (**112 for most of Europe countries, 999 for UK, 911 for USA**). When talking to a dispatcher, stay on the line and never hang up. After reporting the accident, wait for cave rescuers and direct them to the accident site.

photo: Vladimir Kržalić



How to report caving accident

Call emergency telephone number to report the accident and provide a dispatcher with the following information:

- time and date of the accident,
- you name, surname and mobile phone number,
- location where you placed your call,
- name of the cave where the accident occurred,
- nearest settlement or municipality,
- number of injured person(s),
- name and surname of the injured person(s),
- injuries suffered,
- cause or type of the accident,
- description of the accident site (depth, distance from the entrance, the name of the accident location in the cave, obstacles in the cave),
- location where you are going to wait for the rescue team.

ERP

EMERGENCY RESPONSE PROCEDURE

Fill out the form and, when on the surface, submit it to the rescuers

INSTRUCTION

FILL OUT
(mark or enter)

!! PAY ATTENTION

1. STOP! ASSESS THE SITUATION

a) Are you or is the injured person in any additional danger? !! YES > remove the hazard

b) Use protective equipment (clean gloves, glasses)

c) How many people are injured? 1 2 3 4 []

d) What is the mechanism of injury?

High Energy Trauma
(a fall from height, a fall of an object on the person)

Low Energy Trauma
(slip)

e) Have the first-aid kit ready as well as other first-aid equipment

f) Is the approach to the injured person safe? !! NO > ensure secure access and approach the injured person

2. EXAMINE THE INJURED PERSON

a) Is the surroundings of the injured person safe? !! NO > remove the hazard

b) General assessment of the injured person

Severe bleeding NO YES !! YES > control of external bleeding

Age []

Sex M F

Weight []

c) Approach the injured person from the front

d) Consciousness

A awake

V responsive to your speech

P responsive to pain

U unresponsive

Always carry the Emergency Response Procedure (ERP) with you as this can help you to properly respond to emergency situations (the entire ERP is available on page 48).

SITUATION ASSESSMENT

Arriving at the site of accident, your primary concern is safety. When approaching the site of an accident, pay attention to potentially dangerous situations that can greatly vary in a cave (falling rocks, caving equipment malfunction, rising waters, unstable rock-fall area, risk of falling or slipping, etc.). If you detect a hazard, do not attempt to carelessly approach the injured person. Stop and assess whether hazards can be reduced, otherwise remove the injured person from the dangerous location if you can do so without danger to yourself.



Use of improvised equipment to protect against potentially infective bodily fluids.

While approaching the injured person, put on a pair of gloves and glasses to **protect yourself against infectious bodily fluids** (blood, saliva, urine, etc.). If no such protective equipment is available, make use of improvised items, such as caving gloves, plastic bags, safety glasses, etc. The first person to approach the injured person should be **carrying the basic first-aid kit**. Upon arrival at the accident site, **check the number of persons injured** and provide such information to rescue services that will accordingly provide adequate equipment and the appropriate number of rescuers. Knowing the circumstances of injury (**Mechanism of Injury or MOI**) is mandatory for understanding the consequences. Before approaching the injured person, assess the situation as quickly as possible.

Mechanism of Injury (MOI)

The mechanism of injury describes how an injury occurred (e.g. a fall from a height, slip, falling rocks, etc.) and eases the assessment of the force magnitude that acted on the victim's body. As a result, we can predict possible injuries.

Mechanisms of caving injuries:

High Energy Trauma

- falling from a height
- a hit of an object falling from a significant height



Low Energy Trauma

- a slip
- an attempt to stop a running rope without gloves



EXAMINING AN INJURED PERSON

Assessing the danger near the injured person

When approaching the injured person, make sure that you can approach safely.

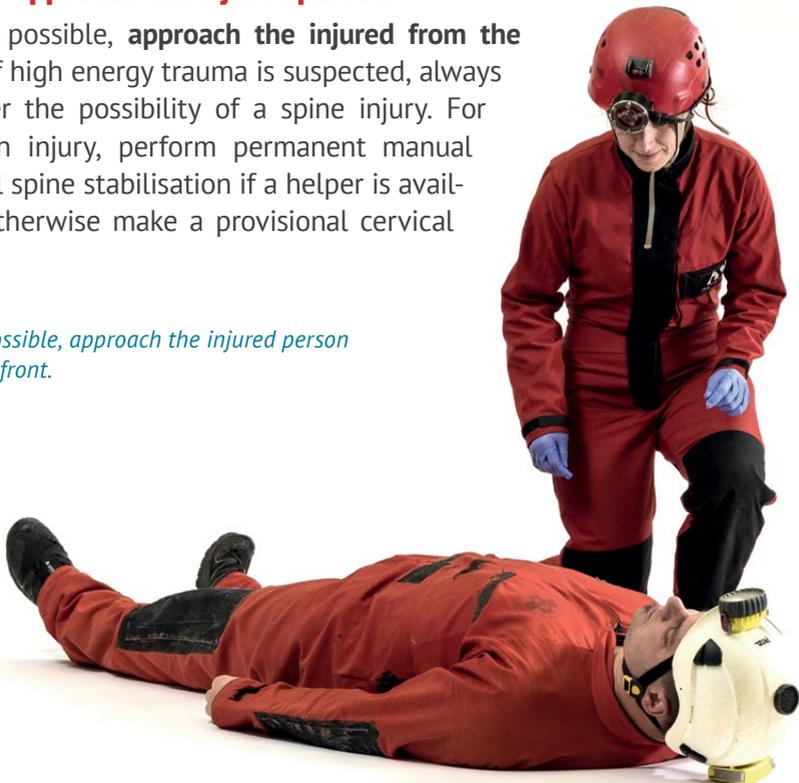
First impression of the injured

Form a first impression about the injured person and rule out any severe bleeding. Estimate the injured person's age, sex, weight, general appearance (pale and/or sweaty skin, restlessness, uncontrolled movements, etc.), body position, and the person's position with regard to surroundings.

How to approach the injured person

If only possible, **approach the injured from the front**. If high energy trauma is suspected, always consider the possibility of a spine injury. For such an injury, perform permanent manual cervical spine stabilisation if a helper is available, otherwise make a provisional cervical collar.

If only possible, approach the injured person from the front.



Assessing level of consciousness

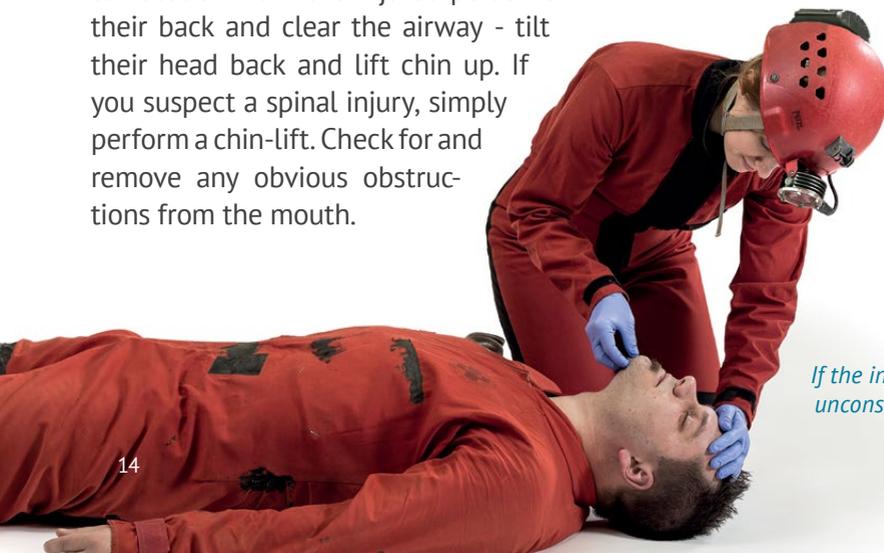
Reasons for altered consciousness are diverse in cave accidents: head injury, dehydration, shock, stroke, low blood sugar in case of diabetes, poisoning, hypothermia, etc. The level of consciousness is assessed by the **AVPU** scale.

- A** The injured person is awake, oriented in time and space (knows where they are, knows the exact day and year, and remembers/describes the event).
- V** The injured person responds to verbal stimuli.
- P** The injured person responds to painful stimuli.
- U** The injured person does not respond to any stimuli.

* **A** (awake), **V** (verbal), **P** (pain), **U** (unresponsive)

Airway assessment

If the injured person is conscious and can talk to you, then the airway is clear. If the injured person is unconscious, the tongue muscles relax and the tongue can fall to the back of the throat, blocking the airway and leading to suffocation. Turn the injured person on their back and clear the airway - tilt their head back and lift chin up. If you suspect a spinal injury, simply perform a chin-lift. Check for and remove any obvious obstructions from the mouth.



If the injured person is unconscious, open the airway.

Breathing assessment

After you have cleared the airway, check the breathing. Place your ear over the person's mouth and nose, look towards the chest and perform the "look, listen, feel" step for 10 seconds: listen to hear the sound of breathing, feel for the movement of air, and watch to see the chest expansions. If the injured person is conscious and you talk to them, it suffices to place your palm on the upper part of their chest and count their breaths for 10 seconds. Then multiply this number by 6 to get the breathing rate per minute. The normal respiratory rate for an adult at rest is 12 to 20 breaths per minute. When assessing breathing, also observe the breathing pattern – whether it is abnormally deep or shallow, or if accessory respiratory muscles (between the ribs, on the neck) are used, and whether the chest is rising and falling symmetrically.



Checking the unconscious for breathing

Assessment of cardiovascular status

To assess cardiovascular status check the colour, temperature and condition of the person's skin. Pale, cool and moist skin is a sign of a shock. If you are trained, check/palpate the pulse of the injured person. Assessing cardiovascular status also includes stopping/controlling the major bleeding. If an injured person is unresponsive, check for indirect signs of blood circulation (moving, coughing, and swallowing).

Head-to-toe examination

While examining, try to keep eye contact with the injured person at all times, in particular if the person's consciousness is altered. Only then you can assess whether a certain part of the body is painful during the examination. Conduct the head-to-toe assessment systematically, examining all body parts. First visually inspect and then examine each part of the body. After establishing that an injury of the body part has occurred, **remove the clothing to expose the skin** and examine the site of the injury. Do not interrupt the examination with the attempt to take care of individual injury,

unless there is an obstruction in the airway, breathing has stopped, there is a severe bleeding, or there is imminent danger to your life.

First, inspect and palpate the person's head and the back of their neck. Check for a possible leakage of bodily fluids from the ear and the nose. Then, inspect and palpate the neck. Palpate the thorax and check whether the chest is rising equally on both sides and whether the thorax is symmetrical. Before examining the person's abdomen and pelvis, tell them you will be examining them. Otherwise the injured person might react very sensitively by making their abdomen tense. Inspect the abdomen and palpate if it is tense, painful, or sensitive to the touch. When examining the pelvis, first examine the front part by pressing against the pubic symphysis (part of the pelvis above the genital area). When you make sure that this part of the body is not injured, squeeze the iliac bones (practical demonstration video). Carefully inspect and palpate the limbs for any deformities, potential pain and swelling. Check the movements and sensitivity of the extremities. End the examination by palpating the back. When a serious injury is suspected and the injured person is attached to a climbing harness, first remove the upper part of the harness, disengage any equipment, and leave the lower part of the harness attached.



[Head-to-toe examination](#)

PROTECTING THE INJURED PERSON AGAINST ENVIRONMENTAL FACTORS

Once you have examined the injured person and administered first aid, protect them against environmental factors, like exposure to cold. The temperatures in lower-lying caves range between 8°C and 12°C, while in the mountains they come closer to the freezing point, so **an injured person may develop hypothermia and cold-induced injury** very quickly. Also, the time needed for rescuers to reach the injured person may be prolonged due to the challenging environment. Your main concern should be to prevent further heat loss. To do so, first, remove any wet clothes and put on dry clothes or wrap the injured person in a sleeping bag. Use sleeping pads, ropes or caving bags to isolate the injured person from cold and wet grounds. Use emergency blankets and supplementary ropes to make an improvised bivouac. If possible, heat air around the injured person with an acetylene lamp, a gas burner or candles. Be cautious to avoid causing burns to the injured person or starting a fire. Encourage the injured person, while monitoring them constantly and recording potential changes.



Create an improvised bed for the injured person.



Dress the injured person in dry clothing and additionally protect them against cold.



Set up an improvised bivouac using emergency blankets and supplementary ropes.



Heat the improvised bivouac using a gas burner or an acetylene lamp. Place the heat sources at both ends of the bivouac, thus creating a mass of hot air, which will prevent heat leakage from the bivouac.

BASIC CARDIOPULMONARY RESUSCITATION TECHNIQUES – CPR

First check the level of the injured person’s consciousness. Then talk to the injured person and gently shake their shoulder. Put the injured person in supine position (on their back) and **open the airway** (tilt their head back and lift their chin), listen and feel the breathing (perform the “look, listen, feel step” for 10 seconds). If the injured person is not breathing or is not breathing normally, call for help (shout loudly “HELP” and call emergency telephone number).



Correct hand position for the chest compressions.

Then start with chest compressions. First, remove any clothing from the upper part of the person’s body as chest compressions are performed on exposed skin. Kneel beside the injured person. Place the heel of one hand over the centre of the injured person’s chest (lower half of the injured person’s breastbone); then place the heel of your other hand on top of the first and interlock your fingers. Make sure that the pressure is not applied over the ribs, bottom end of breastbone or upper abdomen. Position yourself vertically over the injured person’s chest and keep your arms straight. Compress the chest to a depth of approximately 5cm (but not more than 6cm). Do not take off your hands from the chest during the release. Allow the same amount of time for compression as for decompression. Give 30 compressions at a rate of 100-120 per minute (slightly less than two per second). Then if trained, combine chest compressions with rescue breaths. If this is not the case, only perform chest compressions at a frequency of between 100 and 120 per minute.



5 to 6cm

Give rescue breaths when you are sure that the airways are cleared. Using your thumb and index finger of the hand positioned on the person's forehead, pinch the person's nose closed. Slightly open the injured person's mouth, while maintaining the chin-lift. Take a normal breath, then place your lips around the person's mouth, creating a tight seal. Blow steadily into the mouth, while watching for the chest rise, taking about 1 second. Remove your mouth, keeping their airway open and observe chest fall. Take another regular breath and deliver a second rescue breath in the same manner as the first. **The time taken to give both rescue breaths should not exceed 5 seconds.** Continue with chest compressions. The ratio between chest compressions and rescue breaths is **30:2**. If there is a portable semi-automatic external defibrillator (AED) available nearby, send someone to bring the device and use it.



CPR for drowning

The CPR for a drowned person slightly differs from the basic CPR administered to an adult person. The difference is that once you have established that the injured person is not breathing, first **provide 5 rescue breaths** and then check for 10 seconds for indirect signs of blood circulation (swallowing, moving or coughing). In the absence of such signs, begin the compressions and rescue breathing at a rate of 30:2.



Basic cardiopulmonary resuscitation techniques – CPR



Preparing to work with AED



Basic CPR for drowning

Care for an unconscious person

Loosen the injured person's clothes. If the injured person has a climbing harness attached, first remove the upper part of the harness and disengage any equipment but leave the lower part of the harness attached. Kneel down at the person's side that is least injured. Take the person's arm that is nearest to you and extend it at a right angle, with the palm facing up. Take the palm of the other hand, place it across their chest under the person's cheek. Bend the knee of the person's leg that is farthest from you to a right angle; holding the shoulder that is farthest from you, roll the person on the side towards you. Tilt the person's head back and pull the jaw forward to allow fluid to drain from their mouth if the person vomits. Protect the injured from the environmental factors and wait for the rescue team. Pay attention to the person's breathing and to the possibility of vomiting. If unconscious, keep an eye on the person all the time and **continue to monitor the person's breathing**.

A stable position for an unconscious person is on their side. Make sure that the upper leg and lower arm are at a 90° angle. The head is tilted backwards and it rests on the palm of the upper arm.



Care for an unconscious person

CARE FOR INJURIES

Head injuries



Ocular haematoma results from the bleeding from the skull base. Haematoma behind the ears

As severe head trauma could be accompanied by cervical spine injury, it is important to manually protect and immobilise the spine of the injured person. Head injuries could be divided into face and skull injuries. If there is an ear or nose bleeding, cover it with a sterile pad. If the injured person is unconscious, put them in a stable recovery position and monitor them. If the injured person is conscious and has no pain along the spine, escort them under supervision from the cave. When the injured person is not able to do so, place them in a supine position with the head lifted to 15-20 cm. Protect the person from the effects of the environment and observe the changes in the level of consciousness continuously. If the injured person is vomiting, place them in a stable recovery position while monitoring their airway.

Signs and symptoms of a traumatic head injury are as follows:

- altered consciousness
- eye haematoma
- haematoma behind ears
- seizures, convulsions
- leakage of blood and/or cerebrospinal fluid through the ear canal or nose

Care for head injuries



Wound on forehead.



Cover the wound using sterile gauze.



Anchor the gauze with circular turns around the head.

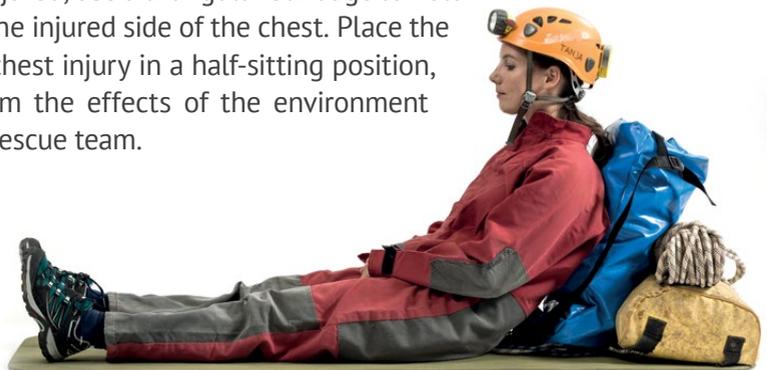


Continue with a "T-bandage" and finish with a few circular bandaging turns around the head to secure the dressing.

Chest injuries

Cover open chest wounds with sterile gauze or as much clean cloth as possible. In doing so, care must be taken to ensure that the injury is not sealed airtight, as this can cause a life-threatening condition. If blood is coming from the chest wound, stop the bleeding by direct pressure through sterile gauze. If a rib is injured, use a triangular bandage to hold the arm against the injured side of the chest. Place the person with the chest injury in a half-sitting position, protect them from the effects of the environment and wait for the rescue team.

The injured person must be seated and supported at an angle of 45°.



Abdominal injuries

Position the injured person on their back with their head slightly lifted and their knees flexed. With a severe open abdominal injury, internal organs may protrude through the wound. Do not push any protruding organs back through the open wound. Only apply a sterile dressing loosely over the wound. Intra-abdominal injuries can cause the injured person to bleed out into the abdominal cavity. In such cases, fast transport is of the paramount priority. Protect the injured person from the effects of the environment and wait for the rescue team.

Position the person on their back, support their head and flex their knees.



Pelvic injuries

In the event of pelvic injuries, move the injured person as little as possible. Disengage and remove the upper part of the climbing harness, remove any equipment, and **leave the lower part of the harness attached** as it acts as the pelvic immobilisation device. Flex the person's knees, put a cushion under the knees and bandage the knees together. Look for a possible shock, as pelvic injury might be associated with significant bleeding. Protect the injured person from the effects of the environment and wait for the rescue team.



Position the person on their back with a cushion under their knees.



Put soft cushion between their knees and secure them with a folded triangular bandage.

Fractures, sprains or dislocations

Fractures are classified into closed and open types. To provide first-aid, it is good to have an assistant as a broken limb should be held above and below the fracture site until final immobilisation. An open fracture is characterised by a wound in which the bone protrudes through the skin. First carefully remove or cut the clothing and place sterile gauze over the wound. Protect the wound where the bone protrudes through the skin with a roller bandage or a pad to avoid direct pressure on the bone. Immobilise the broken limb as soon as possible. If possible, **immobilise the site of the fracture, as well as the joint above and below the fracture.** In case of a closed fracture, the fractured limb should be immobilised without removing the clothing. After you have immobilised the fractured limb, check for the pulse, movements, sensitivity and skin colour. For a closed fracture, apply a cold compress to the fracture site. Sprain and/or dislocation are handled in the same way as closed fractures.

Wrist injuries

Put the arm in a triangular bandage with the wrist elevated above the heart level.



Ulnar injuries



To immobilise the injury, use a folded caving bag (if not available, place the arm in a triangular bandage).



Attach the bag to the arm using a bandage.



Apply the bandage over the entire length of the immobilised injury.



Put the arm in a triangular bandage with the elbow at a right angle; fold another triangular bandage into a long band and additionally immobilise the arm (you can also use any other improvised means, e.g. caving bag straps, etc.).

Humeral injuries

A folded caving bag can be used to immobilise a humeral injury.





Attach the bag to the arm using a bandage.



Put the arm into a triangular bandage with the elbow at a right angle.



Additionally, immobilise the arm against the body: fold two triangular bandages into long bands and apply them above and below the injury site.

Elbow injuries



Apply a tortoise bandage around the elbow – start applying the bandage at the inside of the elbow joint and continue to wrap at the outer sides of the elbow, steadily extending the bandaging on either side of the joint.



Use a triangular bandage to place it under the injured arm and then tie it around the neck. Place the elbow in the position that causes the least pain.



Further, secure the elbow against the chest by using two triangular bandages (folded as a long band).

Shoulder injuries



Wrap the shoulder loosely using a bandage.



Apply a layer of padding between the humerus and the body.



Put the arm into a triangular bandage with the elbow at a right angle and immobilise it additionally against the body by using two triangular bandages folded into long bands.

Ankle injuries

Do not remove the shoes, just loosen them. Immobilise the ankle by rigging a U-shaped support out of a folded caving bag and secure it using two triangular bandages folded into long bands.



Tibia injuries



Place the folded covering bag between the legs, extending from the perineum to the ankle. Immobilise the injured leg against the healthy one, fold at least four triangular bandages into long bands and place them on the thigh (1), above (2) and under (3) the injury, and on the ankles (4) in figure eight.

Thigh bone injuries

Place a folded covering bag between the legs, extending from the perineum to the ankle. Immobilise the injured leg against the healthy one, fold at least four triangular bandages into long bands and place them on the thigh above (1) and under (2) the injury, on the tibia (3) and on ankles (4) applying a figure-of-eight shape.



Care for open fractures

An open fracture is characterized by a wound in which the bone protrudes through the skin.





Cover the wound using sterile gauze.



Protect the injured bone with a roller bandage or a pad.



Apply a triangular bandage to the injury site or a bandage in the event of heavy bleeding.



Immobilise the injured limb.

SPINAL INJURIES

Spine injuries should be considered in case of high-energy trauma. If the injured person is unresponsive, check for breathing first and then place them in a stable recovery position on their side. In this case, priority is given to saving the injured person's life over caring for the spinal injury.

If the injured person is conscious, immediately perform manual cervical spine stabilisation. Do not move the injured person and instruct them not to move. Also manually stabilise the spine if the injured person has pain in their spinal area or if the injured person reports loss of sensation or weakness in arms and/or legs.

The cervical spine is manually stabilised by supporting the cervical spine and head in a neutral position using both hands. Do not cover the external ear canal with your hands, as this prevents the injured person from hearing rescue workers. Keep applying such manual stabilisation until the injured person is fully immobilised and transported to a stretcher or a spinal board. The cervical spine could also be immobilised with various objects, however, this does not mean that you should stop stabilising the spine manually. If alone in the cave with the injured, secure the person's neck using other useful items (caving bag filled with stones, coils of twisted rope, etc.).

Manual stabilisation of the cervical spine.



Provisional cervical collar



Create an improvised cervical collar with a folded caving bag.



Secure the caving bag with a bandage.

BURNS AND SCALDS

Cavers frequently suffer from friction burns (caused by ropes) and burns caused by acetylene lamps and/or gas burners. All types of burns are treated in the same manner. Do not remove clothing that sticks to the skin due to melting. Remove all jewellery or watches from the injured parts of the body. **Cool the burn under cool water for at least 10 minutes** or until the pain subsides. Care should be taken not to expose the injured too much to water to avoid hypothermia. Cover the burn with an aluminium compress (if not available, use sterile gauze and wrap the gauze with emergency blanket) and then apply the dressing or a triangular bandage and immobilise. The scalds are treated in the same manner except that the clothes should be removed.



Do not remove clothing that sticks to skin due to melting.



Cool the burn under cool water for at least 10 minutes or until the pain subsides.



Cover the burn with an aluminium compress (if not available, use sterile gauze and wrap the gauze with emergency blanket).



Next, secure the compress with a bandage.



Elevate the injured limb above the heart level.

BLEEDINGS AND WOUNDS

Bleedings

Bleedings could be divided into arterial (severe bleeding, characterised by spurting bright red blood), venous (slower steadily bleeding, blood is dark red), and capillary (e.g. minor from the skin). Bleedings could also be divided into internal (not directly visible but noticeable through the changes like a tense abdomen, heavily swollen leg, signs of shock) and external (bleeding from the wound).

Severe arterial bleeds can cause a person to bleed to death in a few minutes.



In case of severe bleeding, raise the injured limb above the heart level, if possible. Apply direct pressure to the wound with fingers (use sterile gauze or cloth that is available). Then place a compress dressing over the wound. First cover the wound with sterile gauze and then place a hard item over the site of the wound. Secure it firmly in place with a bandage to provide compression to the wound site. Then check if the bleeding has stopped, check for the sensitivity, temperature, skin colour and pain response of the injured limb. Repeat the check every 5 to 10 minutes. Finally immobilise the limb. If the bleeding does not stop with the compression dressing, apply the Esmarch bandage above the site of bleeding.

Making a compression dressing



Apply direct pressure to the bleeding wound using sterile gauze, if available.



Cover the wound with sterile gauze and secure a hard item over it (a roller bandage, stone, etc.)



Then secure the item firmly in place with a bandage to provide direct compression to the wound.



If blood leaks through the dressing, remove the blood-soaked bandage from the gauze but do not remove the gauze. Then apply a compression dressing again. If, even after that, the bleeding has not stopped, apply an Esmarch bandage above the site of bleeding.

Making the Esmarch bandage



Place at least a 5-cm wide strip above the bleeding site. Apply the dressing as close as possible to the bleeding site where the bone is still firm, but never over the joint.



Use a stick or other object to tighten the site until the bleeding stops.



Secure the stick in place to prevent it from disintegrating. Make a written note of the time the bandage was applied.



After the bleeding has stopped, raise the injured limb above the heart level and immobilise it.

Shock



A person suffering from shock has pale, clammy and cool skin.

Shock is a condition when body organs and tissues do not get enough blood flow, causing their progressive damage and dysfunction, finally resulting in death unless timely and appropriately treated. Shock must be diagnosed quickly and appropriate action must be taken since a delay in treating shock may lead to irreversible damage. Shock may result from a lack of blood or water (bleeding, dehydration) in the circulation due to heart failure, the obstruction of blood flow or other causes such as poisoning or an allergic reaction.

Symptoms may include altered consciousness (confusion, restlessness), pale, cool and clammy skin with cyanotic extremities, thirst, fast and shallow breathing, nausea or vomiting, or fast and shallow heartbeat.

If the injured person develops signs of shock, place them in a horizontal position with raised or supported legs. Loosen their collar, disengage and remove the upper part of the climbing harness, remove any equipment (leave the lower part of the harness attached), loosen tight clothing, and immobilise the injured limbs. Cover the person with emergency blanket and calm them down. If the person is unconscious, put the person in a stable lateral/recovery position. Do not give the person anything to drink, but you may moisten their lips. Protect the injured person from the effects of the environment and wait for the rescue team.



Wounds

There are several types of wounds: bites, bruises, lacerations, cuts, gunshot wounds, wounds caused by electric currents, contusions. If possible, do not touch the wounds due to the risk of infection. If dirty, rinse it with clean water, preferably under a gentle jet of water. Cover the wound with sterile gauze (or as clean fabric as possible). Secure the gauze with a bandage or triangular bandages. Do not remove embedded foreign objects from the wound.

Care for embedded foreign objects

Do not remove embedded foreign bodies.





Cover the entry and exit wounds with sterile gauze.



Secure the embedded foreign object against the body using roller bandages or other means to prevent excessive movement.



Apply the bandage to the wound site.



Apply the bandage to the wound site.



Immobilise the injured limb against the body.

OTHER EMERGENCY SITUATIONS

Hypothermia

There are several factors that may lead to hypothermia: exposure to cold environment, wind, humidity, wet clothes, tiredness, injuries, inadequate food, etc.

Mild hypothermia symptoms: shivering, increased heart and respiratory rate, vasoconstriction, apathy, excessive urine production, poor judgment. Moderate hypothermia symptoms: slow heart and respiratory rates, a decreased level of consciousness, shivering have stopped. Severe hypothermia symptoms: very slow and shallow breathing, a coma, cessation of breathing.

If a person is suffering from mild hypothermia, encourage them to move around and give them warm drinks or high-energy food. If a person is suffering from moderate hypothermia, protect them from the effects of the environment (set up an emergency bivouac and isolate the person from the ground). Wrap them in emergency blanket, but do not place the blanket directly on the skin. You can warm up a person with your own body or with a provisional compress of warm water in a plastic bottle (chest, groins, neck, armpits) or heaters. For hypothermia victims apply the principle **“Nobody is dead until warm and dead”**. If a person experiencing hypothermia shows no signs of life, start CPR.

Protection of a person suffering from mild hypothermia from further heat losses. A gas burner or acetylene lamp can also be placed between the hypothermia victim's legs for additional heat and drying with caution to prevent burn.





You can actively warm up a person suffering from hypothermia with a provisional compress of warm water in a plastic bottle: apply this compress to the person's chest, groin, neck and armpits. Do not apply warm bottles directly to the skin.

Dehydration

Dehydration occurs when the body does not have as much water as it needs. There are various causes of dehydration. In caves, it is usually caused by an inadequate intake of water or electrolytes. The first symptoms of dehydration include thirst and a sense of discomfort, the loss of appetite and the occurrence of dry skin. The symptoms of mild dehydration are also decreased urine production with abnormally dark urine, tiredness, irritability, dry mouth and insomnia. Severe dehydration is characterised by a lack of urination. Its symptoms are also apathy, lethargy, cramps, the loss of consciousness and sunken eyes. Due to a decrease in blood volume and falling blood pressure, heart rate and breathing are accelerated. The best treatment for mild dehydration is drinking of fluids and the prevention of the factors that have caused excess water loss. It is recommended that instead of water dehydrated persons drink rehydrating drinks, which also contain sugar and electrolytes. In the event of advanced dehydration, replace fluids with rehydration solutions.

The recipe for a simple, homemade rehydration drink: mix 2 dcl of water with 2 tsp of sugar or honey, a pinch of salt and add the juice of half a lemon.



Exhaustion

Exhaustion in caves is most often due to insufficient intake of nutrients into the body and an overestimation of the caver's physical condition. **In order to prevent exhaustion, it is important to have a sufficiently high calories intake of nutrients before and during the visiting of the cave.** Avoid heavy foods and rather eat smaller meals more often. It is best to have various cereal bars, nuts, dried fruit at hand, which you can quickly eat while moving. Before the expedition, plan the objectives realistically according to the least physically fit team member.

If exhaustion arises, stop and take time to rest. Put the exhausted caver in the sitting position and protect them from the effects of the environment. Offer them high-energy food and hot drinks. Take care and protect the exhausted caver from hypothermia.

When the caver recovers, accompany them to the surface. If necessary, set up an emergency bivouac where the caver can sleep and regain strength to exit the cave.

Types of food good for caving.



Carbon monoxide poisoning

Carbon monoxide (CO) is a colourless, odourless, and tasteless gas that is formed as a by-product of incomplete combustion. During caving, the most common sources of CO are internal combustion engines (gasoline drilling machines, generators, etc.) or, in some cases, explosives. CO binds to haemoglobin with an affinity 250 times greater than that of oxygen, leading to oxygen deficiency in tissues.

The symptoms of CO poisoning are headache, shortness of breath upon exertion, impaired judgement, irritability, dizziness, vision disturbances, confusion, syncope, muscle cramps, unconsciousness and, ultimately, death.

Special attention should be paid to the early symptoms of poisoning and, if they occur, withdraw as quickly as possible to a safe place. Treating someone with CO poisoning begins with **immediate evacuation to a safe place** (CO is slightly lighter than air and, therefore, gets concentrated in the area's upper levels). Then, depending on the injured person's condition, put them into the recovery position or perform CPR. In severe poisoning, the best treatment is to use a hyperbaric chamber or to deliver 100% oxygen, both of which accelerate the removal of CO from the blood. If this is not available, the CO removes itself from the body by breathing fresh air, but much later (the half-life of CO in the body in ambient air is **between 6 and 7 hours**, but if 100% oxygen is administered, the half-life can be decreased to about 1.5 to 2 hours). As a rule, only use internal combustion drilling machines to widen narrow passages if the passages are well ventilated; it is also recommended to use CO meters to measure the concentration of CO.

Widening of narrow passages in caves by using gas-powered drills poses an immense danger in poorly ventilated passages.



photo: Damijan Šinigoj

Accidental burial

If a large portion of the body (usually the lower limbs up to the abdomen) is entrapped for a longer period of time (from one to a few hours), the injured person can suffer from crush syndrome. In prolonged entrapment, oxygen delivery is substantially reduced, which eventually causes the cells to die and their by-products to be released into surrounding tissue. The blood flow is reduced and, as a result, by-products are kept in the entrapped part of the limb. Once the entrapped part of the body is decompressed and blood flow is returned, all cellular by-products will spread throughout the body. This can cause arrhythmia, cardiac arrest, respiratory failure, and/or renal and liver failure.

If the entrapment time is less than 30 minutes, rescue/release the person, administer care for injuries and immobilise them. If the entrapment lasts for more than 30 minutes, decide in view of the rescue team's response time.

Immobilising feet in the event of entrapment.



Suspension syndrome

Suspension trauma is an effect that occurs during sports or work activities when a human body hangs motionless (passively) on a climbing strap. The same problems arise in all situations where a person is stuck and hanging motionless in a vertical position – problems are caused by the lack of movement and not by pressure from the harness. As a result, suspension syndrome is the preferred term, rather than harness hang syndrome. Veins in the legs bring blood back to the heart only if the leg muscles are active. Hanging motionless slows down the blood returning from the legs and the blood gets trapped in the legs, leading to shock and/or loss of consciousness. This can occur already after a few minutes (death cases are recorded in as little as 5 minutes of hanging), but most often a slightly longer suspension time is required. The effects of suspension can still cause death during the rescue operation, immediately or just a few hours after it. Late death is caused by kidney failure, failure of the liver and other organs, even after a few days, weeks. Dehydration, hypothermia, exhaustion, consumption of alcohol and associated diseases or injuries further decrease the body's tolerance for suspension.

Suspension trauma (presyncope) symptoms: pallor, nausea, vertigo, dizziness, sweating, tingling, numbness, visual impairment, hot flashes, etc. Any of the abovementioned symptoms raises the alarm for immediate emergency assistance. It is of vital importance that you move, flex, raise your legs, or lean or place your foot in a foot loop. If the symptoms do not subside, call for help and immediately start with the rescue. If a hanging person is showing the signs of presyncope, shock or altered consciousness, bring them down to the ground immediately. If this is not possible, put them into a horizontal position or, if feasible, at least raise their legs.

In the event of a hanging person, the standard rules apply to the first-aid treatment. It is important that the person is released from a suspended position and brought to a horizontal position as soon as possible. This will stop further progression of shock caused by an awkward body position. If the person is unconscious and shows no signs of life, start CPR. If unconscious but breathing, move the injured person in a stable lateral position. If conscious

but in shock, place the person in a supine position. If conscious but not in shock, place the person in a comfortable position that suits them best. A horizontal position is the most appropriate. Monitor the injured person at all times. Remove the harness and examine the injured person, checking for any associated injury or disease.

CONCLUSION

This Manual presents a wide range of the appropriate first-aid measures in line with the first-aid guidelines for laypeople of the Slovenian Red Cross and the recent European Resuscitation Council Guidelines for Resuscitation 2015. However, since the cave environment is very specific, we have adjusted the treatment of certain injuries in view of a better outcome in such circumstances. With this in mind, we have decided to present the guidelines for the best possible first-aid treatment in caves.

In addition to first-aid knowledge, the knowledge and mastery of buddy aid techniques are essential in providing assistance to an injured caver.

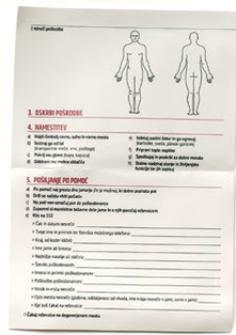
In addition to theoretical knowledge, practical knowledge is also important in first aid. You can, therefore, take part in various courses and workshops organised by the Red Cross or other similar organisations. In particular, you should be proactive in acquiring new knowledge. Being familiar with first-aid measures should be perceived as our duty to the fellow cavers because it is improper to leave an injured person to their fate while waiting for a rescue team to help.

Responsibility for the life of injured cavers is in our hands!

FIRST AID KIT FOR CAVERS

List of the recommended caver's first-aid kit (3-4 persons)

Content	Quantity	Content	Quantity
1 Waterproof packaging	1	13 Alcohol wipes	3
2 Bandage (8cm)	2	14 Pencil	1
3 Sterile gauze (10 x 10cm)	2	15 Emergency response procedure	1
4 Triangular bandage	2	16 List of contents	1
5 Steri-Strip (6 x 75mm)	3	17 Multipurpose adhesive tape	5m
6 Transpore tape	1	18 Whistle	1
7 Patches (various)	10	19 Marking tape	10m
8 Emergency blanket	2		
9 Hand warmer	1	20 Paracetamol	5
10 Scissors (small)	1	21 Aspirin	4
11 Gloves (a pair)	2	22 Water purification tablets	10
12 Syringe (20ml)	1	23 Rehydration salt	3





ERP EMERGENCY RESPONSE PROCEDURE

Fill out the form and, when on the surface, submit it to the rescuers

INSTRUCTION

FILL OUT
(mark or enter)

**!! PAY
ATTENTION**

1. STOP! ASSESS THE SITUATION

- a) Are you or is the injured person in any additional danger? **!! YES** > remove the hazard
- b) Use protective equipment (clean gloves, glasses)
- c) How many people are injured?
- d) What is the mechanism of injury?
- High Energy Trauma (a fall from height, a fall of an object on the person)
- Low Energy Trauma (slip)
- e) Have the first-aid kit ready as well as other first-aid equipment
- f) Is the approach to the injured person safe? **!! NO** > ensure secure access and approach the injured person

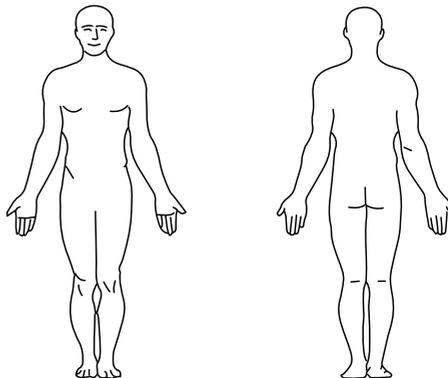
2. EXAMINE THE INJURED PERSON

- a) Is the surroundings of the injured person safe? **!! NO** > remove the hazard
- b) General assessment of the injured person
- Severe bleeding **!! YES** > control of external bleeding
- Age Sex Weight
- c) Approach the injured person from the front
- d) Consciousness
- awake responsive to your speech responsive to pain unresponsive
- e) Airway
- Responsive and speaks Responsive and suffocating (gurgling, wheezing) Unresponsive **!! Position the injured person on their back, tilt their head back, and lift their chin up**
- f) Breathing?
- If unresponsive, place the person in a lateral/recovery position **!! Start CPR** (30 chest compressions, 2 rescue breaths)
- Respiratory rate (count breaths for 10 seconds and multiply by 6): breaths
- Irregular breathing Asymmetrical chest rise (left / right side)
- g) Circulation
- Excessive Sweating Skin Colour Skin Temperature
- h) Head-to-Toe Examination (look and feel)

head > face > neck > chest > abdomen > pelvis > legs > arms > spine

!! Check for sensitivity and motor function at the ends of limbs

i) Mark injuries



3. TAKE CARE OF INJURIES

4. POSITIONING

- Find the most possible flat, dry and safe place**
- Isolate the injured person from the ground**
(caving bags, ropes, sleeping pads)
- Cover their head** (cap, hood)
- Remove wet clothes**
- Set up an improvised bivouac and heat it**
(carbide lamp, candles, gas burner)
- Give warm drinks**
- Encourage the injured person and boost their morale**
- Continuously monitor their condition and body functions, and keep a written record of them**

5. SENDING FOR HELP

- If possible, send for help at least two cavers who are very familiar with the way out**
- Follow the saying "more haste, less speed"**
- On the way out mark the route to the injured person**
- Memorize potentially challenging parts of the cave and report them to rescuers**
- Call emergency telephone number**

- > Time and date of the accident: _____
- > You name, surname and mobile phone number: _____
- > Location where you placed your call: _____
- > Name of the cave where the accident happened: _____
- > Nearest settlement or municipality: _____
- > Number of injured person(s): _____
- > Name and surname of the injured person(s): _____
- > Injuries suffered: _____
- > Cause or type of the accident: _____
- > Description of the accident site (depth, distance from the entrance, name of the accident location in the cave, obstacles in the cave): _____
- > Location where you are going to wait for the rescue team: _____

!! Wait for the rescue team at the agreed location



Jamarska
Zveza
Slovenije

USED AND RECOMMENDED LITERATURE

Adishes, A., Robinson, L., Codling, A., Harris-Roberts, J., Lee, C., Porter, K., (2009), *Health and Safety Executive: Evidence-based review of the current guidance on first aid measures for suspension trauma*. <http://www.hse.gov.uk/research/rrpdf/rr708.pdf>

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of injured cavers is in our hands!**



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ADMINISTRATION



FOR CIVIL PROTECTION
AND DISASTER RELIEF

